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# Test Problems and Results for OMNITAB II

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## Test Problems and Results for OMNITAB II

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# Test Problems And Results For OMNITAB II

Ruth N. Varner and Sally T. Peavy

The lack of test problems and results for many software packages is a great hindrance to both the systems programmer and the general user. In this publication a set of fifty-two test problems and results for the OMNITAB II system is provided to assist individuals in checking the implementation of the OMNITAB II program on their particular computer. The general user will also find these descriptive examples instructive in the use of OMNITAB commands.

Key words: Accuracy, ANSI FORTRAN, computer system implementation, examples, OMNITAB II, software, test problems.

The OMNITAB II computing system enables the non-programmer to use a digital computer to perform data, statistical and numerical analysis without having any prior knowledge of computers or computer languages. The user writes simple English instructions to obtain accurate results simply and effectively. The instructions reference reliable, varied and sophisticated algorithms for analysis and manipulation. The tedious task of formatting data for input and output is alleviated by OMNITAB II through free field input and readable and automatic printing. If desired, considerable flexibility is allowed in the printing of results. The system permits the user to perform simple arithmetic, complex arithmetic, trigonometric calculations, data manipulation, special function calculations, statistical analysis, and operations on matrices and arrays.

OMNITAB was originally conceived and developed by Joseph Hilsenrath and his co-workers and was fully documented in Hilsenrath et al. (1966). During the past three years OMNITAB has been completely rewritten and expanded, while carefully maintaining the original spirit and philosophy. The current version is called NBS OMNITAB II Version 5.0. This paper is one of four which constitute the documentation for OMNITAB II. A complete program listing is given in Peavy et al. (1970a). A user's guide is contained in Hogben et al. (1970) and a systems programmer's guide is contained in Peavy et al. (1970b). This note contains a set of test problems and results which can be used to determine whether a systems programmer has successfully implemented OMNITAB II.

The OMNITAB II system was not only developed with the user in mind, but the systems programmer as well. All the subprograms in the package are written in American National Standards Institute (ANSI) FORTRAN. Extensive effort has been made to create a virtually machine independent program in order to minimize the effort needed to implement OMNITAB II on any large computer. Necessary modifications are clearly outlined in Peavy et al. (1970b). We have tried to avoid the use of any ANSI FORTRAN statement which can not be successfully compiled on a given large computer.

The lack of test problems and results for many software packages is a great hindrance to both the systems programmer and the general user. In implementing a software package for a specific computer configuration it is necessary for the programmer to make modifications however minor. Furthermore all FORTRAN compilers do not interpret FORTRAN statements in the same manner. Considerable effort has been expended to keep the need to make modifications

to an absolute minimum. Thus, it is essential that the system analyst have a means of determining whether the program performs as it originally was designed to do. It is important to the user to know what to expect from a software system when he inputs his data as well as to know how to use the package.

This note contains a set of fifty-two test problems and results for all of the OMNITAB II command names in Version 5.0 with the following exceptions: PUNCH, NHISTOGRAM, EXTREMA, DUMMY and all the commands for using magnetic tapes. The commands MAXMIN, a synonym for EXTREMA, and HISTOGRAM, similar to NHISTOGRAM, were both used. In most instances only one version of the command was used since it was too cumbersome to supply test problems for all possibilities. The test problems were constructed so as to minimize the output and make it possible to determine errors at a glance. The test problems F1 through F11 reference the FORMAT instructions and are grouped together at the end. A table of contents is given on page 4.

The checks in the test problems are gross error checks, not necessarily accuracy checks. They are to be used to determine whether the entire OMNITAB system has been successfully implemented. They are not intended as a definitive test for each instruction. Each instruction has undergone a far more rigorous testing for both programming and numerical accuracy. In addition, some errors which escaped detection in the initial testing were subsequently found in the extensive use of the instructions by users at the National Bureau of Standards and later corrected. The results of the test problems are based on the use of OMNITAB with a computer having a 36 binary bit word length. When the same problems are run on a computer with a different word length the results may differ depending upon the word length of the particular computer in use. The set of test problems and results is published here for convenient use and reference. The same set of test problems is stored on the magnetic tape which contains the OMNITAB II program and is available from National Technical Information Service (formerly "Clearinghouse"), U.S. Department of Commerce, Springfield, Va. 22151.

The test problems can serve a dual purpose. They are intended primarily to determine the success of the implementation of OMNITAB at a computer center by easily running all the test problems and comparing the results with those contained herein. The examples included illustrate many different ways to print results and are very descriptive; therefore they may serve as a guide to users of OMNITAB II and provide a valuable supplement to Hogben et al. (1970). Possibly, students will find the examples instructive.

Each set of test problems begins with the command OMNITAB. Information on the OMNITAB card includes the title of the test and, in parentheses, the name of the subprogram associated with the commands being tested, for example, (PROROW) in TEST 1. This information may be of interest to the systems programmer, but should be ignored by the user.

The command ACCURACY was added to the system primarily for the purpose of testing the implementation of new commands. The instruction has been used in this set of test problems and allows the reader to see at a glance whether anticipated results agree with the actual results. When used in conjunction with the instruction AVERAGE, it is possible to summarize in a single number the accuracy of large set of calculations. The instruction ACCURACY compares two (sets of) numbers and gives the number of first significant digits they have in common. Further details are given in Hogben et al. (1970).

In each problem the data used as input are assumed to be exact. The results determine whether the calculations have been performed successfully. If anyone desires to assess the effect of errors in input data on the final results he could use the instruction ROUND with the input data and repeat the test problem. For example, one could ROUND the original data to seven significant digits and see what effect this has on the final results.

Mathematical identities are frequently used to obtain a single result which simultaneously verifies several computed quantities. See, for example, TEST 12 on hyperbolic functions. For the special functions, frequent reference is made to Abramowitz and Stegun (1964).

This is a rare, if not the first, attempt to provide a comprehensive set of test problems and results for a computer software package. The results should be very useful, but further development is needed and expected in preparing test problems. Readers are encouraged to express their comments, experiences and criticisms. The valuable assistance received from all members of the Statistical Engineering Laboratory is gratefully acknowledged. A special thanks is extended to Shirley G. Bremer for preparing the final form of the examples and to Carla G. Messina for preparing the examples for computerized phototypesetting. Last but not least, we extend our appreciation to David Hogben for his valuable assistance.

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TABLE OF CONTENTS FOR TEST PROBLEM LISTINGS

OMNITAB prints PAGE and number at the extreme right of the top line of each page. The page number for this table of contents appears at the bottom of each page. Numbering does not begin anew with each set of instructions as does the OMNITAB page number.

COLUMNS 1 THROUGH 5 CONTAIN AN 11 BY 5 ARRAY DEFINED BY THE COMMANDS GENERATE, ADD AND MULTIPLY.
COL 6 AND 7 CONTAIN ROW SUMS OF THE ARRAY PRODUCED BY THE ROWSUM COMMAND. COL 8 CONTAINS ROW SUMS BY USING ADD COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 | COLUMN 8 |
|---|---|---|---|---|---|---|---|
| 2.0000000 | 4.0000000 | 8.0000000 | 6.0000000 | 10.000000 | 30.000000 | 30.000000 | 30.000000 |
| 3.9876540 | 5.9876540 | 23.876692 | 9.9753079 | 27.864346 | 71.691653 | 71.691653 | 71.691653 |
| 5.9753079 | 7.9753079 | 47.654921 | 13.950616 | 53.630229 | 129.18638 | 129.18638 | 129.18638 |
| 7.9629619 | 9.9629619 | 79.334685 | 17.925924 | 87.297647 | 202.48418 | 202.48418 | 202.48418 |
| 9.9506159 | 11.950616 | 118.91599 | 21.901232 | 128.86660 | 291.58505 | 291.58505 | 291.58505 |
| 11.938270 | 13.938270 | 166.39883 | 25.876540 | 178.33710 | 396.48900 | 396.48900 | 396.48900 |
| 13.925924 | 15.925924 | 221.78320 | 29.851848 | 235.70912 | 517.19601 | 517.19601 | 517.19601 |
| 15.913578 | 17.913578 | 285.06911 | 33.827156 | 300.98269 | 653.70610 | 653.70610 | 653.70610 |
| 17.901232 | 19.901232 | 356.25656 | 37.802464 | 374.15779 | 806.01928 | 806.01928 | 806.01928 |
| 19.888886 | 21.888886 | 435.34555 | 41.777771 | 455.23443 | 974.13551 | 974.13551 | 974.13551 |
| 20.000000 | 22.000000 | 440.00000 | 42.000000 | 460.00000 | 984.00000 | 984.00000 | 984.00000 |

**********

COLUMNS 6 7 AND 8 SHOULD CONTAIN THE SAME VALUES.
THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO ZERO.

0. 0.

**********

COLUMNS 1 THROUGH 5 CONTAIN AN 11 BY 5 ARRAY DEFINED BY THECOMMANDS GENERATE, ADD AND MULTIPLY.
COL 10 CONTAINS ROW BY ROW PRODUCT OF COLS 1 2 AND 3 USING PRODUCT COMMAND. COL 9 CONTAINS PRODUCT USING MULT COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 10 | COLUMN 9 |
|---|---|---|---|---|
| 2.0000000 | 4.0000000 | 8.0000000 | 64.000000 | 64.000000 |
| 3.9876540 | 5.9876540 | 23.876692 | * 5.7009642+02 | * 5.7009642+02 |
| 5.9753079 | 7.9753079 | 47.654921 | * 2.2709915+03 | * 2.2709915+03 |
| 7.9629619 | 9.9629619 | 79.334685 | * 6.2939922+03 | * 6.2939922+03 |
| 9.9506159 | 11.950616 | 118.91599 | * 1.4141012+04 | * 1.4141012+04 |
| 11.938270 | 13.938270 | 166.39883 | * 2.7688569+04 | * 2.7688569+04 |
| 13.925924 | 15.925924 | 221.78320 | * 4.9187788+04 | * 4.9187788+04 |
| 15.913578 | 17.913578 | 285.06911 | * 8.1264397+04 | * 8.1264397+04 |
| 17.901232 | 19.901232 | 356.25656 | * 1.2691874+05 | * 1.2691874+05 |
| 19.888886 | 21.888886 | 435.34555 | * 1.8952574+05 | * 1.8952574+05 |
| 20.000000 | 22.000000 | 440.00000 | * 1.9360000+05 | * 1.9360000+05 |

**********

COLUMNS 9 AND 10 SHOULD CONTAIN THE SAME VALUES.
THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    GENERATE NOS. STARTING WITH 2. IN STEPS OF 1.987654 UP TO 20.0 STORE IN COL 1
    ADD COLUMN 1 TO THE VALUE 2.0 AND STORE RESULTS IN COLUMN 2
    MULTIPLY COLUMN 1 BY COLUMN 2 AND STORE PRODUCT IN COLUMN 3
    ADD COLUMN 1 TO VALUES IN COLUMN 2 AND STORE SUM IN COL 4
    ADD COL 1 TO COL 3 STORE IN COL 5
    ROWSUM THE ENTIRE ARRAY ROW BY ROW STORE SUM IN COL 6
    ROWSUM COLUMNS 1 THROUGH 5 AND STORE RESULTS IN COLUMN 7
    ADD COLUMN 1 TO COL 2 STORE IN COL 8
    ADD COLUMN 8 TO COL 3 STORE IN COL 8
    ADD COLUMN 8 TO COL 4 STORE IN COL 8
    ADD COLUMN 8 TO COL 5 STORE IN COL 8
    TITLE1COLUMNS 1 THROUGH 5 CONTAIN AN 11 BY 5 ARRAY DEFINED BY THE
    TITLE2COMMANDS GENERATE, ADD AND MULTIPLY.
    TITLE3COL 6 AND 7 CONTAIN ROW SUMS OF THE ARRAY PRODUCED BY THE RO
    TITLE4WSUM COMMAND. COL 8 CONTAINS ROW SUMS BY USING ADD COMMAND.
    PRINT 1***8
    SUBTRACT COL 6 FROM COL 7 STORE IN COLUMN 9
    SUBTRACT COL 8 FROM COL 7 STORE IN COLUMN 10
    SPACE
    NOTE ************************************************************************
    SPACE
    NOTE COLUMNS 6 7 AND 8 SHOULD CONTAIN THE SAME VALUES.
    NOTE THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO ZERO.
    SPACE
    ABRIDGE ROW 1 OF COLUMNS 9 AND 10
    SPACE
    NOTE ************************************************************************
    PRODUCT OF COLUMNS 1 2 AND 3 ROW BY ROW AND STORE IN COL 10
    MULT COL 1 BY COL 2 STORE IN COL 9
    MULT COL 9 BY COL 3 STORE IN COL 9
    TITLE1 COLUMNS 1 THROUGH 5 CONTAIN AN 11 BY 5 ARRAY DEFINED BY THE
    TITLE3COL 10 CONTAINS ROW BY ROW PRODUCT OF COLS 1 2 AND 3 USING
    TITLE4PRODUCT COMMAND. COL 9 CONTAINS PRODUCT USING MULT COMMAND.
    SUBTRACT COL 9 FROM COLUMN 10 AND STORE COLUMN 11
    SUM COL 11 STORE IN COLUMN 12
    PRINT COLUMNS 1***3 10 9
    SPACE
    NOTE ************************************************************************
    SPACE
    NOTE COLUMNS 9 AND 10 SHOULD CONTAIN THE SAME VALUES.
    NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.
    SPACE
    ABRIDGE ROW 1 OF COLUMN 12
    SPACE
    NOTE ************************************************************************
```

COLUMNS 1 THROUGH 8 WERE DEFINED BY THE READ COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 | COLUMN 8 |
|---|---|---|---|---|---|---|---|
| 1.0000000 | 2.0000000 | 3.0000000 | 4.0000000 | 5.0000000 | 6.0000000 | 7.0000000 | 8.0000000 |
| 9.0000000 | 10.000000 | 11.000000 | 12.000000 | 13.000000 | 14.000000 | 15.000000 | .16000000 |
| 20.000000 | 30.000000 | 40.000000 | 50.000000 | 60.000000 | 70.000000 | 80.000000 | 90.000000 |

THE FOLLOWING VALUES WERE PRINTED BY THE COMMAND NPRINT.
COLUMN 1 WAS EXCHANGED WITH COLUMN 2, COLUMN 3 WITH COLUMN 4 AND
COLUMN 5 WITH COLUMN 6.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.0000000 | 1.0000000 | 4.0000000 | 3.0000000 | 6.0000000 | 5.0000000 | 7.0000000 | 8.0000000 |
| 10.000000 | 9.0000000 | 12.000000 | 11.000000 | 14.000000 | 13.000000 | 15.000000 | .16000000 |
| 30.000000 | 20.000000 | 50.000000 | 40.000000 | 70.000000 | 60.000000 | 80.000000 | 90.000000 |

**********

THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO 0.0

| | | |
|---|---|---|
| 0. | 0. | 0. |

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
READ THE FOLLOWING VALUES INTO COLUMNS 1***8
1. 2. 3. 4. 5. 6. 7. 8.
9. 10. 11. 12. 13. 14. 15. .16
20.  30   40   50   60   70   80   90
TITLE1 COLUMNS 1 THROUGH 8 WERE DEFINED BY THE READ COMMAND.
PRINT COLUMNS 1***8
MOVE THE ARRAY STARTING IN ROW 1 COL 1 3X1 STORE ROW 1 COL 9
MOVE THE ARRAY START IN ROW 1 COL 3 3X1 STORE ROW 1 COL 10
MOVE THE ARRAY START IN ROW 1 COL 5 3X1 STORE ROW 1 COL 11
EXCHANGE COLUMN 1 WITH COLUMN 2 COLUMN 3 WITH 4 COLUMN 5 WITH COLUMN 6
SPACE
NOTE THE FOLLOWING VALUES WERE PRINTED BY THE COMMAND NPRINT.
NOTE COLUMN 1 WAS EXCHANGED WITH COLUMN 2, COLUMN 3 WITH COLUMN 4 AND
NOTE COLUMN 5 WITH COLUMN 6.
SPACE
NPRINT COLUMNS 1***8 WITH NO HEADINGS
SUBTRACT COL 2 FROM COL 9 STORE IN COL 12
SUBTRACT COL 4 FROM COL 10 STORE IN COL 13
SUBTRACT COL 6 FROM COL 11 STORE IN COL 14
SPACE
NOTE ********************************************************************************
SPACE
NOTE THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO 0.0
SPACE
ABRIDGE ROW 1 OF COLUMNS 12***14
SPACE
NOTE ********************************************************************************
```

COLUMNS 1 THROUGH 8 WERE DEFINED BY THE READ COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 | COLUMN 8 |
|---|---|---|---|---|---|---|---|
| 1.0000000 | 2.0000000 | 3.0000000 | 4.0000000 | 5.0000000 | 6.0000000 | 7.0000000 | 8.0000000 |
| 9.0000000 | 10.000000 | 11.000000 | 12.000000 | 13.000000 | 14.000000 | 15.000000 | .16000000 |
| 20.000000 | 30.000000 | 40.000000 | 50.000000 | 60.000000 | 70.000000 | 80.000000 | 90.000000 |

THE FOLLOWING VALUES WERE PRINTED BY THE COMMAND NPRINT.
THE VALUES IN COLUMNS 1 3 AND 8 HAVE BEEN SET TO ZERO BY ERASE COMMAND.

| | | | | | |
|---|---|---|---|---|---|
| 2.0000000 | 4.0000000 | 5.0000000 | 6.0000000 | 7.0000000 | |
| 10.000000 | 12.000000 | 13.000000 | 14.000000 | 15.000000 | |
| 30.000000 | 50.000000 | 60.000000 | 70.000000 | 80.000000 | |

**********

THE FOLLOWING VALUES SHOULD BE 0.0

| | |
|---|---|
| 0. | 0. |

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    READ THE FOLLOWING VALUES INTO COLUMNS 1***8
    1. 2. 3. 4. 5. 6. 7. 8.
    9. 10. 11. 12. 13. 14. 15. .16
    20.  30   40   50   60   70   80   90
    TITLE1 COLUMNS 1 THROUGH 8 WERE DEFINED BY THE READ COMMAND.
    PRINT COLUMNS 1***8
    ERASE THE VALUES IN COLUMNS 1 3 AND 8
    SPACE
    NOTE THE FOLLOWING VALUES WERE PRINTED BY THE COMMAND NPRINT.
    NOTE THE VALUES IN COLUMNS 1 3 AND 8 HAVE BEEN SET TO ZERO BY ERASE COMMAND.
    SPACE
    NPRINT COLUMNS 1***8 WITH NO HEADINGS
    SPACE
    NOTE ********************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES SHOULD BE 0.0
    SPACE
    ABRIDGE ROW 3 OF COLUMNS 1 AND 3
    SPACE
    NOTE ********************************************************************************
```

COLUMN 1 WAS DEFINED BY THE SET COMMAND.
COLUMNS 2 AND 3 WERE DEFINED BY FLIP COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 |
|---|---|---|
| 2.3456700 | 12.300000 | 2.3456700 |
| 2.1456700 | 8.1214559 | 2.1456700 |
| 7.8945600 | 2.4560000 | 7.8945600 |
| 2.4560000 | 7.8945600 | 2.4560000 |
| 8.1214559 | 2.1456700 | 8.1214559 |
| 12.300000 | 2.3456700 | 12.300000 |

**********

THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO 0.0

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SET THE FOLLOWING VALUES IN COLUMN 1
    2.34567  2.14567    7.89456   2.456    8.121456   12.3
    FLIP COLUMN 1 INTO COLUMN 2 COLUMN 2 INTO COLUMN 3
    TITLE1 COLUMN 1 WAS DEFINED BY THE SET COMMAND.
    TITLE3 COLUMNS 2 AND 3 WERE DEFINED BY FLIP COMMAND.
    PRINT COLUMNS 1 2 AND 3
    SUBTRACT COLUMN 3 FROM COLUMN 1 AND STORE IN COLUMN 4
    SPACE
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO 0.0
    SPACE
    ABRIDGE ROW 1 OF COLUMN 4
    SPACE
    NOTE ***************************************************************************
```

COLUMNS 1 AND 2 WERE DEFINED BY READ COMMAND.
COLUMNS 3 THROUGH 8 WERE DEFINED BY THE MAXIMUM AND MINIMUM COMMANDS.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 8 |
|---|---|---|---|---|---|---|
| 1.2345000 | 5.4600000 | 213.45000 | 7.8900000 | 4.5599999 | 1.2345000 | 213.45000 |
| 4.5599999 | 7.8900000 | 213.45000 | 7.8900000 | 4.5599999 | 1.2345000 | 213.45000 |
| 213.45000 | 0. | 213.45000 | 7.8900000 | 4.5599999 | 1.2345000 | 213.45000 |
| 21.400000 | 5.6000000 | 213.45000 | 7.8900000 | 4.5599999 | 1.2345000 | 213.45000 |
| 4.5678000 | 5.4450000 | 213.45000 | 7.8900000 | 4.5599999 | 1.2345000 | 213.45000 |
| 2.1110000 | 3.1121000 | 213.45000 | 7.8900000 | 4.5599999 | 1.2345000 | 213.45000 |

**********

THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO 440.5845

440.58450

**********

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LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    READ THE FOLLOWING VALUES INTO COLUMNS 1 AND 2
    1.2345   5.46
    4.56  7.89
    213.45 0.0
    21.4  5.6
    4.5678  5.445
    2.111  3.1121
    MAXIMUM VALUE OF COLUMN 1 IS STORED IN COLUMN 3
    MAX     OF COL 2 STORE IN COL 4 STORE CORRESPONDING VALUE OF COL 1 INTO COL 5
    MINIMUM VALUE OF COLUMN 1 IS STORED IN COLUMN 6
    MIN     OF COL 2 STORE IN COL 7 STORE CORRESPONDING VALUE OF COL 1 INTO COL 8
    TITLE1 COLUMNS 1 AND 2 WERE DEFINED BY READ COMMAND.
    TITLE3 COLUMNS 3 THROUGH 8 WERE DEFINED BY THE MAXIMUM AND MINIMUM
    TITLE4 COMMANDS.
    PRINT THE VALUES IN COLUMNS 1***8
    RESET  1
    ROWSUM COLUMNS 3 4 5 6 7 AND 8 STORE IN 9
    SPACE
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO 440.5845
    SPACE
    ABRIDGE ROW 1 OF COLUMN 9
    SPACE
    NOTE ***************************************************************************
```

OMNITAB TEST 6 DEFINE (DEFINE) VERSION 5.00 6/19/70

COLUMN 1 WAS DEFINED BY THE SET COMMAND.
ELEMENTS OF COLUMNS 2 AND 3 WERE DEFINED BY DEFINE COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 |
|---|---|---|
| 2.3456700 | 0. | 2.4560000 |
| 2.1456700 | 1023.6700 | 2.4560000 |
| 7.8945600 | 2.1456700 | 2.4560000 |
| 2.4560000 | | 2.4560000 |
| 8.1214559 | | 2.4560000 |
| 12.300000 | | 2.4560000 |

**********

THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO 0.0

| | |
|---|---|
| 0. | 0. |

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SET THE FOLLOWING VALUES IN COLUMN 1
    2.34567  2.14567    7.89456   2.456    8.121456   12.3
    DEFINE THE VALUE IN ROW 2 OF COLUMN 1 INTO ROW 3 OF COLUMN 2
    DEFINE THE CONSTANT 1023.67 INTO ROW 2 OF COLUMN 2
    DEFINE THE VALUE IN ROW 4 OF COLUMN 1 INTO ALL OF COLUMN 3
    TITLE1 COLUMN 1 WAS DEFINED BY THE SET COMMAND.
    TITLE3 ELEMENTS OF COLUMNS 2 AND 3 WERE DEFINED BY DEFINE COMMAND.
    PRINT COLUMNS 1 2 AND 3
    SUM  COLUMN 2 AND STORE RESULT IN COLUMN 4
    SUB THE CONSTANT 1025.81567 FROM COLUMN 4 STORE RESULT IN COLUMN 4
    SUBTRACT THE VALUE IN *4,1* FROM COL 3 AND STORE IN COL 5
    SPACE
    NOTE ************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO 0.0
    SPACE
    ABRIDGE ROW 2 OF COLUMNS 4 AND 5
    SPACE
    NOTE ************************************************************************
```

COLUMNS 1 THROUGH 8 WERE DEFINED BY THE READ COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 | COLUMN 8 |
|---|---|---|---|---|---|---|---|
| 1.0000000 | 2.0000000 | 3.0000000 | 4.0000000 | 5.0000000 | 6.0000000 | 7.0000000 | 8.0000000 |
| 9.0000000 | 10.000000 | 11.000000 | 12.000000 | 13.000000 | 14.000000 | 15.000000 | .16000000 |
| 20.000000 | 30.000000 | 40.000000 | 0. | 0. | 0. | 0. | 0. |

THE FOLLOWING VALUES WERE PRINTED BY THE COMMAND NPRINT.
THE SIGNS OF THE VALUES IN COLUMNS 2,3 AND 8 HAVE BEEN CHANGED.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1.0000000 | -2.0000000 | -3.0000000 | 4.0000000 | 5.0000000 | 6.0000000 | 7.0000000 | -8.0000000 |
| 9.0000000 | -10.000000 | -11.000000 | 12.000000 | 13.000000 | 14.000000 | 15.000000 | -.16000000 |
| 20.000000 | -30.000000 | -40.000000 | 0. | 0. | 0. | 0. | 0. |

**********

THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    READ THE FOLLOWING VALUES INTO COLUMNS 1***8
    1. 2. 3. 4. 5. 6. 7. 8.
    9. 10. 11. 12. 13. 14. 15. .16
    20.  30   40
    TITLE1 COLUMNS 1 THROUGH 8 WERE DEFINED BY THE READ COMMAND.
    PRINT COLUMNS 1***8
    ROWSUM COLUMNS 2 3 AND 8 AND STORE IN COLUMN 9
    CHANGE THE SIGNS OF THE VALUES IN COLUMNS 2 3 AND 8
    ROWSUM COLUMNS 2 3 AND 8 AND STORE IN COLUMN 10
    SPACE
    NOTE THE FOLLOWING VALUES WERE PRINTED BY THE COMMAND NPRINT.
    NOTE THE SIGNS OF THE VALUES IN COLUMNS 2,3 AND 8 HAVE BEEN CHANGED.
    SPACE
    NPRINT COLUMNS 1***8 WITH NO HEADINGS
    ADD  COLUMN  9 TO COLUMN 10 STORE IN COLUMN 11
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.
    SPACE
    ABRIDGE ROW 1 OF COLUMN 11
    SPACE
    NOTE ***************************************************************************
```

COLUMNS 1 AND 2 WERE DEFINED BY THE SET COMMAND.
COLUMN 3 CONTAINS THE LOCATIONS OF THE SMALLEST TO LARGEST VALUES IN COLUMN 1.

| COLUMN 1 | COLUMN 2 | COLUMN 3 |
|---|---|---|
| 30.000000 | 1.2450000 | 5.0000000 |
| 3.5600000 | .44000000 | 10.000000 |
| 2.1400000 | 7.5800000 | 4.0000000 |
| 1.0000000 | 23.000000 | 3.0000000 |
| 0. | 56.000000 | 2.0000000 |
| 5.7800000 | 45.000000 | 6.0000000 |
| 8.9000000 | 78.000000 | 7.0000000 |
| 9.0000000 | 96.000000 | 8.0000000 |
| 123.00000 | 2.0000000 | 1.0000000 |
| .12000000 | 0. | 9.0000000 |

THE VALUES BELOW RESULTED FROM SORTING COLUMN 2 AND CARRYING ALONG THE
CORRESPONDING VALUES OF COLUMNS 1 AND 3.

| | | |
|---|---|---|
| .12000000 | 0. | 9.0000000 |
| 3.5600000 | .44000000 | 10.000000 |
| 30.000000 | 1.2450000 | 5.0000000 |
| 123.00000 | 2.0000000 | 1.0000000 |
| 2.1400000 | 7.5800000 | 4.0000000 |
| 1.0000000 | 23.000000 | 3.0000000 |
| 5.7800000 | 45.000000 | 6.0000000 |
| 0. | 56.000000 | 2.0000000 |
| 8.9000000 | 78.000000 | 7.0000000 |
| 9.0000000 | 96.000000 | 8.0000000 |

THE VALUES BELOW ARE THE SORTED VALUES OF THE ABOVE COLUMNS

| | | |
|---|---|---|
| 0. | 0. | 1.0000000 |
| .12000000 | .44000000 | 2.0000000 |
| 1.0000000 | 1.2450000 | 3.0000000 |
| 2.1400000 | 2.0000000 | 4.0000000 |
| 3.5600000 | 7.5800000 | 5.0000000 |
| 5.7800000 | 23.000000 | 6.0000000 |
| 8.9000000 | 45.000000 | 7.0000000 |
| 9.0000000 | 56.000000 | 8.0000000 |
| 30.000000 | 78.000000 | 9.0000000 |
| 123.00000 | 96.000000 | 10.000000 |

**********

THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO ZERO.

| | | |
|---|---|---|
| *-2.3841858-07 | 0. | 0. |

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SET THE FOLLOWING VALUES INTO COLUMN 1
    30.0  3.56  2.14  1.  0.0  5.78  8.9  9  123.  .12
    SET THE FOLLOWING VALUES INTO COLUMN 2
    1.245 .44 7.58  23  56 45 78 96 2
    HIERARCHY OF COLUMN 1 STORE LOCATIONS OF SMALLEST TO LARGEST INTO COL 3
    AVERAGE OF COLUMN 1 AND STORE IN COLUMN 4
    AVERAGE OF COLUMN 2 AND STORE IN COLUMN 5
    AVERAGE OF COLUMN 3 AND STORE IN COLUMN 6
    TITLE1 COLUMNS 1 AND 2 WERE DEFINED BY THE SET COMMAND.
    TITLE3 COLUMN 3 CONTAINS THE LOCATIONS OF THE SMALLEST TO LARGEST
    TITLE4VALUES IN COLUMN 1.
    PRINT THE VALUES IN COLUMNS 1***3
    SORT COLUMN 2 AND CARRY ALONG THE CORRESPONDING VALUES OF COLUMNS 1 AND 3
    AVERAGE OF COLUMN 1 STORE IN COL 7
    AVERAGE OF COLUMN 2 STORE IN COL 8
    SPACE
    AVERAGE OF COLUMN 3 STORE IN COL 9
    NOTE THE VALUES BELOW RESULTED FROM SORTING COLUMN 2 AND CARRYING ALONG THE
    NOTE CORRESPONDING VALUES OF COLUMNS 1 AND 3.
    SPACE
    NPRINT COLUMNS 1***3 WITHOUT HEADINGS
    ORDER COLUMNS 1***3
    AVERAGE OF COLUMN 1 STORE IN COLUMN 10
    AVERAGE OF COLUMN 2 STORE IN COLUMN 11
    AVERAGE OF COLUMN 3 STORE IN COLUMN 12
    SPACE
    NOTE THE VALUES BELOW ARE THE SORTED VALUES OF THE ABOVE COLUMNS
    SPACE
    NPRINT COLUMNS 1***3 WITHOUT HEADINGS
    SUBTRACT COL 4 FROM COL 7 AND STORE IN COL 13
    SUBTRACT COL 8 FROM COL 11 STORE IN COL 14
    SUBTRACT COL 6 FROM COL 12 STORE IN COL 15
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO ZERO.
    SPACE
    ABRIDGE ROW 1 OF COLUMN 13 14 15
    SPACE
    NOTE ***************************************************************************
```

| COL 1 X-TABLE | COL 2 Y-TABLE SIN | COL 3 X TO BE INTR | COL 4 EXACT VALUE | COL 5 ORDER 2 | COL 7 ORDER 4 | COL 9 ORDER 6 | COL 10 ORDER 9 |
|---|---|---|---|---|---|---|---|
| 0. | 0. | -.15000000 | -.14943813 | -.14943813 | -.14951348 | -.14943478 | -.14943324 |
| .15000000 | .14943813 | -.049999999 | -.049979167 | -.049812709 | -.049991465 | -.049978784 | -.049978714 |
| .30000000 | .29552020 | .050000001 | .049979169 | .049812710 | .049983094 | .049979084 | .049979121 |
| .45000000 | .43496553 | .15000000 | .14943813 | .14943813 | .14943813 | .14943813 | .14943813 |
| .59999999 | .56464246 | .25000000 | .24740396 | .24682618 | .24740159 | .24740398 | .24740398 |
| .74999999 | .68163875 | .35000000 | .34289780 | .34200197 | .34289405 | .34289779 | .34289780 |
| .89999999 | .78332690 | .45000000 | .43496553 | .43496553 | .43496553 | .43496553 | .43496553 |
| 1.0500000 | .86742321 | .54999999 | .52268721 | .52141681 | .52268196 | .52268718 | .52268722 |
| 1.2000000 | .93203907 | .64999998 | .60518639 | .60364121 | .60517991 | .60518634 | .60518639 |
| 1.3500000 | .97572335 | .74999998 | .68163874 | .68163873 | .68163872 | .68163872 | .68163873 |
| 1.5000000 | .99749498 | .84999997 | .75128038 | .74943084 | .75127273 | .75128037 | .75128042 |
| 1.6499999 | .99686503 | .94999997 | .81341548 | .81135899 | .81340696 | .81341551 | .81341556 |
| 1.7999999 | .97384764 | 1.0500000 | .86742320 | .86742319 | .86742318 | .86742319 | .86742317 |
| 1.9499999 | .92895973 | 1.1499999 | .91276392 | .91050044 | .91275451 | .91276384 | .91276392 |
| 2.0999999 | .86320941 | 1.2499999 | .94898460 | .94660049 | .94897468 | .94898454 | .94898460 |
| 2.2499999 | .77807327 | 1.3499999 | .97572334 | .97572333 | .97572333 | .97572333 | .97572331 |
| 2.4000000 | .67546319 | 1.4499999 | .99271298 | .99023777 | .99270268 | .99271292 | .99271283 |
| | | 1.5499999 | .99978376 | .99728500 | .99977337 | .99978369 | .99978375 |
| | | 1.6499999 | .99686503 | .99686503 | .99686503 | .99686503 | .99686500 |
| | | 1.7499999 | .98398596 | .98152011 | .98397568 | .98398586 | .98398587 |
| | | 1.8499999 | .96127523 | .95888502 | .96126527 | .96127526 | |
| | | 1.9499999 | .92895975 | .92895975 | .92895974 | | |
| | | 2.0499999 | .88736241 | .88512620 | .88735311 | | |
| | | 2.1499999 | .83689885 | .83483071 | .83689026 | | |
| | | 2.2499999 | .77807327 | .77807327 | .77807327 | | |
| | | 2.3499999 | .71147344 | .70966660 | | | |
| | | 2.4499999 | .63776480 | .64125993 | | | |
| | | 2.5499999 | .55768383 | .57285327 | | | |
| | | 2.6500000 | .47203056 | .50444651 | | | |

**********

THE FOLLOWING VALUES INDICATE NUMBER OF SIGNIFICANT DIGITS FOR EACH ORDER
OF INTERPOLATION.
THE NUMBERS SHOULD BE EQUAL OR NEAR TO 4.2, 4.9, 5.8, 6.5, 7.1 AND 7.2

4.2 4.9 5.8 6.5 7.1 7.2

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    GENERATE NOS. FROM 0. STEPS OF .15 THRU 2.4 STORE IN COL 1
    SIN OF COL 1 STORE IN COL 2
    GENERATE NOS. FROM -.15 IN STEPS OF .1 THRU 2.65 STORE IN COL 3
    SIN OF COL 3 STORE IN COL 4
    BEGIN COMMANDS TO BE REPEATED
1   INTERP TABLE IN COLS 1 AND 2 LENGTH 17, FOR 29 VALUES OF X IN 3 ORDER 2 PUT IN 5
2   INCREMENT ABOVE COMMAND 1 WITH 0 0 0 -2 0 1 1
    FINISH REPEAT COMMANDS
    REPEAT 1 THRU      2  5 TIMES
      ++++++++++++++++++EXTRAPOLATION DONE FOR MORE THAN ONE DELTA
    INTERP WITH TABLE IN COLS 1 2 LENGTH 17, FOR 20 VALUES OF X IN 3 ORDER 9   10
    HEAD COL1/ X-TABLE
    HEAD COL2/ Y-TABLE SIN
    HEAD COL3/X TO BE INTR
    HEAD COL4/ EXACT VALUE
    HEAD COL5/   ORDER 2
    HEAD COL7/   ORDER 4
    HEAD COL9/   ORDER 6
    HEAD COL10/   ORDER 9
    TITLE3      COL 1          COL 2          COL 3          COL 4
    TITLE4      COL 5          COL 7          COL 9          COL 10
    PRINT COLUMNS  1  2  3  4  5  7  9 AND 10
    1/ RESET NRMAX TO 29
    1.5/ INCREMENT COMMAND 1 BY -2
    2/ ACCURATE DIGITS COL 5 VS COL 4 AND STORE IN COL 11
    2.5/ AVERAGE COL 11 STORE IN COL 11
    3/ INCREMENT COMMAND 2 BY 1 0 1
    4/ INCREMENT COMMAND 2.5 BY 1 1
    REPEAT  COMMANDS 1 THRU 4  6TIMES
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES INDICATE NUMBER OF SIGNIFICANT DIGITS FOR EACH ORDER
    NOTE OF INTERPOLATION.
    NOTE THE NUMBERS SHOULD BE EQUAL OR NEAR TO 4.2, 4.9, 5.8, 6.5, 7.1 AND 7.2
    SPACE
    ABRIDGE ROW 1 COLS 11 *** 16 WITH 2.0 SIG. DIGITS
    SPACE
    NOTE ***************************************************************************
```

RESULTS OF AVERAGE,SUM,PARPRODUCT,PARSUM AND RMS COMMANDS.
COLUMN 1 WAS DEFINED BY READ COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 |
|---|---|---|---|---|---|---|
| 1.0000000 | 3.0000000 | 18.000000 | 17.000000 | 1.0000000 | 1.0000000 | 3.8297084 |
| 2.0000000 | 3.0000000 | 18.000000 | 17.000000 | 2.0000000 | 3.0000000 | 3.8297084 |
| 3.0000000 | 3.0000000 | 18.000000 | 17.000000 | 6.0000000 | 6.0000000 | 3.8297084 |
| 5.0000000 | 3.0000000 | 18.000000 | 17.000000 | 30.000000 | 11.000000 | 3.8297084 |
| 7.0000000 | 3.0000000 | 18.000000 | 17.000000 | 210.00000 | 18.000000 | 3.8297084 |
| 0. | 3.0000000 | 18.000000 | 17.000000 | 0. | 18.000000 | 3.8297084 |

COLUMN 2 CONTAINS AVERAGE OF COLUMN 1.
COLUMN 3 CONTAINS SUM OF COLUMN 1.
COLUMN 4 CONTAINS SUM OF ROWS 2-5 OF COLUMN 1.
COLUMN 5 CONTAINS PARTIAL PRODUCTS OF COLUMN 1.
COLUMN 6 CONTAINS PARTIAL SUMS OF COLUMN 1.
COL 7 CONTAINS THE ROOT MEAN SQUARE OF THE VALUES IN COL 1.

**********

THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO ZERO.

| | | | |
|---|---|---|---|
| 0. | 0. | 0. | 0. |

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
READ THE FOLLOWING NUMBERS INTO COLUMN 1
1.0
2.0
3.0
5.0
7.0
0.0
AVERAGE COLUMN 1 AND STORE RESULT IN COLUMN 2
SUM COLUMN 1 AND STORE RESULT IN COLUMN 3
SUM COLUMN 1 ROWS 2 3 4 AND 5 STORE RESULT IN COLUMN 4
PARPRODUCT OF COLUMN 1 AND STORE RESULT IN COLUMN 5
PARSUM OF COLUMN 1 AND STORE RESULT IN COLUMN 6
RMS OF COLUMN 1 AND STORE RESULT IN COLUMN 7
SQUARE COLUMNS 1 AND STORE RESULT IN COLUMN 11
SUM COLUMN 11 AND STORE RESULT IN COLUMN 12
DIVIDE COLUMN 12 BY 6.0 STORE IN COLUMN 12
SQRT OF COLUMN 12 IN COLUMN 13
SUB COLUMN 7 FROM COLUMN 13 STORE IN COLUMN 8
TITLE1RESULTS OF AVERAGE,SUM,PARPRODUCT,PARSUM AND RMS COMMANDS.
TITLE3COLUMN 1 WAS DEFINED BY READ COMMAND.
PRINT COLUMNS 1 2 3 4 5 6 AND 7
SPACE 2
NOTE COLUMN 2 CONTAINS AVERAGE OF COLUMN 1.
NOTE COLUMN 3 CONTAINS SUM OF COLUMN 1.
NOTE COLUMN 4 CONTAINS SUM OF ROWS 2-5 OF COLUMN 1.
NOTE COLUMN 5 CONTAINS PARTIAL PRODUCTS OF COLUMN 1.
NOTE COLUMN 6 CONTAINS PARTIAL SUMS OF COLUMN 1.
NOTE COL 7 CONTAINS THE ROOT MEAN SQUARE OF THE VALUES IN COL 1.
SUB  *6,3* FROM *6,6* STORE IN COLUMN 9
SUB  3.0 FROM COLUMN 2 AND STORE IN COLUMN 10
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO ZERO.
SPACE
ABRIDGE ROW 6 OF COLUMNS 8 9 10 AND 5
SPACE
NOTE ***************************************************************************
```

THE FOLLOWING IS AN EXAMPLE OF PROMOTE AND DEMOTE.
COLUMN 1 WAS DEFINED BY THE GENERATE COMMAND. COLUMNS 2, 3, 4 AND 5 WERE DEFINED BY THE PROMOTE AND DEMOTE COMMANDS.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 |
|---|---|---|---|---|
| 1.0000000 | 0. | 0. | 1.0000000 | 0. |
| 2.0000000 | 0. | 0. | 2.0000000 | 0. |
| 3.0000000 | 1.0000000 | 0. | 3.0000000 | 1.0000000 |
| 4.0000000 | 2.0000000 | 0. | 4.0000000 | 2.0000000 |
| 5.0000000 | 3.0000000 | 1.0000000 | 5.0000000 | 3.0000000 |
| 6.0000000 | 4.0000000 | 2.0000000 | 6.0000000 | 4.0000000 |
| 7.0000000 | 5.0000000 | 3.0000000 | 7.0000000 | 5.0000000 |
| 8.0000000 | 6.0000000 | 4.0000000 | 8.0000000 | 6.0000000 |
| 9.0000000 | 7.0000000 | 5.0000000 | 9.0000000 | 7.0000000 |
| 10.000000 | 8.0000000 | 6.0000000 | 10.000000 | 8.0000000 |
| 0. | 9.0000000 | 7.0000000 | 0. | 0. |
| 0. | 10.000000 | 8.0000000 | 0. | 0. |

COLUMN 1 WAS MOVED DOWN BY 2 ROWS AND STORED IN COLUMN 2.
COLUMN 2 WAS MOVED DOWN BY 2 ROWS AND STORED IN COLUMN 3.
COLUMN 2 WAS MOVED UP BY 2 ROWS AND STORED IN COLUMN 4.
COLUMN 3 WAS MOVED UP BY 2 ROWS AND STORED IN COLUMN 5.
ROW 11 OF COL 9 CONTAINS SUM OF TERMS OF THE 8X2 ARRAY IN ROW 1 COL 6

**********

THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    GENERATE STARTING WITH 1 IN STEPS OF 1 UP TO 10 AND STORE VALUES IN COLUMN 1
    DEMOTE BY 2 ROWS COLUMN 1 INTO COLUMN 2 COLUMN 2 INTO COLUMN 3
    PROMOTE BY 2 ROWS COLUMN 2 INTO COLUMN 4 COLUMN 3 INTO COLUMN 5
    TITLE1 THE FOLLOWING IS AN EXAMPLE OF PROMOTE AND DEMOTE.
    TITLE3 COLUMN 1 WAS DEFINED BY THE GENERATE COMMAND. COLUMNS 2, 3,
    TITLE4 4 AND 5 WERE DEFINED BY THE PROMOTE AND DEMOTE COMMANDS.
    PRINT COLUMNS  1***5
    SPACE
    NOTE COLUMN 1 WAS MOVED DOWN BY 2 ROWS AND STORED IN COLUMN 2.
    NOTE COLUMN 2 WAS MOVED DOWN BY 2 ROWS AND STORED IN COLUMN 3.
    NOTE COLUMN 2 WAS MOVED UP BY 2 ROWS AND STORED IN COLUMN 4.
    NOTE COLUMN 3 WAS MOVED UP BY 2 ROWS AND STORED IN COLUMN 5.
    ASUB BEGIN ROW 3 COL 2 8X2 MINUS ROW 1 COL 4 8X2 STORE IN ROW 1 COL 6
    SAPROP  OF ARRAY IN ROW 1 COL 6 SIZE 8X2 STORE PROPERTIES IN COLUMN 9
    NOTE ROW 11 OF COL 9 CONTAINS SUM OF TERMS OF THE 8X2 ARRAY IN ROW 1 COL 6
    SPACE 2
    NOTE ********************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.
    SPACE
    ABRIDGE ROW 11 OF COLUMN 9
    SPACE
    NOTE ********************************************************************************
```

| COL 1 X | COL 2 SINH X | COL 3 COSH X | COL 4 TANH X | COL 5 COTH X |
|---|---|---|---|---|
| .25000000 | .25261232 | 1.0314131 | .24491867 | 4.0829880 |
| .50000000 | .52109531 | 1.1276260 | .46211716 | 2.1639534 |
| .75000000 | .82231673 | 1.2946833 | .63514896 | 1.5744338 |
| 1.0000000 | 1.1752012 | 1.5430806 | .76159415 | 1.3130353 |
| 1.2500000 | 1.6019190 | 1.8884239 | .84828363 | 1.1788510 |
| 1.5000000 | 2.1292794 | 2.3524096 | .90514827 | 1.1047914 |
| 1.7500000 | 2.7904143 | 2.9641883 | .94137554 | 1.0622753 |
| 2.0000000 | 3.6268604 | 3.7621956 | .96402760 | 1.0373147 |
| 2.2500000 | 4.6911682 | 4.7965674 | .97802611 | 1.0224676 |
| 2.5000000 | 6.0502045 | 6.1322894 | .98661432 | 1.0135673 |
| 2.7500000 | 7.7893520 | 7.8532798 | .99185974 | 1.0082071 |
| 3.0000000 | 10.017875 | 10.067662 | .99505476 | 1.0049698 |
| 3.2500000 | 12.875783 | 12.914557 | .99699763 | 1.0030114 |
| 3.5000000 | 16.542627 | 16.572824 | .99817791 | 1.0018254 |
| 3.7500000 | 21.248782 | 21.272300 | .99889447 | 1.0011068 |
| 4.0000000 | 27.289917 | 27.308233 | .99932931 | 1.0006711 |
| 4.2500000 | 35.045574 | 35.059838 | .99959316 | 1.0004070 |
| 4.5000000 | 45.003012 | 45.014120 | .99975324 | 1.0002468 |
| 4.7500000 | 57.787816 | 57.796467 | .99985031 | 1.0001497 |
| 5.0000000 | 74.203210 | 74.209947 | .99990922 | 1.0000908 |



**********

(COSH(X))**2 - (SINH(X))**2=1
(TANH(X))**2 + (1/(COSH(X))**2)=1
(COTH(X))**2 - (1/(SINH(X))**2)=1
THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0

.99998391 .99999999 .99999985

**********

| COL 1<br>X | COL 8<br>ARCSINH X | COL 9<br>ARCCOSH X | COL 10<br>ARCTANH X | COL 11<br>ARCCOTH X |
|---|---|---|---|---|
| .25000000 | .24999999 | .24999996 | .24999999 | .25000000 |
| .50000000 | .49999999 | .49999997 | .49999999 | .50000001 |
| .75000000 | .74999998 | .74999998 | .75000000 | .75000000 |
| 1.0000000 | .99999999 | .99999999 | .99999997 | 1.0000000 |
| 1.2500000 | 1.2500000 | 1.2500000 | 1.2500000 | 1.2500000 |
| 1.5000000 | 1.5000000 | 1.5000000 | 1.5000001 | 1.5000001 |
| 1.7500000 | 1.7500000 | 1.7500000 | 1.7500000 | 1.7500001 |
| 2.0000000 | 2.0000000 | 2.0000000 | 2.0000002 | 2.0000003 |
| 2.2500000 | 2.2499999 | 2.2500000 | 2.2499998 | 2.2500000 |
| 2.5000000 | 2.5000000 | 2.5000000 | 2.5000007 | 2.5000015 |
| 2.7500000 | 2.7500000 | 2.7500000 | 2.7500006 | 2.7500018 |
| 3.0000000 | 3.0000000 | 3.0000000 | 2.9999998 | 3.0000018 |
| 3.2500000 | 3.2500000 | 3.2500000 | 3.2499982 | 3.2500001 |
| 3.5000000 | 3.5000000 | 3.5000000 | 3.5000009 | 3.5000058 |
| 3.7500000 | 3.7500000 | 3.7500000 | 3.7500114 | 3.7500122 |
| 4.0000000 | 4.0000000 | 4.0000000 | 4.0000103 | 4.0000126 |
| 4.2500000 | 4.2499999 | 4.2499999 | 4.2500092 | 4.2500296 |
| 4.5000000 | 4.5000000 | 4.5000000 | 4.5000525 | 4.5000551 |
| 4.7500000 | 4.7499999 | 4.7499999 | 4.7499846 | 4.7500097 |
| 5.0000000 | 4.9999999 | 4.9999999 | 5.0000983 | 5.0001438 |



**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

*-2.5331974-08 *-3.1664968-08 * 8.3282589-06 * 1.3724528-05

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE  X  STARTING WITH .25 IN STEPS OF .25 UP TO AND INCL 5. INTO 1
SINH OF X IN COL 1 STORE RESULTS IN COL 2
COSH OF X IN COL 1 STORE RESULTS IN COL 3
TANH OF X IN COL 1 STORE RESULTS IN COL 4
COTH OF X IN COL 1 STORE RESULTS IN COL 5
1/ SQUARE COL 2 STORE IN COL 6
2/ INCREMENT 1 BY 1 1
REPEAT STATEMENTS 1 AND 2 4 TIMES
SUBTRACT COL 6 FROM COL 7 STORE IN 10
DIVIDE 1.0 BY COL 7 MULT BY 1.0 ADD TO 8 AND STORE IN 11
DIVIDE 1.0 BY COL 6 MULT BY -1.0 ADD TO 9 AND STORE IN 12
AVERAGE COL 10 STORE IN 10
AVERAGE COL 11 STORE IN 11
AVERAGE COL 12 STORE IN 12
NEW PAGE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE         X          SINH X         COSH X         TANH X         COTH X
SPACE
NPRINT COLS 1***5
SPACE  2
NOTE ********************************************************************************
SPACE
NOTE (COSH(X))**2 - (SINH(X))**2=1
NOTE (TANH(X))**2 + (1/(COSH(X))**2)=1
NOTE (COTH(X))**2 - (1/(SINH(X))**2)=1
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0
SPACE
ABRIDGE ROW 1 COLS 10 11 12
SPACE
NOTE ********************************************************************************
ASINH OF COL 2 STORE RESULTS IN COL 8
ACOSH OF COL 3 STORE RESULTS IN COL 9
ATANH OF COL 4 STORE RESULTS IN COL 10
ACOTH OF COL 5 STORE RESULTS IN COL 11
NEW PAGE
NOTE       COL 1          COL 8          COL 9          COL 10         COL 11
NOTE         X          ARCSINH X      ARCCOSH X      ARCTANH X      ARCCOTH X
SPACE
NPRINT COLS 1 8***11
SPACE  2
1/ SUBTRACT COL 1 FROM COL 8 STORE RESULTS IN 8
2/ AVERAGE COL 8 STORE IN 8
3/INCREMENT 1 BY 0 1 1
4/INCREMENT 2 BY 1 1
PERFORM STATEMENTS 1 THRU 4 4 TIMES
NOTE ********************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLS 8***11
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SPACE
NOTE ************************************************************************
```

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THE FOLLOWING IS AN EXAMPLE OF THE CENSOR AND MATCH COMMANDS. COLUMN 1 WAS SET UP BY THE GENERATE COMMAND.
COLUMNS 2 AND 3 WERE DEFINED BY THE CENSOR COMMAND. COLUMN 4 WAS DEFINED BY THE MATCH COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 |
|---|---|---|---|
| 10.000000 | 1.0000000 | 10.000000 | 1.0000000 |
| 20.000000 | 1.0000000 | 20.000000 | 1.0000000 |
| 30.000000 | 1.0000000 | 30.000000 | 1.0000000 |
| 40.000000 | 1.0000000 | 40.000000 | 1.0000000 |
| 50.000000 | 1.0000000 | 50.000000 | 1.0000000 |
| 60.000000 | 60.000000 | 60.000000 | 1.0000000 |
| 70.000000 | 70.000000 | 70.000000 | 1.0000000 |
| 80.000000 | 80.000000 | 80.000000 | 1.0000000 |
| 90.000000 | 90.000000 | 90.000000 | 1.0000000 |
| 100.00000 | 100.00000 | 100.00000 | 1.0000000 |

**********

COLUMNS 1 AND 3 SHOULD CONTAIN THE SAME VALUES.
COLUMN 4 SHOULD BE EQUAL TO 1.0
THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

| | |
|---|---|
| 0. | 0. |

**********

THE FOLLOWING IS AN EXAMPLE OF THE SELECT COMMAND.
COLUMNS 9 10 11 AND 12 WERE DEFINED BY SELECT COMMAND

| COLUMN 1 | COLUMN 2 | COLUMN 4 | COLUMN 5 | COLUMN 9 | COLUMN 10 | COLUMN 11 | COLUMN 12 |
|---|---|---|---|---|---|---|---|
| 10.000000 | 1.0000000 | 5.0000000 | 0. | 1.0000000 | 1.0000000 | 1.0000000 | 5.0000000 |
| 20.000000 | 1.0000000 | 10.000000 | 0. | 1.0000000 | 1.0000000 | 1.0000000 | 5.0000000 |
| 30.000000 | 1.0000000 | 10.000000 | 0. | 1.0000000 | 1.0000000 | 1.0000000 | 5.0000000 |
| 40.000000 | 1.0000000 | 12.000000 | 0. | 0. | 0. | 0. | 0. |
| 50.000000 | 1.0000000 | 15.000000 | 0. | 0. | 0. | 0. | 0. |
| 60.000000 | 60.000000 | 1.0000000 | 60.000000 | 1.0000000 | 1.0000000 | 1.0000000 | 5.0000000 |
| 70.000000 | 70.000000 | 2.0000000 | 70.000000 | 1.0000000 | 1.0000000 | 1.0000000 | 5.0000000 |
| 80.000000 | 80.000000 | 10.000000 | 80.000000 | 1.0000000 | 1.0000000 | 1.0000000 | 5.0000000 |
| 90.000000 | 90.000000 | 10.000000 | 90.000000 | 1.0000000 | 1.0000000 | 1.0000000 | 5.0000000 |
| 100.00000 | 100.00000 | 84.000000 | 100.00000 | 80.000000 | 90.000000 | 0. | 2.0000000 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

0.

**********

THE FOLLOWING IS AN EXAMPLE OF THE SEARCH COMMAND.
COLUMN 13 WAS DEFINED BY THE SEARCH COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 13 |
|---|---|---|---|
| 10.000000 | 1.0000000 | 10.000000 | 1.0000000 |
| 20.000000 | 1.0000000 | 20.000000 | 1.0000000 |
| 30.000000 | 1.0000000 | 30.000000 | 1.0000000 |
| 40.000000 | 1.0000000 | 40.000000 | 1.0000000 |
| 50.000000 | 1.0000000 | 50.000000 | 1.0000000 |
| 60.000000 | 60.000000 | 60.000000 | 60.000000 |
| 70.000000 | 70.000000 | 70.000000 | 70.000000 |
| 80.000000 | 80.000000 | 80.000000 | 80.000000 |
| 90.000000 | 90.000000 | 90.000000 | 90.000000 |
| 100.00000 | 100.00000 | 100.00000 | 100.00000 |

**********

COLUMNS 2 AND 13 SHOULD CONTAIN THE SAME VALUES.
THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    GENERATE STARTING WITH 10 IN STEPS OF 10 UP TO 100 AND STORE VALUES IN COLUMN 1
    CENSOR COLUMN 1 FOR VALUES LESS OR EQUAL TO 50. REPLACE BY 1.0 STORE IN COL 2
    CENSOR COL 2 FOR VALUES LESS OR EQUAL TO VALUES IN 1 REPLACE BY COL 1 PUT IN 3
    MATCH COL 1 FOR VALUES EQUAL TO VALUES IN COL 3 REPLACE BY 1.0 PUT IN COLUMN 4
    SUBTRACT COLUMN 1 FROM COLUMN 3 AND STORE IN COLUMN 20
    AVERAGE COLUMN 20 AND STORE IN COLUMN 20
    AVERAGE COLUMN 4 AND STORE IN COLUMN 21
    SUBTRACT 1.0 FROM COLUMN 21 AND STORE IN COL 21
    TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE CENSOR AND MATCH COMMAND
    TITLE2S. COLUMN 1 WAS SET UP BY THE GENERATE COMMAND.
    TITLE3 COLUMNS 2 AND 3 WERE DEFINED BY THE CENSOR COMMAND.
    TITLE4 COLUMN 4 WAS DEFINED BY THE MATCH COMMAND.
    PRINT COLUMNS 1 2 3 AND 4
    SPACE  2
    NOTE ***************************************************************************
    SPACE
    NOTE COLUMNS 1 AND 3 SHOULD CONTAIN THE SAME VALUES.
    NOTE COLUMN 4 SHOULD BE EQUAL TO 1.0
    NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE ROW 1 OF COLUMNS 20  AND 21
    SPACE
    NOTE ***************************************************************************
    SET THE FOLLOWING VALUES IN COLUMN 4
    5.0  10.0  10.0  12.0  15.0  1.0  2.0  10.0  10.0  84.0
    SELECT IN COL 1 VALUES APPROXIMATING COL 2 TO TOLERANCE .5  STORE IN COL 5
    SELECT COL 2 VALUES APPROXIMATING COL 4 TO 10.0 STORE IN 9 TO 11 FREQ CT IN 12
    TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE SELECT COMMAND.
    TITLE2
    TITLE3 COLUMNS 9 10 11 AND 12 WERE DEFINED BY SELECT COMMAND
    TITLE4
    PRINT  COLUMNS  1  2  4  5  9  10  11 AND 12
    ROWSUM COLUMNS 5 9 10 11 12 STORE IN 40
    SET IN COLUMN 41
    8. 8. 8. 0. 0. 68. 78. 88. 98. 272.
    SUBTRACT COLUMN 40 FROM COLUMN 41 STORE IN 40
    AVERAGE COLUMN 40 STORE IN COLUMN 40
    SPACE  2
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE ROW 1 OF COLUMN 40
    SPACE
    NOTE ***************************************************************************
    SEARCH IN COL 3 FOR NUMBERS IN COL 1 TRANSFER CORRESPONDING VALUES FOR 2 TO 13
    TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE SEARCH COMMAND.
    TITLE2
    TITLE3 COLUMN 13 WAS DEFINED BY THE SEARCH COMMAND.
    TITLE4
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    PRINT COLUMNS 1 2 3 AND 13
    SUBTRACT COL 2 FROM COLUMN 13 STORE IN 30
    AVERAGE COL 30 AND STORE RESULT IN COL 30
    SPACE  2
    NOTE ***************************************************************************
    SPACE
    NOTE COLUMNS 2 AND 13 SHOULD CONTAIN THE SAME VALUES.
    NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.
    SPACE
    ABRIDGE ROW 1 OF COLUMN 30
    SPACE
    NOTE ***************************************************************************
```

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C. 20234, OMNITAB II VERSION 5.00 MAY 15

THE FOLLOWING IS AN EXAMPLE OF THE ISOLATE COMMAND. COLUMN 1 WAS DEFINED BY THE GENERATE COMMAND.
COLUMNS 2 4 6 8 10 AND 12 WERE DEFINED BY SIN COMMAND. COLUMNS 3 5 7 9 AND 11 WERE DEFINED BY THE ISOLATE COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 | COLUMN 8 |
|---|---|---|---|---|---|---|---|
| 1.0000000 | .84147098 | 3.0000000 | .14112001 | 3.0000000 | .14112001 | 3.1250000 | .016591892 |
| 2.0000000 | .90929742 | 3.2500000 | -.10819513 | 3.0625000 | .079010216 | 3.1406250 | .00096765344 |
| 3.0000000 | .14112001 | 3.5000000 | -.35078323 | 3.1250000 | .016591892 | 3.1562500 | -.014656821 |
| 4.0000000 | -.75680249 | 3.7500000 | -.57156131 | 3.1875000 | -.045891223 | 3.1718750 | -.030277718 |
| 5.0000000 | -.95892427 | 4.0000000 | -.75680249 | 3.2500000 | -.10819513 | 3.1875000 | -.045891223 |
| 6.0000000 | -.27941550 | 6.0000000 | -.27941550 | 6.2500000 | -.033179216 | 6.2500000 | -.033179216 |
| 7.0000000 | .65698659 | 6.2500000 | -.033179216 | 6.3125000 | .029310494 | 6.2656250 | -.017559404 |
| 8.0000000 | .98935825 | 6.5000000 | .21511999 | 6.3750000 | .091685747 | 6.2812500 | -.0019353060 |
| 9.0000000 | .41211848 | 6.7500000 | .45004407 | 6.4375000 | .15370297 | 6.2968750 | .013689265 |
| 10.000000 | -.54402111 | 7.0000000 | .65698659 | 6.5000000 | .21511999 | 6.3125000 | .029310494 |
| | | 9.0000000 | .41211848 | 9.2500000 | .17388948 | 9.3750000 | .049757406 |
| | | 9.2500000 | .17388948 | 9.3125000 | .11204221 | 9.3906250 | .034146321 |
| | | 9.5000000 | -.075151118 | 9.3750000 | .049757406 | 9.4062500 | .018526901 |
| | | 9.7500000 | -.31951919 | 9.4375000 | -.012721696 | 9.4218750 | .0029029568 |
| | | 10.000000 | -.54402111 | 9.5000000 | -.075151118 | 9.4375000 | -.012721696 |

| COLUMN 9 | COLUMN 10 | COLUMN 11 | COLUMN 12 |
|---|---|---|---|
| 3.1406250 | .00096765344 | 3.1406250 | * 9.6765344-04 |
| 3.1445313 | -.0029385920 | 3.1416016 | *-8.9088280-06 |
| 3.1484375 | -.0068447927 | 3.1425781 | *-9.8547115-04 |
| 3.1523438 | -.010750889 | 3.1435547 | -.0019620325 |
| 3.1562500 | -.014656821 | 3.1445313 | -.0029385920 |
| 6.2812500 | -.0019353060 | 6.2812500 | -.0019353060 |
| 6.2851563 | .0019709414 | 6.2822266 | *-9.5874464-04 |
| 6.2890625 | .0058771587 | 6.2832031 | * 1.7817656-05 |
| 6.2929688 | .0097832864 | 6.2841797 | * 9.9437998-04 |
| 6.2968750 | .013689265 | 6.2851563 | .0019709414 |
| 9.4218750 | .0029029568 | 9.4218750 | .0029029568 |
| 9.4257813 | -.0010032888 | 9.4228516 | .0019263972 |
| 9.4296875 | -.0049095192 | 9.4238281 | * 9.4983578-04 |
| 9.4335938 | -.0088156747 | 9.4248047 | *-2.6726513-05 |
| 9.4375000 | -.012721696 | 9.4257813 | -.0010032888 |

THE FOLLOWING IS AN EXAMPLE OF THE ISOLATE COMMAND. COLUMN 1 WAS DEFINED BY THE GENERATE COMMAND.
COLUMNS 2 4 6 8 10 AND 12 WERE DEFINED BY SIN COMMAND. COLUMNS 3 5 7 9 AND 11 WERE DEFINED BY THE ISOLATE COMMAND.
COLUMN 45

3.1411133
6.2827148
9.4243164

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

* 2.3841858-07

**********

THE FOLLOWING IS AN EXAMPLE OF THE ISETUP AND ITERATE COMMANDS.

| X | Y=SIN(X) | BRACKETING X'S | BRACKETING Y'S | DESIRED Y |
|---|---|---|---|---|
| .30000000 | 0. | .34999999 | .34246927 | .30000000 |
| .32500000 | .099833415 | .54999999 | .52203399 | .50000000 |
| .34999999 | .19866933 | | | |
| .37499999 | .29552020 | | | |
| .39999999 | .38941834 | | | |
| .49999999 | .47942553 | | | |
| .52499999 | .56464246 | | | |
| .54999999 | | | | |
| .57499999 | | | | |
| .59999999 | | | | |

THE FOLLOWING IS THE RESULTS OF THE ITERATE COMMAND

| | | | | |
|---|---|---|---|---|
| .30000000 | .29552020 | .31250000 | .30741449 | .30000000 |
| .30624999 | .31930878 | .51249999 | .49031926 | .50000000 |
| .31249999 | .34289780 | | | |
| .31874999 | .36627252 | | | |
| .32500000 | .38941834 | | | |
| .49999999 | .47942553 | | | |
| .50624999 | .50121299 | | | |
| .51249998 | .52268721 | | | |
| .51874997 | .54383478 | | | |
| .52499999 | .56464246 | | | |

THE FOLLOWING IS THE RESULTS OF THE ITERATE COMMAND

| | | | | |
|---|---|---|---|---|
| .30000000 | .29552020 | .30312499 | .29850272 | .30000000 |
| .30156250 | .30148524 | .52187498 | .49850397 | .50000000 |
| .30312499 | .30743851 | | | |
| .30468749 | .31337976 | | | |
| .30624999 | .31930878 | | | |
| .51874997 | .47942553 | | | |
| .52031247 | .48490101 | | | |
| .52187497 | .49035756 | | | |
| .52343747 | .49579495 | | | |
| .52499999 | .50121299 | | | |

THE FOLLOWING IS THE RESULTS OF THE ITERATE COMMAND

| | | | | |
|---|---|---|---|---|
| .30468749 | .29552020 | .30546874 | .30074016 | .30000000 |
| .30507812 | .29701255 | .52421873 | .50053664 | .50000000 |
| .30546874 | .29850418 | | | |
| .30585936 | .29999508 | | | |
| .30624999 | .30148524 | | | |
| .52343747 | .49579495 | | | |
| .52382810 | .49715128 | | | |
| .52421872 | .49850640 | | | |
| .52460935 | .49986029 | | | |
| .52499999 | .50121299 | | | |

THE FOLLOWING IS THE RESULTS OF THE ITERATE COMMAND

| | | | | |
|---|---|---|---|---|
| .30468749 | .29999508 | .30488280 | .30018138 | .30000000 |
| .30478515 | .30036768 | .52363278 | .50002944 | .50000000 |
| .30488280 | .30074025 | | | |
| .30498046 | .30111276 | | | |
| .30507812 | .30148524 | | | |
| | | | | |
| .52343747 | .49986029 | | | |
| .52353512 | .50019858 | | | |
| .52363278 | .50053679 | | | |
| .52373043 | .50087492 | | | |
| .52382810 | .50121299 | | | |

THE FOLLOWING IS THE RESULTS OF THE ITERATE COMMAND

| | | | | |
|---|---|---|---|---|
| .30468749 | .29999508 | .30473632 | .30004165 | .30000000 |
| .30471190 | .30008823 | .52358395 | .49998716 | .50000000 |
| .30473632 | .30018138 | | | |
| .30476073 | .30027453 | | | |
| .30478515 | .30036768 | | | |
| | | | | |
| .52353512 | .49986029 | | | |
| .52355953 | .49994487 | | | |
| .52358394 | .50002944 | | | |
| .52360835 | .50011401 | | | |
| .52363278 | .50019858 | | | |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

| | |
|---|---|
| 0. | 0. |

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE TRIAL VALUES OF X EQUAL TO 1(1)10 IN COLUMN 1
1/ SIN OF X IN COLUMN 1 PUT Y=SIN(X) IN COLUMN 2
2/ ISOLATE X IN COLUMN 1 FOR Y IN COLUMN 2=0.0 STORE IN COLUMN 3 AND 45
3/ INCREMENT  1  2  2
4/ INCREMENT  2  2  2  0.0  2  0
REPEAT 1 THROUGH 4  6 TIMES
TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE ISOLATE COMMAND. COLUMN
TITLE21 WAS DEFINED BY THE GENERATE COMMAND.
TITLE3 COLUMNS 2 4 6 8 10 AND 12 WERE DEFINED BY SIN COMMAND. COLU
TITLE4MNS 3 5 7 9 AND 11 WERE DEFINED BY THE ISOLATE COMMAND.
PRINT COLUMNS 1 *** 8
SPACE  2
 NOTE   COLUMN 9       COLUMN 10      COLUMN 11      COLUMN 12
NPRINT COLUMN 9 *** 12
RESET NRMAX TO 3
PRINT  45
SUM COLUMN 45 AND STORE IN COLUMN 46
SUBTRACT THE VALUE 18.8481445 FROM COLUMN 46 AND STORE IN COLUMN 46
AVERAGE COLUMN 46 AND STORE IN COLUMN 46
SPACE
NOTE ********************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLUMN 46
SPACE
NOTE ********************************************************************************
RESET 0
ERASE
GENERATE TRIAL VALUES OF X EQUAL TO 0(.1).6 IN COLUMN 1
GENERATE DESIRED Y EQUAL TO .3(.2).5 IN COLUMN 14
 NOTE1 THE FOLLOWING IS THE RESULTS OF THE ITERATE COMMAND
1/ SIN X IN COLUMN 1 PUT Y=SIN(X) IN COLUMN 12
2/ ITERATE X IN COLUMN 1 Y IN COLUMN 12 DESIRED Y IN COLUMN 14 STORE IN 1
2.2/ SPACE
2.5/ PRINT NOTE
2.6/ SPACE
3/ NPRINT COLUMNS 1  12  2  3 AND 4
SIN X IN COLUMN 1 PUT Y=SIN(X) IN COLUMN 12
ISETUP X IN COL 1, Y=SIN(X) IN COL 12, DESIRED Y IN COL 14 STORE IN COL 1
TITLE1
TITLE2
TITLE3
TITLE4
NEW PAGE
NOTE   THE FOLLOWING IS AN EXAMPLE OF THE ISETUP AND ITERATE COMMANDS.
SPACE
NOTE          X         Y=SIN(X)        BRACKETING X,S BRACKETING Y,S DESIRED Y
NPRINT COLUMNS  1  12  2  3 AND 4
REPEAT INSTRUCTIONS 1 THROUGH 3  5 TIMES
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SUM COLUMN 2 STORE IN COLUMN 45
    SUM COLUMN 3 STORE IN COLUMN 46
    SUBTRACT THE VALUE .82832027 FROM COL 45 AND STORE IN COL 45
    SUBTRACT THE VALUE .80002881 FROM COL 46 AND STORE IN COLUMN 46
    SPACE
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE ROW 1 OF COLUMNS 45 AND 46
    SPACE
    NOTE ***************************************************************************
```

THE FOLLOWING IS AN EXAMPLE OF SHORTEN AND EXPAND COMMANDS. COLUMN 1 WAS DEFINED BY THE EXPAND COMMAND. COLUMNS 5 AND
WERE DEFINED BY THE SHORTEN COMMAND.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 6 | COLUMN 7 |
|---|---|---|---|---|---|
| 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 |
| 2.0000000 | 4.0000000 | 16.000000 | 64.000000 | 2.0000000 | 4.0000000 |
| 3.0000000 | 9.0000000 | 81.000000 | * 7.2900000+02 | 3.0000000 | 9.0000000 |
| 4.0000000 | 16.000000 | * 2.5600000+02 | * 4.0960000+03 | 4.0000000 | 16.000000 |
| 5.0000000 | 25.000000 | * 6.2500000+02 | * 1.5625000+04 | 5.0000000 | 25.000000 |
| 6.0000000 | 36.000000 | * 1.2960000+03 | * 4.6656000+04 | 6.0000000 | 36.000000 |
| 7.0000000 | 49.000000 | * 2.4010000+03 | * 1.1764900+05 | 7.0000000 | 49.000000 |
| 8.0000000 | 64.000000 | * 4.0960000+03 | * 2.6214400+05 | | |
| 9.0000000 | 81.000000 | * 6.5610000+03 | * 5.3144100+05 | | |
| 10.000000 | 100.00000 | * 1.0000000+04 | * 1.0000000+06 | | |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

0. 0. 0. 0. 0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE BEGIN WITH 1. IN STEPS OF 1. UP TO 10. STORE IN COLUMN 1
EXPAND VALUES IN COL 1 TO 6TH POWER IN INTERVALS OF 2 START STORING IN COLUMN 2
SHORTEN COLUMN 1 FOR COLUMN 2=49. STORE SHORTENED COLUMNS IN 6 AND 7
RESET NRMAX TO 10
TITLE1THE FOLLOWING IS AN EXAMPLE OF SHORTEN AND EXPAND COMMANDS.
TITLE2 COLUMN 1 WAS DEFINED BY THE EXPAND COMMAND. COLUMNS 5 AND 6
TITLE3 WERE DEFINED BY THE SHORTEN COMMAND.
PRINT COLUMNS 1 2 3 4 5 6 7
SQRT OF COLUMN 2 AND STORE IN COLUMN 5
SUBTRACT COLUMN 5 FROM COLUMN 1 AND STORE IN COLUMN 11
MULTIPLY COL 2 BY COL 2 MULT BY -1.0 ADD TO 3 STORE IN 12
MULTIPLY COL 2 BY COL 3 MULT BY -1.0 ADD TO 4 STORE IN 13
SUM COLUMN 1 AND STORE IN COLUMN 1
SUM COLUMN 6 AND STORE IN COLUMN 6
SUBTRACT COLUMN 6 FROM COLUMN 1 AND STORE IN COLUMN 14
SUB THE VALUE 27.0 FROM COLUMN 14 AND STORE IN COLUMN 14
SUM COLUMN 2 AND STORE IN COLUMN 2
SUM COLUMN 7 AND STORE IN COLUMN 7
SUBTRACT COLUMN 7 FROM COLUMN 2 AND STORE IN COLUMN 15
SUB THE VALUE 245.0 FROM COLUMN 15 AND STORE IN COLUMN 15
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLUMNS 11  12  13  14 AND 15
SPACE
NOTE ***************************************************************************
```

| COL 1<br>X | COL 2<br>K (X)<br>ELLIPT 1ST | COL 3<br>E (X)<br>ELLIPT 2ND | COL 4<br>Y<br>Y=1-X | COL 5<br>K (Y)<br>ELLIPT 1ST | COL 6<br>E (Y)<br>ELLIPT 2ND |
|---|---|---|---|---|---|
| 0. | 1.5707963 | 1.5707963 | 1.0000000 | 1.3506439 | 1.0000000 |
| .050000000 | 1.5910034 | 1.5509733 | .95000000 | 2.9083373 | 1.0604737 |
| .10000000 | 1.6124413 | 1.5307576 | .90000001 | 2.5780921 | 1.1047747 |
| .15000000 | 1.6352567 | 1.5101218 | .85000001 | 2.3890165 | 1.1433958 |
| .20000000 | 1.6596236 | 1.4890351 | .80000001 | 2.2572053 | 1.1784899 |
| .25000000 | 1.6857504 | 1.4674622 | .75000001 | 2.1565157 | 1.2110560 |
| .29999999 | 1.7138894 | 1.4453631 | .70000002 | 2.0753632 | 1.2416705 |
| .34999999 | 1.7443506 | 1.4226911 | .65000002 | 2.0075984 | 1.2707075 |
| .39999999 | 1.7775194 | 1.3993921 | .60000002 | 1.9495678 | 1.2984280 |
| .44999998 | 1.8138839 | 1.3754020 | .55000003 | 1.8989249 | 1.3250245 |
| .50000000 | 1.8540747 | 1.3506439 | .50000000 | 1.8540747 | 1.3506439 |

**********

LET Y=1-X, K(X) AND K(Y) ARE ELLIPTICAL INTEGRALS OF 1ST ORDER,
AND E(X) AND E(Y) ARE ELLIPTICAL INTEGRALS OF 2ND ORDER, THEN
E(X)*K(Y)+E(Y)*K(X)-K(X)*K(Y)=PI/2 (HANDBOOK OF MATH. FUNC. AMS 55 PG 591)
THEREFORE FOLLOWING VALUE MUST EQUAL OR BE NEAR 1.5707963

1.5707963

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    GENERATE 0 (.05) .5 IN COL 1
    SUBTRACT 1 FROM 1.0  STORE IN 4
    ELLIPTICAL FIRST ORDER OF COL 1 STORE IN COL 2
    ELLIPTICAL SECOND ORDER OF COL 1 STORE IN COL 3
    ELLIPTICAL FIRST ORDER OF COL 4 STORE IN COL 5

** ARITHMETIC FAULT IN ABOVE COMMAND, ZERO RETURNED   1 TIMES
* X FOR ELLIPTICAL INTEGRALS IS = 1.0 OR GREATER. RESULT IS SET TO 0.0.   1 TIMES

    ELLIPTICAL SECOND ORDER OF COL 4 STORE IN COL 6

** ARITHMETIC FAULT IN ABOVE COMMAND, ZERO RETURNED   1 TIMES
** NEGATIVE ARGUMENT TO SQRT, LOG OR RAISE

    TITLE1    COL 1             COL 2          COL 3        COL 4
    TITLE2       COL 5         COL 6
    HEAD 1/
    HEAD 2/  ELLIPT 1ST
    HEAD 3/  ELLIPT 2ND
    HEAD 4/    Y=1-X
    HEAD 5/  ELLIPT 1ST
    HEAD 6/  ELLIPT 2ND
    TITLE3       X               K (X)          E (X)           Y
    TITLE4        K (Y)         E (Y)
    PRINT  1***6
    MULTIPLY COL 6 BY COL 2  STORE IN COL 7
    SUBTRACT COL 2 FROM COL 3 MULTIPLY BY COL 5 ADD TO COL 7 AND STORE IN COL 7
    AVERAGE COL 7 STORE IN 8
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE LET Y=1-X,  K(X) AND K(Y) ARE ELLIPTICAL INTEGRALS OF 1ST ORDER,
    NOTE AND  E(X) AND E(Y) ARE ELLIPTICAL INTEGRALS OF 2ND ORDER, THEN
    NOTE E(X)*K(Y)+E(Y)*K(X)-K(X)*K(Y)=PI/2 (HANDBOOK OF MATH. FUNC. AMS 55 PG 591)
    NOTE THEREFORE FOLLOWING VALUE MUST EQUAL OR BE NEAR 1.5707963
    SPACE
    ABRIDGE  ROW 1  COL 8
    SPACE
    NOTE ***************************************************************************
```

EVALUATE SINE, COSINE, TANGENT, AND COTANGENT OF X, X IN DEGREES

| COL 1<br>X DEGREES | COL 2<br>SIN X | COL 3<br>COS X | COL 4<br>TAN X | COL 5<br>COT X |
|---|---|---|---|---|
| 5.0000000 | .087155741 | .99619470 | .087488661 | 11.430053 |
| 15.000000 | .25881904 | .96592582 | .26794919 | 3.7320508 |
| 45.000000 | .70710677 | .70710678 | .99999998 | 1.0000000 |
| 75.000000 | .96592582 | .25881907 | 3.7320505 | .26794921 |
| 125.00000 | .81915205 | -.57357641 | -1.4281481 | -.70020750 |
| 175.00000 | .087155785 | -.99619469 | -.087488706 | -11.430047 |
| 200.00000 | -.34202010 | -.93969263 | .36397018 | 2.7474778 |
| 200.00000 | -.34202010 | -.93969263 | .36397018 | 2.7474778 |
| 300.00000 | -.86602545 | .49999992 | -1.7320512 | -.57735014 |
| 350.00000 | -.17364826 | .98480774 | -.17632707 | -5.6712790 |

FOLLOWING COLUMNS SHOULD CONTAIN VALUES EQUAL OR CLOSE TO 1.0
RELATIONAL EXPRESSIONS OF TRIGNOMETRIC FUNCTIONS

| COL 14<br>SIN**2+COS**2 | COL 15<br>SEC**2-TAN**2 | COL 16<br>COSEC**2-COT**2 |
|---|---|---|
| .99999999 | 1.0000000 | 1.0000019 |
| .99999998 | 1.0000000 | 1.0000006 |
| .99999998 | 1.0000001 | 1.0000000 |
| .99999999 | 1.0000001 | 1.0000000 |
| .99999998 | 1.0000001 | 1.0000000 |
| .99999999 | 1.0000000 | 1.0000019 |
| .99999999 | 1.0000000 | 1.0000002 |
| .99999999 | 1.0000000 | 1.0000002 |
| .99999999 | 1.0000001 | 1.0000000 |
| .99999999 | 1.0000000 | 1.0000000 |

**********

FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0

| | | |
|---|---|---|
| .99999995 | 1.0000000 | 1.0000005 |

**********



412-718 O - 71 - 4

EVALUATE IN DEGREES THE ARCSIN, ARCCOS, ARCTAN, AND ARCCOT OF X

| COL 1 X | COL 2 ARCSIN X | COL 3 ARCCOS X | COL 4 ARCTAN X | COL 5 ARCCOT X |
|---|---|---|---|---|
| .1000 | 5.7392 | 84.2608 | 5.7106 | 84.2894 |
| .2000 | 11.5370 | 78.4630 | 11.3099 | 78.6901 |
| .3000 | 17.4576 | 72.5424 | 16.6992 | 73.3008 |
| .4000 | 23.5782 | 66.4218 | 21.8014 | 68.1986 |
| .5000 | 30.0000 | 60.0000 | 26.5651 | 63.4349 |
| .6000 | 36.8699 | 53.1301 | 30.9638 | 59.0362 |
| .7000 | 44.4270 | 45.5730 | 34.9920 | 55.0080 |
| .8000 | 53.1301 | 36.8699 | 38.6598 | 51.3402 |
| .9000 | 64.1581 | 25.8419 | 41.9872 | 48.0128 |
| 1.0000 | 90.0000 | .0000 | 45.0000 | 45.0000 |

THE VALUES IN THE FOLLOWING COLS SHOULD BE EQUAL TO OR NEAR 90.

| COL 6 ARCSIN+ARCCOS | COL 7 ARCTAN+ARCCOT |
|---|---|
| 90.0000 | 90.0000 |
| 90.0000 | 90.0000 |
| 90.0000 | 90.0000 |
| 90.0000 | 90.0000 |
| 90.0000 | 90.0000 |
| 90.0000 | 90.0000 |
| 90.0000 | 90.0000 |
| 90.0000 | 90.0000 |
| 90.0000 | 90.0000 |
| 90.0000 | 90.0000 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 90.

90.0000 90.0000

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
SET FOLLOWING DATA IN COL 1
5,15,45,75,125,175,200,200,300,350
SIND OF COL 1 STORE RESULTS IN COL 2
COSD OF COL 1 STORE RESULTS IN COL 3
TAND OF COL 1 STORE RESULTS IN COL 4
COTD OF COL 1 STORE RESULTS IN COL 5
TITLE1  EVALUATE SINE, COSINE, TANGENT, AND COTANGENT OF X, X IN D
TITLE2EGREES
NEW PAGE
NOTE    COL  1         COL 2          COL 3          COL 4          COL 5
NOTE  X DEGREES        SIN X          COS X          TAN X          COT X
SPACE
NPRINT  COLS 1***5
1/SQUARE COL 2 STORE RESULT IN COL 10
2/INCREMENT COMMAND 1 BY 1 AND 1
REPEAT  1 THRU 2  4 TIMES
ADD SIND(X) SQUARED IN COL 10 TO COSD(X) SQUARED IN COL 11 AND STORE IN 14
DIVIDE 1.0 BY COL 11   STORE IN 15
DIVIDE 1.0 BY COL 10  STORE IN 16
SUBTRACT COL 12 FROM COL 15 STORE IN 15
SUBTRACT COL 13 FROM COL 16 STORE IN 16
SPACE 2
NOTE FOLLOWING COLUMNS SHOULD CONTAIN VALUES EQUAL OR CLOSE TO 1.0
NOTE RELATIONAL EXPRESSIONS OF TRIGNOMETRIC FUNCTIONS
SPACE
NOTE    COL  14          COL  15         COL  16
NOTE  SIN**2+COS**2  SEC**2-TAN**2  COSEC**2-COT**2
SPACE
NPRINT COLS 14 15 16
AVERAGE COL 14 STORE IN 14
AVERAGE COL 15 STORE IN 15
AVERAGE COL 16 STORE IN 16
SPACE 2
NOTE ********************************************************************************
SPACE
NOTE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0
SPACE
ABRIDGE ROW 1 COLS 14 15 16
SPACE
NOTE ********************************************************************************
RESET NRMAX 0
GENERATE NOS FROM .1  STEPS .1 THRU 1.0 IN COL 1
ASIND OF X IN COL 1 STORE IN COL 2
ACOSD OF X IN COL 1 STORE IN COL 3
ATAND OF X IN COL 1 STORE IN COL 4
ACOTD OF X IN COL 1 STORE IN COL 5
TITLE1 EVALUATE IN DEGREES THE ARCSIN, ARCCOS, ARCTAN, AND ARCCOT
TITLE2 OF X
NEW PAGE
FIXED 4
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
NOTE    COL 1            COL 2          COL 3          COL 4          COL 5
NOTE      X            ARCSIN X       ARCCOS X       ARCTAN X       ARCCOT X
SPACE
NPRINT COLS 1***5
ADD COL 2  TO COL 3  STORE RESULTS IN COL 6
ADD COL 4  TO COL 5  STORE RESULTS IN COL 7
SPACE 2
NOTE THE VALUES IN THE FOLLOWING COLS SHOULD BE EQUAL TO OR NEAR 90.
SPACE
NOTE    COL 6              COL 7
NOTE  ARCSIN+ARCCOS     ARCTAN+ARCCOT
SPACE
NPRINT COL 6 AND 7
AVERAGE  COL  6 STORE IN COL 6
AVERAGE  COL 7 STORE IN COL 7
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 90.
SPACE
ABRIDGE ROW 1 COLS 6  7
SPACE
NOTE ***************************************************************************
```

BESSEL FUNCTIONS J AND Y FOR ORDERS 0 AND 1

| COL 1 X | COL 2 J ZERO (X) | COL 3 J ONE (X) | COL 4 Y ZERO (X) | COL 5 Y ONE (X) |
|---|---|---|---|---|
| 1.0000000 | .76519768 | .44005058 | .088256964 | -.78121281 |
| 1.5000000 | .51182767 | .55793650 | .38244892 | -.41230863 |
| 2.0000000 | .22389078 | .57672480 | .51037567 | -.10703243 |
| 2.5000000 | -.048383776 | .49709410 | .49807036 | .14591814 |
| 3.0000000 | -.26005195 | .33905896 | .37685001 | .32467442 |
| 3.5000000 | -.38012774 | .13737753 | .18902194 | .41018842 |
| 4.0000000 | -.39714981 | -.066043328 | -.016940739 | .39792571 |
| 4.5000000 | -.32054251 | -.23106043 | -.19470501 | .30099732 |
| 5.0000000 | -.17759677 | -.32757914 | -.30851762 | .14786314 |

**********

RELATIONAL EXPRESSION OF BESSEL FUNCTIONS
 LET YO =Y ZERO (X), YONE=Y ONE (X),
     JO =J ZERO (X), JONE=J ONE (X),
THEN   YO*JONE-YONE*JO-2/(PI*X)=0
HANDBOOK OF MATHEMATICAL FUNCTIONS AMS 55 PAGE 360
THEREFORE THE FOLLOWING VALUE MUST BE EQUAL OR NEAR 0.0

*-7.6575412-09

**********

BESSEL FUNCTIONS I AND K FOR ORDERS 0 AND 1

| COL 1 X | COL 2 I ZERO (X) | COL 3 I ONE (X) | COL 4 K ZERO (X) | COL 5 K ONE (X) |
|---|---|---|---|---|
| 1.0000000 | 1.2660659 | .56515910 | .42102444 | .60190722 |
| 1.5000000 | 1.6467232 | .98166642 | .21380556 | .27738780 |
| 2.0000000 | 2.2795853 | 1.5906368 | .11389387 | .13986588 |
| 2.5000000 | 3.2898391 | 2.5167162 | .062347553 | .073890815 |
| 3.0000000 | 4.8807926 | 3.9533702 | .034739504 | .040156431 |
| 3.5000000 | 7.3782034 | 6.2058349 | .019598897 | .022239393 |
| 4.0000000 | 11.301922 | 9.7594651 | .011159676 | .012483499 |
| 4.5000000 | 17.481172 | 15.389223 | .0063998572 | .0070780949 |
| 5.0000000 | 27.239872 | 24.335642 | .0036910983 | .0040446134 |

| COL 1 X | COL 2 I ZERO (X) *EXP(-X) | COL 3 I ONE (X) *EXP(-X) | COL 4 K ZERO (X) *EXP(X) | COL 5 K ONE (X) *EXP(X) |
|---|---|---|---|---|
| 1.0000000 | .46575961 | .20791041 | 1.1444631 | 1.6361535 |
| 1.5000000 | .36743361 | .21903939 | .95821005 | 1.2431659 |
| 2.0000000 | .30850832 | .21526929 | .84156821 | 1.0334768 |
| 2.5000000 | .27004644 | .20658465 | .75954869 | .90017442 |
| 3.0000000 | .24300035 | .19682671 | .69776160 | .80656347 |
| 3.5000000 | .22280244 | .18739998 | .64902633 | .73646755 |
| 4.0000000 | .20700192 | .17875084 | .60929766 | .68157594 |
| 4.5000000 | .19419828 | .17095882 | .57609679 | .63714980 |
| 5.0000000 | .18354081 | .16397227 | .54780756 | .60027386 |



```
**************************************************************************

RELATIONAL EXPRESSION OF BESSEL FUNCTIONS
 LET KO =K ZERO (X), KONE=K ONE (X),
     IO =I ZERO (X), IONE=I ONE (X),
THEN   KO*IONE+KONE*IO-1/X=0
HANDBOOK OF MATHEMATICAL FUNCTIONS AMS 55 PAGE 375
THEREFORE THE FOLLOWING VALUES MUST BE EQUAL OR NEAR 0.0

*-8.6923440-09 *-7.4505806-09

**************************************************************************
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE X FROM 1.0 IN STEPS OF .5 THRU 5.0 IN COL 1
RJZERO OF COL 1 STORE IN COL 2
BJONE  OF COL 1 STORE IN COL 3
BYZERO OF COL 1 STORE IN COL 4
BYONE OF COL 1 STORE IN COL 5
TITLE1  BESSEL FUNCTIONS J AND Y FOR ORDERS 0 AND 1
NEW PAGE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE         X         J ZERO (X)     J ONE (X)      Y ZERO (X)     Y ONE (X)
SPACE
NPRINT COLS 1***5
MULTIPLY COL 4 BY COL 3  STORE IN COL 6
MULTIPLY COL 5 BY COL 2 MULTIPLY -1.0 ADD TO COL 6 AND STORE IN COL 6
MULTIPLY COL 1 BY *PI* STORE IN COL 7
DIVIDE 2.0 BY COL 7 MULT -1.0 ADD TO COL 6 AND STORE IN COL 6
AVERAGE COL 6  STORE IN COL 6
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE RELATIONAL EXPRESSION OF BESSEL FUNCTIONS
NOTE  LET YO =Y ZERO (X), YONE=Y ONE (X),
NOTE      JO =J ZERO (X), JONE=J ONE (X),
NOTE THEN   YO*JONE-YONE*JO-2/(PI*X)=0
NOTE HANDBOOK OF MATHEMATICAL FUNCTIONS AMS 55 PAGE 360
NOTE THEREFORE THE FOLLOWING VALUE MUST BE EQUAL OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COL 6
SPACE
NOTE ***************************************************************************
BIZERO OF COL 1 STORE IN COL 2
BIONE  OF COL 1 STORE IN COL 3
BKZERO  OF COL 1 STORE IN COL 4
BKONE  OF COL 1 STORE IN COL 5
MULTIPLY COL 2 BY COL 5 STORE IN COL 6
MULTIPLY COL 3 BY COL 4 MULT BY 1.0 ADD TO COL 6 AND STORE IN COL 6
DIVIDE 1.0 BY COL 1 MULTIPLY BY -1.0 ADD TO COL 6 AND STORE IN COL 6
AVERAGE COL 6  STORE IN COL 6
TITLE1  BESSEL FUNCTIONS I AND K FOR ORDERS 0 AND 1
NEW PAGE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE         X         I ZERO (X)     I ONE (X)      K ZERO (X)     K ONE (X)
SPACE
NPRINT COLS 1***5
EXIZERO OF COL 1 STORE IN COL 2
EXIONE OF COL 1 STORE IN COL 3
EXKZERO OF COL 1 STORE IN COL 4
EXKONE OF COL 1 STORE IN COL 5
MULTIPLY COL 2 BY COL 5 STORE IN COL 7
MULTIPLY COL 3 BY COL 4 MULT BY 1.0 ADD TO COL 7 AND STORE IN COL 7
DIVIDE 1.0 BY COL 1 MULTIPLY BY -1.0 ADD TO COL 7 AND STORE IN COL 7
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
AVERAGE COL 7  STORE IN COL 7
SPACE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE         X         I ZERO (X)     I ONE (X)      K ZERO (X)     K ONE (X)
NOTE                     *EXP(-X)       *EXP(-X)       *EXP(X)        *EXP(X)
SPACE
NPRINT COLS 1***5
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE RELATIONAL EXPRESSION OF BESSEL FUNCTIONS
NOTE  LET KO =K ZERO (X), KONE=K ONE (X),
NOTE      IO =I ZERO (X), IONE=I ONE (X),
NOTE THEN   KO*IONE+KONE*IO-1/X=0
NOTE HANDBOOK OF MATHEMATICAL FUNCTIONS AMS 55 PAGE 375
NOTE THEREFORE THE FOLLOWING VALUES MUST BE EQUAL OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLS  6 7
SPACE
NOTE ***************************************************************************
```

| COL 1<br>X | COL 2<br>H ZERO (X) | COL 3<br>H ONE (X) | COL 4<br>INTEGRAL OF J ZERO |
|---|---|---|---|
| 0. | 0. | 0. | 0. |
| .50 | .30955591 | .052173744 | .48968051 |
| 1.0 | .56865662 | .19845734 | .91973041 |
| 1.5 | .73672346 | .41028848 | 1.2414495 |
| 2.0 | .79085884 | .64676373 | 1.4257703 |
| 2.5 | .72995774 | .86315420 | 1.4679809 |
| 3.0 | .57430615 | 1.0201096 | 1.3875673 |
| 3.5 | .36082077 | 1.0915723 | 1.2233057 |
| 4.0 | .13501457 | 1.0697267 | 1.0247342 |
| 4.5 | -.058543316 | .96597435 | .84186254 |
| 5.0 | -.18521681 | .80781195 | .71531191 |

**********

INTEGRAL OF J ZERO = X *J0+(PI*X/2)*(H0*J1-H1*J0)
WHERE J1 = J ONE(X), H1 = H ONE(X)
WHERE J0 = J ZERO (X), H0 = H ZERO (X)
J1 = J ONE (X), H1 = H ONE (X)
HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 480
THEREFORE FOLLOWING VALUE MUST BE NEAR OR EQUAL TO 0.0

*-3.1495636-08

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE  0. (.5)  5.0  1
STRUVE ZERO  OF VALUES IN COL 1 STORE IN 2
STRUVE ONE OF VALUES IN COL 1 STORE IN 3
INTJO OF COL 1 STORE IN COL 4
NEW PAGE
NOTE       COL 1          COL 2          COL 3          COL 4
NOTE         X         H ZERO (X)     H ONE (X)      INTEGRAL OF J ZERO
SPACE
NPRINT COL 1 WITH 2. SIGNIFICANT DIGITS AND COLS 2,3,4 WITH 8.0 SIG DIGITS
BJZERO OF COL 1 STORE IN COL 5
BJONE OF COL 1 STORE IN COL 6
MULTIPLY COL 3 BY COL 5 MULT -1.0 ADD TO COL 7 AND STORE IN COL 7
MULT COL 2 BY COL 6 MULT 1.0 ADD TO COL 7 AND STORE IN COL 7
DIVIDE COL 1 BY 2.0 STORE IN 8
MULT COL 1 BY COL 5 STORE IN COL 9
MULT COL 8 BY *PI* MULT BY COL 7 ADD COL 9 STORE IN 7
SUBTRACT COL 4 FROM COL 7 STORE IN 7
AVERAGE COL 7 STORE IN COL 7
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE INTEGRAL OF J ZERO = X *J0+(PI*X/2)*(H0*J1-H1*J0)
NOTE WHERE J1 = J ONE(X), H1 = H ONE(X)
NOTE WHERE J0 = J ZERO (X), H0 = H ZERO (X)
NOTE       J1 = J ONE (X),  H1 = H ONE (X)
NOTE HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 480
NOTE THEREFORE FOLLOWING VALUE MUST BE NEAR OR EQUAL TO 0.0
SPACE
ABRIDGE ROW 1 COL 7
SPACE
NOTE ***************************************************************************
```

4TH ORDER T CHEBYSHEV POLYNOMIAL

| COL 1 X | COL 3 ORDER 1 | COL 4 ORDER 2 | COL 5 ORDER 3 | COL 6 ORDER 4 |
|---|---|---|---|---|
| .25000000 | .25000000 | -.87500000 | -.68750000 | .53125000 |
| .50000000 | .50000000 | -.50000000 | -1.0000000 | -.50000000 |
| .75000000 | .75000000 | .12500000 | -.56250000 | -.96875000 |
| 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 |
| 1.2500000 | 1.2500000 | 2.1250000 | 4.0625000 | 8.0312500 |
| 1.5000000 | 1.5000000 | 3.5000000 | 9.0000000 | 23.500000 |
| 1.7500000 | 1.7500000 | 5.1250000 | 16.187500 | 51.531250 |
| 2.0000000 | 2.0000000 | 7.0000000 | 26.000000 | 97.000000 |

4TH ORDER U CHEBYSHEV POLYNOMIAL

| COL 1 X | COL 12 ORDER 1 | COL 13 ORDER 2 | COL 14 ORDER 3 | COL 15 ORDER 4 |
|---|---|---|---|---|
| .25000000 | .50000000 | -.75000000 | -.87500000 | .31250000 |
| .50000000 | 1.0000000 | 0. | -1.0000000 | -1.0000000 |
| .75000000 | 1.5000000 | 1.2500000 | .37500000 | -.68750000 |
| 1.0000000 | 2.0000000 | 3.0000000 | 4.0000000 | 5.0000000 |
| 1.2500000 | 2.5000000 | 5.2500000 | 10.625000 | 21.312500 |
| 1.5000000 | 3.0000000 | 8.0000000 | 21.000000 | 55.000000 |
| 1.7500000 | 3.5000000 | 11.250000 | 35.875000 | 114.31250 |
| 2.0000000 | 4.0000000 | 15.000000 | 56.000000 | 209.00000 |



**********

LET TN = T (X) OF ORDER N, VN = U (X) ORDER N, AND VN1=U (X) ORDER N-1
WHERE T AND U ARE THE T AND U CHEBYSHEV POLYNOMIALS RESPECTIVELY
THEN TN-VN-X*VN1=0
REFERENCE - HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 777
THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

0. 0. 0. 0.

**********

3RD ORDER LAGUERRE POLYNOMIAL

| COL 1 X | COL 2 ORDER 1 | COL 3 ORDER 2 | COL 4 ORDER 3 |
|---|---|---|---|
| .25000000 | .75000000 | .53125000 | .34114583 |
| .50000000 | .50000000 | .12500000 | -.14583333 |
| .75000000 | .25000000 | -.21875000 | -.47656250 |
| 1.0000000 | 0. | -.50000000 | -.66666666 |
| 1.2500000 | -.25000000 | -.71875000 | -.73177083 |
| 1.5000000 | -.50000000 | -.87500000 | -.68750000 |
| 1.7500000 | -.75000000 | -.96875000 | -.54947916 |
| 2.0000000 | -1.0000000 | -1.0000000 | -.33333333 |

3RD ORDER NORMALIZED LAGUERRE

| COL 1 X | COL 12 ORDER 1 | COL 13 ORDER 2 | COL 14 ORDER 3 |
|---|---|---|---|
| .25000000 | .75000000 | 1.0625000 | 2.0468750 |
| .50000000 | .50000000 | .25000000 | -.87500000 |
| .75000000 | .25000000 | -.43750000 | -2.8593750 |
| 1.0000000 | 0. | -1.0000000 | -4.0000000 |
| 1.2500000 | -.25000000 | -1.4375000 | -4.3906250 |
| 1.5000000 | -.50000000 | -1.7500000 | -4.1250000 |
| 1.7500000 | -.75000000 | -1.9375000 | -3.2968750 |
| 2.0000000 | -1.0000000 | -2.0000000 | -2.0000000 |



**********

LET Y= X/2 AND LX(N) = L OF ORDER N
THEN LX(3)-8*LY(3)+12*LY(2)-6LY(1)+1.0=0.
AND FOR NORMALIZED LAGUERRE
LX(3)-8*LY(3)+36*LY(2)-36*LY(1)+6=0.
REFERENCE - HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 785
THE FOLLOWING VALUES MUST BE EQUAL OR NEAR TO 0.0

* 3.7252903-09 0.

**********

4TH ORDER HERMITE POLYNOMIAL

| COL 1 X | COL 2 ORDER 1 | COL 3 ORDER 2 | COL 4 ORDER 3 | COL 5 ORDER 4 |
|---|---|---|---|---|
| .25000000 | .50000000 | -1.7500000 | -2.8750000 | 9.0625000 |
| .50000000 | 1.0000000 | -1.0000000 | -5.0000000 | 1.0000000 |
| .75000000 | 1.5000000 | .25000000 | -5.6250000 | -9.9375000 |
| 1.0000000 | 2.0000000 | 2.0000000 | -4.0000000 | -20.000000 |
| 1.2500000 | 2.5000000 | 4.2500000 | .62500000 | -23.937500 |
| 1.5000000 | 3.0000000 | 7.0000000 | 9.0000000 | -15.000000 |
| 1.7500000 | 3.5000000 | 10.250000 | 21.875000 | 15.062500 |
| 2.0000000 | 4.0000000 | 14.000000 | 40.000000 | 76.000000 |

**********

LET Y=SQRT (2)*X/2, AND HX(N)=H OF ORDER N FOR EITHER X OR Y
THEN HX(4)-.5*HY(4)-2*HY(1)*HY(3)-3*(HY(2))**2=0.0
REFERENCE - HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 785
FOLLOWING VALUE MUST BE EQUAL OR NEAR TO 0.0

* 7.3015690-07

**********

4TH ORDER LEGENDRE POLYNOMIAL

| COL 1 X | COL 2 ORDER 1 | COL 3 ORDER 2 | COL 4 ORDER 3 |
|---|---|---|---|
| .25000000 | .25000000 | -.40625000 | -.33593750 |
| .50000000 | .50000000 | -.12500000 | -.43750000 |
| .75000000 | .75000000 | .34375000 | -.070312504 |
| 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 |
| 1.2500000 | 1.2500000 | 1.8437500 | 3.0078125 |
| 1.5000000 | 1.5000000 | 2.8750000 | 6.1874999 |
| 1.7500000 | 1.7500000 | 4.0937500 | 10.773437 |
| 2.0000000 | 2.0000000 | 5.5000000 | 17.000000 |

**********

3*(P ORDER 3 (X)) - 5*X- (P ORDER 2 (X)) + 2* (P ORDER 1 (X)) = 0.0
REFERENCE - HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 334
FOLLOWING VALUE MUST BE EQUAL OR NEAR TO 0.0

*-2.8610229-06

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    $   VERSION 5.00   6/19/70
    GENERATE X FROM .25 IN STEPS OF .25 THRU 2.0 AND STORE IN COL 1
    TCHEBYSHEV POL OF ORDER 4 X IN 1 PUT IN 2 $ ORDERS 1 THRU 4 STORED IN COLS 2-5
    UCHEBYSHEV POL 4TH ORDER X IN 1 PUT IN 12
    NEW PAGE
    NOTE                 4TH ORDER T CHEBYSHEV POLYNOMIAL
    SPACE
    NOTE       COL 1          COL 3          COL 4          COL 5          COL 6
    NOTE         X          ORDER 1        ORDER 2        ORDER 3        ORDER 4
    SPACE
    NPRINT 1***5
    SPACE
    NOTE                 4TH ORDER U CHEBYSHEV POLYNOMIAL
    SPACE
    NOTE       COL 1          COL 12         COL 13         COL 14         COL 15
    NOTE         X          ORDER 1        ORDER 2        ORDER 3        ORDER 4
    NPRINT 1 12***15
    DEFINE  1.0 IN COL 11
    BEGIN
1   MULTIPLY COL 1 BY COL 11 MULT -1.0 ADD TO 12 STORE IN 6
2   SUBTRACT 6 FROM 2 STORE IN 6
3   AVERAGE 6 STORE IN COL 6
4   INCREMENT ST.  1 BY 0  1  0.0  1 1
5   INCREMENT ST.  2 BY 1  1  1
6   INCREMENT ST.  3 BY 1  1
    FINISH
    PERFORM STATEMENTS  1 THRU 6  4 TIMES
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE  LET TN = T (X) OF ORDER N, VN = U (X) ORDER N, AND VN1=U (X) ORDER N-1
    NOTE  WHERE T AND U ARE THE T AND U CHEBYSHEV POLYNOMIALS RESPECTIVELY
    NOTE  THEN  TN-VN-X*VN1=0
    NOTE  REFERENCE - HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 777
    NOTE  THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE ROW 1 COLS  6 7 8 9
    SPACE
    NOTE ***************************************************************************
    LAGUERRE POLYNOMIAL OF 3RD ORDER X IN COL 1 STORE STARTING IN COL 2
    NORMLAGUERRE ORDER 5 X IN COL 1 STORE STARTING IN COL 12
    DIVIDE COL 1 BY 2.0 STORE IN COL 6
    LAGUERRE OF 3RD ORDER X IN 6 STORE IN COL 7
    NORMLAGUERRE OF 3RD ORDER X IN COL 6 STORE IN COL 17
    NEW PAGE
    NOTE                 3RD ORDER LAGUERRE POLYNOMIAL
    SPACE
    NOTE       COL 1          COL 2          COL 3          COL 4
    NOTE         X          ORDER 1        ORDER 2        ORDER 3
    SPACE
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
NPRINT COLS 1***4
SPACE
NOTE                 3RD ORDER NORMALIZED LAGUERRE
SPACE
NOTE       COL 1          COL 12         COL 13         COL 14
NOTE         X          ORDER 1        ORDER 2        ORDER 3
NPRINT COLS 1, 12,13,14
MULT COL 8 BY 2.0 STORE IN COL 10
SUB COL 7 FROM COL 10 MULT 6.0  ADD +1.0 STORE IN COL 10
MULT COL 9 BY 8.0 STORE IN 9
SUB COL 9 FROM COL 4 MULT BY 1.0 ADD COL 10 AND STORE IN 10
AVERAGE COL 10 STORE IN 10
SUB COL 17 FROM COL 18 MULT BY 36.0 ADD 6.0 STORE IN COL 11
RAISE 2.0 TO 3.0 MULT BY COL 19 ADD 0.0 STORE IN 20
SUB COL 20 FROM COL 14 MULT 1.0 ADD TO COL 11 AND STORE IN COL 11
AVERAGE 11 STORE IN 11
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE  LET Y= X/2 AND LX(N) = L OF ORDER N
NOTE  THEN  LX(3)-8*LY(3)+12*LY(2)-6LY(1)+1.0=0.
NOTE  AND FOR NORMALIZED LAGUERRE
NOTE  LX(3)-8*LY(3)+36*LY(2)-36*LY(1)+6=0.
NOTE  REFERENCE - HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 785
NOTE  THE FOLLOWING VALUES MUST BE EQUAL OR NEAR TO 0.0
SPACE
ABRIDGE ROW 1 COLS 10 11
SPACE
NOTE ***************************************************************************
HERMITE POLYNOMIAL OF ORDER 4 X IN COL 1 START STORING IN COL 2
SQRT  2.0 MULT BY COL 6 ADD 0.0 STORE IN COL 6
HERMITE OF ORDER 4 X IN COL 6 START STORING IN COL 12
NEW PAGE
SPACE
NOTE                 4TH ORDER HERMITE POLYNOMIAL
SPACE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE         X          ORDER 1        ORDER 2        ORDER 3        ORDER 4
SPACE
NPRINT COLS  1 *** 5
SQUARE COL  13 MULT BY -1.5 ADD 0.0 AND STORE IN COL 10
MULT COL 12 BY COL 14 MULT BY -2.0 ADD TO COL 10 AND STORE IN COL 10
MULT COL 15 BY -.5 STORE IN 12
ADD COL 12 TO COL 5 MULT 1.0 ADD TO COL 10 AND STORE IN COL 10
AVERAGE  COL 10 STORE IN 10
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE LET Y=SQRT (2)*X/2, AND HX(N)=H OF ORDER N FOR EITHER X OR Y
NOTE THEN HX(4)-.5*HY(4)-2*HY(1)*HY(3)-3*(HY(2))**2=0.0
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    NOTE REFERENCE - HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 785
    NOTE FOLLOWING VALUE MUST BE EQUAL OR NEAR TO 0.0
    SPACE
    ABRIDGE ROW 1 COL 10
    SPACE
    NOTE ***************************************************************************
    LEGENDRE  POL OF 3RD ORDER OF X IN 1 STORE IN 2
    NEW PAGE
    NOTE                  4TH ORDER LEGENDRE POLYNOMIAL
    SPACE
    NOTE       COL 1          COL 2          COL 3          COL 4
    NOTE         X          ORDER 1        ORDER 2        ORDER 3
    NPRINT COL 1 *** 4
    SUM COL 2 STORE IN 5
    SUM COL 4 STORE IN 7
    MULT COL 3 BY COL 1 STORE IN COL 3
    SUM COL 3 STORE IN 3
    RESET NRMAX TO 1
    MULT COL 5 BY 2.0 STORE IN COL 5
    MULT COL 3 BY 5.0 STORE IN COL 3
    MULT COL 7 BY 3.0 STORE IN COL 7
    SUBTRACT COL 5 FROM COL 3 MULT -1.0 ADD COL 7 STORE IN 7
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE 3*(P ORDER 3 (X)) - 5*X- (P ORDER 2 (X)) + 2* (P ORDER 1 (X)) = 0.0
    NOTE REFERENCE - HANDBOOK MATHEMATICAL FUNCTIONS AMS 55 PAGE 334
    NOTE FOLLOWING VALUE MUST BE EQUAL OR NEAR TO 0.0
    SPACE
    NPRINT COL 7
    SPACE
    NOTE ***************************************************************************
```



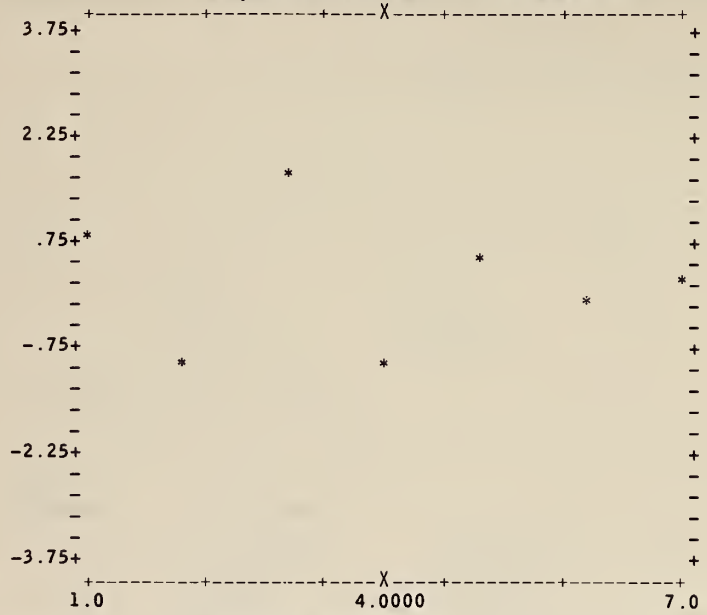
412-718 O - 71 - 5

EXAMPLE FROM NBS HANDBOOK 91, PAGE 6-27

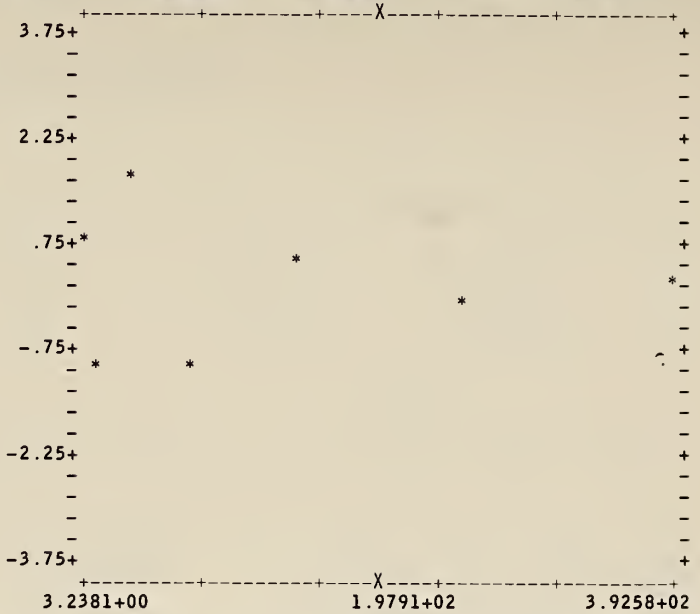
LEAST SQUARES FIT FOR DATA IN COLUMN 2
AS A POLYNOMIAL OF DEGREE 3 IN VARIABLE X IN COLUMN 1
USING 7 NON-ZERO WEIGHTS = 1.0000000

| ROW | VARIABLE X IN COLUMN 1 | DATA IN COLUMN 2 | PREDICTED VALUES | STD. DEV. OF PRED. VALUES | RESIDUALS | STD. RES. | WEIGHTS |
|---|---|---|---|---|---|---|---|
| 1 | 10.000000 | 3.4000000 | 3.2380989 | .72044591 | .16190105 | .81 | 1.000 |
| 2 | 20.000000 | 11.700000 | 12.326194 | .50285859 | -.62619442 | -1.13 | 1.000 |
| 3 | 30.000000 | 37.200000 | 36.290479 | .50285860 | .90952093 | 1.64 | 1.000 |
| 4 | 40.000000 | 80.099999 | 80.714287 | .43165134 | -.61428763 | -1.01 | 1.000 |
| 5 | 50.000000 | 151.40000 | 151.18095 | .50285859 | .21904868 | .40 | 1.000 |
| 6 | 60.000000 | 253.20000 | 253.27381 | .50285860 | -.073807397 | -.13 | 1.000 |
| 7 | 70.000000 | 392.60000 | 392.57618 | .72044591 | .023815283 | .12 | 1.000 |

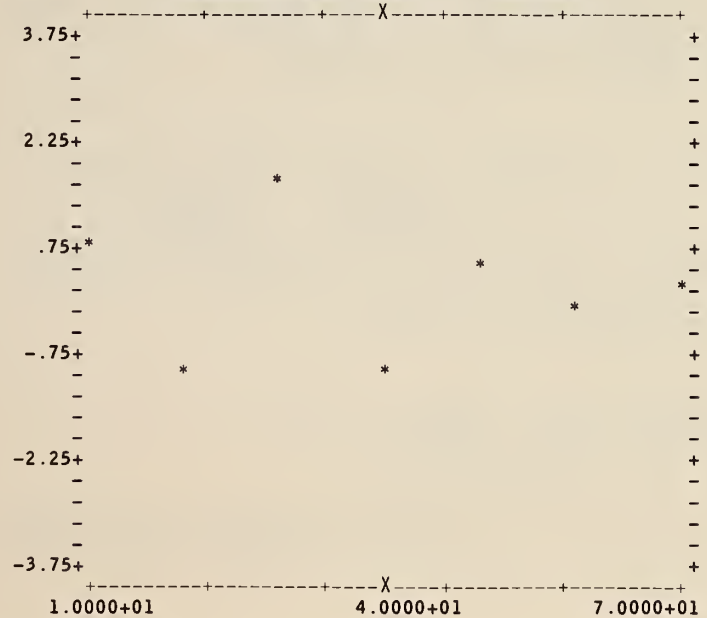
STANDARDIZED RESIDUALS VS ROW NUMBER



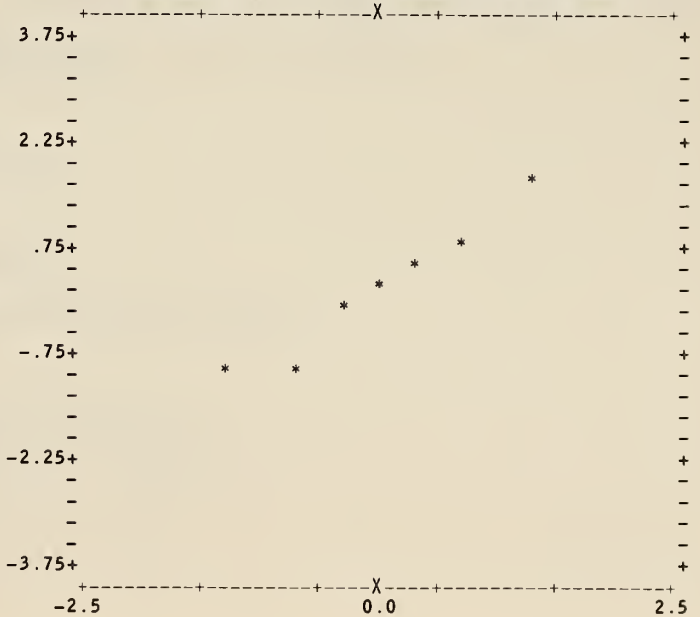

STANDARDIZED RESIDUALS VS PREDICTED VALUES




STANDARDIZED RESIDUALS VS VARIABLE X




PROBABILITY PLOT OF STANDARDIZED RESIDUALS



EXAMPLE FROM NBS HANDBOOK 91, PAGE 6-27

LEAST SQUARES FIT FOR DATA IN COLUMN 2
AS A POLYNOMIAL OF DEGREE 3 IN VARIABLE X IN COLUMN 1
USING 7 NON-ZERO WEIGHTS = 1.0000000

VARIANCE-COVARIANCE MATRIX OF THE ESTIMATED COEFFICIENTS

| TERM | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| 0 | 4.7113083 | | | |
| 1 | -.45382942 | .047959668 | | |
| 2 | .011977902 | -.0013264417 | 3.7930021-05 | |
| 3 | -9.3161461-05 | 1.0610055-05 | -3.1053818-07 | 2.5878182-09 |

ANALYSIS OF VARIANCE
-DEPENDENT ON ORDER VARIABLES ARE ENTERED, UNLESS VECTORS ARE ORTHOGONAL-

| TERM | SS-RED. DUE TO COEF. | CUM. MS REDUCTION | D.F. | CUM. RESIDUAL MS | D.F. | F(COEF=0) | P(F) | F(COEFS=0) | P(F) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 123450.88 | 123450.88 | 1 | 20944.063 | 6 | 220854.738 | .000 | 111416.611 | .000 |
| 1 | 111232.82 | 117341.85 | 2 | 2886.3113 | 5 | 198996.520 | .000 | 74937.235 | .000 |
| 2 | 14242.838 | 82975.512 | 3 | 47.179638 | 4 | 25480.566 | .000 | 12907.593 | .000 |
| 3 | 187.04165 | 62278.394 | 4 | .55896866 | 3 | 334.619 | .000 | 334.619 | .000 |
| RESIDUAL | 1.6769060 | | 3 | | | | | | |
| TOTAL | 249115.26 | | 7 | | | | | | |

EXAMPLE FROM NBS HANDBOOK 91, PAGE 6-27

LEAST SQUARES FIT FOR DATA IN COLUMN 2
AS A POLYNOMIAL OF DEGREE 3 IN VARIABLE X IN COLUMN 1
USING 7 NON-ZERO WEIGHTS = 1.0000000

| | ESTIMATES FROM LEAST SQUARES FIT | | | | FIT OMITTING LAST TERM | | |
|---|---|---|---|---|---|---|---|
| TERM | COEFFICIENT | S.D. OF COEFF. | RATIO | *ACC. DIGITS | COEFFICIENT | S.D. OF COEFF. | RATIO |
| 0 | 3.4428616 | 2.1705548 | 1.59 | 5.82 | 36.942865 | 10.704164 | 3.45 |
| 1 | -.29900796 | .21899696 | -1.37 | 6.02 | -4.1142859 | .61344419 | -6.71 |
| 2 | .018547618 | .0061587353 | 3.01 | 6.20 | .13021429 | .0074944135 | 17.37 |
| 3 | .00093055556 | .000050870602 | 18.29 | 6.88 | | | |
| RESIDUAL STANDARD DEVIATION = | | .74764207 | | | 6.8687434 | | |
| BASED ON DEGREES OF FREEDOM | | 7- 4 = 3 | | | 7- 3 = 4 | | |

* THE NUMBER OF CORRECTLY COMPUTED DIGITS IN EACH COEFFICIENT USUALLY DIFFERS BY LESS THAN 1 FROM THE NUMBER GIVEN HERE

**********

THE CORRECT COEFFICIENTS (TO 8 SIGNIFICANT DIGITS) FOR A THIRD DEGREE POLYNOMIAL FIT TO THE GIVEN DATA ARE
3.4428571, -.29900794, .018547619 AND .00093055556

THE CORRECT RESIDUAL STANDARD DEVIATION IS .74764180

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

* 4.4703484-06 *-2.6077032-08 *-6.9849193-10 * 7.2759576-12 * 2.7567148-07

**********

THE DATA USED ABOVE ARE FROM N. B. S. HANDBOOK 91, 'EXPERIMENTAL STATISTICS', PAGE 6-27

THE RELATION OF THE FOURIER COEFFICIENTS TO LEAST SQUARES PROBLEMS IS GIVEN IN DAVIS AND RABINOWITZ'S 'ADVANCES IN ORTHONORMALIZING COMPUTATION', A CHAPTER IN 'ADVANCES IN COMPUTERS', EDITED BY FRANZ ALT, PUBLISHED BY ACADEMIC PRESS, 1961.

EXAMPLE FROM NBS HANDBOOK 91, PAGE 6-27

| N | COEFFS. $ | RESIDUALS $$ | SD OF PRED.Y | FOURIER $$$ |
|---|---|---|---|---|
| 1.0 | 3.4428616 | .16190105 | .72044591 * | 1.2345088+05 |
| 2.0 | -.29900796 | -.62619442 | .50285859 * | 1.1123282+05 |
| 3.0 | .018547618 | .90952093 | .50285860 * | 1.4242838+04 |
| 4.0 * | 9.3055556-04 | -.61428763 | .43165134 * | 1.8704165+02 |
| 5.0 | 2.1705548 | .21904868 | .50285859 | 1.6769060 |
| 6.0 | .21899696 | -.073807397 | .50285860 * | 2.4911526+05 |
| 7.0 | .0061587353 | .023815283 | .72044591 * | 3.5135577+02 |
| 8.0 * | 5.0870602-05 | | * | 3.3351585+02 |
| 9.0 | 7.0000000 | | * | 1.1934336+02 |
| 10. | 4.0000000 | | | 13.676317 |
| 11. | 3.0000000 | | | |
| 12. | .74764207 | | | |
| 13. | .55896866 | | | |
| 14. | .99998666 | | | |

VARIANCE - COVARIANCE MATRIX, ETC $$$$

| | | | | |
|---|---|---|---|---|
| 1 | 4.7113083 | -.45382942 | .011977902 | *-9.3161461-05 |
| 2 | -.45382942 | .047959668 | -.0013264417 * | 1.0610055-05 |
| 3 | .011977902 | -.0013264417 * | 3.7930021-05 | *-3.1053818-07 |
| 4 | *-9.3161461-05 * | 1.0610055-05 | *-3.1053818-07 * | 2.5878182-09 |
| 5 | 2.6457513 | 52.915026 | * 9.1651511+02 * | 1.4696938+04 |
| 6 | 2.6457513 | * 1.1832160+02 * | 6.8381284+03 * | 4.2990696+05 |
| 7 | 1.0000000 | .19999999 | .0035928140 * | 4.1989379-06 |

ABOVE OUTPUT IS A PRINT OUT OF THE INFORMATION STORED IN COLS 3-6 , 11-14

$ N=1,...,4 COEFFICIENTS
N=5,...,8 STANDARD DEVIATIONS OF THE COEFFICIENTS
N=9 NUMBER OF NON-ZERO WEIGHTS
N=10 DEGREE PLUS 1
N=11 DEGREES OF FREEDOM FOR RESIDUAL STANDARD DEV.
N=12 RESIDUAL STANDARD DEV.
N=13 RESIDUAL VARIANCE
N=14 MULTIPLE CORRELATION COEFF. SQUARED

$$ N=1,...,7 RESIDUALS: DEVS. OF PRED. VALUES FROM MEASUREMENTS

$$$ N=1,...,4 SQUARED FOURIER COEFFICIENTS
N=5,...,8 RESIDUAL SUM OF SQUARES
N=6 TOTAL SUM OF SQUARES
N=7,...,10 FOURIER COEFFICIENTS

$$$$ ROWS 1-4, COLS 1-4 CONTAIN THE VARIANCE-COVARIANCE MATRIX
ROW 5 (N=5) GRAM FACTORS
ROW 6 (N=6) VECTOR NORMS
ROW 7 (N=7) GRAM DETERMINANTS

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
TITLE1EXAMPLE FROM NBS HANDBOOK 91, PAGE 6-27
SET X IN COLUMN 1
10 20 30 40 50 60 70
SET Y IN COLUMN 2
3.4  11.7  37.2  80.1  151.4  253.2  392.6
POLYFIT Y IN COL 2 WTS 1. DEG 3 X IN 1 COEFFS 3 RES 4 SD PV 5 FC 6 VC (1,11)
 $     SD PV DENOTES STANDARD DEVIATIONS OF PREDICTED VALUES
 $     FC DENOTES FOURIER COEFFICIENTS
 $     C DENOTES VARIANCE COVARIANCE MATRIX
HEAD  4/RESIDUALS $$
HEAD  3/COEFFS. $
HEAD  5/SD OF PRED.Y
HEAD  6/FOURIER $$$
NOTE
NOTE
NOTE ***************************************************************************
SPACE
NOTE  THE CORRECT COEFFICIENTS (TO 8 SIGNIFICANT DIGITS) FOR A THIRD
NOTE  DEGREE POLYNOMIAL FIT TO THE GIVEN DATA ARE
NOTE  3.4428571, -.29900794, .018547619 AND .00093055556
NOTE
NOTE  THE CORRECT RESIDUAL STANDARD DEVIATION IS .74764180
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
RESET  NRMAX 1
SUBTRACT 3.4428571 FROM *1,3* STORE IN COL 20
SUBTRACT -.29900794 FROM *2,3* STORE IN COL 21
SUBTRACT .018547619 FROM *3,3* STORE IN COL 22
SUBTRACT .93055556-3 FROM *4,3* STORE IN COL 23
SUBTRACT .7476418 FROM *12,3* STORE IN COL 24
ABRIDGE ROW 1 COL 20 *** 24
SPACE
NOTE ***************************************************************************
NOTE
NOTE  THE DATA USED ABOVE ARE FROM N. B. S. HANDBOOK 91, 'EXPERIMENTAL
NOTE  STATISTICS', PAGE 6-27
NOTE
NOTE  THE RELATION OF THE FOURIER COEFFICIENTS TO LEAST SQUARES PROBLEMS IS
NOTE  GIVEN IN DAVIS AND RABINOWITZ'S 'ADVANCES IN ORTHONORMALIZING
NOTE  COMPUTATION', A CHAPTER IN 'ADVANCES IN COMPUTERS', EDITED BY
NOTE  FRANZ ALT, PUBLISHED BY ACADEMIC PRESS, 1961.
GENERATE 1 IN STEPS OF 1 THRU 14 IN COL 20
RESET 14
HEAD 20/          N
PRINT 20 WITH 2. SIG DIGIT 3***6 WITH 8.0 SIG DIGITS
SPACE
NOTE VARIANCE - COVARIANCE MATRIX, ETC $$$$
SPACE
RESET  NRMAX 7
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
NPRINT COL 20 1. SIG DIGIT 11***14 8.0 SIG DIGITS
SPACE   2
NOTE ABOVE OUTPUT IS A PRINT OUT OF THE INFORMATION STORED IN COLS 3-6 , 11-14
SPACE
NOTE $      N=1,...,4  COEFFICIENTS
NOTE        N=5,...,8  STANDARD DEVIATIONS OF THE COEFFICIENTS
NOTE        N=9 NUMBER OF NON-ZERO WEIGHTS
NOTE        N=10 DEGREE PLUS 1
NOTE        N=11 DEGREES OF FREEDOM FOR RESIDUAL STANDARD DEV.
NOTE        N=12 RESIDUAL STANDARD DEV.
NOTE        N=13 RESIDUAL VARIANCE
NOTE        N=14 MULTIPLE CORRELATION COEFF. SQUARED
SPACE
NOTE $$     N=1,...,7 RESIDUALS: DEVS. OF PRED. VALUES FROM MEASUREMENTS
SPACE
NOTE $$$  N=1,...,4 SQUARED FOURIER COEFFICIENTS
NOTE        N=5,...,8 RESIDUAL SUM OF SQUARES
NOTE        N=6  TOTAL SUM OF SQUARES
NOTE        N=7,...,10 FOURIER COEFFICIENTS
SPACE
NOTE $$$$  ROWS  1-4, COLS 1-4 CONTAIN THE VARIANCE-COVARIANCE MATRIX
NOTE        ROW 5 (N=5) GRAM FACTORS
NOTE        ROW 6 (N=6) VECTOR NORMS
NOTE        ROW 7 (N=7) GRAM DETERMINANTS
```

| COL 1 X | COL 2 SIN X | COL 3 COS X | COL 4 TAN X | COL 5 COT X |
|---|---|---|---|---|
| -1.0000000 | -.84147098 | .54030230 | -1.5574077 | -.64209261 |
| -.80000000 | -.71735609 | .69670670 | -1.0296385 | -.97121460 |
| -.59999999 | -.56464246 | .82533561 | -.68413679 | -1.4616960 |
| -.40000000 | -.38941834 | .92106099 | -.42279322 | -2.3652224 |
| -.20000000 | -.19866933 | .98006658 | -.20271003 | -4.9331549 |
| .20000000 | .19866933 | .98006658 | .20271003 | 4.9331549 |
| .40000000 | .38941834 | .92106099 | .42279322 | 2.3652224 |
| .59999999 | .56464246 | .82533561 | .68413679 | 1.4616960 |
| .80000000 | .71735609 | .69670670 | 1.0296385 | .97121460 |
| 1.0000000 | .84147098 | .54030230 | 1.5574077 | .64209261 |

**********

(SIN(X))**2+(COS(X))**2=1.0
TAN(X)-(SIN(X)/COS(X))=0
COT(X)-(COS(X)/SIN(X))=0
THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0, 0.0 AND 0.0

.99999994 0. 0.

**********

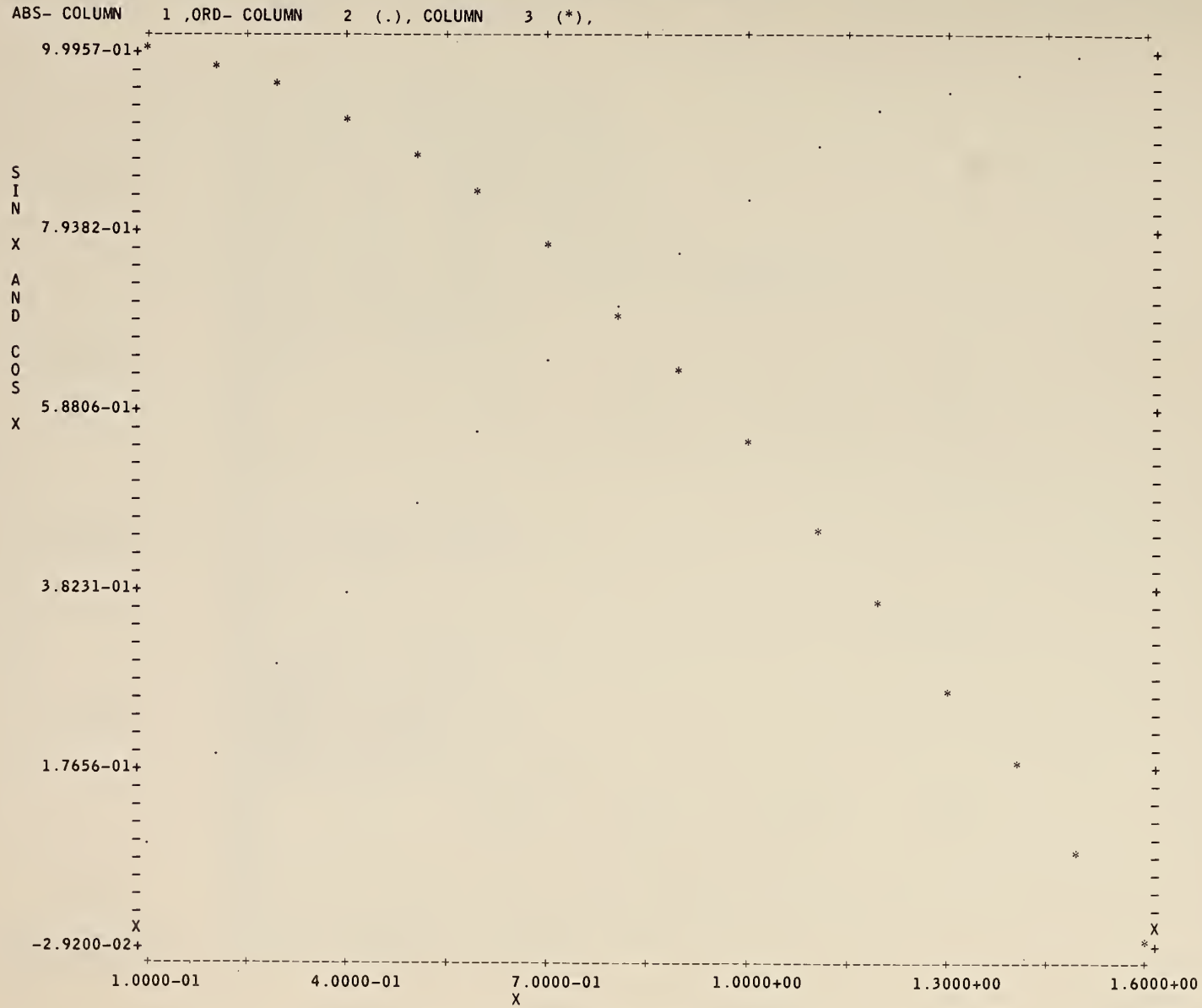
| COL 1<br>X | COL 6<br>ARCSIN X | COL 7<br>ARCCOS X | COL 8<br>ARCTAN X | COL 9<br>ARCCOT X |
|---|---|---|---|---|
| -1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 |
| -.80000000 | .80000001 | .79999997 | .79999997 | .79999997 |
| -.59999999 | .59999996 | .60000000 | .59999996 | .59999998 |
| -.40000000 | .39999999 | .39999999 | .39999999 | .39999999 |
| -.20000000 | .20000000 | .20000001 | .20000000 | .20000000 |
| .20000000 | .20000000 | .20000001 | .20000000 | .20000000 |
| .40000000 | .39999999 | .39999999 | .39999999 | .39999999 |
| .59999999 | .59999996 | .60000000 | .59999996 | .59999998 |
| .80000000 | .79999997 | .79999997 | .79999997 | .79999997 |
| 1.0000000 | .99999997 | 1.0000000 | 1.0000000 | 1.0000000 |

**********

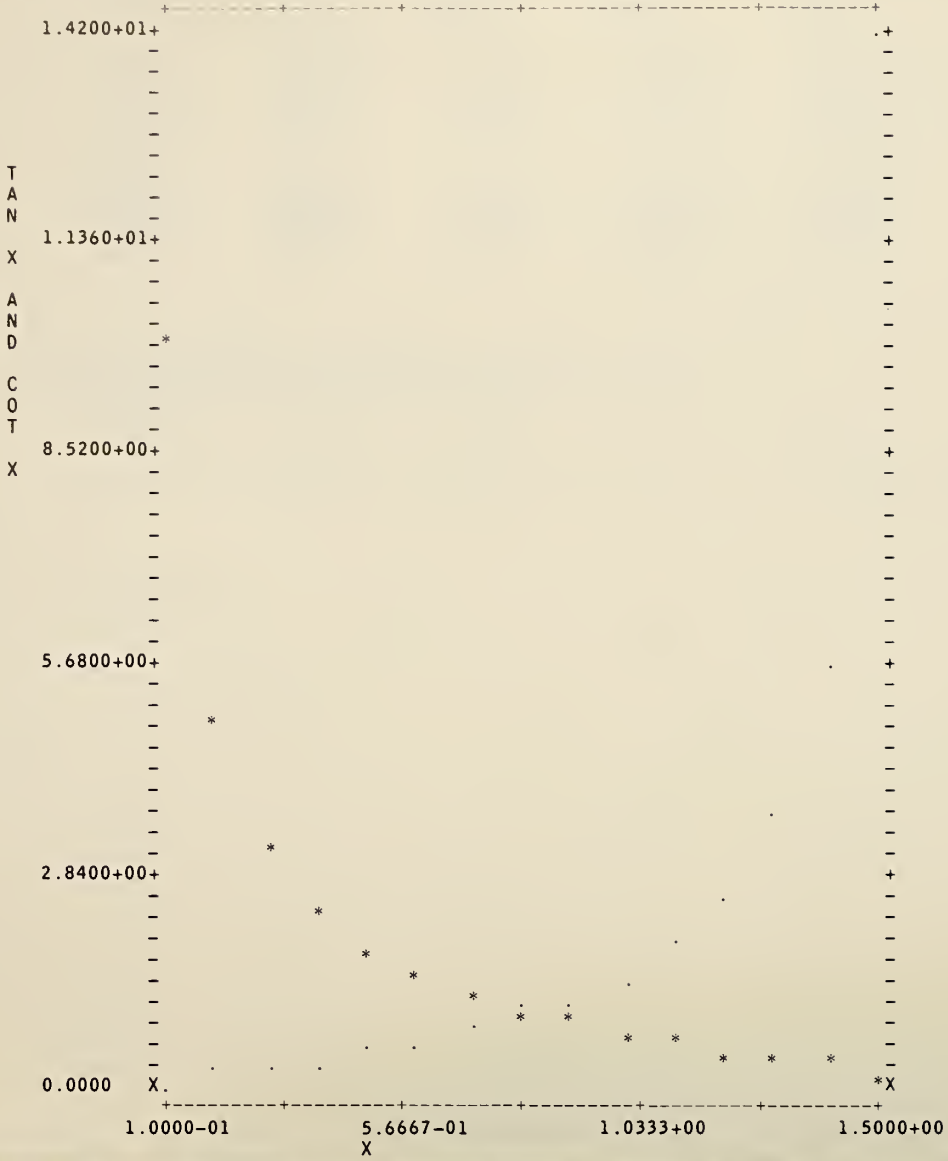
THE FOLLOWING VALUES ARE NUMBER OF SIGNIFICANT DIGITS FOR THE
ABSOLUTE VALUES OF X, ARCSIN, ARCCOS, ARCTAN, AND ARCCOT.
(THE VALUE FOR NUMBER OF SIGNIFICANT DIGITS IS 8.0 FOR NBS COMPUTER)

| | | | | |
|---|---|---|---|---|
| 8.0000000 | 7.6277749 | 7.7078534 | 7.7175097 | 7.7430716 |

**********


ABS- COLUMN 1 ,ORD- COLUMN 2 (.), COLUMN 3 (*),
9.9957-01+
7.9382-01+
5.8806-01+
3.8231-01+
1.7656-01+
-2.9200-02+
SIN X AND COS X
1.0000-01
4.0000-01
7.0000-01
1.0000+00
1.3000+00
1.6000+00
X

ABS- COLUMN 1
ORD- COLUMN 4 (.), COLUMN 5 (*),
NO. OF PTS. PLOTTED 30 NO. NOT PLOTTED (OUT OF BOUNDS) 2



LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SET FOLLOWING DATA IN COL 1
    -1.,-.8,-.6,-.4,-.2,.2,.4,.6,.8,1.
    SIN OF X IN COL 1 STORE RESULTS IN COL 2
    COS OF X IN COL 1 STORE RESULTS IN COL 3
    TAN OF X IN COL 1 STORE RESULTS IN COL 4
    COT OF X IN COL 1 STORE RESULTS IN COL 5
    ASIN OF X IN  COL 2 STORE RESULTS IN COL 6
    ACOS OF X IN  COL 3 STORE RESULTS IN COL 7
    ATAN OF X IN  COL 4 STORE RESULTS IN COL 8
    ACOT OF X IN  COL 5 STORE RESULTS IN COL 9
    SQUARE SIN X IN COL 2 AND     STORE RESULTS IN 10
    SQUARE COS X IN COL 3 MULT BY 1.0 ADD TO COL 10 AND STORE IN COL 12
    DIVIDE COL 2 BY COL 3 MULT BY -1.0 ADD TO COL 4 STORE IN 13
    DIVIDE COL 3 BY COL 2 MULT BY -1.0 ADD TO COL 5 STORE IN 14
    AVERAGE COL 12 STORE IN COL 12
    AVERAGE COL 13 STORE IN COL 13
    AVERAGE COL 14 STORE IN COL 14
    NEW PAGE
    NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
    NOTE          X         SIN X          COS X          TAN X          COT X
    SPACE
    NPRINT COLS 1 *** 5
    SPACE  2
    NOTE ********************************************************************************
    SPACE
    NOTE (SIN(X))**2+(COS(X))**2=1.0
    NOTE TAN(X)-(SIN(X)/COS(X))=0
    NOTE COT(X)-(COS(X)/SIN(X))=0
    NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0, 0.0 AND 0.0
    SPACE
    ABRIDGE ROW 1 COLS 12 13 14
    SPACE
    NOTE ********************************************************************************
    ADD COL 1 TO 0.0 STORE IN COL 5
    1/ABSOLUTE COL 5 STORE IN 5
    2/ACCURACY OF COL 5 VS COL 5 STORE IN COL 10
    3/AVERAGE COL 10 STORE IN COL 10
    4/INCREMENT STATEMENT 1 BY 1 1
    5/INCREMENT STATEMENT 2 BY 0 1 1
    6/INCREMENT STATEMENT 3 BY 1 1
    REPEAT STATEMENTS 1 THRU 6  5 TIMES
    NEW PAGE
    NOTE       COL 1          COL 6          COL 7          COL 8          COL 9
    NOTE         X         ARCSIN X       ARCCOS X       ARCTAN X       ARCCOT X
    SPACE
    NPRINT COLS 1 6***9
    SPACE  2
    NOTE ********************************************************************************
    NOTE
    NOTE THE FOLLOWING VALUES ARE NUMBER OF SIGNIFICANT DIGITS FOR THE
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    NOTE ABSOLUTE VALUES OF X, ARCSIN, ARCCOS, ARCTAN, AND ARCCOT.
    NOTE (THE VALUE FOR NUMBER OF SIGNIFICANT DIGITS IS 8.0 FOR NBS COMPUTER)
    SPACE
    ABRIDGE ROW 1 COLS 10***14
    SPACE
    NOTE ************************************************************************
    GENERATE X FROM 0.1 IN STEPS OF .1 THRU 1.6 IN COL 1
    SIN OF COL 1 STORE IN 2
    COS OF COL 1 STORE IN 3
    TAN OF COL 1 STORE IN 4
    COT OF COL 1 STORE IN 5
    TITLEY          SIN X AND COS X
    TITLEX                    X
    PLOT COLS  2 AND 3  (SIN AND COS X) VS. X IN COL 1
    TITLEX                    X
    TITLEY          TAN X AND COT X
    PAGE PLOT COLS 4 AND 5 (TAN AND COT) Y FROM 0.0 TO 14.2 VS. COL 1 FROM .1 TO 1.5
```

THE FOLLOWING IS AN EXAMPLE OF M(XX') AND M(X'X)

MATRIX X

| ROW/COL | 3 | 4 | 5 |
|---|---|---|---|
| 2 | 5.0000000 | 6.0000000 | 7.0000000 |
| 3 | 5.0000000 | 6.0000000 | 2.0000000 |
| 4 | -2.0000000 | 3.0000000 | 6.0000000 |

MATRIX XX'

| ROW/COL | 37 | 38 | 39 |
|---|---|---|---|
| 1 | 110.00000 | 75.000000 | 50.000000 |
| 2 | 75.000000 | 65.000000 | 20.000000 |
| 3 | 50.000000 | 20.000000 | 49.000000 |

MATRIX Y

| ROW/COL | 1 | 2 | 3 |
|---|---|---|---|
| 2 | 0. | 4.0000000 | 5.0000000 |
| 3 | -14.000000 | 2.0000000 | 5.0000000 |

MATRIX Y'Y

| ROW/COL | 40 | 41 | 42 |
|---|---|---|---|
| 2 | 196.00000 | -28.000000 | -70.000000 |
| 3 | -28.000000 | 20.000000 | 30.000000 |
| 4 | -70.000000 | 30.000000 | 50.000000 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
READ THE FOLLOWING DATA INTO COLUMNS 1***5
1.0  2.0  3.  4.   1.
0.0  4.0  5.  6.  7.
-14.0  2.0  5.  6.  2.
-2.0  3.0 -2.  3.  6.
M(XX') MATRIX X IN ROW 2 COLUMN 3 SIZE=3X3 STORE IN ROW 1 COLUMN 37
M(X'X) MATRIX X IN ROW 2 COLUMN 1 SIZE=2X3 STORE IN ROW 2 COLUMN 40
NEW PAGE
NOTE THE FOLLOWING IS AN EXAMPLE OF M(XX') AND M(X'X)
SPACE  2
NOTE MATRIX X
SPACE
MPRINT MATRIX X IN ROW 2 COLUMN 3  SIZE=3X3
SPACE  2
NOTE MATRIX  XX'
SPACE
MPRINT MATRIX IN ROW 1 COLUMN 37 SIZE=3X3
SPACE  2
NOTE MATRIX  Y
SPACE
MPRINT MATRIX Y IN ROW 2 COLUMN 1 SIZE=2X3
SPACE  2
NOTE MATRIX Y'Y
SPACE
MPRINT MATRIX IN ROW 2 COLUMN 40 SIZE=3X3
ROWSUM COLUMNS 37***42 AND STORE IN COLUMN 43
AVERAGE COLUMN 43 AND STORE IN COLUMN 43
SUBTRACT THE VALUE 161. FROM COLUMN 43 AND STORE IN COLUMN 43
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLUMN 43
NOTE ***************************************************************************
```

412-718 O - 71 - 6

| COL 1 X | COL 2 EXP(X) | COL 3 EXP(-X) | COL 4 NATURAL LOG(X) | COL 5 LOG BASE 10 |
|---|---|---|---|---|
| .25000000 | 1.2840254 | .77880078 | -1.3862944 | -.60205998 |
| .50000000 | 1.6487213 | .60653065 | -.69314718 | -.30102999 |
| .75000000 | 2.1170000 | .47236655 | -.28768207 | -.12493873 |
| 1.0000000 | 2.7182818 | .36787944 | 0. | 0. |
| 1.2500000 | 3.4903429 | .28650479 | .22314356 | .096910013 |
| 1.5000000 | 4.4816890 | .22313016 | .40546511 | .17609126 |
| 1.7500000 | 5.7546026 | .17377394 | .55961579 | .24303805 |
| 2.0000000 | 7.3890560 | .13533528 | .69314718 | .30102999 |
| 2.2500000 | 9.4877357 | .10539922 | .81093022 | .35218251 |
| 2.5000000 | 12.182494 | .082084998 | .91629074 | .39794001 |
| 2.7500000 | 15.642632 | .063927861 | 1.0116009 | .43933269 |
| 3.0000000 | 20.085537 | .049787068 | 1.0986123 | .47712125 |
| 3.2500000 | 25.790340 | .038774208 | 1.1786550 | .51188336 |
| 3.5000000 | 33.115452 | .030197383 | 1.2527630 | .54406804 |
| 3.7500000 | 42.521082 | .023517746 | 1.3217558 | .57403126 |
| 4.0000000 | 54.598150 | .018315639 | 1.3862944 | .60205998 |

| COL 2 EXP(X) | COL 6 INTEGRAL PART OF EXP(X) | COL 7 FRACTIONAL PART OF EXP(X) |
|---|---|---|
| 1.2840254 | 1.0000000 | .28402540 |
| 1.6487213 | 1.0000000 | .64872126 |
| 2.1170000 | 2.0000000 | .11700001 |
| 2.7182818 | 2.0000000 | .71828184 |
| 3.4903429 | 3.0000000 | .49034294 |
| 4.4816890 | 4.0000000 | .48168904 |
| 5.7546026 | 5.0000000 | .75460261 |
| 7.3890560 | 7.0000000 | .38905603 |
| 9.4877357 | 9.0000000 | .48773575 |
| 12.182494 | 12.000000 | .18249381 |
| 15.642632 | 15.000000 | .64263177 |
| 20.085537 | 20.000000 | .085536718 |
| 25.790340 | 25.000000 | .79033971 |
| 33.115452 | 33.000000 | .11545181 |
| 42.521082 | 42.000000 | .52108192 |
| 54.598150 | 54.000000 | .59814978 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

* 2.9802322-08 * 3.7252903-09 0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE X FROM .25 IN INTERVALS OF .25 THRU 4. IN COL 1
EXP  OF COL 1 STORE IN COL 2
NEGEXPONENT OF COL 1 STORE IN COL 3
DIVIDE COL 2 BY COL 3 STORE IN COL 21
LOGE COL 1 STORE IN COL 4
LOGTEN COL 1 STORE IN COL 5
ANTILOG OF COL 5 STORE IN COL 22
INTEGER PART OF COL 2 STORE IN COL 6
FRACTIONAL PART OF COL 2 STORE IN COL 7
SUBTRACT COL 6 FROM COL 2 MULT BY -1.0 ADD TO COL 7 STORE IN COL 23
NEW PAGE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE          X         EXP(X)         EXP(-X)        NATURAL LOG(X) LOG BASE 10
SPACE
NPRINT COLS 1 *** 5
SPACE  2
NOTE       COL 2          COL 6          COL 7
NOTE      EXP(X)     INTEGRAL PART  FRACTIONAL PART
NOTE                   OF EXP(X)      OF EXP(X)
SPACE
NPRINT COLS 2  6  7
DEFINE 0.0 IN COL 17
SQUARE COL 2 STORE IN 18
DEFINE COL 1 IN COL 19
ADD  1.0 TO 0.0 STORE IN COL 15
1/ SUBTRACT COL 21 FROM COL 18 STORE IN COL 21
3/ ABS COL 21 STORE IN 21
4/ IFNE  0.0 NOT EQUAL TO 21 WITHIN A TOLERANCE OF 1.0E-5
5/ INCREMENT 1 BY 1 1 AND 1
6/ INCREMENT  3 BY  1 AND 1
7/ INCREMENT 4 BY 0.0 1 AND 0.0
7.5/ IFEQ COL 15 IS EQ TO 2.0
8/ REPEAT  COMMANDS 1 THRU 7.5  2 TIMES
10/RESTORE 1 AS 23 17 23
11/ ADD 1.0 TO COL 15 STORE IN 15
REPEAT  COMMANDS 8 THRU 11  2 TIMES
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE  ROW 1 COL 21 22 23
SPACE
NOTE ***************************************************************************
```

CORRELATION ANALYSIS FOR 7 VARIABLES WITH 16 OBSERVATIONS

SIMPLE CORRELATION COEFFICIENTS

| COLUMN | 1 | 2 | 3 | 4 | 5 | 6 | 8 |
|---|---|---|---|---|---|---|---|
| 1 | 1.0000 | | | | | | |
| 2 | .9916 | 1.0000 | | | | | |
| 3 | .6206 | .6043 | 1.0000 | | | | |
| 4 | .4647 | .4464 | -.1774 | 1.0000 | | | |
| 5 | .9792 | .9911 | .6866 | .3644 | 1.0000 | | |
| 6 | .9911 | .9953 | .6683 | .4172 | .9940 | 1.0000 | |
| 8 | .9708 | .9835 | .5024 | .4570 | .9604 | .9713 | 1.0000 |

SIGNIFICANCE LEVELS OF SIMPLE CORRELATION COEFFICIENTS (ASSUMING NORMALITY)

| COLUMN | 1 | 2 | 3 | 4 | 5 | 6 | 8 |
|---|---|---|---|---|---|---|---|
| 1 | .0000 | | | | | | |
| 2 | .0000 | .0000 | | | | | |
| 3 | .0103 | .0132 | .0000 | | | | |
| 4 | .0697 | .0830 | .5109 | .0000 | | | |
| 5 | .0000 | .0000 | .0033 | .1652 | .0000 | | |
| 6 | .0000 | .0000 | .0047 | .1078 | .0000 | .0000 | |
| 8 | .0000 | .0000 | .0473 | .0751 | .0000 | .0000 | .0000 |

PARTIAL CORRELATION COEFFICIENTS WITH 5 REMAINING VARIABLES FIXED

| COLUMN | 1 | 2 | 3 | 4 | 5 | 6 | 8 |
|---|---|---|---|---|---|---|---|
| 1 | 1.0000 | | | | | | |
| 2 | .6296 | 1.0000 | | | | | |
| 3 | .3712 | -.7952 | 1.0000 | | | | |
| 4 | .2316 | -.5177 | -.8783 | 1.0000 | | | |
| 5 | -.6525 | .7592 | .3876 | .0391 | 1.0000 | | |
| 6 | -.1560 | .7213 | .9376 | .8527 | -.1753 | 1.0000 | |
| 8 | .0554 | -.3344 | -.8080 | -.8479 | -.0717 | .7993 | 1.0000 |

SIGNIFICANCE LEVELS OF PARTIAL CORRELATION COEFFICIENTS (ASSUMING NORMALITY)

| COLUMN | 1 | 2 | 3 | 4 | 5 | 6 | 8 |
|---|---|---|---|---|---|---|---|
| 1 | .0000 | | | | | | |
| 2 | .0379 | .0000 | | | | | |
| 3 | .2610 | .0034 | .0000 | | | | |
| 4 | .4931 | .1029 | .0004 | .0000 | | | |
| 5 | .0295 | .0067 | .2389 | .9091 | .0000 | | |
| 6 | .6468 | .0122 | .0000 | .0009 | .6061 | .0000 | |
| 8 | .8715 | .3148 | .0026 | .0010 | .8340 | .0032 | .0000 |

SPEARMAN RANK CORRELATION COEFFICIENTS (ADJUSTED FOR TIES)

| COLUMN | 1 | 2 | 3 | 4 | 5 | 6 | 8 |
|---|---|---|---|---|---|---|---|
| 1 | 1.0000 | | | | | | |
| 2 | .9971 | 1.0000 | | | | | |
| 3 | .6647 | .6382 | 1.0000 | | | | |
| 4 | .2206 | .2235 | -.3412 | 1.0000 | | | |
| 5 | .9971 | .9941 | .6853 | .2265 | 1.0000 | | |
| 6 | .9971 | .9941 | .6853 | .2265 | 1.0000 | 1.0000 | |
| 8 | .9824 | .9853 | .5647 | .2265 | .9765 | .9765 | 1.0000 |

SIGNIFICANCE LEVEL OF QUADRATIC FIT OVER LINEAR FIT BASED ON F RATIO WITH 1 AND 13 DEGREES OF FREEDOM
(FOR EXAMPLE, .1099 IS THE SIGNIFICANCE LEVEL OF THE QUADRATIC TERM WHEN COLUMN 2 IS FITTED TO COLUMN 1)

| COLUMN | 1 | 2 | 3 | 4 | 5 | 6 | 8 |
|---|---|---|---|---|---|---|---|
| 1 | 1.0000 | .0465 | .4560 | .0001 | .0009 | .1908 | .6482 |
| 2 | .1099 | 1.0000 | .5834 | .0001 | .0068 | .6670 | .4973 |
| 3 | .0560 | .1795 | 1.0000 | .0028 | .4280 | .1796 | .1435 |
| 4 | .0007 | .0018 | .2827 | 1.0000 | .0108 | .0030 | .0006 |
| 5 | .0013 | .0027 | .5545 | .0002 | 1.0000 | .0000 | .0920 |
| 6 | .0896 | .8106 | .6234 | .0001 | .0000 | 1.0000 | .5806 |
| 8 | .8852 | .3038 | .7556 | .0001 | .0444 | .6047 | 1.0000 |

CONFIDENCE INTERVALS FOR SIMPLE CORRELATION COEFFICIENTS (USING FISHER TRANSFORMATION)
95 PER CENT LIMITS BELOW DIAGONAL, 99 PER CENT LIMITS ABOVE DIAGONAL

| COLUMN | 1 | 2 | 3 | 4 | 5 | 6 | 8 |
|---|---|---|---|---|---|---|---|
| 1 | 99.0000 | .9980 | .8938 | .8390 | .9950 | .9979 | .9929 |
| | 95.0000 | .9654 | .0116 | -.2080 | .9158 | .9636 | .8834 |
| 2 | .9972 | 99.0000 | .8884 | .8320 | .9979 | .9989 | .9960 |
| | .9753 | 95.0000 | -.0146 | -.2300 | .9633 | .9804 | .9329 |
| 3 | .8537 | .8464 | 99.0000 | .4893 | .9147 | .9090 | .8530 |
| | .1804 | .1550 | 95.0000 | -.7132 | .1263 | .0929 | -.1605 |
| 4 | .7806 | .7714 | .3490 | 99.0000 | .7992 | .8206 | .8361 |
| | -.0402 | -.0633 | -.6187 | 95.0000 | -.3207 | -.2637 | -.2174 |
| 5 | .9929 | .9970 | .8821 | .7285 | 99.0000 | .9985 | .9904 |
| | .9394 | .9738 | .2893 | -.1602 | 95.0000 | .9750 | .8444 |
| 6 | .9970 | .9984 | .8743 | .7565 | .9980 | 99.0000 | .9930 |
| | .9740 | .9860 | .2580 | -.0989 | .9822 | 95.0000 | .8853 |
| 8 | .9900 | .9944 | .7991 | .7767 | .9865 | .9902 | 99.0000 |
| | .9157 | .9518 | .0090 | -.0500 | .8869 | .9171 | 95.0000 |

**********

THE OUTPUT ON THE PREVIOUS PAGE IS THE AUTOMATIC PRINT OUT OF CORRELATION
THE DATA USED IN THIS PROBLEM WERE TAKEN FROM AN ARTICLE BY
JAMES W. LONGLEY IN ''JOURNAL OF THE AMERICAN STATISTICAL
ASSOCIATION'', VOL. 62, (1967), PAGES 819-841.

**********

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

0. 0. 0. 0. 0. 0. 0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
READ DATA INTO COLS 1***8
83.0  234289  2356  1590  107608  1947  347873.0  60343
88.5  259426  2325  1456  108632  1948  373875.5  61122
88.2  258054  3682  1616  109773  1949  375162.2  60171
96.2  328975  2099  3099  112075  1951  448295.2  63221
89.5  284599  3351  1650  110929  1950  402568.5  61187
98.1  346999  1932  3594  113270  1952  467845.1  63639
99.0  365385  1870  3547  115094  1953  487948.0  64989
100.0  363112  3578  3350  116219  1954  488313.0  63761
101.2  397469  2904  3048  117388  1955  522865.2  66019
104.6  419180  2822  2857  118734  1956  545653.6  67857
108.4  442769  2936  2798  120445  1957  571013.4  68169
110.8  444546  4681  2637  121950  1958  575882.8  66513
112.6  482704  3813  2552  123366  1959  614506.6  68655
114.2  502601  3931  2514  125368  1960  636488.2  69564
115.7  518173  4806  2572  127852  1961  655479.7  69331
116.9  554894  4007  2827  130081  1962  693887.9  70551
CORRELATION 7 VARIABLES IN COLS 1***6, 8, STORE IN 1,9, 8, 9
SCORRELATION  7 VARIABLES IN COLS 1***6,8 STORE IN ROW 1 COL 19 AND ROW 8 COL 19
RESET NRMAX TO 14
NEW PAGE
NOTE1 ***************************************************************************
NOTE2 ***************************************************************************
PRINT NOTE
SPACE
NOTE THE OUTPUT ON THE PREVIOUS PAGE IS THE AUTOMATIC PRINT OUT OF CORRELATION
NOTE THE DATA USED IN THIS PROBLEM WERE TAKEN FROM AN ARTICLE BY
NOTE JAMES W. LONGLEY IN ''JOURNAL OF THE AMERICAN STATISTICAL
NOTE ASSOCIATION'', VOL. 62, (1967), PAGES 819-841.
SPACE
PRINT NOTE
1/SUBTRACT  COL 9 FROM COL 19 STORE IN 19
2/AVERAGE COL 19 STORE IN COL 19
3/INCREMENT 1 BY  1  1  AND 1
4/ INCREMENT 2 BY  1 AND 1
REPEAT 1 THRU 4  7 TIMES
SPACE  2
NOTE ****************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 COLS 19 *** 25
SPACE
NOTE ****************************************************************************
```

THE FOLLOWING IS AN EXAMPLE OF THE ACOALESCE AND AAVERAGE COMMANDS. ARRAY A IS THE ORIGINAL ARRAY.
ARRAY B CONTAINS THE RESULTS OF ACOALESCE. ARRAY C CONTAINS THE RESULTS OF AAVERAGE.

ARRAY A

| | | | |
|---|---|---|---|
| 1.0000000 | 0. | 1.0000000 | 2.0000000 |
| 0. | 2.0000000 | 1.0000000 | 3.0000000 |
| 1.0000000 | 2.0000000 | 0. | 1.0000000 |
| 0. | 1.0000000 | 2.0000000 | 0. |
| 2.0000000 | 1.0000000 | 3.0000000 | 1.0000000 |

ARRAY B

| | | | |
|---|---|---|---|
| 1.0000000 | 2.0000000 | 1.0000000 | 3.0000000 |
| 0. | 3.0000000 | 3.0000000 | 3.0000000 |
| 2.0000000 | 1.0000000 | 3.0000000 | 1.0000000 |
| 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. |

ARRAY C

| | | | |
|---|---|---|---|
| 1.0000000 | 1.0000000 | .50000000 | 1.5000000 |
| 0. | 1.5000000 | 1.5000000 | 1.5000000 |
| 2.0000000 | 1.0000000 | 3.0000000 | 1.0000000 |
| 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
DIMENSION  NO. OF ROWS=5 NO. OF COLUMNS=16
READ THE FOLLOWING DATA INTO COLUMNS 1***4
1   0   1   2
0   2   1   3
1   2   0   1
0   1   2   0
2   1   3   1
ACOALESCE ON FIRST COL OF ARRAY A IN R=1 C=1 SIZE=5X4 PUT ARRAY B IN R=1 C=5
AAVERAGE   ON FIRST COL OF ARRAY A IN R=1 C=1 SIZE=5X4 PUT ARRAY C IN R=1 C=9
TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE ACOALESCE AND AAVERAGE C
TITLE2OMMANDS. ARRAY A IS THE ORIGINAL ARRAY.
TITLE3 ARRAY B CONTAINS THE RESULTS OF ACOALESCE. ARRAY C CONTAINS
TITLE4 THE RESULTS OF AAVERAGE.
NEW PAGE
SPACE
NOTE ARRAY A                                                    ARRAY B
SPACE
NPRINT COLUMNS 1***8
SPACE 2
NOTE                                                            ARRAY C
SPACE
NPRINT COLUMNS 13***16 AND 9***12
ROWSUM THE ENTIRE WORKSHEET AND STORE SUM IN COLUMN 13
SET THE FOLLOWING VALUES IN COLUMN 14
-15.0  -19.5  -18.0  -3.0  -7.0
ADD COLUMN 13 TO COLUMN 14 AND STORE IN COLUMN 14
AVERAGE COLUMN 14 AND STORE AVERAGE IN COLUMN 14
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLUMN 14
SPACE
NOTE ***************************************************************************
```

AUTOMATIC OUTPUT FROM THE COMMAND ONEWAY

ANALYSIS OF VARIANCE

| SOURCE | D.F. | SUM OF SQUARES | MEAN SQUARES | F RATIO | F PROB. |
|---|---|---|---|---|---|
| BETWEEN GROUPS | 5 | 1.320000+03 | 2.640000+02 | 7.135 | .000 |
| SLOPE | 1 | 1.282571+03 | 1.282571+03 | 38.806 | .000 |
| DEVS. ABOUT LINE | 4 | 3.742857+01 | 9.357143+00 | .253 | .905 |
| WITHIN GROUPS | 24 | 8.880000+02 | 3.700000+01 | | |
| TOTAL | 29 | 2.208000+03 | | | |

KRUSKAL-WALLIS RANK TEST FOR DIFFERENCE BETWEEN GROUP MEANS * H = 16.600, F PROB = .001 (APPROX.)

ESTIMATES

| GROUP | NO. | MEAN | WITHIN S.D. | S.D. OF MEAN | MINIMUM | MAXIMUM | S(R) | 95PCT CONF INT FOR MEAN |
|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 4.50000+01L | 4.30116+00L | 1.92354+00 | 4.00000+01 | 5.10000+01 | 23.5 | 3.96595+01 TO 5.03405+01 |
| 2 | 5 | 5.10000+01 | 6.04152+00 | 2.70185+00 | 4.50000+01 | 5.80000+01 | 52.0 | 4.34986+01 TO 5.85014+01 |
| 3 | 5 | 5.50000+01 | 7.64853+00H | 3.42053+00 | 4.50000+01 | 6.30000+01 | 74.0 | 4.55033+01 TO 6.44967+01 |
| 4 | 5 | 5.80000+01 | 6.04152+00 | 2.70185+00 | 5.20000+01 | 6.50000+01 | 86.5 | 5.04986+01 TO 6.55014+01 |
| 5 | 5 | 6.30000+01 | 6.67083+00 | 2.98329+00 | 5.60000+01 | 7.10000+01 | 111.5 | 5.47172+01 TO 7.12828+01 |
| 6 | 5 | 6.40000+01H | 5.24404+00 | 2.34521+00 | 5.70000+01 | 7.00000+01 | 117.5 | 5.74888+01 TO 7.05112+01 |
| TOTAL | 30 | 5.60000+01 | | | 4.00000+01 | 7.10000+01 | | |
| FIXED EFFECTS MODEL | | | 6.08276+00 | 1.11056+00 | | | | 5.37079+01 TO 5.82921+01 |
| RANDOM EFFECTS MODEL | | | 7.26636+00 | 2.96648+00 | | | | 4.83745+01 TO 6.36255+01 |
| UNGROUPED DATA | | | 8.72571+00 | 1.59309+00 | | | | 5.27418+01 TO 5.92582+01 |

PAIRWISE MULTIPLE COMPARISON OF MEANS. THE MEANS ARE PUT IN INCREASING ORDER IN GROUPS SEPARATED BY *****. A MEAN IS ADJUDGED NON-SIGNIFICANTLY DIFFERENT FROM ANY MEAN IN THE SAME GROUP AND SIGNIFICANTLY DIFFERENT AT THE .05 LEVEL FROM ANY MEAN IN ANOTHER GROUP. ***** ***** INDICATES ADJACENT GROUPS HAVE NO COMMON MEAN.

NEWMAN-KEULS TECHNIQUE, HARTLEY MODIFICATION. (APPROXIMATE IF GROUP NUMBERS ARE UNEQUAL.)

4.50000+01, 5.10000+01,
*****
5.10000+01, 5.50000+01, 5.80000+01,
*****
5.50000+01, 5.80000+01, 6.30000+01, 6.40000+01,

SCHEFFE TECHNIQUE.

4.50000+01, 5.10000+01, 5.50000+01, 5.80000+01,
*****
5.10000+01, 5.50000+01, 5.80000+01, 6.30000+01, 6.40000+01,

TESTS FOR HOMOGENEITY OF VARIANCES.

COCHRAN'S C = MAX. VARIANCE/SUM(VARIANCES) = .2635, P = .853 (APPROX.)
BARTLETT-BOX F = .272, P = .929
MAXIMUM VARIANCE / MINIMUM VARIANCE = 3.162

MODEL II - COMPONENTS OF VARIANCE.

ESTIMATE OF BETWEEN COMPONENT 4.5400000+01

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

0. 0. 0. 0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
SET 1
40,51,42,47,45,57,47,58,48,45
49,60,58,45,63,55,64,65,54,52
56,71,58,61,69,61,68,70,64,57
SET 2
1,1,1,1,1,2,2,2,2,3,3,3,3,3
4,4,4,4,4,5,5,5,5,6,6,6,6,6
TITLE1    AUTOMATIC OUTPUT FROM THE COMMAND ONEWAY
ONEWAY ANALYSIS FOR DATA IN COL 1, TAG IN 2, PUT STATISTICS IN 11***14
SONEWAY  1  2  21***24
1/SUB COL 11 FROM 21 STORE IN 21
2/AVERAGE COL 21 STORE IN COL 21
3/INCREMENT 1  1  1  1
4/INCREMENT  2  1  1
REPEAT 1 THRU 4  4 TIMES
TITLE1
NEW PAGE
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE 1  21***24
SPACE 1
NOTE ***************************************************************************
```

THE FOLLOWING IS AN EXAMPLE OF THE MTRIAN COMMAND.

MATRIX A IS THE ORIGINAL MATRIX.

| ROW/COL | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 3 | 4.0000 | 6.0000 | 8.0000 | 10.0000 |
| 4 | 6.0000 | 25.0000 | 20.0000 | 27.0000 |
| 5 | 8.0000 | 20.0000 | 36.0000 | 30.0000 |
| 6 | 10.0000 | 27.0000 | 30.0000 | 36.0000 |

MATRIX B IS THE TRIANGULAR OF MATRIX A (B TIMES B-TRANSPOSE EQUALS A)

| ROW/COL | 7 | 8 | 9 | 10 |
|---|---|---|---|---|
| 3 | 2.0000 | .0000 | .0000 | .0000 |
| 4 | 3.0000 | 4.0000 | .0000 | .0000 |
| 5 | 4.0000 | 2.0000 | 4.0000 | .0000 |
| 6 | 5.0000 | 3.0000 | 1.0000 | 1.0000 |

MATRIX C IS THE INVERSE OF MATRIX B

| ROW/COL | 11 | 12 | 13 | 14 |
|---|---|---|---|---|
| 3 | .5000 | .0000 | .0000 | .0000 |
| 4 | -.3750 | .2500 | .0000 | .0000 |
| 5 | -.3125 | -.1250 | .2500 | .0000 |
| 6 | -1.0625 | -.6250 | -.2500 | 1.0000 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

5.960464-08 5.543776-09

**********

THE FOLLOWING IS AN EXAMPLE OF THE MRAISE COMMAND.

MATRIX A IS THE ORIGINAL MATRIX.

| ROW/COL | 7 | 8 | 9 | 10 |
|---|---|---|---|---|
| 3 | 2.00 | .00 | .00 | .00 |
| 4 | 3.00 | 4.00 | .00 | .00 |
| 5 | 4.00 | 2.00 | 4.00 | .00 |
| 6 | 5.00 | 3.00 | 1.00 | 1.00 |

MATRIX B IS MATRIX A RAISED TO THE SECOND POWER.

| ROW/COL | 25 | 26 | 27 | 28 |
|---|---|---|---|---|
| 3 | 4.00 | .00 | .00 | .00 |
| 4 | 18.00 | 16.00 | .00 | .00 |
| 5 | 30.00 | 16.00 | 16.00 | .00 |
| 6 | 28.00 | 17.00 | 5.00 | 1.00 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

.00

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    READ THE FOLLOWING DATA INTO COLUMNS 2***5
    0.0      0.0       0.0    0.0
    0.0      0.0       0.0    0.0
    4.0      6.0       8.0   10.0
    6.0     25.0      20.0   27.0
    8.0     20.0      36.0   30.0
    10.0    27.0      30.0   36.0
    MTRIAN MATRIX IN R=3 C=2 SIZE=4X4 PUT TRIANGULAR IN R=3 C=7 INVERSE IN R=3 C=11
    MINVERT MATRIX IN R=3 C=7 SIZE4X4 PUT INVERSE IN R=3 C=15
      ++++++++++++++++++++ SMALLEST ERROR BOUND ON INVERTED MATRIX IS  .1-06   ++++
    MSUB MATRIX IN R=3 C=11 SIZE 4X4 MINUS MATRIX IN R=3 C=15 4X4 PUT IN R=3 C=19
    TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE MTRIAN COMMAND.
    NEW PAGE
    SPACE
    NOTE MATRIX A IS THE ORIGINAL MATRIX.
    FIXED 4
    MPRINT MATRIX A IN R=3 C=2  SIZE=4X4
    SPACE
    NOTE MATRIX B IS THE TRIANGULAR OF MATRIX A (B TIMES B-TRANSPOSE EQUALS A)
    MPRINT MATRIX B IN R=3 C=7 SIZE=4X4
    SPACE
    NOTE MATRIX C IS THE INVERSE OF MATRIX B
    MPRINT MATRIX C IN R=3 C=11 SIZE=4X4
    ROWSUM  COLUMNS 7***10 PUT IN COLUMN 23
    ROWSUM  COLUMNS 19***22 PUT IN COLUMN 24
    AVERAGE COLUMN 23 AND STORE IN COLUMN 23
    SUBTRACT 4.8333333 FROM COLUMN 23 AND STORE IN COLUMN 23
    AVERAGE COLUMN 24 AND STORE IN COLUMN 24
    FLOATING 6
    SPACE  2
    NOTE ********************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE  ROW 1 OF COLUMNS 23 AND 24
    SPACE
    NOTE ********************************************************************************
    MRAISE MATRIX A IN R=3 C=7 SIZE=4X4 TO 2ND POWER STORE IN R=3 C=25
    MMULT MATRIX A IN R=3 C=7 SIZE=4X4 BY MATRIX IN R=3 C=7  4X4 PUT IN R=3 C=29
    MSUB MATRIX IN R=3 C=25 SIZE=4X4 FROM MATRIX IN R=3 C=29 4X4 PUT IN R=3 C=33
    ROWSUM COLUMNS  33***36  AND STORE IN COLUMN 37
    AVERAGE COLUMN 37 AND  PUT IN COLUMN 37
    TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE MRAISE COMMAND.
    NEW PAGE
    SPACE
    FIXED 2
    NOTE MATRIX A IS THE ORIGINAL MATRIX.
    MPRINT MATRIX A IN R=3  C=7 SIZE=4X4
    SPACE
    NOTE MATRIX B IS MATRIX A RAISED TO THE SECOND POWER.
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    MPRINT MATRIX IN R=3 C=25 SIZE=4X4
    SPACE  2
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE ROW 1  OF COLUMN 37
    SPACE
    NOTE ***************************************************************************
```

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C. 20234, OMNITAB II VERSION 5.00 MAY 15

| COL 3 POINTS N | COL 1 X | COL 2 WEIGHTS |
|---|---|---|
| 1 | .069431844 | .17392742 |
| 2 | .33000948 | .32607258 |
| 3 | .66999052 | .32607258 |
| 4 | .93056816 | .17392742 |

| COL 6 POINTS N | COL 4 X | COL 5 WEIGHTS |
|---|---|---|
| 1 | .034715922 | .086963711 |
| 2 | .16500474 | .16303629 |
| 3 | .33499526 | .16303629 |
| 4 | .46528408 | .086963711 |
| 5 | .53471592 | .086963711 |
| 6 | .66500474 | .16303629 |
| 7 | .83499526 | .16303629 |
| 8 | .96528408 | .086963711 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

* 3.7252903-09

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GAUSS QUADRATURE  4 PTS. A= 0.0 AND B=1.0 STORE X IN COL 1 WTS. IN COL 2
GENERATE   1 STEPS OF 1 THRU 4 IN COL 3
NEW PAGE
NOTE       COL 3          COL 1          COL 2
NOTE    POINTS  N          X           WEIGHTS
SPACE
NPRINT COLS 3 WITH 1. SIGNIFICANT DIGS   1 2  WITH 8. SIG DIGITS
GAUSS QUADRATURE          8 PTS. A=0.0 AND B=1.0 STORE X IN COL 4 WTS IN COL 5
GENERATE  1 IN STEPS OF 1 THRU 8 IN COL 6
SPACE  2
NOTE       COL 6          COL 4          COL 5
NOTE    POINTS  N          X           WEIGHTS
SPACE
NPRINT COL 6 WITH 1.0 SIG DIG. AND COLS 4 5 WITH 8. SIG DIG.
MULTIPLY COL 1 BY 2 STORE IN COL 7
MULTIPLY COL 4 BY 5 STORE IN COL 8
SUM 7 STORE IN 7
SUM 8 STORE IN 8
SUBTRACT 8 FROM 7 STORE IN 9
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 COL 9
SPACE
NOTE ***************************************************************************
```





412-718 O - 71 - 7

BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 0, PHI=PI/4

| COL 1 | COL 2 | COL 3 | COL 4 | COL 5 |
|---|---|---|---|---|
| | I(Z*EXP(I*PI/4)) | | K(Z*EXP(I*PI/4)) | |
| Z | REAL PART | IMAGINARY | REAL PART | IMAGINARY |
| 1.0000000 | .98438178 | .24956604 | .28670621 | -.49499463 |
| 2.0000000 | .75173418 | .97229163 | -.041664514 | -.20240007 |
| 3.0000000 | -.22138025 | 1.9375868 | -.067029233 | -.051121884 |
| 4.0000000 | -2.5634165 | 2.2926903 | -.036178848 | .0021983993 |
| 5.0000000 | -6.2300825 | .11603438 | -.011511727 | .011187586 |
| 6.0000000 | -8.8583159 | -7.3347465 | -.00065303752 | .0072164915 |
| 7.0000000 | -3.6329302 | -21.239403 | .0019220216 | .0027003651 |
| 8.0000000 | 20.973955 | -35.016725 | .0014858341 | .00036958390 |
| 9.0000000 | 73.935729 | -24.712783 | .00063716419 | -.00031915291 |
| 10.000000 | 138.84047 | 56.370458 | .00012946633 | -.00030752457 |

BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 1, PHI=PI/4

| COL 1 | COL 6 | COL 7 | COL 8 | COL 9 |
|---|---|---|---|---|
| | I(Z*EXP(I*PI/4)) | | K(Z*EXP(I*PI/4)) | |
| Z | REAL PART | IMAGINARY | REAL PART | IMAGINARY |
| 1.0000000 | .30755663 | .39586826 | .24199597 | -.74032227 |
| 2.0000000 | .29977544 | .99707765 | -.080049397 | -.23080593 |
| 3.0000000 | -.48745418 | 1.7326442 | -.080270222 | -.049898308 |
| 4.0000000 | -2.5638217 | 1.8692484 | -.039166010 | .0053512965 |
| 5.0000000 | -5.7979079 | -.35977666 | -.011577754 | .012737390 |
| 6.0000000 | -7.8766769 | -7.4621992 | -.00028834993 | .0076760896 |
| 7.0000000 | -2.3171651 | -20.368926 | .0021488969 | .0027435871 |
| 8.0000000 | 21.673535 | -32.506861 | .0015669748 | .00032285710 |
| 9.0000000 | 72.054291 | -20.719209 | .00065005053 | -.00035578180 |
| 10.000000 | 131.87864 | 59.477610 | .00012351960 | -.00032280186 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO NEAR TO 0.0

*-5.2154064-09 * 3.7951395-09

**********

BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 0, PHI=PI/4

| COL 1 | COL 2 | COL 3 | COL 4 | COL 5 |
|---|---|---|---|---|
| | EXP(-Z/SQRT(2))* I(Z*EXP(I*PI/4)) | | EXP(Z/SQRT(2))* K(Z*EXP(I*PI/4)) | |
| Z | REAL PART | IMAGINARY | REAL PART | IMAGINARY |
| 1.0000000 | .48536783 | .12305320 | .58147316 | -1.0039060 |
| 2.0000000 | .18275916 | .23638036 | -.17137658 | -.83252215 |
| 3.0000000 | -.026537570 | .23226482 | -.55916756 | -.42646615 |
| 4.0000000 | -.15151265 | .13551117 | -.61210372 | .037194341 |
| 5.0000000 | -.18156449 | .0033816124 | -.39500569 | .38388335 |
| 6.0000000 | -.12729042 | -.10539734 | -.045445781 | .50220559 |
| 7.0000000 | -.025740030 | -.15048537 | .27127281 | .38112768 |
| 8.0000000 | .073272289 | -.12233055 | .42531520 | .10579220 |
| 9.0000000 | .12735653 | -.042568515 | .36990016 | -.18528146 |
| 10.000000 | .11792078 | .047876879 | .15243425 | -.36208084 |

BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 1, PHI=PI/4

| COL 1 | COL 6 | COL 7 | COL 8 | COL 9 |
|---|---|---|---|---|
| | EXP(-Z/SQRT(2))* I(Z*EXP(I*PI/4)) | | EXP(Z/SQRT(2))* K(Z*EXP(I*PI/4)) | |
| Z | REAL PART | IMAGINARY | REAL PART | IMAGINARY |
| 1.0000000 | .15164655 | .19519025 | .49079564 | -1.5014587 |
| 2.0000000 | .072880425 | .24240626 | -.32926321 | -.94936258 |
| 3.0000000 | -.058432716 | .20769769 | -.66962581 | -.41625890 |
| 4.0000000 | -.15153659 | .11048333 | -.66264302 | .090537667 |
| 5.0000000 | -.16896955 | -.010485041 | -.39727131 | .43706228 |
| 6.0000000 | -.11318467 | -.10722879 | -.020066669 | .53418966 |
| 7.0000000 | -.016417573 | -.14431787 | .30329384 | .38722802 |
| 8.0000000 | .075716262 | -.11356237 | .44854145 | .092416799 |
| 9.0000000 | .12411569 | -.035689463 | .37738121 | -.20654605 |
| 10.000000 | .11200792 | .050515863 | .14543255 | -.38006840 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO NEAR TO 0.0

*-4.6566129-09 * 4.5576598-09

**********

BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 0 PHI=30 DEGREES OR .523598775 RADIANS

| COL 1 | COL 2 | COL 3 | COL 4 | COL 5 |
|---|---|---|---|---|
| | I(Z*EXP(I*PHI)) | | K(Z*EXP(I*PHI)) | |
| Z | REAL PART | IMAGINARY | REAL PART | IMAGINARY |
| 1.0000000 | 1.1167501 | .23003206 | .36238959 | -.32126957 |
| 2.0000000 | 1.3463908 | 1.0809681 | .048685394 | -.14140496 |
| 3.0000000 | 1.1557921 | 3.0026294 | -.0090476354 | -.051315125 |
| 4.0000000 | -.95624276 | 6.4823126 | -.011997036 | -.014896471 |
| 5.0000000 | -8.4114261 | 11.016143 | -.0066857185 | -.0027524014 |
| 6.0000000 | -27.417000 | 12.101181 | -.0027680361 * 3.0865417-04 | |
| 7.0000000 | -65.537291 | -5.6731651 | *-8.8970528-04 * 6.2478134-04 | |
| 8.0000000 | -121.48827 | -80.956392 | *-1.8934163-04 * 3.8441510-04 | |
| 9.0000000 | -151.42078 | -289.50409 | * 7.3247812-06 * 1.7001488-04 | |
| 10.000000 | 13.941978 | -735.81133 | * 3.5164107-05 * 5.8180746-05 | |

BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 1 PHI=30 DEGREES

| COL 1 | COL 6 | COL 7 | COL 8 | COL 9 |
|---|---|---|---|---|
| | I(Z*EXP(I*PHI)) | | K(Z*EXP(I*PHI)) | |
| Z | REAL PART | IMAGINARY | REAL PART | IMAGINARY |
| 1.0000000 | .43071045 | .31377427 | .43914511 | -.51609738 |
| 2.0000000 | .78785283 | 1.0378416 | .043382938 | -.17529605 |
| 3.0000000 | .64916390 | 2.6807601 | -.014118098 | -.057716939 |
| 4.0000000 | -1.3246755 | 5.7005536 | -.014103119 | -.015767526 |
| 5.0000000 | -8.2791920 | 9.5750115 | -.0073764499 | -.0026735305 |
| 6.0000000 | -25.943990 | 9.9659038 | -.0029510439 * 4.3872465-04 | |
| 7.0000000 | -61.186409 | -7.8292065 | *-9.2250577-04 * 6.9273015-04 | |
| 8.0000000 | -112.10820 | -80.535762 | *-1.8796486-04 * 4.1048937-04 | |
| 9.0000000 | -135.53557 | -279.79750 | * 1.2192358-05 * 1.7787054-04 | |
| 10.000000 | 32.627300 | -703.13503 | * 3.8062966-05 * 5.9819189-05 | |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO NEAR TO 0.0

*-3.8184225-09 * 1.6501872-09

**********

BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 0 PHI=45 DEGREES OR .785398163 RADIANS

| COL 1 | COL 2 EXP(-Z*COS(PHI))* I(Z*EXP(I*PHI)) | | COL 4 EXP(Z*COS(PHI))* K(Z*EXP(I*PHI)) | COL 5 |
|---|---|---|---|---|
| Z | REAL PART | IMAGINARY | REAL PART | IMAGINARY |
| 1.0000000 | .15164655 | .19519024 | .49079566 | -1.5014587 |
| 2.0000000 | .072880426 | .24240626 | -.32926320 | -.94936258 |
| 3.0000000 | -.058432714 | .20769769 | -.66962580 | -.41625892 |
| 4.0000000 | -.15153659 | .11048333 | -.66264302 | .090537650 |
| 5.0000000 | -.16896955 | -.010485037 | -.39727132 | .43706227 |
| 6.0000000 | -.11318467 | -.10722878 | -.020066689 | .53418966 |
| 7.0000000 | -.016417579 | -.14431787 | .30329383 | .38722803 |
| 8.0000000 | .075716257 | -.11356237 | .44854145 | .092416821 |
| 9.0000000 | .12411569 | -.035689469 | .37738122 | -.20654603 |
| 10.000000 | .11200792 | .050515857 | .14543257 | -.38006839 |

BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 1, PHI=45 DEGREES

| COL 1 | COL 6 EXP(-Z*COS(PHI))* I(Z*EXP(I*PHI)) | | COL 8 EXP(Z*COS(PHI))* K(Z*EXP(I*PHI)) | COL 9 |
|---|---|---|---|---|
| Z | REAL PART | IMAGINARY | REAL PART | IMAGINARY |
| 1.0000000 | .15164655 | .19519024 | .49079566 | -1.5014587 |
| 2.0000000 | .072880426 | .24240626 | -.32926320 | -.94936258 |
| 3.0000000 | -.058432714 | .20769769 | -.66962580 | -.41625892 |
| 4.0000000 | -.15153659 | .11048333 | -.66264302 | .090537650 |
| 5.0000000 | -.16896955 | -.010485037 | -.39727132 | .43706227 |
| 6.0000000 | -.11318467 | -.10722878 | -.020066689 | .53418966 |
| 7.0000000 | -.016417579 | -.14431787 | .30329383 | .38722803 |
| 8.0000000 | .075716257 | -.11356237 | .44854145 | .092416821 |
| 9.0000000 | .12411569 | -.035689469 | .37738122 | -.20654603 |
| 10.000000 | .11200792 | .050515857 | .14543257 | -.38006839 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO NEAR TO 0.0

*-2.7939677-09 * 1.2165401-09

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE 1.0 1.0  10  COL  1
KBIZERO  VALUES IN COL 1  RESULTS COL 2 REAL  COL 3 COMPLEX
KBKZERO  OF COL 1 STORE REAL VALUES IN COL 4, COMPLEX IN 5
TITLE1 BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 0, PHI=PI/4
NEW PAGE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE                      I(Z*EXP(I*PI/4))               K(Z*EXP(I*PI/4))
NOTE         Z         REAL PART      IMAGINARY      REAL PART      IMAGINARY
SPACE
NPRINT COLS  1***5
KBIONE  OF COL 1 RESULTS  COL 6 REAL COL 7 COMPLEX
KBKONE  OF COL 1 RESULTS- REAL IN 8 COMPLEX IN 9
SPACE
NOTE   BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 1, PHI=PI/4
SPACE
NOTE       COL 1          COL 6          COL 7          COL 8          COL 9
NOTE                      I(Z*EXP(I*PI/4))               K(Z*EXP(I*PI/4))
NOTE         Z         REAL PART      IMAGINARY      REAL PART      IMAGINARY
SPACE
NPRINT 1 COLS 6***9
MULT COL 2 BY COL 8 STORE IN COL 11
MULT COL 3 BY COL 9 MULT BY -1. ADD TO COL 11 STORE IN 11
MULT COL 6 BY COL 4 MULT 1.0 ADD TO COL 11 AND STORE IN 11
MULT COL 7 BY COL 5 MULT -1.0 ADD TO COL 11 AND STORE IN COL 11
SQRT 2.0 STORE IN 10
DIVIDE COL 10 BY COL 1 MULT .5 ADD 0.0 STORE IN COL 10
SUBTRACT COL 10 FROM COL 11 STORE IN 11
MULT COL 2 BY COL 9 MULT BY 1.0 ADD TO COL 10 STORE IN 12
MULT COL 3 BY COL 8 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
MULT COL 6 BY COL 5 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
MULT COL 7 BY COL 4 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE  THE FOLLOWING VALUES MUST BE EQUAL TO NEAR TO 0.0
SPACE
AVERAGE COL 11 STORE IN COL 11
AVERAGE COL 12 STORE IN COL 12
ABRIDGE ROW 1 COLS  11 12
SPACE
NOTE ***************************************************************************
KEXIZERO     VALUES  IN COL  1 RESULTS COL  2 REAL  COL 3 COMPLEX
KEXKZERO  OF COL 1 STORE REAL NOS. IN 4 COMPLEX IN 5
KEXIONE  OF COL 1 RESULTS COL 6 REAL  COL 7 COMPLEX
KEXKONE  OF COL 1 RESULTS- REAL IN COL 8 COMPLEX IN COL 9
NEW PAGE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE                       EXP(-Z/SQRT(2))*               EXP(Z/SQRT(2))*
NOTE                      I(Z*EXP(I*PI/4))               K(Z*EXP(I*PI/4))
NOTE         Z         REAL PART      IMAGINARY      REAL PART      IMAGINARY
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
SPACE
NPRINT COLS  1***5
SPACE
NOTE   BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 1, PHI=PI/4
SPACE
NOTE       COL 1          COL 6          COL 7          COL 8          COL 9
NOTE                       EXP(-Z/SQRT(2))*              EXP(Z/SQRT(2))*
NOTE                      I(Z*EXP(I*PI/4))              K(Z*EXP(I*PI/4))
NOTE         Z         REAL PART      IMAGINARY      REAL PART      IMAGINARY
SPACE
NPRINT 1 COLS 6***9
MULT COL 2 BY COL 8 STORE IN COL 11
MULT COL 3 BY COL 9 MULT BY -1. ADD TO COL 11 STORE IN 11
MULT COL 6 BY COL 4 MULT 1.0 ADD TO COL 11 AND STORE IN 11
MULT COL 7 BY COL 5 MULT -1.0 ADD TO COL 11 AND STORE IN COL 11
SQRT 2.0 STORE IN 10
DIVIDE COL 10 BY COL 1 MULT .5 ADD 0.0 STORE IN COL 10
SUBTRACT COL 10 FROM COL 11 STORE IN 11
MULT COL 2 BY COL 9 MULT BY 1.0 ADD TO COL 10 STORE IN 12
MULT COL 3 BY COL 8 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
MULT COL  6 BY COL 5 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
MULT COL 7 BY COL 4 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
AVERAGE COL 11 STORE IN COL 11
AVERAGE COL 12 STORE IN COL 12
SPACE 2
NOTE ********************************************************************************
SPACE
NOTE  THE FOLLOWING VALUES MUST BE EQUAL TO NEAR TO 0.0
SPACE
ABRIDGE ROW 1 COLS  11 12
SPACE
NOTE ********************************************************************************
RESET  V  .523598775
CIZERO  OF COL 1 PHI=*V*  STORE REAL VALUES IN 2, COMPLEX IN 3
CKZERO OF COL 1 PHI=*V*  STORE RESULTS- REAL IN 4 COMPLEX IN 5
TITLE1     BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 0       PHI
TITLE2=30 DEGREES OR  .523598775  RADIANS
NEW PAGE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE                      I(Z*EXP(I*PHI))               K(Z*EXP(I*PHI))
NOTE         Z         REAL PART      IMAGINARY      REAL PART      IMAGINARY
SPACE
NPRINT COLS  1***5
CIONE  OF COL 1 PHI=*V*  RESULTS OF COL 6 REAL COL 7 COMPLEX
CKONE  OF COL 1 PHI=*V* REAL RESULTS IN 8 COMPLEX IN 9
SPACE
NOTE        BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 1  PHI=30 DEGREES
SPACE
NOTE       COL 1          COL 6          COL 7          COL 8          COL 9
NOTE                      I(Z*EXP(I*PHI))               K(Z*EXP(I*PHI))
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
NOTE         Z          REAL PART      IMAGINARY      REAL PART      IMAGINARY
SPACE
NPRINT 1 COLS 6***9
MULT COL 2 BY COL 8 STORE IN COL 11
MULT COL 3 BY COL 9 MULT BY -1. ADD TO COL 11 STORE IN 11
MULT COL 6 BY COL 4 MULT 1.0 ADD TO COL 11 AND STORE IN 11
MULT COL 7 BY COL 5 MULT -1.0 ADD TO COL 11 AND STORE IN COL 11
COS *V* STORE IN COL 10
DIVIDE COL 10 BY COL 1 STORE IN COL 10
SUBTRACT COL 10 FROM COL 11 STORE IN 11
SIN *V* STORE IN COL 10
DIVIDE COL 10 BY COL 1 STORE IN COL 10
MULT COL 2 BY COL 9 MULT BY 1.0 ADD TO COL 10 STORE IN 12
MULT COL 3 BY COL 8 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
MULT COL 6 BY COL 5 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
MULT COL 7 BY COL 4 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE  THE FOLLOWING VALUES MUST BE EQUAL TO NEAR TO 0.0
SPACE
AVERAGE COL 11 STORE IN COL 11
AVERAGE COL 12 STORE IN COL 12
ABRIDGE ROW 1 COLS  11 12
SPACE
NOTE ***************************************************************************
RESET  V  .785398163  RADIANS
CEIZERO  OF COL 1 PHI=*V* REAL RESULTS IN 2, COMPLEX IN COL 3
CEKZERO  OF COL 1 PHI=*V* RESULTS- REAL IN COL 4 COMPLEX IN COL 5
CEIONE  OF COL 1 PHI=*V*  RESULTS REAL IN COL 6 COMPLEX IN 7
CEKONE  OF COL 1 PHI=*V* REAL RESULTS IN 8 COMPLEX IN 9
TITLE2=45 DEGREES OR  .785398163  RADIANS
NEW PAGE
NOTE       COL 1          COL 2          COL 3          COL 4          COL 5
NOTE                       EXP(-Z*COS(PHI))*             EXP(Z*COS(PHI))*
NOTE                      I(Z*EXP(I*PHI))               K(Z*EXP(I*PHI))
NOTE         Z         REAL PART      IMAGINARY      REAL PART      IMAGINARY
SPACE
NPRINT 1 COLS 6***9
SPACE
NOTE   BESSEL FUNCTIONS COMPLEX ARGUMENTS OF ORDER 1, PHI=45 DEGREES
SPACE
NOTE       COL 1          COL 6          COL 7          COL 8          COL 9
NOTE                       EXP(-Z*COS(PHI))*             EXP(Z*COS(PHI))*
NOTE                      I(Z*EXP(I*PHI))               K(Z*EXP(I*PHI))
NOTE         Z         REAL PART      IMAGINARY      REAL PART      IMAGINARY
SPACE
NPRINT 1 COLS 6***9
MULT COL 2 BY COL 8 STORE IN COL 11
MULT COL 3 BY COL 9 MULT BY -1. ADD TO COL 11 STORE IN 11
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    MULT COL 6 BY COL 4 MULT 1.0 ADD TO COL 11 AND STORE IN 11
    MULT COL 7 BY COL 5 MULT -1.0 ADD TO COL 11 AND STORE IN COL 11
    COS *V* STORE IN COL 10
    DIVIDE COL 10 BY COL 1 STORE IN COL 10
    SUBTRACT COL 10 FROM COL 11 STORE IN 11
    SIN *V* STORE IN COL 10
    DIVIDE COL 10 BY COL 1 STORE IN COL 10
    MULT COL 2 BY COL 9 MULT BY 1.0 ADD TO COL 10 STORE IN 12
    MULT COL 3 BY COL 8 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
    MULT COL 6 BY COL 5 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
    MULT COL 7 BY COL 4 MULT BY 1.0 ADD TO COL 12 AND STORE IN COL 12
    AVERAGE COL 11 STORE IN COL 11
    AVERAGE COL 12 STORE IN COL 12
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE  THE FOLLOWING VALUES MUST BE EQUAL TO NEAR TO 0.0
    SPACE
    ABRIDGE ROW 1 COLS  11 12
    SPACE
    NOTE ***************************************************************************
```

COLUMNS 1 THROUGH 4 HAVE BEEN DEFINED BY READ COMMAND. THE VALUES OF ROWS 2 THROUGH 6 OF COLUMNS 2 THROUGH 4 HAVE BEEN MOVED TO A NEW LOCATION BEGINNING IN ROW 3 OF COL 5. FIVE ROWS AND 3 COLUMNS WERE MOVED.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 |
|---|---|---|---|---|---|---|
| 1.0000000 | 6.0000000 | 11.000000 | 16.000000 | 0. | 0. | 0. |
| 2.0000000 | 7.0000000 | 12.000000 | 17.000000 | 0. | 0. | 0. |
| 3.0000000 | 8.0000000 | 13.000000 | 18.000000 | 7.0000000 | 12.000000 | 17.000000 |
| 4.0000000 | 9.0000000 | 14.000000 | 19.000000 | 8.0000000 | 13.000000 | 18.000000 |
| 5.0000000 | 10.000000 | 15.000000 | 20.000000 | 9.0000000 | 14.000000 | 19.000000 |
| 0. | 0. | 0. | 0. | 10.000000 | 15.000000 | 20.000000 |
| 0. | 0. | 0. | 0. | 0. | 0. | 0. |

**********

THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.

0.

**********

ARRAYS A AND B HAVE BEEN FORMED BY AMOVE AND MMOVE COMMANDS
THEIR ELEMENTS SHOULD ALL BE EQUAL.

| ARRAY A | | ARRAY B | |
|---|---|---|---|
| 0. | 0. | 0. | 0. |
| 12.000000 | 17.000000 | 12.000000 | 17.000000 |
| 13.000000 | 18.000000 | 13.000000 | 18.000000 |
| 14.000000 | 19.000000 | 14.000000 | 19.000000 |
| 15.000000 | 20.000000 | 15.000000 | 20.000000 |
| 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. |

**********

THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
READ THE FOLLOWING VALUES INTO COLUMNS 1 2 3 AND 4
1. 6. 11.  16.
2.  7.  12.  17.
3.   8.   13.   18.
4.   9.   14.   19.
5.   10.   15.   20.
MOVE THE ARRAY BEGINNING IN ROW 2 COLUMN 2 5 ROWS 3 COLS STORE IN ROW 3 COL 5
TITLE1 COLUMNS 1 THROUGH 4 HAVE BEEN DEFINED BY READ COMMAND. THE
TITLE2VALUES OF ROWS 2 THROUGH 6 OF COLUMNS 2 THROUGH 4 HAVE BEEN
TITLE3MOVED TO A NEW LOCATION BEGINNING IN ROW 3 OF COL 5. FIVE RO
TITLE4WS AND 3 COLUMNS WERE MOVED.
RESET NRMAX TO 7
PRINT COLUMNS 1***7
ASUB  BEGIN ROW 2 COL 2 5X3 FROM BEGIN ROW 3 COL 5 5X3 STORE IN ROW 2 COL 20
SMPROP BEGIN ROW 2 COL 20 5X3 STORE PROPERTIES IN COL 30
SPACE 2
NOTE **************************************************************************
SPACE
NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.
SPACE
ABRIDGE  ROW 11 OF COLUMN 30
SPACE
NOTE **************************************************************************
AMOVE ARRAY BEGINNING IN ROW 3 OF COL 6 R=4 C=2 STORE IN ROW 2 OF COLUMN 10
MMOVE MATRIX BEGINNING IN R=2 C=3 4 ROWS 2 COLUMNS STORE AT R=2 C=12
SPACE 2
NOTE ARRAYS A AND B HAVE BEEN FORMED BY AMOVE AND MMOVE COMMANDS
NOTE THEIR ELEMENTS SHOULD ALL BE EQUAL.
SPACE
NOTE    ARRAY A                         ARRAY B
SPACE
NPRINT COLUMNS 10***13
SUB  COL 11 FROM COL 13 STORE IN 15
AVERAGE  COL 15 STORE IN COL 15
SPACE 2
NOTE **************************************************************************
SPACE
NOTE THE FOLLOWING VALUE  SHOULD BE CLOSE TO OR EQUAL TO ZERO.
SPACE
ABRIDGE ROW 1 OF COLUMN 15
SPACE
NOTE **************************************************************************
```

THE FOLLOWING IS AN EXAMPLE OF THE INSERT AND SEPARATE COMMANDS.
COLUMN 1 WAS DEFINED BY THE GENERATE COMMAND. COLUMNS 2 AND 3 WERE DEFINED BY SEPARATE AND COLUMN 4 BY INSERT.

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 |
|---|---|---|---|
| 1.0000000 | 2.0000000 | 1.0000000 | 1.0000000 |
| 2.0000000 | 4.0000000 | 3.0000000 | 2.0000000 |
| 3.0000000 | 6.0000000 | 5.0000000 | 3.0000000 |
| 4.0000000 | 8.0000000 | 7.0000000 | 4.0000000 |
| 5.0000000 | 10.000000 | 9.0000000 | 5.0000000 |
| 6.0000000 | 12.000000 | 11.000000 | 6.0000000 |
| 7.0000000 | 14.000000 | 13.000000 | 7.0000000 |
| 8.0000000 | 16.000000 | 15.000000 | 8.0000000 |
| 9.0000000 | 18.000000 | 17.000000 | 9.0000000 |
| 10.000000 | 20.000000 | 19.000000 | 10.000000 |
| 11.000000 | | | 11.000000 |
| 12.000000 | | | 12.000000 |
| 13.000000 | | | 13.000000 |
| 14.000000 | | | 14.000000 |
| 15.000000 | | | 15.000000 |
| 16.000000 | | | 16.000000 |
| 17.000000 | | | 17.000000 |
| 18.000000 | | | 18.000000 |
| 19.000000 | | | 19.000000 |
| 20.000000 | | | 20.000000 |

**********

THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.
0.

**********

THE FOLLOWING IS AN EXAMPLE OF THE MAXMIN COMMAND. X WAS DEFINED BY THE GENERATE COMMAND. Y=COSD(X).

| X | Y | COLUMNS 6 AND 7 CONTAIN MAXIMA VALUES OF FUNCTION Y COLUMN 6 | COLUMN 7 | COLUMNS 8 AND 9 CONTAIN MINIMA VALUES OF FUNCTION Y COLUMN 8 | COLUMN 9 |
|---|---|---|---|---|---|
| -10.000000 | .98480775 | * 3.8314035-08 | 1.0000000 | 180.00000 | -1.0000000 |
| 0. | 1.0000000 | * 3.6000000+02 | 1.0000002 | | |
| 10.000000 | .98480775 | | | | |
| 20.000000 | .93969262 | | | | |
| 30.000000 | .86602540 | | | | |
| 40.000000 | .76604445 | | | | |
| 50.000000 | .64278761 | | | | |
| 60.000000 | .50000001 | | | | |
| 70.000000 | .34202016 | | | | |
| 80.000000 | .17364819 | | | | |
| 90.000000 | * 1.5890691-08 | | | | |
| 100.00000 | -.17364815 | | | | |
| 110.00000 | -.34202012 | | | | |
| 120.00000 | -.49999997 | | | | |
| 130.00000 | -.64278758 | | | | |
| 140.00000 | -.76604442 | | | | |
| 150.00000 | -.86602537 | | | | |
| 160.00000 | -.93969261 | | | | |
| 170.00000 | -.98480774 | | | | |
| 180.00000 | -1.0000000 | | | | |
| 190.00000 | -.98480776 | | | | |
| 200.00000 | -.93969263 | | | | |
| 210.00000 | -.86602543 | | | | |
| 220.00000 | -.76604448 | | | | |
| 230.00000 | -.64278767 | | | | |
| 240.00000 | -.50000005 | | | | |
| 250.00000 | -.34202018 | | | | |
| 260.00000 | -.17364825 | | | | |
| 270.00000 | *-4.7759386-08 | | | | |
| 280.00000 | .17364809 | | | | |
| 290.00000 | .34202009 | | | | |
| 300.00000 | .49999992 | | | | |
| 310.00000 | .64278755 | | | | |
| 320.00000 | .76604441 | | | | |
| 330.00000 | .86602536 | | | | |
| 340.00000 | .93969260 | | | | |
| 350.00000 | .98480774 | | | | |
| 360.00000 | 1.0000000 | | | | |
| 370.00000 | .98480777 | | | | |

**********

THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO ZERO.

* 1.9073486-06
0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE STARTING WITH 1 IN STEPS OF 1 UP TO 20 AND STORE VALUES IN COL 1
SEPARATE FROM COLUMN 1 EVERY 2ND ROW START WITH ROW 2 STORE IN COLUMN 2
SEPARATE FROM COL 1 EVERY 2ND ROW START WITH ROW 1 AND STORE IN COL 3
INSERT IN COLUMN 3 FROM COLUMN 2 AT EVERY 2ND ROW STARTING AT 2ND ROW STORE IN 4
TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE INSERT AND SEPARATE COMM
TITLE2ANDS.
TITLE3 COLUMN 1 WAS DEFINED BY THE GENERATE COMMAND. COLUMNS 2 AND
TITLE4 3 WERE DEFINED BY SEPARATE AND COLUMN 4 BY INSERT.
RESET  20
PRINT COLUMNS 1 2 3 AND 4
SPACE 2
SUB  COL 1 FROM COL 4 STORE IN COLUMN 5
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.
ABRIDGE ROW 1 OF COLUMN 5
SPACE
NOTE ***************************************************************************
RESET  0
GENERATE STARTING WITH -10 IN STEPS OF 10 UP TO 370 AND STORE VALUES IN COLUMN 4
COSD OF COLUMN 4 AND STORE IN COLUMN 5
MAXMIN X IN COL 4 Y IN COL 5 STORE MAXIMA IN COLS 6 AND 7 MINIMA IN COLS 8 AND 9
TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE MAXMIN COMMAND.  X WAS D
TITLE2EFINED BY THE GENERATE COMMAND. Y=COSD(X).
TITLE3 COLUMNS 6 AND 7 CONTAIN MAXIMA VALUES OF FUNCTION Y
TITLE4 COLUMNS 8 AND 9 CONTAIN MINIMA VALUES OF FUNCTION Y
HEAD COL 4/      X
HEAD COL 5/     Y
PRINT COLUMNS 4***9
RESET  2
ROWSUM COLS 6***9 STORE IN COLUMN 10
SET IN COL 11
180.0  361.0
SUB  COL 10 FROM COL 11 STORE IN 12
SPACE 2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUES SHOULD BE CLOSE TO OR EQUAL TO ZERO.
SPACE
NPRINT COLUMN 12
SPACE
NOTE ***************************************************************************
```

STATISTICAL ANALYSIS OF COL 2 N = 33

FREQUENCY DISTRIBUTION (1-6) 1 1 2 2 3 8 10 3 2 1

MEASURES OF LOCATION (2-2)

| | | |
|---|---|---|
| UNWEIGHTED MEAN | = | 7.8781205+00 |
| WEIGHTED MEAN | = | 7.8781205+00 |
| MEDIAN | = | 7.8789999+00 |
| MID-RANGE | = | 7.8749999+00 |
| 25 PCT UNWTD TRIMMED MEAN | = | 7.8797643+00 |
| 25 PCT WTD TRIMMED MEAN | = | 7.8797643+00 |

MEASURES OF DISPERSION (2-6)

| | | |
|---|---|---|
| STANDARD DEVIATION | = | 9.2761676-03 |
| S.D. OF MEAN | = | 1.6147735-03 |
| RANGE | = | 4.5999944-02 |
| MEAN DEVIATION | = | 6.9441290-03 |
| VARIANCE | = | 8.6047287-05 |
| COEFFICIENT OF VARIATION | = | 1.1774595-01 |

A TWO-SIDED 95 PCT CONFIDENCE INTERVAL FOR MEAN IS 7.8748+00 TO 7.8814+00 (2-2)
A TWO-SIDED 95 PCT CONFIDENCE INTERVAL FOR S.D. IS 7.3880-03 TO 1.2139-02 (2-7)

LINEAR TREND STATISTICS (5-1)

| | | |
|---|---|---|
| SLOPE | = | 1.5721655-04 |
| S.D. OF SLOPE | = | 1.6996914-04 |
| SLOPE/S.D. OF SLOPE = T | = | 9.2497115-01 |
| PROB EXCEEDING ABS VALUE OF OBS T = | | .362 |

OTHER STATISTICS

| | | |
|---|---|---|
| MINIMUM | = | 7.8520000+00 |
| MAXIMUM | = | 7.8979999+00 |
| BETA ONE | = | 5.1019164-01 |
| BETA TWO | = | 3.7603593+00 |
| WTD SUM OF VALUES | = | 2.5997798+02 |
| WTD SUM OF SQUARES | = | 2.0481407+03 |
| WTD SUM OF DEVS SQUARED | = | 2.7535132-03 |
| STUDENT'S T | = | 4.8787773+03 |
| WTD SUM ABSOLUTE VALUES | = | 2.5997798+02 |
| WTD AVE ABSOLUTE VALUES | = | 7.8781205+00 |

TESTS FOR NON-RANDOMNESS

| | | |
|---|---|---|
| NO OF RUNS UP AND DOWN | = | 21 |
| EXPECTED NO OF RUNS | = | 21.7 |
| S.D. OF NO OF RUNS | = | 2.35 |
| MEAN SQ SUCCESSIVE DIFF | = | 2.0103105-04 |
| MEAN SQ SUCC DIFF/VAR | = | 2.336 |

DEVIATIONS FROM WTD MEAN

| | | |
|---|---|---|
| NO OF + SIGNS | = | 20 |
| NO OF - SIGNS | = | 13 |
| NO OF RUNS | = | 19 |
| EXPECTED NO OF RUNS | = | 16.8 |
| S.D. OF RUNS | = | 2.70 |
| DIFF./S.D. OF RUNS | = | .832 |

NOTE - ITEMS IN PARENTHESES REFER TO PAGE NUMBER IN NBS HANDBOOK 91

OBSERVATIONS

| I | X(I) | RANK | X(I)-MEAN |
|---|---|---|---|
| 1 | 7.8839999+00 | 25.5 | 5.8794618-03 |
| 2 | 7.8640000+00 | 3.5 | -1.4120519-02 |
| 3 | 7.8789999+00 | 15.5 | 8.7946653-04 |
| 4 | 7.8720000+00 | 8.0 | -6.1205029-03 |
| 5 | 7.8780000+00 | 13.0 | -1.2052059-04 |
| 6 | 7.8900000+00 | 32.0 | 1.1879504-02 |
| 7 | 7.8740000+00 | 9.0 | -4.1205287-03 |
| 8 | 7.8690000+00 | 6.0 | -9.1205239-03 |
| 9 | 7.8830000+00 | 22.5 | 4.8794746-03 |
| 10 | 7.8520000+00 | 1.0 | -2.6120484-02 |
| 11 | 7.8860000+00 | 29.5 | 7.8794956-03 |
| 12 | 7.8820000+00 | 20.5 | 3.8794875-03 |
| 13 | 7.8760000+00 | 10.5 | -2.1204948-03 |
| 14 | 7.8839999+00 | 25.5 | 5.8794618-03 |
| 15 | 7.8830000+00 | 22.5 | 4.8794746-03 |
| 16 | 7.8760000+00 | 10.5 | -2.1204948-03 |
| 17 | 7.8789999+00 | 15.5 | 8.7946653-04 |
| 18 | 7.8850000+00 | 28.0 | 6.8795085-03 |
| 19 | 7.8839999+00 | 25.5 | 5.8794618-03 |
| 20 | 7.8789999+00 | 15.5 | 8.7946653-04 |
| 21 | 7.8609999+00 | 2.0 | -1.7120540-02 |
| 22 | 7.8810000+00 | 19.0 | 2.8795004-03 |
| 23 | 7.8710000+00 | 7.0 | -7.1204901-03 |
| 24 | 7.8979999+00 | 33.0 | 1.9879460-02 |
| 25 | 7.8770000+00 | 12.0 | -1.1205077-03 |
| 26 | 7.8670000+00 | 5.0 | -1.1120498-02 |
| 27 | 7.8640000+00 | 3.5 | -1.4120519-02 |
| 28 | 7.8860000+00 | 29.5 | 7.8794956-03 |
| 29 | 7.8820000+00 | 20.5 | 3.8794875-03 |
| 30 | 7.8800000+00 | 18.0 | 1.8795133-03 |
| 31 | 7.8839999+00 | 25.5 | 5.8794618-03 |
| 32 | 7.8890000+00 | 31.0 | 1.0879517-02 |
| 33 | 7.8789999+00 | 15.5 | 8.7946653-04 |

ORDERED OBSERVATIONS

| NO. | X(J) | X(J+1)-X(J) |
|---|---|---|
| 10 | 7.8520000+00 | 8.9999437-03 |
| 21 | 7.8609999+00 | 3.0000210-03 |
| 2 | 7.8640000+00 | 0.0000000 |
| 27 | 7.8640000+00 | 3.0000210-03 |
| 26 | 7.8670000+00 | 1.9999743-03 |
| 8 | 7.8690000+00 | 2.0000339-03 |
| 23 | 7.8710000+00 | 9.9998713-04 |
| 4 | 7.8720000+00 | 1.9999743-03 |
| 7 | 7.8740000+00 | 2.0000339-03 |
| 13 | 7.8760000+00 | 0.0000000 |
| 16 | 7.8760000+00 | 9.9998713-04 |
| 25 | 7.8770000+00 | 9.9998713-04 |
| 5 | 7.8780000+00 | 9.9998713-04 |
| 3 | 7.8789999+00 | 0.0000000 |
| 17 | 7.8789999+00 | 0.0000000 |
| 20 | 7.8789999+00 | 0.0000000 |
| 33 | 7.8789999+00 | 1.0000467-03 |
| 30 | 7.8800000+00 | 9.9998713-04 |
| 22 | 7.8810000+00 | 9.9998713-04 |
| 12 | 7.8820000+00 | 0.0000000 |
| 29 | 7.8820000+00 | 9.9998713-04 |
| 9 | 7.8830000+00 | 0.0000000 |
| 15 | 7.8830000+00 | 9.9998713-04 |
| 1 | 7.8839999+00 | 0.0000000 |
| 14 | 7.8839999+00 | 0.0000000 |
| 19 | 7.8839999+00 | 0.0000000 |
| 31 | 7.8839999+00 | 1.0000467-03 |
| 18 | 7.8850000+00 | 9.9998713-04 |
| 11 | 7.8860000+00 | 0.0000000 |
| 28 | 7.8860000+00 | 3.0000210-03 |
| 32 | 7.8890000+00 | 9.9998713-04 |
| 6 | 7.8900000+00 | 7.9999566-03 |
| 24 | 7.8979999+00 | |

**********

FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 7.580526, 7.87812, 0.0
AND 0.0 RESPECTIVELY

7.5805261 7.8781206 * 6.9719372-07 0.

**********

| COL 21 | COL 22 | COL 23 |
|---|---|---|
| LOWER BOUNDARY | UPPER BOUNDARY | FREQUENCY |
| 7.8494444 | 7.8545555 | 1.0000000 |
| 7.8545555 | 7.8596666 | 0. |
| 7.8596666 | 7.8647777 | 3.0000000 |
| 7.8647777 | 7.8698888 | 2.0000000 |
| 7.8698888 | 7.8749999 | 3.0000000 |
| 7.8749999 | 7.8801110 | 9.0000000 |
| 7.8801110 | 7.8852221 | 10.000000 |
| 7.8852221 | 7.8903332 | 4.0000000 |
| 7.8903332 | 7.8954443 | 0. |
| 7.8954443 | 7.9005554 | 1.0000000 |

THE RESULTS IN ABOVE COL 23 ARE DIFFERENT FROM THE FREQUENCIES IN THE STATISTICAL ANALYSIS PRINT OUT BECAUSE DIFFERENT METHODS FOR COMPUTING WERE USED.

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

0. 0.

**********

HISTOGRAM FOR FREQUENCIES IN COLUMN 26, MID-POINTS IN COLUMN 23

| MID-POINTS | FREQUENCY | |
|---|---|---|
| 7.8520000 | 1 | + |
| 7.8571111 | 0 | |
| 7.8622222 | 3 | +++ |
| 7.8673333 | 2 | ++ |
| 7.8724444 | 3 | +++ |
| 7.8775555 | 9 | +++++++++ |
| 7.8826666 | 10 | ++++++++++ |
| 7.8877777 | 4 | ++++ |
| 7.8928888 | 0 | |
| 7.8979999 | 1 | + |

ABOVE PRINT OUT IS FROM HISTOGRAM COMMAND

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SET IN COL 2 THE FOLLOWING DATA
    7.884, 7.864, 7.879, 7.872, 7.878, 7.890, 7.874, 7.869, 7.883, 7.852
    7.886, 7.882, 7.876, 7.884, 7.883, 7.876, 7.879, 7.885, 7.884, 7.879
    7.861, 7.881, 7.871, 7.898, 7.877, 7.867, 7.864, 7.886, 7.882, 7.880
    7.884, 7.889, 7.879
    STATISTICAL ANALYSIS OF COL 2
    SSTATISTICAL ANALYSIS OF COL 2 STORE RESULTS IN 3 4 5 6
    RANKS OF COL 2 STORE RESULTS IN COL 10
    SUBTRACT COL 10 FROM COL 4 STORE IN COL 11
    AVERAGE COL 11 STORE IN COL 11
    AVERAGE 3 STORE IN 4
    AVERAGE 5 STORE IN 5
    AVERAGE 6 STORE IN 6
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR  7.580526, 7.87812, 0.0
    NOTE AND 0.0 RESPECTIVELY
    SPACE
    ABRIDGE 1 4 5 6 11
    SPACE
    NOTE ***************************************************************************
    FREQUENCY DIST. OF COL 2 USE 10 CELLS LOWER BOUND 21 UPPER IN 22 FREQ 23
    MOVE 51,3 SIZE 10X1 TO 1X24
    SUM COL 24 STORE IN COL 24
    SUM COL 23 STORE IN COL 25
    SUBTRACT COL 25 FROM COL 24 STORE IN 25
    NEW PAGE
    NOTE       COL 21         COL 22         COL 23
    SPACE
    NOTE     LOWER BOUNDARY UPPER BOUNDARY FREQUENCY
    SPACE
    NPRINT  21 22 23
    ADD COL 21 TO COL 22 MULT .5 ADD 0.0 AND STORE IN COL 26
    RESET NRMAX TO 1
    SUBTRACT 1.0 FROM VALUE IN *2,3*  STORE IN 30
    SQUARE VALUE IN *21,3* STORE IN COL 31
    F PROBABILITY OF 1.0 AND COL 30 DEG OF FREEDOM IN COL 31 STORE IN COL 32
    SUBTRACT VALUE IN *22,3* WITH COL 32 STORE IN COL 32
    SPACE
    NOTE1  THE RESULTS IN ABOVE COL 23 ARE DIFFERENT FROM THE FREQUEN
    NOTE2CIES IN THE STATISTICAL ANALYSIS PRINT OUT BECAUSE
    PRINT NOTE
    NOTE DIFFERENT METHODS FOR COMPUTING WERE USED.
    SPACE  2
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE ROW 1 COL 25  32
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SPACE
    NOTE ***************************************************************************
    RESET NRMAX TO 10
    HISTOGRAM MID PTS IN COL 26 FREQ. IN COL 23
    SPACE   5
    NOTE ABOVE PRINT OUT IS FROM HISTOGRAM COMMAND
```

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C. 20234, OMNITAB II VERSION 5.00 MAY 15

ZEROS OF J ORDER 0 AND 1 AND THEIR DERIVATIVES

| COL 8 N | COL 1 ZEROS J 0 | COL 2 DERIV J 0 | COL 3 ZEROS J ONE | COL 4 DERIV J ONE |
|---|---|---|---|---|
| 0. | 2.4048256 | .51914749 | 3.8317060 | -.40275940 |
| 1.0 | 5.5200781 | -.34026480 | 7.0155866 | .30011575 |
| 2.0 | 8.6537279 | .27145230 | 10.173468 | -.24970488 |
| 3.0 | 11.791534 | -.23245983 | 13.323692 | .21835941 |
| 4.0 | 14.930918 | .20654643 | 16.470630 | -.19646537 |
| 5.0 | 18.071064 | -.18772880 | 19.615858 | .18006337 |
| 6.0 | 21.211637 | .17326589 | 22.760084 | -.16718460 |
| 7.0 | 24.352471 | -.16170155 | 25.903672 | .15672499 |
| 8.0 | 27.493479 | .15218121 | 29.046829 | -.14801111 |
| 9.0 | 30.634606 | -.14416598 | 32.189680 | .14060580 |
| 10. | 33.775820 | .13729694 | 35.332307 | -.13421124 |
| 11. | 36.917098 | -.13132463 | 38.474766 | .12861662 |
| 12. | 40.058425 | .12606950 | 41.617094 | -.12366796 |
| 13. | 43.199791 | -.12139862 | 44.759319 | .11924981 |
| 14. | 46.341188 | .11721120 | 47.901461 | -.11527369 |
| 15. | 49.482610 | -.11342919 | 51.043535 | .11167050 |
| 16. | 52.624052 | .10999114 | 54.185554 | -.10838535 |
| 17. | 55.765511 | -.10684789 | 57.327525 | .10537405 |
| 18. | 58.906984 | .10395957 | 60.469458 | -.10260057 |
| 19. | 62.048469 | -.10129350 | 63.611356 | .10003515 |
| 20. | 65.189964 | .098822554 | 66.753226 | -.097653016 |
| 21. | 68.331469 | -.096524040 | 69.895071 | .095433339 |
| 22. | 71.472981 | .094378794 | 73.036895 | -.093358452 |
| 23. | 74.614500 | -.092370505 | 76.178699 | .091413272 |
| 24. | 77.756025 | .090485194 | 79.320487 | -.089584822 |
| 25. | 80.897555 | -.088710802 | 82.462259 | .087861876 |
| 26. | 84.039090 | .087036863 | 85.604019 | -.086234663 |
| 27. | 87.180630 | -.085454242 | 88.745767 | .084694634 |
| 28. | 90.322172 | .083954928 | 91.887504 | -.083234273 |
| 29. | 93.463718 | -.082531861 | 95.029231 | .081846938 |

**********

SUM 1/(X**4)=.03125 FOR J ZERO (X)= 0
THE FOLLOWING VALUES MUST BE EQUAL OR NEAR .03125 AND 0.0 RESPECTIVELY

.031249874 * 3.1044086-11

**********

RESULTS OF J N (X), I N (X), K N (X) FOR N=0 (1) 29

| N<br>COL 8 | J N (5)<br>COL 1 | I N (2)<br>COL 2 | K N (1)<br>COL 3 |
|---|---|---|---|
| 0. | -.17759677 | 2.2795853 | .42102444 |
| 1.0 | -.32757914 | 1.5906368 | .60190722 |
| 2.0 | .046565116 | .68894845 | 1.6248389 |
| 3.0 | .36483123 | .21273996 | 7.1012628 |
| 4.0 | .39123236 | .050728570 | 44.232416 |
| 5.0 | .26114054 | .0098256792 * | 3.6096059+02 |
| 6.0 | .13104873 | .0016001734 * | 3.6538383+03 |
| 7.0 | .053376410 * | 2.2463914-04 * | 4.4207020+04 |
| 8.0 | .018405217 * | 2.7699369-05 * | 6.2255212+05 |
| 9.0 | .0055202831 * | 3.0441859-06 * | 1.0005041+07 |
| 10. | .0014678026 * | 3.0169639-07 * | 1.8071329+08 |
| 11. | * 3.5092745-04 * | 2.7222023-08 * | 3.6242708+09 |
| 12. | * 7.6278131-05 * | 2.2541310-09 * | 7.9914671+10 |
| 13. | * 1.5207582-05 * | 1.7245163-10 * | 1.9215764+12 |
| 14. | * 2.8012958-06 * | 1.2259834-11 * | 5.0040900+13 |
| 15. | * 4.7967433-07 * | 8.1394325-13 * | 1.4030668+15 |
| 16. | * 7.6750156-08 * | 5.0685714-14 * | 4.2142045+16 |
| 17. | * 1.1526677-08 * | 2.9718290-15 * | 1.3499485+18 |
| 18. | * 1.6312443-09 * | 1.6462152-16 * | 4.5940391+19 |
| 19. | * 2.1828258-10 * | 8.6416033-18 * | 1.6552040+21 |
| 20. | * 2.7703300-11 * | 4.3105606-19 * | 6.2943693+22 |
| 21. | * 3.3438200-12 * | 2.0482232-20 * | 2.5194029+24 |
| 22. | * 3.8478737-13 * | 9.2917755-22 * | 1.0587787+26 |
| 23. | * 4.2308846-14 * | 4.0326091-23 * | 4.6611455+27 |
| 24. | * 4.4540221-15 * | 1.6774623-24 * | 2.1451857+29 |
| 25. | * 4.4976606-16 * | 6.6995569-26 * | 1.0301553+31 |
| 26. | * 4.3638521-17 * | 2.5730921-27 * | 5.1529215+32 |
| 27. | * 4.0745521-18 * | 9.5173970-29 * | 2.6805494+34 |
| 28. | * 3.6664192-19 * | 3.3948943-30 * | 1.4480119+36 |
| 29. | * 3.1837336-20 * | 1.1693106-31 | 0. |

**********

(SUM OF (J N (X))**2)*2.+(J ZERO (X))**2=1. FOR N=1 THRU INFINITY. (IN THIS EXAMPLE N=0,...,29)
(SUM OF ( I N (X))**2. +I ZERO (X) - EXP(X)=0. FOR N=1 THRU INFINITY. (IN THIS EXAMPLE N=0,...,29)

HANDBOOK OF MATHEMATICAL FUNCTIONS AMS 55 PAGES 363 AND 376
THE FOLLOWING VALUES MUST BE EQUAL OR NEAR 1.0, 0.0 AND 0.0 RESPECTIVELY

99999994 *-4.1723251-07 *-3.7252903-09

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    TITLE1 ZEROS OF J ORDER 0 AND 1 AND THEIR DERIVATIVES
    RESET NRMAX TO 30
    ZEROS BJZERO OF J N ZERO FOR N FROM ZERO THRU TWENTY-NINE PUT IN  1 DERIV 2
    ZEROS BJONE  OF J N ZERO FOR N FROM ZERO THRU TWENTY-NINE PUT IN  3 DERIV 4
    SQUARE  COL 1 STORE IN COL 6
    SQUARE  COL 6 STORE IN COL 6
    DIV     1.0 BY COL 6  STORE IN 6
    SUM      COL 6 STORE IN COL 6
    BJZERO OF COL 3 STORE IN COL 7
    SUBTRACT COL 7 FROM COL 4 STORE IN COL 7
    AVERAGE  COL 7 STORE IN COL 7
    GENERATE 0.0 IN STEPS OF 1.0 THRU  29 STORE IN 8
    NEW PAGE
    NOTE          COL 8       COL 1          COL 2          COL 3       COL 4
    NOTE            N      ZEROS J 0      DERIV J 0      ZEROS J ONE   DERIV J ONE
    NPRINT COL 8  WITH 2.0 SIG. DIGITS AND COLS 1 *** 4 WITH 8.0 SIG DIGITS
    SPACE  2
    NOTE ************************************************************************
    SPACE
    NOTE SUM 1/(X**4)=.03125  FOR J ZERO (X)= 0
    NOTE THE FOLLOWING VALUES MUST BE EQUAL OR NEAR .03125 AND 0.0 RESPECTIVELY
    SPACE
    ABRIDGE ROW 1 COLS 6  7
    SPACE
    NOTE ************************************************************************
    TITLE1 RESULTS OF J N (X), I N (X), K N (X) FOR N=0 (1) 29
    BESJN  OF X= 5.0  STORE RESULTS IN COL 1
    BESIN  OF X= 2.0  STORE RESULTS IN COL 2
    BESKN  OF X= 1.0  STORE RESULTS IN COL 3
    NEW PAGE
    NOTE            N      J N (5)        I N (2)        K N (1)
    NOTE          COL 8       COL 1          COL 2          COL 3
    NPRINT COL 8 WITH 2.0 SIG. DIGITS COLS 1,2,3 WITH 8.0 SIGNIFICANT DIGITS
    SQUARE COL 1  STORE IN 1
    1/MULT     COL 1 BY 2. STORE IN 10
    2/SUM COL 10  STORE IN 10
    3/SUBTRACT *1,1*  FROM 10 STORE IN 10
    4/INCREMENT 1 BY  1  0. 1
    5/INCREMENT 2 BY 1  1
    6/INCREMENT 3  BY *0,1*  1  1
    EXECUTE 1 THRU 6 2 TIMES
    DIV  1.0 BY COL  3 STORE IN COL 12

** ARITHMETIC FAULT IN ABOVE COMMAND, ZERO RETURNED   1 TIMES
** DIVISION BY ZERO, RESULT SET=0   1 TIMES

    AVERAGE COL 12 STORE IN COL 12
    RESET NRMAX 1
    SUB   .16061621  FROM COL 12 STORE IN COL 12
    EXPONENTIAL OF 2. STORE IN COL 4
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SUBTRACT COL 4 FROM COL 11 STORE IN 11
    SPACE  2
    NOTE ***************************************************************************
    SPACE
    NOTE1  (SUM OF (J N (X))**2)*2.+(J ZERO (X))**2=1.  FOR N=1 THRU
    NOTE2INFINITY.  (IN THIS EXAMPLE N=0,...,29)
    PRINT NOTE
    NOTE1  (SUM OF ( I N (X))**2. +I ZERO (X) - EXP(X)=0. FOR N=1 THR
    NOTE2U INFINITY.  (IN THIS EXAMPLE N=0,...,29)
    PRINT NOTE
    NOTE
    NOTE HANDBOOK OF MATHEMATICAL FUNCTIONS AMS 55 PAGES 363 AND 376
    NOTE THE  FOLLOWING VALUES MUST BE EQUAL OR NEAR 1.0, 0.0 AND 0.0 RESPECTIVELY
    SPACE
    NPRINT  COLS 10,11,12
    SPACE
    NOTE ***************************************************************************
```

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C. 20234, OMNITAB II VERSION 5.00 MAY 15

PROPERTIES OF 4 X 4 MATRIX STARTING LOCATION ( 2, 1)

| COL 30 | |
|---|---|
| GENERAL | |
| R | |
| 1 TRACE ( 4 VALUES USED) | 4.000000+00 |
| 2 TRACE NO. 2 | 6.000000+00 |
| 3 MAXIMUM ELEMENT | 1.000000+00 |
| 4 MINUMUM ELEMENT | 0.000000 |
| 5 MAXIMUM ELEMENT IN ABS VALUE | 1.000000+00 |
| 6 MINUMUM ELEMENT IN ABS VALUE | 0.000000 |
| 7 MIN NON-ZERO ELEM IN ABS VAL | 1.000000+00 |
| 8 NUMBER OF POSITIVE ELEMENTS | 4 |
| 9 NUMBER OF ZERO ELEMENTS | 12 |
| 10 NUMBER OF NEGATIVE ELEMENTS | 0 |
| 11 SUM OF TERMS | 4.000000+00 |
| 12 AVERAGE | 2.500000-01 |
| 13 SUM OF SQUARES | 4.000000+00 |
| 14 SUM OF SQUARES ABOUT MEAN | 3.000000+00 |
| 15 WITHIN ROWS SUM OF SQUARES | 3.000000+00 |
| 16 WITHIN COLS SUM OF SQUARES | 3.000000+00 |
| 17 SUM OF ABSOLUTE VALUES | 4.000000+00 |
| 18 AVERAGE OF ABSOLUTE VALUES | 2.500000-01 |
| SPECIFIC | |
| 19 DETERMINANT | 1.000000+00 |
| 18 RANK | 4 |
| NORMS | |
| 21 SQ ROOT OF SUM OF B(I,J)**2 | 0.0 |
| 22 N*MAX(B(I,J)) | 0.0 |
| 23 MAX VAL OF ROW SUM | 0.0 |
| 24 NORMALITY | YES*(1) |
| 25 SYMMETRY | YES*(1) |
| 26 SKEW SYMMETRY | NO*(0) |
| 27 DIAGONALITY | YES*(1) |
| 28 ORTHOGONALITY: A'A=I | YES*(1) |
| 29 A'A=DIAGONAL MATRIX | YES*(1) |
| 30 TRIANGULAR | UPPER AND LOWER**(3) |
| 31 STOCHASTIC (R AND/OR C SUMS=1) | TWO-WAY***(3) |

* IF ANSWER IS YES, (R,C)=1 OR 2. (1, IF EXACT; 2, IF TOLERANCE IS SATISFIED.)
IF ANSWER IS NO, (R,C)=0.

TRIANGULAR
** (R,C)=0,IF ANSWER IS NO; (R,C)=1, IF UPPER PART OF MATRIX IS ZERO;
(R,C)=2, IF LOWER PART IS ZERO; (R,C)=3, IF ALL OFF DIAGONAL ELEMENTS = 0.

STOCHASTIC
*** (R,C)=0, IF MATRIX IS NOT STOCHASTIC; (R,C)=1, IF SUM OF EACH ROW = 1;
(R,C)=2, IF SUM OF EACH COLUMN=1; (R,C)=3, IF SUM OF EACH ROW AND COLUMN=1.

**********

THE ABOVE IS AN EXAMPLE OF THE AUTOMATIC PRINTOUT FROM MPROPERTIES

**********

PROPERTIES OF 4 X 4 ARRAY STARTING LOCATION ( 2, 11)

| COL 32 GENERAL R | |
|---|---|
| 1 TRACE ( 4 VALUES USED) | 4.000000+00 |
| 2 TRACE NO. 2 | 6.000000+00 |
| 3 MAXIMUM ELEMENT | 1.000000+00 |
| 4 MINUMUM ELEMENT | 0.000000 |
| 5 MAXIMUM ELEMENT IN ABS VALUE | 1.000000+00 |
| 6 MINUMUM ELEMENT IN ABS VALUE | 0.000000 |
| 7 MIN NON-ZERO ELEM IN ABS VAL | 1.000000+00 |
| 8 NUMBER OF POSITIVE ELEMENTS | 4 |
| 9 NUMBER OF ZERO ELEMENTS | 12 |
| 10 NUMBER OF NEGATIVE ELEMENTS | 0 |
| 11 SUM OF TERMS | 4.000000+00 |
| 12 AVERAGE | 2.500000-01 |
| 13 SUM OF SQUARES | 4.000000+00 |
| 14 SUM OF SQUARES ABOUT MEAN | 3.000000+00 |
| 15 WITHIN ROWS SUM OF SQUARES | 3.000000+00 |
| 16 WITHIN COLS SUM OF SQUARES | 3.000000+00 |
| 17 SUM OF ABSOLUTE VALUES | 4.000000+00 |
| 18 AVERAGE OF ABSOLUTE VALUES | 2.500000-01 |

**********

THE ABOVE IS AN EXAMPLE OF THE AUTOMATIC PRINTOUT FROM APROPERTIES.

**********

MATRIX A WAS DEFINED BY THE MIDENT COMMAND, COLUMN 5 BY THE MVECDIAG COMMAND AND COLUMN 6 BY THE MVECMAT COMMAND.

| MATRIX A | | | | COLUMN 5 | COLUMN 6 |
|---|---|---|---|---|---|
| 0. | 0. | 0. | 0. | 0. | 1.0000000 |
| 1.0000000 | 0. | 0. | 0. | 1.0000000 | 0. |
| | 1.0000000 | 0. | 0. | 1.0000000 | 0. |
| | | 1.0000000 | 0. | 1.0000000 | 0. |
| | | | 1.0000000 | 1.0000000 | 0. |
| | | | | | 1.0000000 |
| | | | | | 0. |
| | | | | | 0. |
| | | | | | 0. |
| | | | | | 0. |
| | | | | | 1.0000000 |
| | | | | | 0. |
| | | | | | 0. |
| | | | | | 0. |
| | | | | | 0. |
| | | | | | 1.0000000 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

0.

**********

THE FOLLOWING IS AN EXAMPLE OF MTRANSPOSE, MMULT AND MEIGEN.
MATRIX A WAS DEFINED BY THE READ COMMAND. MATRIX B IS THE TRANSPOSE OF MATRIX A.

| MATRIX A | | | | MATRIX B=A' | | | |
|---|---|---|---|---|---|---|---|
| 4.0000000 | 4.0000000 | -2.0000000 | -6.0000000 | 4.0000000 | -2.0000000 | -6.0000000 | 4.0000000 |
| -2.0000000 | -6.0000000 | 4.0000000 | 4.0000000 | 4.0000000 | -6.0000000 | -2.0000000 | 4.0000000 |
| -6.0000000 | -2.0000000 | 4.0000000 | 4.0000000 | -2.0000000 | 4.0000000 | 4.0000000 | -6.0000000 |
| 4.0000000 | 4.0000000 | -6.0000000 | -2.0000000 | -6.0000000 | 4.0000000 | 4.0000000 | -2.0000000 |

MATRIX C EQUALS MATRIX A TIMES MATRIX B.

| | | | |
|---|---|---|---|
| 72.000000 | 56.000000 | -64.000000 | -64.000000 |
| 56.000000 | 72.000000 | -64.000000 | -64.000000 |
| -64.000000 | -64.000000 | 72.000000 | 56.000000 |
| -64.000000 | -64.000000 | 56.000000 | 72.000000 |

THE FOLLOWING RESULTS ARE FROM THE MEIGEN COMMAND.

| E-VALUES | VECTOR 1 | VECTOR 2 | VECTOR 3 | VECTOR 4 |
|---|---|---|---|---|
| * 2.5600000+02 | .50000000 | -.53154530 | -.46632566 | .49999999 |
| 16.000000 | .50000001 | .53154529 | .46632564 | .50000002 |
| 16.000000 | -.50000002 | -.46632566 | .53154528 | .50000000 |
| *-1.1324343-06 | -.50000001 | .46632564 | -.53154529 | .49999999 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

*-9.5367432-07

**********

THE COMMANDS MERASE, MZERO AND AZERO HAVE BEEN EXECUTED.
THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

0. 0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
MIDENT MATRIX A BEGIN IN ROW 2 COLUMN 1 SIZE IS 4X4
MPROPERTIES OF  A BEGIN IN ROW 2 COLUMN 1 SIZE IS 4X4 STORE PROPERTIES IN COL 30
SMPROP OF MATRIX A BEGIN IN ROW 2 COLUMN 1 SIZE IS 4X4 STORE PROPERTIES IN 31
RESET NRMAX EQUAL TO 4
NOTE ***************************************************************************
SPACE
NOTE THE ABOVE IS AN EXAMPLE OF THE AUTOMATIC PRINTOUT FROM MPROPERTIES
SPACE
NOTE ***************************************************************************
SUBTRACT COLUMN 30 FROM COLUMN 31 STORE IN 31
AVERAGE COLUMN 31 STORE IN COLUMN 31
MVECDIAG MATRIX A IN ROW 2 COLUMN 1 SIZE IS 4X4 INTO ROW 2 COLUMN 5
MVECMAT MATRIX A IN ROW 2 COL 1 SIZE 4X4 INTO COLUMN 6 BY ROWS
MMATVEC COLUMN 6 INTO MATRIX B ROW 2 COL 7 SIZE 4X4
MDIAGONAL OF C      IN ROW 2 COLUMN 11 SIZE IS 4X4 VALUE EQUALS 1.0
APROPERTIES OF C BEGIN IN ROW 2 COLUMN 11 SIZE IS 4X4 STORE PROPERTIES IN 32
NOTE ***************************************************************************
SPACE
NOTE THE ABOVE IS AN EXAMPLE OF THE AUTOMATIC PRINTOUT FROM APROPERTIES.
SPACE
NOTE ***************************************************************************
MVECDIAGONAL OF C IN ROW 2 COLUMN 11 SIZE IS 4X4 INTO ROW 2 COLUMN 15
MVECMATRIX OF C IN ROW 2 COLUMN 15 SIZE IS 4X4 INTO COLUMN 16 BY ROWS.
MMATVECTOR OF  16 INTO MATRIX D ROW 2 COLUMN 17 SIZE IS 4X4
ASUBTRACT   B R=2 C=7 SIZE 4X4 FROM MATRIX D R=2 C=17 SIZE=4X4 STORE IN R=1 C=33
ROW SUM COLS   33***36 STORE IN COLUMN 37
AVERAGE COLUMN 37 AND STORE IN COLUMN 37
TITLE1 MATRIX A WAS DEFINED BY THE MIDENT COMMAND, COLUMN 5 BY THE
TITLE2 MVECDIAG COMMAND AND COLUMN 6 BY THE MVECMAT COMMAND.
RESET NRMAX TO 16
HEAD COL 1/ MATRIX A
HEAD COL 2/
HEAD COL 3/
HEAD COL 4/
PRINT COLUMNS 1***6
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLUMN 37
SPACE
NOTE ***************************************************************************
READ THE FOLLOWING DATA INTO COLUMNS 12  13 14 AND 15
4   4  -2   -6
-2  -6   4    4
-6  -2   4    4
4   4  -6   -2
ATRANSPOSE MATRIX B IN ROW 1 COLUMN 12 SIZE 4X4 STORE IN MATRIX C R=1 C=16
MMULT MATRIX C IN R=1 C=16 SIZE 4X4 BY MATRIX B R=1 C=12 4X4 STORE R=9 C=12
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
MEIGEN MATRIX D IN R=9 C=12 SIZE 4X4 STORE VALUES IN COLUMN 20 VECTORS IN 1 21
TITLE1 THE FOLLOWING IS AN EXAMPLE OF MTRANSPOSE, MMULT AND MEIGEN.
TITLE2.
TITLE3 MATRIX A WAS DEFINED BY THE READ COMMAND. MATRIX B IS THE T
TITLE4RANSPOSE OF MATRIX A.
HEAD COL 12/ MATRIX A
HEAD COL 13/
HEAD COL 14/
HEAD COL 15/
HEAD COL 16/ MATRIX B=A,
HEAD COL 17/
HEAD COL 18/
HEAD COL 19/
RESET  NRMAX TO 4
PRINT COLUMNS 12***19
SPACE 2
NOTE MATRIX C EQUALS MATRIX A TIMES MATRIX B.
SPACE
APRINT MATRIX C BEGIN ROW 9 COLUMN 12 SIZE IS 4X4
SPACE 2
NOTE THE FOLLOWING RESULTS ARE FROM THE MEIGEN COMMAND.
SPACE
NOTE       E-VALUES       VECTOR 1       VECTOR 2       VECTOR 3       VECTOR 4
SPACE
NPRINT COLUMNS 20***24
ROWSUM COLUMNS 20***24 STORE IN COLUMN 25
AVERAGE COLUMN 25 AND STORE IN COLUMN 25
SUBTRACT THE VALUE 72.5   FROM COLUMN 25 STORE IN COLUMN 25
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLUMN 25
SPACE
NOTE ***************************************************************************
MERASE MATRIX BEGINNING IN ROW 1 COLUMN 20 SIZE IS 4X2
MZERO MATRIX  BEGINNING IN ROW 1 COLUMN 22 SIZE IS 4X2
AZERO MATRIX BEGINNING IN ROW 1 COLUMN 24 SIZE IS 4X2
ROWSUM COLUMNS 20***24 STORE IN COLUMN 26
AVERAGE COLUMN 26 AND STORE IN COLUMN 26
SPACE
NOTE THE COMMANDS MERASE, MZERO AND AZERO HAVE BEEN EXECUTED.
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLUMNS 25 AND 26
SPACE
NOTE ***************************************************************************
```

UNIFORM RANDOM NUMBERS STARTING VALUE
1.0 3473.0 NOS IN COL 1 3473.0

| COLUMN 1 | COLUMN 2 | COLUMN 3 | COLUMN 4 |
|---|---|---|---|
| .015258789 | .99377441 | .015258789 | .99377441 |
| .90734863 | .22180176 | .90734863 | .22180176 |
| .41857910 | .72521973 | .41857910 | .72521973 |
| .32238770 | .65246582 | .32238770 | .65246582 |
| .29846191 | .55822754 | .29846191 | .55822754 |
| .30773926 | .77844238 | .30773926 | .77844238 |
| .46740723 | .30529785 | .46740723 | .30529785 |
| .42590332 | .16223145 | .42590332 | .16223145 |
| .23791504 | .27893066 | .23791504 | .27893066 |
| .73937988 | .86633301 | .73937988 | .86633301 |
| .42248535 | .29162598 | .42248535 | .29162598 |
| .81066895 | .45324707 | .81066895 | .45324707 |
| .33361816 | .65588379 | .33361816 | .65588379 |
| .70227051 | .98547363 | .70227051 | .98547363 |
| .78381348 | .18420410 | .78381348 | .18420410 |
| .97668457 | .025512695 | .97668457 | .025512695 |
| .085571289 | .18908691 | .085571289 | .18908691 |
| .69641113 | .63586426 | .69641113 | .63586426 |
| .051391602 | .48303223 | .051391602 | .48303223 |
| .42395020 | .37902832 | .42395020 | .37902832 |



FIRST TWENTY SECOND TWENTY FIRST FORTY

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    RESET 20
    UNIFORM RANDOM NUMBERS STARTING WITH 1.0 PUT IN COLUMN 1

* INFORMATIVE DIAGNOSTIC IN ABOVE COMMAND
* CAUTION, USE EXPERIMENTALLY ONLY.  NOT OPTIMUM IN ORDER TO MAKE IT MACHINE
  INDEPENDENT.  REFERENCES - J.B. KRUSKAL,ACM,12,92. AND J.H. HALTON,SIAM REV.,12,1.

    UNIFORM RANDOM NUMBERS STARTING WITH *20,1* PUT IN COLUMN 2

* INFORMATIVE DIAGNOSTIC IN ABOVE COMMAND
* CAUTION, USE EXPERIMENTALLY ONLY.  NOT OPTIMUM IN ORDER TO MAKE IT MACHINE
  INDEPENDENT.  REFERENCES - J.B. KRUSKAL,ACM,12,92. AND J.H. HALTON,SIAM REV.,12,1.

    RESET 40
    UNIFORM RANDOM NUMBERS, STARTING WITH INTEGER 1, PUT IN COLUMN 3

* INFORMATIVE DIAGNOSTIC IN ABOVE COMMAND
* CAUTION, USE EXPERIMENTALLY ONLY.  NOT OPTIMUM IN ORDER TO MAKE IT MACHINE
  INDEPENDENT.  REFERENCES - J.B. KRUSKAL,ACM,12,92. AND J.H. HALTON,SIAM REV.,12,1.

    MOVE 21,3 SIZE 20X1 TO 1,4
    RESET NRMAX  20
    SUBTRACT 2,4,5
    TITLE1      UNIFORM   RANDOM   NUMBERS   STARTING   VALUE
    TITLE3         1.0         3473.0        NOS IN COL 1    3473.0
    PRINT COLUMNS 1 *** 4
    AVERAGE COL 4 STORE IN COL 4
    SPACE  2
    NOTE  FIRST TWENTY    SECOND TWENTY          FIRST FORTY
    SPACE  2
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE ROW 1 COL 5
    SPACE
    NOTE ***************************************************************************
```

| X | | Y | | X+Y | | Y-X | |
|---|---|---|---|---|---|---|---|
| REAL COLUMN 51 | IMAGINARY COLUMN 52 | REAL COLUMN 61 | IMAGINARY COLUMN 62 | REAL COLUMN 1 | IMAGINARY COLUMN 2 | REAL COLUMN 11 | IMAGINARY COLUMN 12 |
| 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 1.0000000 | 0. | 1.0000000 | 0. | 2.0000000 | 0. | 0. |
| 0. | 1.0000000 | 1.0000000 | 0. | 1.0000000 | 1.0000000 | 1.0000000 | -1.0000000 |
| 1.0000000 | 0. | 1.0000000 | 1.0000000 | 2.0000000 | 1.0000000 | 0. | 1.0000000 |
| 1.0000000 | 0. | 1.0000000 | 0. | 2.0000000 | 0. | 0. | 0. |
| 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 | 2.0000000 | 2.0000000 | 0. | 0. |
| 1.0000000 | 1.0000000 | 0. | 0. | 1.0000000 | 1.0000000 | -1.0000000 | -1.0000000 |
| 0. | 0. | 3.0000000 | 0. | 3.0000000 | 0. | 3.0000000 | 0. |
| 0. | 0. | 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 |
| 3.0000000 | 1.0000000 | 1.0000000 | -1.0000000 | 4.0000000 | 0. | -2.0000000 | -2.0000000 |
| 1.0000000 | 1.0000000 | -2.0000000 | -1.0000000 | -1.0000000 | 0. | -3.0000000 | -2.0000000 |
| 1.0000000 | -1.0000000 | 1.0000000 | -1.0000000 | 2.0000000 | -2.0000000 | 0. | 0. |
| 10.000000 | 2.0000000 | 10.000000 | 1.0000000 | 20.000000 | 3.0000000 | 0. | -1.0000000 |
| 10.000000 | 1.0000000 | -1.2345678 | 10.000000 | 8.7654322 | 11.000000 | -11.234568 | 9.0000000 |
| 1.2345678 | 10.000000 | 0. | 10.000000 | 1.2345678 | 20.000000 | -1.2345678 | 0. |
| 0. | -1.2345678 | 0. | -1.2345678 | 0. | -2.4691356 | 0. | 0. |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

*-1.8626451-09 0. 0. 0.

**********



412-718 O - 71 - 9

| X | | X*(3.5+1.0I) | | X*(3.5+1.0I)/(3.5+1.0I) | |
|---|---|---|---|---|---|
| REAL COLUMN 51 | IMAGINARY COLUMN 52 | REAL COLUMN 21 | IMAGINARY COLUMN 22 | REAL COLUMN 31 | IMAGINARY COLUMN 32 |
| 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 1.0000000 | -1.0000000 | 3.5000000 | 0. | 1.0000000 |
| 0. | 1.0000000 | -1.0000000 | 3.5000000 | 0. | 1.0000000 |
| 1.0000000 | 0. | 3.5000000 | 1.0000000 | 1.0000000 | 0. |
| 1.0000000 | 0. | 3.5000000 | 1.0000000 | 1.0000000 | 0. |
| 1.0000000 | 1.0000000 | 2.5000000 | 4.5000000 | 1.0000000 | 1.0000000 |
| 1.0000000 | 1.0000000 | 2.5000000 | 4.5000000 | 1.0000000 | 1.0000000 |
| 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. | 0. | 0. |
| 3.0000000 | 1.0000000 | 9.5000000 | 6.5000000 | 3.0000000 | 1.0000000 |
| 1.0000000 | 1.0000000 | 2.5000000 | 4.5000000 | 1.0000000 | 1.0000000 |
| 1.0000000 | -1.0000000 | 4.5000000 | -2.5000000 | 1.0000000 | -1.0000000 |
| 10.000000 | 2.0000000 | 33.000000 | 17.000000 | 10.000000 | 2.0000000 |
| 10.000000 | 1.0000000 | 34.000000 | 13.500000 | 10.000000 | 1.0000000 |
| 1.2345678 | 10.000000 | -5.6790127 | 36.234568 | 1.2345678 | 10.000000 |
| 0. | -1.2345678 | 1.2345678 | -4.3209873 | *-1.1246159-09 | -1.2345678 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

* 7.0288496-11 0.

**********

| X REAL COLUMN 51 | IMAGINARY COLUMN 52 | POLAR COORDINATES (X) THETA(ANGLE) COLUMN 53 | RHO(RADIUS) COLUMN 54 | CHANGE BACK TO RECTANGULAR COORDS. REAL COLUMN 55 | IMAGINARY COLUMN 56 |
|---|---|---|---|---|---|
| 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 1.0000000 | 1.0000000 | 1.5707963 | * 3.0794416-08 | 1.0000000 |
| 0. | 1.0000000 | 1.0000000 | 1.5707963 | * 3.0794416-08 | 1.0000000 |
| 1.0000000 | 0. | 1.0000000 | 0. | 1.0000000 | 0. |
| 1.0000000 | 0. | 1.0000000 | 0. | 1.0000000 | 0. |
| 1.0000000 | 1.0000000 | 1.4142136 | .78539816 | 1.0000000 | 1.0000000 |
| 1.0000000 | 1.0000000 | 1.4142136 | .78539816 | 1.0000000 | 1.0000000 |
| 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. | 0. | 0. |
| 3.0000000 | 1.0000000 | 3.1622777 | .32175056 | 3.0000000 | 1.0000000 |
| 1.0000000 | 1.0000000 | 1.4142136 | .78539816 | 1.0000000 | 1.0000000 |
| 1.0000000 | -1.0000000 | 1.4142136 | -.78539816 | 1.0000000 | -1.0000000 |
| 10.000000 | 2.0000000 | 10.198039 | .19739556 | 10.000000 | 2.0000000 |
| 10.000000 | 1.0000000 | 10.049876 | .099668653 | 10.000000 | 1.0000000 |
| 1.2345678 | 10.000000 | 10.075920 | 1.4479611 | 1.2345679 | 10.000000 |
| 0. | -1.2345678 | 1.2345678 | -1.5707963 | * 3.8017794-08 | -1.2345678 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

*-1.0882027-08 0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
SET REAL PART OF X IN COLUMN 51
0. 0. 0. 1. 1. 1. 1. 0. 0. 3. 1. 1. 10. 10. 1.2345678
SET IMAGINARY PART OF X IN COLUMN 52
0. 1. 1. 0. 0. 1. 1. 0. 0.  1. 1. -1.  2.  1.  10. -1.2345678
SET REAL PART OF Y IN COLUMN 61
0. 0. 1. 1. 1. 1. 0. 3.  1.  1.  -2.  1.  10.  -1.2345678
SET IMAGINARY PART OF Y IN COLUMN 62
0. 1. 0. 1. 0. 1. 0. 0. 1. -1. -1. -1.  1. 10.  10.  -1.2345678
CADD X 51,52 TO Y 61,62 PUT IN COLUMNS 1,2
CSUBTRACT X 51,52 FROM Y 61,62 PUT IN 11,12
TITLE1              X                              Y
TITLE2            X+Y                            Y-X
TITLE3      REAL          IMAGINARY        REAL          IMAGINARY
TITLE4      REAL          IMAGINARY        REAL          IMAGINARY
PRINT 51,52   61,62   1,2   11,12
CADD 1,2 TO 11,12 PUT IN COLS 41,42
CSUBTRACT 11,12 FROM 1,2 PUT IN COLS 43,44
CDIVIDE 41,42 BY 2.0,0.0 PUT IN COLS 45,46
CDIVIDE COLS 43,44 BY 2.0,0.0 PUT IN COLS 47,48
SUBTRACT COL 45 FROM COL 61 STORE IN COL 31
SUBTRACT COL 46 FROM 62 STORE IN COL 32
SUBTRACT 47,51,33
SUBTRACT 48,52,34
AVERAGE 31 35
AVERAGE 32 36
AVERAGE 33 37
AVERAGE 34 38
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLS 35 *** 38
SPACE 1
NOTE ***************************************************************************
CMULTIPLY 51,52 BY 3.5,1.0 PUT IN COLUMNS 21,22
CDIVIDE 21,22 BY 3.5,1.0 PUT IN COLUMNS 31,32
TITLE1              X                          X*(3.5+1.0I)
TITLE2          X*(3.5+1.0I)/(3.5+1.0I)
TITLE4      REAL          IMAGINARY
PRINT  51,52  21,22  31,32
SUBTRACT 31,51,33
SUBTRACT 32,52,34
AVERAGE 33 35
AVERAGE 34 36
SPACE  2
NOTE ***************************************************************************
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE 1
ABRIDGE ROW 1 OF COLS 35 AND 36
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
SPACE 1
NOTE ************************************************************************
CPOLAR 51,52 PUT IN COLS 53,54
CRECTANGULAR 53,54 PUT IN COLS 55,56
SUBTRACT 55 51 57
SUBTRACT 56 52 58
AVERAGE COL 57 STORE IN COL 57
AVERAGE COL 58 STORE IN COL 58
TITLE1              X                     POLAR COORDINATES (X)
TITLE2      CHANGE BACK TO RECTANGULAR COORDS.
TITLE3      REAL         IMAGINARY    THETA(ANGLE)   RHO(RADIUS)
TITLE4      REAL         IMAGINARY
PRINT 51***56
SPACE  2
NOTE ************************************************************************
SPACE 1
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 COLUMNS 57,58
SPACE
NOTE ************************************************************************
```

ANALYSIS OF VARIANCE FOR TWO-WAY 3 X 4 TABLE

| SOURCE | D.F. | SUM OF SQUARES | MEAN SQUARES | F RATIO | F PROB. |
|---|---|---|---|---|---|
| BETWEEN ROWS | 2 | 7.1666666 | 3.5833333 | .942 | .441 |
| BETWEEN COLS | 3 | 24.916666 | 8.3055551 | 2.182 | .191 |
| RESIDUALS | 6 | 22.833332 | 3.8055554 | | |
| TOTAL | 11 | 54.916668 | | | |

TUKEY'S TEST FOR NON-ADDITIVITY

| | | | | | |
|---|---|---|---|---|---|
| NON-ADDITIVITY | 1 | 7.9069896 | 7.9069896 | 2.649 | .165 |
| BALANCE | 5 | 14.926343 | 2.9852685 | | |
| RESIDUALS | 6 | 22.833332 | 3.8055554 | | |

| COEFFICIENT | | ESTIMATE | STD. DEV. |
|---|---|---|---|
| GRAND MEAN | | 2.4166667 | .56314261 |
| ROW | 1 | 1.0833333 | .79640393 |
| ROW | 2 | -.66666667 | .79640394 |
| ROW | 3 | -.41666666 | .79640394 |
| COLUMN | 1 | 2.2499999 | .97539163 |
| COLUMN | 2 | -1.4166666 | .97539163 |
| COLUMN | 3 | -1.0833333 | .97539164 |
| COLUMN | 4 | .25000001 | .97539164 |
| RESIDUAL | | | 1.9507833 |

3 X 4 TABLE OF RESIDUALS, STANDARDIZED BY DIVIDING EACH RESIDUAL BY ITS STANDARD DEVIATION.

| COLUMN / ROW | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 1.63 | -.06 | -1.03 | -.54 |
| 2 | -1.45 | .48 | -.48 | 1.45 |
| 3 | -.18 | -.42 | 1.51 | -.91 |

OUTPUT OF THE 2 PREVIOUS PAGES IS FROM THE COMMAND TWOWAY

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

| | | |
|---|---|---|
| 0. | 0. | 0. |
| 0. | 0. | 0. |

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
SET DATA IN COLUMN 11
8 2 1 3
2 1 0 4
4 0 3 1
TWOWAY ANALYSIS FOR 3 BY 4 TABLE, DATA IN COL 11, STORE IN 31 AND SUCC. COLS
SFIT 11 1.0 6 31***36 41***44 1,45
RESET 40
1/SUBTRACT COL 38 FROM COL 42 IN COL 51
2/ INCREMENT 1 BY 1 1
3/AVERAGE COL 51 STORE IN COL 51
4/INCREMENT 3 BY 1,1
PERFORM 1 THRU 4 3 TIMES
SPACE 2
NOTE OUTPUT OF THE 2 PREVIOUS PAGES IS FROM THE COMMAND TWOWAY
SPACE 2
NOTE ********************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 COLS 51 52 53
MOVE 1,37   30X4   TO 1,41
RESET 12
STWOWAY 3,4,11,31
RESET 40
1/SUBTRACT COL 38 FROM COL 42 IN COL 51
3/AVERAGE COL 51 STORE IN COL 51
PERFORM 1 THRU 4 3 TIMES
ABRIDGE ROW 1 COLS 51 52 53
SPACE
NOTE ********************************************************************************
```

NUMBER OF SIGNIFICANT DIGITS PER COLUMN.

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|
| COLUMN 21 | COLUMN 22 | COLUMN 23 | COLUMN 24 | COLUMN 25 | COLUMN 26 | COLUMN 27 | COLUMN 28 |
| 72.444443 | 72.444440 | 72.444400 | 72.444000 | 72.440000 | 72.400000 | 72.000000 | 70.000000 |
| 6.4748596 | 6.4748600 | 6.4748600 | 6.4749000 | 6.4750000 | 6.4800000 | 6.5000000 | 6.0000000 |
| 1.6718015 | 1.6718020 | 1.6718000 | 1.6718000 | 1.6720000 | 1.6700000 | 1.7000000 | 2.0000000 |
| 20.000000 | 20.000000 | 20.000000 | 20.000000 | 20.000000 | 20.000000 | 20.000000 | 20.000000 |
| 5.2533334 | 5.2533330 | 5.2533300 | 5.2533000 | 5.2530000 | 5.2500000 | 5.2000000 | 5.0000000 |
| 41.923807 | 41.923810 | 41.923800 | 41.924000 | 41.920000 | 41.900000 | 42.000000 | 40.000000 |
| 9.0262909 | 9.0262910 | 9.0262901 | 9.0263000 | 9.0260000 | 9.0300000 | 9.0000000 | 9.0000000 |
| 68.147674 | 68.147670 | 68.147700 | 68.148000 | 68.150000 | 68.200000 | 68.000000 | 70.000000 |
| -.82094830 | -.82094830 | -.82094800 | -.82095000 | -.82100000 | -.82100000 | -.82000000 | -.80000000 |
| .42543463 | .42543460 | .42543500 | .42544000 | .42540000 | .42500000 | .42000000 | .40000000 |
| 10.000000 | 10.000000 | 10.000000 | 10.000000 | 10.000000 | 10.000000 | 10.000000 | 10.000000 |
| .13563949 | .13563950 | .13564000 | .13564000 | .13560000 | .13600000 | .14000000 | .10000000 |
| 1.9525860 | 1.9525860 | 1.9525900 | 1.9526000 | 1.9530000 | 1.9500000 | 2.0000000 | 2.0000000 |
| * 1.0760000+03 | * 1.0760000+03 | * 1.0760000+03 | * 1.0760000+03 | * 1.0760000+03 | * 1.0800000+03 | * 1.1000000+03 | * 1.0000000+03 |
| * 7.7772000+04 | * 7.7772000+04 | * 7.7772000+04 | * 7.7772000+04 | * 7.7770000+04 | * 7.7800000+04 | * 7.8000000+04 | * 8.0000000+04 |

NUMBER OF SIGNIFICANT DIGITS PER COLUMN.

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|
| 72.444443 | 72.444440 | 72.444400 | 72.444000 | 72.440000 | 72.400000 | 72.000000 | 70.000000 |
| 6.4748596 | 6.4748600 | 6.4748600 | 6.4749000 | 6.4750000 | 6.4700000 | 6.5000000 | 6.0000000 |
| 1.6718015 | 1.6718020 | 1.6718000 | 1.6718000 | 1.6720000 | 1.6700000 | 1.7000000 | 2.0000000 |
| 20.000000 | 20.000000 | 20.000000 | 20.000000 | 20.000000 | 20.000000 | 20.000000 | 20.000000 |
| 5.2533334 | 5.2533330 | 5.2533300 | 5.2533000 | 5.2530000 | 5.2500000 | 5.3000000 | 5.0000000 |
| 41.923807 | 41.923810 | 41.923800 | 41.924000 | 41.920000 | 41.900000 | 42.000000 | 40.000000 |
| 9.0262909 | 9.0262910 | 9.0262901 | 9.0263000 | 9.0260000 | 9.0300000 | 9.0000000 | 9.0000000 |
| 68.147674 | 68.147670 | 68.147700 | 68.148000 | 68.150000 | 68.100000 | 68.000000 | 70.000000 |
| -.82094830 | -.82094830 | -.82094800 | -.82095000 | -.82090000 | -.82100000 | -.82000000 | -.80000000 |
| .42543463 | .42543460 | .42543500 | .42543000 | .42540000 | .42500000 | .43000000 | .40000000 |
| 10.000000 | 10.000000 | 10.000000 | 10.000000 | 10.000000 | 10.000000 | 10.000000 | 10.000000 |
| .13563949 | .13563950 | .13563900 | .13564000 | .13560000 | .13600000 | .14000000 | .10000000 |
| 1.9525860 | 1.9525860 | 1.9525900 | 1.9526000 | 1.9530000 | 1.9500000 | 2.0000000 | 2.0000000 |
| * 1.0760000+03 | * 1.0760000+03 | * 1.0760000+03 | * 1.0760000+03 | * 1.0760000+03 | * 1.0800000+03 | * 1.1000000+03 | * 1.0000000+03 |
| * 7.7772000+04 | * 7.7772000+04 | * 7.7772000+04 | * 7.7772000+04 | * 7.7770000+04 | * 7.7800000+04 | * 7.8000000+04 | * 8.0000000+04 |

THE FOLLOWING VALUES SHOULD BE EQUAL TO OR NEAR 0.0
THEY ARE NOT EXACTLY ZERO DUE TO USING TWO DIFFERENT METHODS OF ROUNDING

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0. | 0. | * 6.6682696-08 | * 6.6657861-07 | *-6.6667795-06 | .0073332945 | -.0073333348 | 0. |

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
SET IN COLUMN 21 DATA
 7.2444443+01   6.4748596+00   1.6718015+00
2.0000000+01   5.2533334+00   4.1923807+01   9.0262909+00   6.8147674+01
-8.2094830-01   4.2543463-01   1.0000000+01
1.3563949-01   1.9525860+00   1.0760000+03   7.7772000+04
DEFINE COLUMN 21 INTO COLUMN 1
SUBTRACT COLUMN 21 FROM 1 PUT IN COL 41
5/ ROUND 21 TO 7 SIGNIFICANT DIGITS AND STORE IN COL 22
6/ INCREMENT 5 BY 1,-1,1
7/ROUND COL 1 TO 7 SIG. DIGITS STORE IN COL 2
8/INCREMENT 7 BY 0 -1  1
9/SUBTRACT COL 2 FROM COL 22 STORE IN COL 32
10/INCREMENT 9 BY 1,1,1
11/AVERAGE COL 32 STORE IN COL 42
12/INCREMENT 11 BY 1  1
PERFORM 5 THRU 12, 7 TIMES
TITLE1 NUMBER OF SIGNIFICANT DIGITS PER COLUMN.
TITLE3        8              7              6              5
TITLE4        4              3              2              1
PRINT 21 *** 28
SPACE  2
NOTE NUMBER OF SIGNIFICANT DIGITS PER COLUMN.
 NOTE2        4              3              2              1
 NOTE1        8              7              6              5
SPACE  2
PRINT NOTE
SPACE 2
NPRINT 1 *** 8
NOTE1 ********************************************************************************
NOTE2 ********************************************************************************
PRINT NOTE
SPACE
NOTE THE FOLLOWING VALUES SHOULD BE EQUAL TO OR NEAR 0.0
 NOTE THEY ARE NOT EXACTLY ZERO DUE TO USING TWO DIFFERENT METHODS OF ROUNDING
SPACE
ABRIDGE  ROW 1 COL 41***48
SPACE
PRINT NOTE
```

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C. 20234, OMNITAB II VERSION 5.00 MAY 15

| X COLUMN 1 | EXACT ERF(X) COLUMN 11 | COMPUTED ERF(X) COLUMN 21 | EXACT ERFC(X) COLUMN 12 | COMPUTED ERFC(X) COLUMN 22 |
|---|---|---|---|---|
| 0. | 0. | 0. | 1.0000000 | 1.0000000 |
| .10000000 | .11246292 | .11246292 | .88753709 | .88753708 |
| .20000000 | .22270259 | .22270259 | .77729742 | .77729741 |
| .30000000 | .32862676 | .32862676 | .67137325 | .67137324 |
| .40000000 | .42839236 | .42839235 | .57160765 | .57160765 |
| .50000000 | .52049988 | .52049988 | .47950013 | .47950012 |
| .59999999 | .60385609 | .60385609 | .39614391 | .39614391 |
| .70000000 | .67780118 | .67780119 | .32219882 | .32219881 |
| .80000000 | .74210095 | .74210096 | .25789905 | .25789904 |
| .90000000 | .79690821 | .79690821 | .20309180 | .20309179 |
| 1.0000000 | .84270079 | .84270079 | .15729922 | .15729921 |
| 1.1000000 | .88020507 | .88020507 | .11979493 | .11979493 |
| 1.2000000 | .91031398 | .91031397 | .089686021 | .089686025 |
| 1.3000000 | .93400794 | .93400794 | .065992072 | .065992055 |
| 1.4000000 | .95228512 | .95228512 | .047714889 | .047714882 |
| 1.5000000 | .96610515 | .96610515 | .033894852 | .033894854 |
| 1.6000000 | .97634838 | .97634839 | .023651630 | .023651617 |
| 1.7000000 | .98379046 | .98379046 | .016209543 | .016209542 |
| 1.8000000 | .98909049 | .98909050 | .010909513 | .010909499 |
| 1.9000000 | .99279042 | .99279043 | .0072095841 | .0072095710 |
| 2.0000000 | .99532226 | .99532226 | .0046777427 | .0046777350 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

* 4.2574746-09

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE 0(1)20 IN COLUMN 1   $   21 VALUES
DIVIDE COLUMN 1 BY 10.0 AND PUT IN COLUMN 1
SET IN COLUMN 11   $   AMS 55, 310-311 VALUES OF ERF
0.00000000   0.11246292   0.22270259   0.32862676   0.42839236   0.52049988
0.60385609   0.67780119   0.74210096   0.79690821   0.84270079   0.88020507
0.91031398   0.93400794   0.95228512   0.96610515   0.97634838   0.98379046
0.98909050   0.99279043   0.99532226
SUBTRACT COLUMN 11 FROM 1.0 AND PUT CERF IN COLUMN 12
ERROR OF COLUMN 1 PUT IN COLUMN 21
CERF OF COLUMN 1 PUT IN COLUMN 22
ADD COLUMN 21 TO COLUMN 22 AND PUT IN COLUMN 23
SUBTRACT COLUMN 23 FROM 1. PUT IN COLUMN 33
AVERAGE COLUMN 33 PUT IN COLUMN 43
TITLE1                      EXACT        COMPUTED         EXACT
TITLE2    COMPUTED
TITLE3       X              ERF(X)       ERF(X)          ERFC(X)
TITLE4    ERFC(X)
PRINT COLUMNS 1,11,21,12,22
SPACE  2
NOTE ********************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE 1
ABRIDGE ROW 1 OF COLUMN 43
SPACE
NOTE ********************************************************************************
```

EINSTEIN FUNCTION

| X COLUMN 11 | -(F-E)/RT COLUMN 13 | (H-E)-RT COLUMN 14 | S/R COLUMN 15 | C/R COLUMN 16 | (H-E)/R COLUMN 17 |
|---|---|---|---|---|---|
| 1.0500000 | .43068715 | .56522992 | .99591707 | .91297628 | .81324715 |
| 1.1000000 | .40477197 | .54885672 | .95362869 | .90498610 | .78968956 |
| 1.1500000 | .38072874 | .53285320 | .91358195 | .89671371 | .76666385 |
| 1.2000000 | .35838242 | .51721531 | .87559773 | .88817006 | .74416421 |
| 1.2500000 | .33757957 | .50193889 | .83951846 | .87936628 | .72218466 |
| 1.3000000 | .31818499 | .48701968 | .80520466 | .87031374 | .70071904 |
| 1.3500000 | .30007895 | .47245326 | .77253220 | .86102398 | .67976101 |
| 1.4000000 | .28315496 | .45823515 | .74139010 | .85150865 | .65930414 |
| 1.4500000 | .26731789 | .44436075 | .71167864 | .84177955 | .63934179 |
| 1.5000000 | .25248246 | .43082537 | .68330783 | .83184856 | .61986723 |

**********

MOLECULAR WEIGHTS OF

| WATER | PROPANAL | TETRATOMIC PHOSP | URANIUM OXIDE |
|---|---|---|---|
| 18.015400 | 60.096399 | 123.89520 | 842.08219 |

**********

TRANSLATIONAL CONTRIBUTIONS OF WATER

| TEMPERATURE COLUMN 4 | -(F-E)/RT COLUMN 5 | (H-E)/RT COLUMN 6 | S/R COLUMN 7 | C/R COLUMN 8 | (H-E)/R COLUMN 9 |
|---|---|---|---|---|---|
| 100.00000 | 12.184816 | 2.5000000 | 14.684816 | 2.5000000 | 250.00000 |
| 200.00000 | 13.917684 | 2.5000000 | 16.417684 | 2.5000000 | 500.00000 |
| 300.00000 | 14.931346 | 2.5000000 | 17.431346 | 2.5000000 | 750.00000 |
| 400.00000 | 15.650552 | 2.5000000 | 18.150552 | 2.5000000 | 1000.0000 |
| 500.00000 | 16.208411 | 2.5000000 | 18.708411 | 2.5000000 | 1250.0000 |
| 600.00000 | 16.664214 | 2.5000000 | 19.164214 | 2.5000000 | 1500.0000 |
| 700.00000 | 17.049591 | 2.5000000 | 19.549591 | 2.5000000 | 1750.0000 |
| 800.00000 | 17.383420 | 2.5000000 | 19.883420 | 2.5000000 | 2000.0000 |
| 900.00000 | 17.677877 | 2.5000000 | 20.177877 | 2.5000000 | 2250.0000 |
| 1000.0000 | 17.941278 | 2.5000000 | 20.441278 | 2.5000000 | 2500.0000 |
| 1100.0000 | 18.179554 | 2.5000000 | 20.679554 | 2.5000000 | 2750.0000 |
| 1200.0000 | 18.397082 | 2.5000000 | 20.897082 | 2.5000000 | 3000.0000 |
| 1300.0000 | 18.597189 | 2.5000000 | 21.097189 | 2.5000000 | 3250.0000 |
| 1400.0000 | 18.782459 | 2.5000000 | 21.282459 | 2.5000000 | 3500.0000 |
| 1500.0000 | 18.954941 | 2.5000000 | 21.454941 | 2.5000000 | 3750.0000 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

0. 0. 0. 0.

**********

PTATOMIC OF ATOMIC OXYGEN

| TEMPERATURE COLUMN 41 | -(F-E)/RT COLUMN 42 | (H-E)/RT COLUMN 43 | S/R COLUMN 44 | C/R COLUMN 45 | (H-E)/R COLUMN 46 |
|---|---|---|---|---|---|
| 1000.0000 | 18.802985 | 2.5000000 | 21.302985 | 2.5000000 | 2500.0000 |
| 1500.0000 | 19.816648 | 2.5000000 | 22.316648 | 2.5000000 | 3750.0000 |
| 2000.0000 | 20.535853 | 2.5000000 | 23.035853 | 2.5000000 | 5000.0000 |
| 2500.0000 | 21.093712 | 2.5000000 | 23.593712 | 2.5000000 | 6250.0000 |
| 3000.0000 | 21.549516 | 2.5000000 | 24.049516 | 2.5000000 | 7500.0000 |
| 3500.0000 | 21.934893 | 2.5000000 | 24.434893 | 2.5000000 | 8750.0000 |
| 4000.0000 | 22.268721 | 2.5000000 | 24.768721 | 2.5000000 | 10000.000 |
| 4500.0000 | 22.563179 | 2.5000000 | 25.063179 | 2.5000000 | 11250.000 |
| 5000.0000 | 22.826580 | 2.5000000 | 25.326580 | 2.5000000 | 12500.000 |
| 5500.0000 | 23.064856 | 2.5000000 | 25.564856 | 2.5000000 | 13750.000 |
| 6000.0000 | 23.282384 | 2.5000000 | 25.782384 | 2.5000000 | 15000.000 |
| 6500.0000 | 23.482491 | 2.5000000 | 25.982491 | 2.5000000 | 16250.000 |
| 7000.0000 | 23.667761 | 2.5000000 | 26.167761 | 2.5000000 | 17500.000 |
| 7500.0000 | 23.840243 | 2.5000000 | 26.340243 | 2.5000000 | 18750.000 |
| 8000.0000 | 24.001589 | 2.5000000 | 26.501589 | 2.5000000 | 20000.000 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

| | | | | | |
|---|---|---|---|---|---|
| 0. | 0. | 0. | 0. | 0. | 0. |

**********

PARTFUNCTION OF ATOMIC OX

| TEMPERATURE COLUMN 1 | WAVE NO. COLUMN 2 | G COLUMN 3 | Q(0) COLUMN 11 | Q(1) COLUMN 12 | Q(2) COLUMN 13 |
|---|---|---|---|---|---|
| 1000.0000 | 78.000000 | 9.0000000 | 8.0445831 | .90280834 | .10131854 |
| 1500.0000 | 15868.000 | 5.0000000 | 8.3512200 | .62483248 | .047030965 |
| 2000.0000 | 33792.000 | 1.0000000 | 8.5089474 | .47808712 | .033974776 |
| 2500.0000 | | | 8.6054622 | .39121396 | .062425896 |
| 3000.0000 | | | 8.6720195 | .34316519 | .15559990 |
| 3500.0000 | | | 8.7233441 | .32740384 | .32170693 |
| 4000.0000 | | | 8.7676088 | .34034358 | .54851407 |
| 4500.0000 | | | 8.8096472 | .37795565 | .81356907 |
| 5000.0000 | | | 8.8522937 | .43549771 | 1.0940631 |
| 5500.0000 | | | 8.8971039 | .50806658 | 1.3717714 |
| 6000.0000 | | | 8.9448112 | .59111446 | 1.6342110 |
| 6500.0000 | | | 8.9956322 | .68073445 | 1.8739578 |
| 7000.0000 | | | 9.0494714 | .77374944 | 2.0873997 |
| 7500.0000 | | | 9.1060584 | .86768169 | 2.2735298 |
| 8000.0000 | | | 9.1650347 | .96066564 | 2.4329863 |

BOLDISTRIBUTION POPULATION OF STATES

| TEMPERATURE COLUMN 1 | WAVE NO. COLUMN 2 | G COLUMN 3 | ********** RESULTS ********** COLUMN 21 | COLUMN 22 | COLUMN 23 |
|---|---|---|---|---|---|
| 1000.0000 | 78.000000 | 9.0000000 | .99999999 * | 7.5545894-11 * | 9.5340204-23 |
| 1500.0000 | 15868.000 | 5.0000000 | .99999985 * | 1.4690943-07 * | 1.0033131-15 |
| 2000.0000 | 33792.000 | 1.0000000 | .99999352 * | 6.4783792-06 * | 3.2547225-12 |
| 2500.0000 | | | .99993718 * | 6.2819367-05 * | 4.1604245-10 |
| 3000.0000 | | | .99971438 * | 2.8560418-04 * | 1.0555358-08 |
| 3500.0000 | | | .99915780 * | 8.4208674-04 * | 1.0626662-07 |
| 4000.0000 | | | .99810585 | .0018935420 * | 6.0022453-07 |
| 4500.0000 | | | .99644448 | .0035532139 * | 2.3055273-06 |
| 5000.0000 | | | .99412020 | .0058730415 * | 6.7592748-06 |
| 5500.0000 | | | .99113363 | .0088500881 * | 1.6278724-05 |
| 6000.0000 | | | .98752514 | .012441027 * | 3.3824035-05 |
| 6500.0000 | | | .98335995 | .016577322 * | 6.2729649-05 |
| 7000.0000 | | | .97871576 | .021177842 * | 1.0639390-04 |
| 7500.0000 | | | .97367394 | .026158058 * | 1.6799906-04 |
| 8000.0000 | | | .96831357 | .031436120 * | 2.5030143-04 |

**********

THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.

* 1.4901161-08

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE 1.05 .05 1.5 1
ADD 0. TO 1.43879 PUT IN COL 2
EINSTEIN OF TEMPS IN COL 2, WAVE NOS. IN 1, PUT TABLE IN 11 AND SUCC. COLS.
TITLE1                                  EINSTEIN          FUNCTION
TITLE3        X          -(F-E)/RT      (H-E)-RT          S/R
TITLE4     C/R             (H-E)/R
PRINT 11,13***17
ERASE
RESET NRMAX TO 10
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE        MOLECULAR WEIGHTS OF
NOTE      WATER          PROPANAL  TETRATOMIC PHOSP  URANIUM OXIDE
MOLWT 1 2 8 1 1
MOLWT 6 3 1 8 8 1 2          $ C3 H7 OH
MOLWT 15 4 3                 $ P4
MOLWT 92 3 8 8 4             $ U3 O8
SPACE
ABRIDGE  ROW 1    COL  1***4
SPACE
NOTE ***************************************************************************
RESET NRMAX 0
GENERATE 100. 100. 1500. 61
ADD  1.98717 0. 28
PFTRANSLATIONAL COL 61  *1, 1 * 4
TITLE1                    TRANSLATIONAL     CONTRIBUTIONS     OF
TITLE2   WATER
TITLE3  TEMPERATURE      -(F-E)/RT      (H-E)/RT          S/R
TITLE4      C/R          (H-E)/R
PRINT    4***9
MULTIPLY  5 28 10
MULTIPLY  7 28 11
MULTIPLY  8 28 12
LOG  61 IN 21
LOGE  *1, 1*   STORE  IN    COL    22
ADD  2.5 0. 23
MULTIPLY 23 21 24
MULTIPLY 1.5 22 25
ADD  0. -3.66495 26
ROWSUM 24***26 TO 31
ADD  23 31 32
MULTIPLY 31 28 33
MULTIPLY 32 28 34
SUBTRACT  5 31 31
SUB     7 32 32
SUB    10 33 33
SUB    11 34 34
1/ AVERAGE  COL 31  STORE IN 31
2/ INCREMENT  1 BY  1  1
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
EXECUTE   1  THRU 2  4 TIMES
SPACE  2
NOTE ********************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE  ROW  1   COLS  31***34
SPACE
NOTE ********************************************************************************
ERASE
TITLE1                          PTATOMIC      OF      ATOMIC
TITLE2OXYGEN
GENERATE 1000. 500. 8000. 1
SET INTO COL 2
78. 15868. 33792.
SET INTO COL 3
9. 5. 1.
PFATOMIC 1 31.9988 2 3 41
PFTRANS 1 31.9988 31
1/SUBTRACT COL 41 FROM 31 STORE IN 31
2/AVERAGE COL 31 STORE IN 31
3/INCREMENT 1 BY 1,1,1
4/INCREMENT 2 BY 1,1
REPEAT 1 THRU 4 6 TIMES
PRINT 41***46
SPACE  2
NOTE ********************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 COLS 31***36
SPACE
NOTE ********************************************************************************
PARTFUNCTION  1 2 3 11
TITLE1                        PARTFUNCTION     OF     ATOMIC     OX
TITLE2YGEN
TITLE2
TITLE3  TEMPERATURE       WAVE NO.         G              Q(0)
TITLE4     Q(1)            Q(2)
PRINT 1,2,3,11,12,13
BOLDISTRIBUTION POPULATIONS OF STATES 1 2 3 21
ROWSUM  21***23 INTO 24
SUBTRACT COL 24 FROM 1.0 STORE IN COL 24
TITLE1                      BOLDISTRIBUTION     POPULATION     OF
TITLE2   STATES
TITLE3  TEMPERATURE       WAVE NO.         G           ***********
TITLE4*** RESULTS *****************
PRINT  1,2,3,21,22,23
SPACE  2
NOTE ********************************************************************************
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SPACE
    NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO.
    SPACE
    ABRIDGE ROW 1 COL 24
    SPACE
    NOTE ********************************************************************************
```

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C. 20234, OMNITAB II VERSION 5.00 MAY 15

| DEGREE | POINTS | COEF |
|---|---|---|
| 0. | 149.00000 | * 1.6716667+02 |
| 15.000000 | 137.00000 | *-1.9983114+01 |
| 30.000000 | 128.00000 | -3.4098820 |
| 45.000000 | 126.00000 | 5.4706860 |
| 60.000000 | 128.00000 | -1.2916667 |
| 75.000000 | 135.00000 | .24975992 |
| 90.000000 | 159.00000 | .74999999 |
| 105.00000 | 178.00000 | .30921159 |
| 120.00000 | 189.00000 | .45833333 |
| 135.00000 | 191.00000 | -.30401935 |
| 150.00000 | 189.00000 | -.090117976 |
| 165.00000 | 187.00000 | -.24252388 |
| 180.00000 | 178.00000 | -.083333333 |
| 195.00000 | 170.00000 | *-1.2779232+01 |
| 210.00000 | 177.00000 | *-1.6624570+01 |
| 225.00000 | 183.00000 | -.32322330 |
| 240.00000 | 181.00000 | 1.5155444 |
| 255.00000 | 179.00000 | 1.4616939 |
| 270.00000 | 179.00000 | -2.5833333 |
| 285.00000 | 185.00000 | .32216583 |
| 300.00000 | 182.00000 | -.21650635 |
| 315.00000 | 176.00000 | .67677669 |
| 330.00000 | 166.00000 | -.45876290 |
| 345.00000 | 160.00000 | -.63970397 |

ABOVE PROBLEM IS EXAMPLE FROM J.B. SCARBOROUGH
NUMERICAL MATHEMATICAL ANALYSIS (2ND ED.,1950) PAGES 490-491

**********

VALUE IN THE NEXT ROW MUST BE CLOSE TO OR EQUAL ZERO

-1.612507-06

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SET   1
    149 137 128 126 128 135 159 178 189 191
    189 187 178 170 177 183 181 179 179 185
    182 176 166 160
    HARMONIC  OF POINTS IN COL 1 24 POINTS RESULT IN 2
    GENERATE  0. (15.) 345.  3
    HEAD 3/ DEGREE
    HEAD 1/ POINTS
    HEAD 2/ COEF
    PRINT 3  1  2
    SPACE
    NOTE ABOVE PROBLEM IS EXAMPLE FROM J.B. SCARBOROUGH
    NOTE NUMERICAL MATHEMATICAL ANALYSIS (2ND ED.,1950) PAGES 490-491
     $ READ FOLLOWING DATA INTO COL 11 DATA WILL NOT BE LISTED
    NO LIST
    SUBTRACT  11  FROM 2  STORE IN 11
    AVERAGE  11  STORE  IN  11
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE  VALUE IN THE NEXT ROW MUST BE CLOSE TO OR EQUAL ZERO
    SPACE
    FORMAT  A  (30X,1PE15.6)
    ABRIDGE  A  ROW 1  COL 11
    SPACE
    NOTE ***************************************************************************
```

```
THIS IS A TEST ON THE BRANCH COMMANDS.
THUS THE OUTPUT MUST BE AS FOLLOWS

**************************************************************************

BECAUSE THE IFGT CONDITION IS TRUE, REPEAT MODE IS TERMINATED
AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
THE FOLLOWING VALUE MUST BE NEAR OR EQUAL TO 25.
        25.0

**************************************************************************


**************************************************************************

BECAUSE THE IFGE CONDITION IS TRUE, REPEAT MODE IS TERMINATED
AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
THE FOLLOWING VALUE MUST BE NEAR OR EQUAL TO 25.
        25.0

**************************************************************************


**************************************************************************

BECAUSE THE IFLT CONDITION IS TRUE, REPEAT MODE IS TERMINATED
AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
THE FOLLOWING VALUE MUST BE NEAR OR EQUAL TO 25.
        25.0

**************************************************************************


**************************************************************************

BECAUSE THE IFLE CONDITION IS TRUE, REPEAT MODE IS TERMINATED
AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
THE FOLLOWING VALUE MUST BE NEAR OR EQUAL TO 25.
        25.0

**************************************************************************


**************************************************************************

BECAUSE THE COMPARE CONDITION IS TRUE, REPEAT MODE IS TERMINATED
AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
THE FOLLOWING VALUE MUST BE NEAR OR EQUAL TO 25.
        25.0

**************************************************************************
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE  X  FROM 0.0 IN STEPS OF 10.0 THRU 50. IN COL 1
ADD COL 1 TO 0.0 STORE IN COL 2
FORMAT F (50H  THE FOLLOWING VALUE MUST BE NEAR OR EQUAL TO 25./10X,F5.1)
1/AVERAGE COL 2 STORE IN COL 10
2/IFGT  IF COL 10 IS GREATER THAN 27.0 STOP REPEAT MODE
3/NULL OTHERWISE CONTINUE
4/ABRIDGE F ROW 1 COL 10
5/ADD 10.0 TO COL 2 STORE IN 2
10/ ADD  0.0 TO COL 1 STORE IN COL 2
NEW PAGE
NOTE THIS IS A TEST ON THE BRANCH COMMANDS.
NOTE THUS THE OUTPUT MUST BE AS FOLLOWS
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE BECAUSE THE IFGT CONDITION IS TRUE, REPEAT MODE IS TERMINATED
NOTE AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
REPEAT COMMAND 10 THRU 10 1 TIME
REPEAT COMMANDS 1 THRU 5  3 TIMES
SPACE
NOTE ***************************************************************************
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE BECAUSE THE IFGE CONDITION IS TRUE, REPEAT MODE IS TERMINATED
NOTE AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
2/IFGE  IF COL 10 IS GREATER THAN OR EQUAL TO 30.0 STOP REPEAT MODE
REPEAT COMMAND 10 THRU 10 1 TIME
REPEAT COMMANDS 1 THRU 5  3 TIMES
SPACE
NOTE ***************************************************************************
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE BECAUSE THE IFLT CONDITION IS TRUE, REPEAT MODE IS TERMINATED
NOTE AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
2/IFLT  IF 27.0 IS LESS THAN ALL VALUES OF COL 10 STOP REPEAT MODE
REPEAT COMMAND 10 THRU 10 1 TIME
REPEAT COMMANDS 1 THRU 5  3 TIMES
SPACE
NOTE ***************************************************************************
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE BECAUSE THE IFLE CONDITION IS TRUE, REPEAT MODE IS TERMINATED
NOTE AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
2/IFLE  IF 30.0 IS LESS THAN OR EQUAL TO ALL VALUES IN COL 10 STOP REPEAT MODE
REPEAT COMMAND 10 THRU 10 1 TIME
REPEAT COMMANDS 1 THRU 5  3 TIMES
SPACE
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    NOTE ************************************************************************
    SPACE  2
    NOTE ************************************************************************
    SPACE
    NOTE BECAUSE THE COMPARE CONDITION IS TRUE, REPEAT MODE IS TERMINATED
    NOTE AND THE FOLLOWING STATEMENT IS PRINTED ONLY ONCE.
    2/ COMPARE COL 10 WITH VALUE 35. RELATIVE ERROR OF  91E-3
    REPEAT COMMAND 10 THRU 10 1 TIME
    REPEAT COMMANDS 1 THRU 5  3 TIMES
    SPACE
    NOTE ************************************************************************
```

RESULTS FROM ADD, SUBTRACT, MULTIPLY, AND DIVIDE COMMANDS

| COL 1 | COL 20 | COL 2 | COL 3 | COL 4 | COL 9 |
|---|---|---|---|---|---|
| X | Y | X+Y | X-Y | X*Y | X/Y |
| 1.0000000 | -.80000000 | .20000000 | 1.8000000 | -.80000000 | -1.2500000 |
| 1.5000000 | -.67654350 | .82345650 | 2.1765435 | -1.0148153 | -2.2171523 |
| 2.0000000 | -.55308701 | 1.4469130 | 2.5530870 | -1.1061740 | -3.6160676 |
| 2.5000000 | -.42963052 | 2.0703695 | 2.9296305 | -1.0740763 | -5.8189535 |
| 3.0000000 | -.30617402 | 2.6938260 | 3.3061740 | -.91852206 | -9.7983493 |
| 3.5000000 | -.18271752 | 3.3172825 | 3.6827175 | -.63951133 | -19.155251 |
| 4.0000000 | -.059261026 | 3.9407390 | 4.0592610 | -.23704410 | -67.497988 |
| 4.5000000 | .064195474 | 4.5641955 | 4.4358045 | .28887963 | 70.098400 |
| 5.0000000 | .18000000 | 5.1799999 | 4.8200001 | .90000000 | 27.777778 |

ALL THE COLUMNS BELOW SHOULD BE THE SAME AS X (FIRST COL)

| COL 1 | COL 6 | COL 7 | COL 8 | COL 9 |
|---|---|---|---|---|
| X | (X+Y)-Y | (X-Y)+Y | (X*Y)/Y | (X/Y)*Y |
| 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 | .99999999 |
| 1.5000000 | 1.5000000 | 1.5000000 | 1.5000000 | 1.5000000 |
| 2.0000000 | 2.0000000 | 2.0000000 | 2.0000000 | 2.0000000 |
| 2.5000000 | 2.5000000 | 2.5000000 | 2.5000000 | 2.5000000 |
| 3.0000000 | 3.0000000 | 3.0000000 | 3.0000000 | 3.0000000 |
| 3.5000000 | 3.5000000 | 3.5000000 | 3.5000000 | 3.4999999 |
| 4.0000000 | 4.0000000 | 4.0000000 | 4.0000000 | 4.0000000 |
| 4.5000000 | 4.5000000 | 4.5000000 | 4.4999999 | 4.4999999 |
| 5.0000000 | 5.0000000 | 5.0000000 | 5.0000000 | 4.9999999 |

**********

THE FOLLOWING VALUES SHOULD BE EQUAL TO OR NEAR 3.0

| | | | | |
|---|---|---|---|---|
| 3.0000000 | 3.0000000 | 3.0000000 | 2.9999999 | 2.9999999 |

**********

RESULTS FROM ADD, SUBTRACT, MULTIPLY, AND DIVIDE COMMANDS

| COL 1<br>X | COL 2<br>(X+.5)X+1 | COL 3<br>2(X-.5) |
|---|---|---|
| 1.0000000 | 2.5000000 | 1.0000000 |
| 1.5000000 | 4.0000000 | 2.0000000 |
| 2.0000000 | 6.0000000 | 3.0000000 |
| 2.5000000 | 8.5000000 | 4.0000000 |
| 3.0000000 | 11.500000 | 5.0000000 |
| 3.5000000 | 15.000000 | 6.0000000 |
| 4.0000000 | 19.000000 | 7.0000000 |
| 4.5000000 | 23.500000 | 8.0000000 |
| 5.0000000 | 28.500000 | 9.0000000 |

**********

FOLLOWING VALUES MUST EQUAL OR BE NEAR ZERO.

* 2.4835269-08 0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    GENERATE  NOS FROM 1.0 IN STEP OF .5 UP TO AND INCLUDING 5. IN COL 1
    GENERATE NOS FROM -.8 IN STEPS OF .1234565 THRU .18 IN COL 20
    ADD COL 1 TO COL 20 STORE RESULTS IN COL 2
    SUBTRACT COL 20 FROM COL 1 STORE IN COL 3
    MULTIPLY  COL 1 BY COL 20 STORE IN 4
    DIVIDE   COL 1 BY COL 20 AND STORE IN COL 5
    TITLE1 RESULTS FROM ADD, SUBTRACT, MULTIPLY, AND DIVIDE COMMANDS
    SUBTRACT COL 20 FROM COL 2 STORE IN COL 6
    ADD      COL 20 TO   COL 3 STORE IN COL 7
    DIVIDE COL 4 BY COL 20 AND STORE IN 8
    MULTIPLY COL 5 BY COL 20 AND STORE IN COL 9
    2/AVERAGE COL   6 STORE IN 15
    4/INCREMENT COMMAND 2 WITH 1 1
    REPEAT 2 THRU 4 4 TIMES
    FORMAT  A (13A6)
    READ A  1  31***43
        1 DATA CARD(S) READ BUT NOT LISTED
    NEW PAGE
    FORMAT B(8X,13A6)
    ABRIDGE B 1 31***43
    SPACE
    READ A  1  31***43
        1 DATA CARD(S) READ BUT NOT LISTED
    ABRIDGE B 1 31***43
    SPACE
    NPRINT COLS 1 20 2 3 4 5
    NOTE
    NOTE ALL THE COLUMNS BELOW SHOULD BE THE SAME AS X (FIRST COL)
    NOTE
    NOTE      COL 1        COL 6           COL 7          COL 8        COL 9
    SPACE
    NOTE      X            (X+Y)-Y         (X-Y)+Y        (X*Y)/Y      (X/Y)*Y
    SPACE
    NPRINT COLS  1 6***9
    AVERAGE COL  1 STORE IN COL 14
    SPACE
    NOTE ***************************************************************************
    SPACE
    NOTE  THE FOLLOWING VALUES SHOULD BE EQUAL TO OR NEAR 3.0
    SPACE
    ABRIDGE  1 14***18
    SPACE
    NOTE ***************************************************************************
    SPACE
    ADD 1.0  0.0 STORE IN 2
    ADD COL 1 TO  .5 MULT BY COL 1 ADD TO COL 2 AND STORE IN COL 2
    DEFINE   0.0  IN COL 3
    SUB COL .5 FROM COL 1 MULT 2.0 ADD TO COL 3 AND STORE IN COL 3
    DIVIDE  1.0 BY COL 1  STORE IN 10
    SUBTRACT 1.0 FROM COL 2 MULT BY COL 10 ADD -.5 STORE IN 4
```

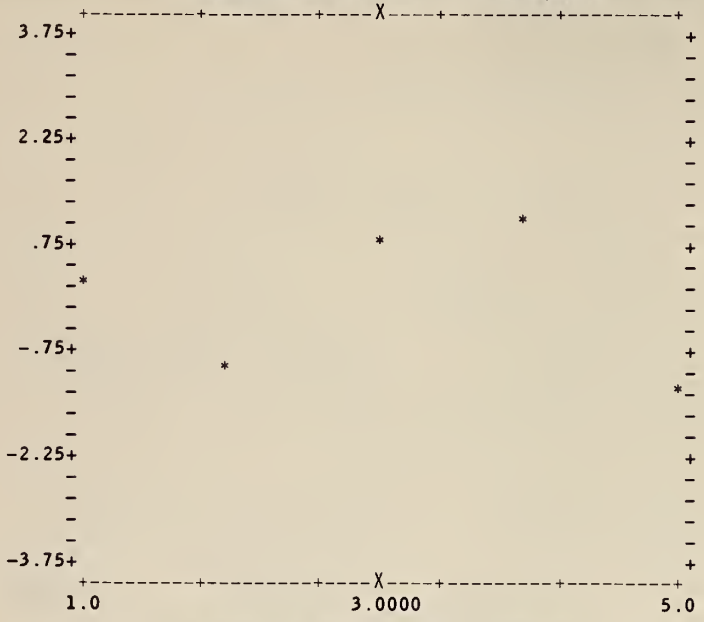
LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    DIVIDE  COL 3 BY 2.0  MULT BY 1.0 ADD .5  STORE IN 5
    SUBTRACT  COL 4 FROM COL 1 STORE IN 6
    SUBTRACT  COL  5 FROM COL 1 STORE IN 7
    NEW PAGE
    NOTE     COL 1          COL 2          COL 3
    NOTE       X          (X+.5)X+1       2(X-.5)
    SPACE
    NPRINT  1 2  3
    AVERAGE  6  INTO COL 6
    AVERAGE  7  INTO COL 7
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE FOLLOWING VALUES MUST EQUAL OR BE NEAR ZERO.
    SPACE
    ABRIDGE  1  6  7
    SPACE
    NOTE ***************************************************************************
```

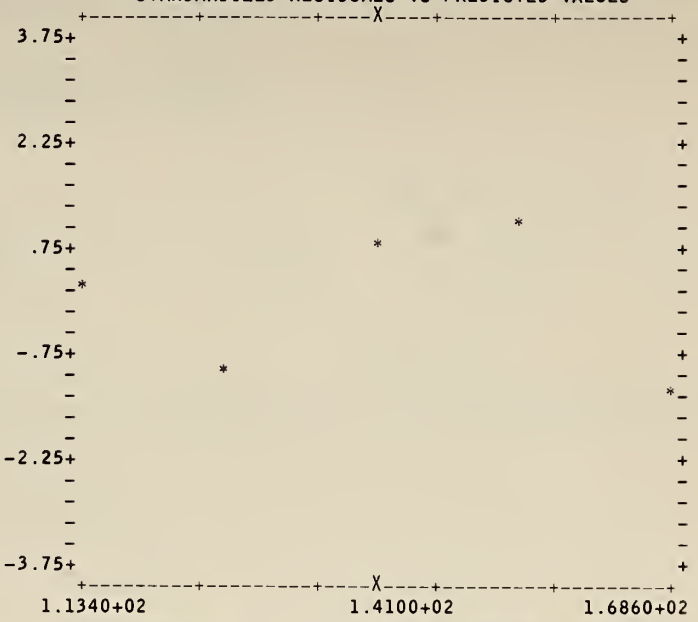
LEAST SQUARES FIT FOR DATA IN COLUMN 37
AS A LINEAR FUNCTION OF 2 PREDICTOR VARIABLES IN COLUMNS 10, 11
USING 5 NON-ZERO WEIGHTS AND 0 ZERO WEIGHTS IN COLUMN 10

| ROW | VARIABLE X IN COLUMN 11 | DATA IN COLUMN 37 | PREDICTED VALUES | STD. DEV. OF PRED. VALUES | RESIDUALS | STD. RES. | WEIGHTS |
|---|---|---|---|---|---|---|---|
| 1 | 35.000000 | 114.00000 | 113.40000 | 2.5139609 | .59999935 | .29 | 1.000 |
| 2 | 45.000000 | 124.00000 | 127.20000 | 1.7776388 | -3.2000003 | -1.18 | 1.000 |
| 3 | 55.000000 | 143.00000 | 141.00000 | 1.4514360 | 2.0000000 | .69 | 1.000 |
| 4 | 65.000000 | 158.00000 | 154.80000 | 1.7776388 | 3.2000003 | 1.18 | 1.000 |
| 5 | 75.000000 | 166.00000 | 168.60000 | 2.5139609 | -2.5999994 | -1.27 | 1.000 |

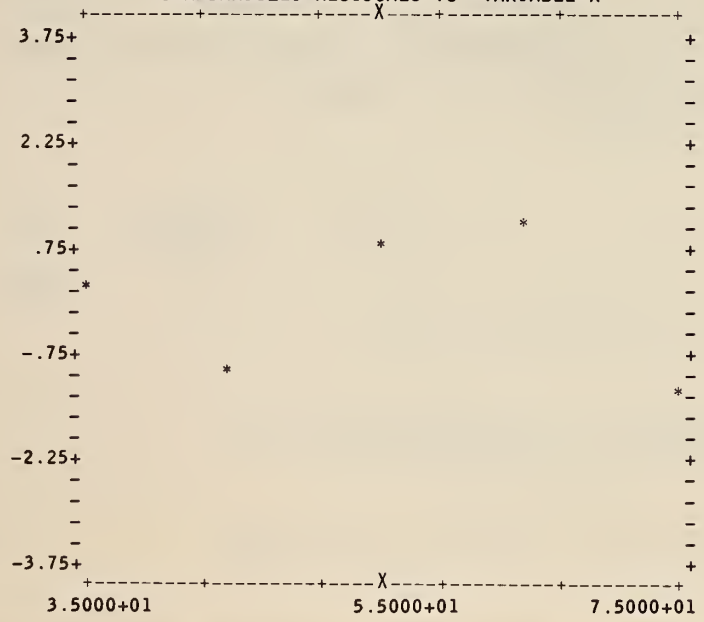
STANDARDIZED RESIDUALS VS ROW NUMBER



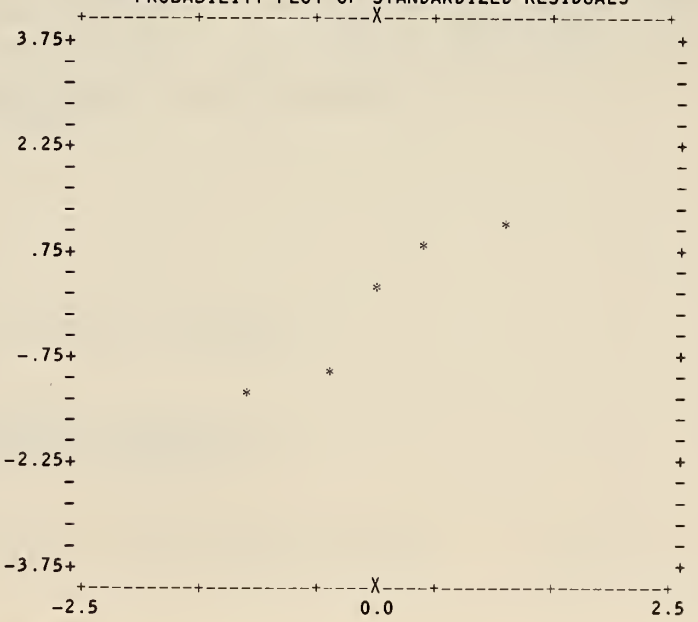

STANDARDIZED RESIDUALS VS PREDICTED VALUES




STANDARDIZED RESIDUALS VS VARIABLE X




PROBABILITY PLOT OF STANDARDIZED RESIDUALS



LEAST SQUARES FIT FOR DATA IN COLUMN 37
AS A LINEAR FUNCTION OF 2 PREDICTOR VARIABLES IN COLUMNS 10, 11
USING 5 NON-ZERO WEIGHTS AND 0 ZERO WEIGHTS IN COLUMN 10

VARIANCE-COVARIANCE MATRIX OF THE ESTIMATED COEFFICIENTS

| COLUMN | 10 | 11 |
|---|---|---|
| 10 | 33.969998 | |
| 11 | -.57933331 | .010533333 |

ANALYSIS OF VARIANCE
-DEPENDENT ON ORDER VARIABLES ARE ENTERED, UNLESS VECTORS ARE ORTHOGONAL-

| COLUMN | SS-RED. DUE TO COEF. | CUM. MS REDUCTION | D.F. | CUM. RESIDUAL MS | D.F. | F(COEF=0) | P(F) | F(COEFS=0) | P(F) |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 99404.994 | 99404.994 | 1 | 483.99998 | 4 | 9437.183 | .000 | 4808.990 | .000 |
| 11 | 1904.3999 | 50654.697 | 2 | 10.533333 | 3 | 180.797 | .001 | 180.797 | .001 |
| RESIDUAL | 31.599998 | | 3 | | | | | | |
| TOTAL | 101341.00 | | 5 | | | | | | |

LEAST SQUARES FIT FOR DATA IN COLUMN 37
AS A LINEAR FUNCTION OF 2 PREDICTOR VARIABLES IN COLUMNS 10, 11
USING 5 NON-ZERO WEIGHTS AND 0 ZERO WEIGHTS IN COLUMN 10

| | ESTIMATES FROM LEAST SQUARES FIT | | | | FIT OMITTING LAST COLUMN | | |
|---|---|---|---|---|---|---|---|
| COLUMN | COEFFICIENT | S.D. OF COEFF. | RATIO | *ACC. DIGITS | COEFFICIENT | S.D. OF COEFF. | RATIO |
| 10 | 65.100002 | 5.8283787 | 11.17 | 8.00 | 141.00000 | 9.8386989 | 14.33 |
| 11 | 1.3800000 | .10263203 | 13.45 | 8.00 | | | |
| RESIDUAL STANDARD DEVIATION = | | 3.2455097 | | | 22.000000 | | |
| BASED ON DEGREES OF FREEDOM | | 5- 2 = 3 | | | 5- 1 = 4 | | |

* THE NUMBER OF CORRECTLY COMPUTED DIGITS IN EACH COEFFICIENT USUALLY DIFFERS BY LESS THAN 1 FROM THE NUMBER GIVEN HERE

**********

THE EXAMPLE GIVEN ABOVE IS FROM G. W. SNEDECOR'S 'STATISTICAL METHODS'
(5TH ED., 1956), PAGES 122-126.

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

0.00000 0.00000 0.00000 0.00000 0.00000 0.00000

**********

RESULTS FROM MORTHO

ORTHONORMAL VECTORS

| ROW/COL | 20 | 21 |
|---|---|---|
| 1 | 4.472136-01 | -6.324555-01 |
| 2 | 4.472136-01 | -3.162278-01 |
| 3 | 4.472136-01 | 1.281805-10 |
| 4 | 4.472136-01 | 3.162278-01 |
| 5 | 4.472136-01 | 6.324555-01 |

TRANSFORMATION MATRIX

| ROW/COL | 25 | 26 |
|---|---|---|
| 1 | .44721360 | -1.7392527 |
| 2 | -1.7392527 | .031622777 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

0. 0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SCAN  55        THIS WILL IGNORE ALL NUMERICS IN CARD COLS 56 AND BEYOND CARD  1

* INFORMATIVE DIAGNOSTIC IN ABOVE COMMAND
* MORE THAN ONE ARGUMENT IN COMMAND. ONLY FIRST ONE IS USED

    SET X  IN COL 11                                                          CARD  2
    35,45,55,65,75                                                            CARD  3
    SET Y  IN COL 37                                                          CARD  4
    114,124,143,158,166                                                       CARD  5
    DEFINE  1.0 AND STORE IN COLUMN 10                                        CARD  6
    SQUARE COL 11 AND STORE IN COL 12                                         CARD  7
    MULTIPLY COL 11 BY COL 12 AND STORE IN 13                                 CARD  8
    SPOLYFIT Y COL 37 WT=1. DEG 1 X IN 11 STORE 20***23,1,24                  CARD  9
    FIT Y IN 37 WT IN 10 FUNC2 X IN 10,11 STORE 40***43,1,44                  CARD 10
    SUBTRACT COL 41 FROM COL 21 STORE IN 41                                   CARD 11
    SUBTRACT COL 42 FROM COL 22 STORE IN 42                                   CARD 12
    AVERAGE COL 41 STORE IN COL 41                                            CARD 13
    AVERAGE COL 42 STORE IN COL 42                                            CARD 14
    RESET NRMAX TO 16                                                         CARD 15
    SUBTRACT COL 20 FROM COL 40 STORE IN 40                                   CARD 16
    AVERAGE COL 40 STORE IN COL 40                                            CARD 17
    RESET NRMAX TO 12                                                         CARD 18
    SUBTRACT COL 43 FROM COL 23 PUT IN COL 43                                 CARD 19
    AVERAGE COL 43 STORE IN 43                                                CARD 20
    RESET NRMAX TO 8                                                          CARD 21
    SUBTRACT COL 44 FROM COL 24 PUT IN COL 44                                 CARD 22
    AVERAGE COL 44 PUT IN COL 44                                              CARD 23
    SUBTRACT COL 45 FROM COL 25 PUT IN COL 45                                 CARD 24
    AVERAGE COL 45 PUT IN COL 45                                              CARD 25
    FORMAT D(1X,1P6E13.5)                                                     CARD 26
    SPACE 2
    NOTE ***************************************************************************
    SPACE
    NOTE THE EXAMPLE GIVEN ABOVE IS FROM G. W. SNEDECOR'S 'STATISTICAL METHODS'
    NOTE (5TH ED., 1956), PAGES 122-126.
    SPACE
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE D ROW 1 OF COLS 40***45
    SPACE
    NOTE ***************************************************************************
    SCAN  ALL 80 COLUMNS OF EACH CARD
    RESET NRMAX TO 5
    SFIT Y IN 37 WT=1.0 FUNC. OF 2 X IN 10,11 STORE 50***53,1,54
    MORTHO ROW 1 COL 10 SIZE 5X2 WTS=1.0 STORE ORTHO VEC IN 1,20 AND A IN 1,25
    NEW PAGE
    NOTE RESULTS FROM MORTHO
    SPACE
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    NOTE  ORTHONORMAL VECTORS
    SPACE
    MPRINT MATRIX IN ROW 1 COL 20 SIZE 5X2
    SPACE  2
    NOTE  TRANSFORMATION MATRIX
    SPACE
    MPRINT MATRIX IN ROW 1 COL 25 SIZE 2X2
    MSUB MATRIX IN ROW 3 COL 25 SIZE 3X2 AND MATRIX 3,54 3X2 STORE IN 1,20
    RESET NRMAX 3
    AVERAGE COL 20 STORE IN 20
    AVERAGE COL 21 STORE IN 21
    SPACE  2
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE ROW 1 COLS 20,21
    SPACE
    NOTE ***************************************************************************
```

MATRIX TO BE INVERTED

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2. | -1. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| -1. | 2. | -1. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | -1. | 2. | -1. | 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 0. | -1. | 2. | -1. | 0. | 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | -1. | 2. | -1. | 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. | -1. | 2. | -1. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. | 0. | -1. | 2. | -1. | 0. | 0. |
| 0. | 0. | 0. | 0. | 0. | 0. | -1. | 2. | -1. | 0. |
| 0. | 0. | 0. | 0. | 0. | 0. | 0. | -1. | 2. | -1. |
| 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | -1. | 2. |

INVERSE OF MATRIX

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| .90909085 | .81818171 | .72727260 | .63636349 | .54545439 | .45454532 | .36363625 | .27272718 | .18181812 | .09090906 |
| .81818171 | 1.63636342 | 1.45454517 | 1.27272697 | 1.09090880 | .90909064 | .72727249 | .54545436 | .36363624 | .18181812 |
| .72727259 | 1.45454518 | 2.18181777 | 1.90909046 | 1.63636315 | 1.36363593 | 1.09090872 | .81818153 | .54545435 | .27272718 |
| .63636348 | 1.27272695 | 1.90909044 | 2.54545394 | 2.18181759 | 1.81818125 | 1.45454498 | 1.09090872 | .72727248 | .36363624 |
| .54545438 | 1.09090877 | 1.63636315 | 2.18181753 | 2.72727200 | 2.27272663 | 1.81818128 | 1.36363594 | .90909062 | .45454531 |
| .45454531 | .90909062 | 1.36363593 | 1.81818125 | 2.27272666 | 2.72727209 | 2.18181762 | 1.63636322 | 1.09090881 | .54545441 |
| .36363623 | .72727247 | 1.09090871 | 1.45454496 | 1.81818126 | 2.18181762 | 2.54545403 | 1.90909050 | 1.27272700 | .63636350 |
| .27272717 | .54545434 | .81818152 | 1.09090871 | 1.36363593 | 1.63636319 | 1.90909049 | 2.18181783 | 1.45454521 | .72727261 |
| .18181811 | .36363623 | .54545435 | .72727246 | .90909062 | 1.09090878 | 1.27272698 | 1.45454521 | 1.63636346 | .81818173 |
| .09090906 | .18181811 | .27272717 | .36363623 | .45454530 | .54545439 | .63636349 | .72727261 | .81818173 | .90909086 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0

1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

**********



412-718 O - 71 - 12

SOLVE A X = Y

| MATRIX A | | | | | | | | | | X | Y |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2. | -1. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 5.4545431+00 | .5 |
| -1. | 2. | -1. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 1.0090905+01 | 1.0 |
| 0. | -1. | 2. | -1. | 0. | 0. | 0. | 0. | 0. | 0. | 1.3090903+01 | 1.5 |
| 0. | 0. | -1. | 2. | -1. | 0. | 0. | 0. | 0. | 0. | 1.4636356+01 | 2.0 |
| 0. | 0. | 0. | -1. | 2. | -1. | 0. | 0. | 0. | 0. | 1.4909083+01 | 2.5 |
| 0. | 0. | 0. | 0. | -1. | 2. | -1. | 0. | 0. | 0. | 1.4090901+01 | 3.0 |
| 0. | 0. | 0. | 0. | 0. | -1. | 2. | -1. | 0. | 0. | 1.2363629+01 | 3.5 |
| 0. | 0. | 0. | 0. | 0. | 0. | -1. | 2. | -1. | 0. | 9.9090850+00 | 4.0 |
| 0. | 0. | 0. | 0. | 0. | 0. | 0. | -1. | 2. | -1. | 6.9090868+00 | 4.5 |
| 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | -1. | 2. | 3.5454524+00 | 5.0 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

0.

**********

MATRIX TO BE INVERTED

| ROW/COL | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| 1 | 27720.0 | 13860.0 | 9240.0 | 6930.0 | 5544.0 | 4620.0 |
| 2 | 13860.0 | 9240.0 | 6930.0 | 5544.0 | 4620.0 | 3960.0 |
| 3 | 9240.0 | 6930.0 | 5544.0 | 4620.0 | 3960.0 | 3465.0 |
| 4 | 6930.0 | 5544.0 | 4620.0 | 3960.0 | 3465.0 | 3080.0 |
| 5 | 5544.0 | 4620.0 | 3960.0 | 3465.0 | 3080.0 | 2772.0 |
| 6 | 4620.0 | 3960.0 | 3465.0 | 3080.0 | 2772.0 | 2520.0 |

THE ABOVE MATRIX IS 27720.0 TIMES THE HILBERT MATRIX OF ORDER 6

INVERSE OF MATRIX

| ROW/COL | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| 7 | 1.301223-03 | -2.279867-02 | 1.216940-01 | -2.739792-01 | 2.741082-01 | -1.005439-01 |
| 8 | -2.279911-02 | 5.323362-01 | -3.195534+00 | 7.671989+00 | -7.993835+00 | 3.015472+00 |
| 9 | 1.216983-01 | -3.195575+00 | 2.045642+01 | -5.115005+01 | 5.481115+01 | -2.110462+01 |
| 10 | -2.739930-01 | 7.672169+00 | -5.115054+01 | 1.315361+02 | -1.438731+02 | 5.627218+01 |
| 11 | 2.741256-01 | -7.994095+00 | 5.481212+01 | -1.438742+02 | 1.598543+02 | -6.330054+01 |
| 12 | -1.005514-01 | 3.015594+00 | -2.110514+01 | 5.627296+01 | -6.330093+01 | 2.531847+01 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0
HOWEVER IN INVERTING THE MATRIX A, SOME SIGNIFICANCE IS LOST.
IF DONE IN DOUBLE PRECISION OR ON MACHINE WHICH HAS MORE THAN 8
SIGNIFICANT DIGITS, BETTER RESULTS WILL BE OBTAINED.

.99989320 1.0054760 .96771546 1.0552921 .94148036 1.0261038

**********

SOLVE A X = Y

| MATRIX A | | | | | | X | Y |
|---|---|---|---|---|---|---|---|
| 27720. | 13860. | 9240. | 6930. | 5544. | 4620. | -7.8531945-03 | 1. |
| 13860. | 9240. | 6930. | 5544. | 4620. | 3960. | 2.6688486-01 | 2. |
| 9240. | 6930. | 5544. | 4620. | 3960. | 3465. | -2.0723200+00 | 3. |
| 6930. | 5544. | 4620. | 3960. | 3465. | 3080. | 6.0304626+00 | 4. |
| 5544. | 4620. | 3960. | 3465. | 3080. | 2772. | -7.3063543+00 | 5. |
| 4620. | 3960. | 3465. | 3080. | 2772. | 2520. | 3.1132524+00 | 6. |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
HOWEVER IN INVERTING THE MATRIX A, SOME SIGNIFICANCE IS LOST.
IF DONE IN DOUBLE PRECISION OR ON MACHINE WHICH HAS MORE THAN 8
SIGNIFICANT DIGITS, BETTER RESULTS WILL BE OBTAINED.

-.00062575936

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
READ  1 2 3 4 5 6 7 8 9 10
2. -1. 0. 0. 0. 0. 0. 0. 0. 0.
-1. 2. -1. 0. 0. 0. 0. 0. 0. 0.
0. -1. 2. -1. 0. 0. 0. 0. 0. 0.
0. 0. -1. 2. -1. 0. 0. 0. 0. 0.
0. 0. 0. -1. 2. -1. 0. 0. 0. 0.
0. 0. 0. 0. -1. 2. -1. 0. 0. 0.
0. 0. 0. 0. 0. -1. 2. -1. 0. 0.
0. 0. 0. 0. 0. 0. -1. 2. -1. 0.
0. 0. 0. 0. 0. 0. 0. -1. 2. -1.
0. 0. 0. 0. 0. 0. 0. 0. -1. 2.
MINVERT MATRIX A IN ROW 1 COL 1 SIZE 10X10 STORE B IN ROW 1 COL 11
  ++++++++++++++++++++ SMALLEST ERROR BOUND ON INVERTED MATRIX IS  .5-05   ++++
NEW PAGE
FORMAT D (10F12.0)
NOTE  MATRIX TO BE INVERTED
SPACE
MPRINT D MATRIX A IN ROW 1 COL 1 SIZE 10X10
SPACE 2
NOTE  INVERSE OF MATRIX
SPACE
FORMAT B (10F12.8)
MPRINT B MATRIX B IN ROW 1 COL 11 SIZE 10X10
MMULT A IN ROW 1 COL 1 10X10 WITH B ROW 1 COL 11 10X10 STORE IN ROW 1 COL 21
1/SUM COL 21 STORE IN COL 21
2/ INCREMENT 1 BY 1  1
REPEAT 1 THRU 2 10 TIMES
SPACE  2
NOTE ********************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0
SPACE
FORMAT C (5X,10F10.2)
ABRIDGE C ROW 1 COLS 21***30
SPACE
NOTE ********************************************************************************
SOLVE A IN ROW 1 COL 1 SIZE 10X10 Y IN COL 12 STORE X IN COL 11
  ++++++++++++++++++++ SMALLEST ERROR BOUND ON INVERTED MATRIX IS  .5-05   ++++
GENERATE Y FROM .5 IN STEPS OF .5 THRU 5. IN COL 12
NEW PAGE
NOTE                                          SOLVE A X = Y
SPACE
NOTE                      MATRIX A                              X        Y
SPACE
FORMAT A(10F5.0,1PE15.7,0PF5.1)
APRINT A STARTING ROW 1 COL 1 10X12 ARRAY
M(AV) MULT MATRIX A IN ROW 1 COL 1 SIZE 10X10 WITH X IN COL 11 STORE IN COL 13
SUBTRACT COL 13 FROM COL 12 STORE IN 13
AVERAGE COL 13 STORE IN 13
SPACE  2
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
NOTE ************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 COL 10
SPACE
NOTE ************************************************************************
RESET NRMAX TO 0
READ  2 3 4 5 6 7
27720.  13860.  9240.  6930.  5544.  4620.
13860.   9240.  6930.  5544.  4620.  3960.
9240.   6930.  5544.  4620.  3960.  3465.
6930.   5544.  4620.  3960.  3465.  3080.
5544.   4620.  3960.  3465.  3080.  2772.
4620.   3960.  3465.  3080.  2772.  2520.
INVERT MATRIX A IN ROW 1 COL 2 SIZE 6X6 STORE IN MATRIX B IN ROW 7 COL 2
  ++++++++++++++++++++ SMALLEST ERROR BOUND ON INVERTED MATRIX IS  .2+02   ++++
SET IN COL 9 THE FOLLOWING DATA
1.    2.    3.    4.    5.    6.
NEW PAGE
FIXED 1
NOTE  MATRIX TO BE INVERTED
SPACE
MPRINT MATRIX A IN ROW 1 COL 2 SIZE 6X6
SPACE  2
NOTE THE ABOVE MATRIX IS 27720.0 TIMES THE HILBERT MATRIX OF ORDER 6
SPACE 2
NOTE  INVERSE OF MATRIX
SPACE
FLEXIBLE
MPRINT MATRIX B IN ROW 7 COL 2 SIZE 6X6
MMULT MATRIX A IN ROW 1 COL 2 6X6 BY MATRIX B ROW 7 COL 2 6X6 STORE IN 1,15
1/ SUM COL 15 STORE IN COL 15
2/ INCREMENT 1 BY 1  1
REPEAT 1 THRU 2  6 TIMES
SPACE  2
NOTE ************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 1.0
NOTE HOWEVER IN INVERTING THE MATRIX A, SOME SIGNIFICANCE IS LOST.
NOTE IF DONE IN DOUBLE PRECISION OR ON MACHINE WHICH HAS MORE THAN 8
NOTE SIGNIFICANT DIGITS, BETTER RESULTS WILL BE OBTAINED.
SPACE
ABRIDGE ROW 1 COL 15 *** 20
SPACE
NOTE ************************************************************************
SOLVE  A IN ROW 1 COL 2 SIZE 6X6 Y IN COL 9 STORE X IN COL 8
  ++++++++++++++++++++ SMALLEST ERROR BOUND ON INVERTED MATRIX IS  .2+02   ++++
NEW PAGE
NOTE                                          SOLVE A X = Y
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
SPACE
NOTE                      MATRIX A                 X          Y
SPACE
FORMAT E(6F7.0,1PE15.7,0PF5.0)
APRINT E STARTING ROW 1 COL 2 6X8 ARRAY
M(AV) MULT MATRIX A IN ROW 1 COL 2 SIZE 6X6 WITH X IN COL 8 STORE IN COL 10
SUBTRACT COL 10 FROM COL 9 STORE IN 10
AVERAGE COL 10  STORE IN 10
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
NOTE HOWEVER IN INVERTING THE MATRIX A, SOME SIGNIFICANCE IS LOST.
NOTE IF DONE IN DOUBLE PRECISION OR ON MACHINE WHICH HAS MORE THAN 8
NOTE SIGNIFICANT DIGITS, BETTER RESULTS WILL BE OBTAINED.
SPACE
ABRIDGE ROW 1 COL 10
SPACE
NOTE ***************************************************************************
```

THE FOLLOWING IS AN EXAMPLE OF THE MKRONECKER COMMAND. MATRIX A WAS DEFINED BY MDEFINE. MATRIX B WAS DEFINED BY THE MDIAGONAL, MADD, AND AERASE COMMANDS. MATRIX C WAS DEFINED BY THE MKRONECKER COMMAND.

| MATRIX A | | MATRIX B | | MATRIX C | | | |
|---|---|---|---|---|---|---|---|
| 2.0000000 | 2.0000000 | 3.0000000 | 2.0000000 | 6.0000000 | 4.0000000 | 6.0000000 | 4.0000000 |
| 2.0000000 | 2.0000000 | 2.0000000 | | 4.0000000 | 0. | 4.0000000 | 0. |
| 0. | 0. | 0. | | 6.0000000 | 4.0000000 | 6.0000000 | 4.0000000 |
| 0. | 0. | 0. | | 4.0000000 | 0. | 4.0000000 | 0. |

ARRAYS

| A | | B | | D=A*B | | E=-2*B | |
|---|---|---|---|---|---|---|---|
| 2.00 | 2.00 | 3.00 | 2.00 | 6.00 | 4.00 | -6.00 | -4.00 |
| 2.00 | 2.00 | 2.00 | .00 | 4.00 | .00 | -4.00 | .00 |

ARRAYS

| F=D+E | | G=A**2 | | H=-2*A | | I=G/H | |
|---|---|---|---|---|---|---|---|
| .00 | .00 | 4.00 | 4.00 | -4.00 | -4.00 | -1.00 | -1.00 |
| .00 | .00 | 4.00 | 4.00 | -4.00 | -4.00 | -1.00 | -1.00 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
MDEFINE MATRIX A IN ROW 1 COLUMN 1 SIZE IS 2X2 VALUE=2.0
MDIAGONAL OF B IN ROW 1 COLUMN 3 SIZE IS 2X2 VALUE=1.0
MADD MATRIX A IN R=1 C=1 SIZE IS 2X2 TO MATRIX B R=1 C=3 SIZE 2X2  STORE 1  3
AERASE MATRIX B IN R=2 C=4 SIZE IS 1X1
MKRONECKER OF A R=1 C=1 SIZE=2X2 BY MATRIX B R=1 C=3 SIZE=2X2 INTO MATRIX C 1 5
RESET NRMAX TO 4
TITLE1 THE FOLLOWING IS AN EXAMPLE OF THE MKRONECKER COMMAND. MATR
TITLE2IX A WAS DEFINED BY MDEFINE.  MATRIX B WAS DEFINED BY THE
TITLE3 MDIAGONAL, MADD, AND AERASE COMMANDS. MATRIX C WAS DEFINED
TITLE4BY THE MKRONECKER COMMAND.
HEAD COL  1/   MATRIX A
HEAD COL  2/
HEAD COL  3/   MATRIX B
HEAD COL  4/
HEAD COL  5/   MATRIX C
HEAD COL  6/
HEAD COL  7/
HEAD COL  8/
PRINT 1***8
AMULT MATRIX A R=1 C=1 SIZE=2X2 TIMES MATRIX B R=1 C=3 STORE IN ROW 1 COLUMN 9
MSCALAR MATRIX B R=1 C=3 SIZE=2X2 TIMES THE VALUE-2.0 STORE IN ROW 1 COLUMN 11
AADD MATRIX IN R=1 C=9 SIZE IS 2X2 TO MATRIX IN R=1 C=11 SIZE IS 2X2 INTO 1,13
ARAISE MATRIX IN R=1 C=1 SIZE IS 2X2 TO POWER 2.0 STORE IN R=1 C=15
MSCALAR MATRIX IN R=1 C=1 SIZE IS 2X2 TIMES VALUE=-2.0 STORE IN R=1 C=17
ADIVIDE MATRIX IN R=1 C=15 SIZE IS 2X2 BY MATRIX IN R=1 C=17 STORE IN R=1 C=19
AMULTIPLY      B R=1 C=3 SIZE=2X2 TIMES THE VALUE 2.0 STORE IN ROW 1 COLUMN 21
ADEFINE MATRIX J IN R=1 COLUMN 23 SIZE=2X2 VALUE=1.0
ADIV MATRIX E R=1 C=11 SIZE=2X2 BY MATRIX J R=1 C=21 STORE IN R=1 C=25
SPACE 2
RESET NRMAX EQUAL TO 2
NOTE ARRAYS
SPACE
NOTE     A                    B                    D=A*B              E=-2*B
SPACE
FORMAT C (8F10.2)
NPRINT C COLUMNS 1 2 3 4 9 10 11 12
SPACE 2
NOTE ARRAYS
SPACE
NOTE      F=D+E               G=A**2               H=-2*A              I=G/H
SPACE
FORMAT B (8F10.2)
NPRINT B COLUMNS 13***20
ROWSUM COLUMNS 13***26 AND STORE IN COLUMN 27
SET THE FOLLOWING VALUES IN COLUMN 28
8.0 3.0
SUBTRACT COLUMN 27 FROM COLUMN 28 AND STORE IN COLUMN 28
AVERAGE COLUMN 28 AND STORE IN COLUMN 27
SPACE  2
NOTE ***************************************************************************
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    SPACE
    NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
    SPACE
    ABRIDGE ROW 1  COLUMN 27
    SPACE
    NOTE ************************************************************************
```

NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C. 20234, OMNITAB II VERSION 5.00 MAY 15

RESULTS FROM DUPLICATING 2 TIMES THE VALUES IN A 5X3 ARRAY BEGINNING IN ROW 2 COL 3. RESULTS ARE STORED BEGINNING IN ROW 2 COL 6. COLS 3-5 WERE DEFINED BY GENERATE, SET AND ADD COMMANDS. COLS 6-8 WERE DEFINED BY DUPLICATE COMMAND.

| COLUMN 3 | COLUMN 4 | COLUMN 5 | COLUMN 6 | COLUMN 7 | COLUMN 8 |
|---|---|---|---|---|---|
| 1.2345679 | 20.000000 | 30.000000 | 0. | 0. | 0. |
| 2.2345679 | 14.000000 | 24.000000 | 2.2345679 | 14.000000 | 24.000000 |
| 3.2345679 | -24.000000 | -14.000000 | 3.2345679 | -24.000000 | -14.000000 |
| 4.2345679 | 4.0000000 | 14.000000 | 4.2345679 | 4.0000000 | 14.000000 |
| 5.2345679 | 5.0000000 | 15.000000 | 5.2345679 | 5.0000000 | 15.000000 |
| 6.2345679 | 14.000000 | 24.000000 | 6.2345679 | 14.000000 | 24.000000 |
| 7.2345679 | 12.000000 | 22.000000 | 2.2345679 | 14.000000 | 24.000000 |
| 8.2345679 | 0. | 10.000000 | 3.2345679 | -24.000000 | -14.000000 |
| 9.2345679 | 0. | 10.000000 | 4.2345679 | 4.0000000 | 14.000000 |
| 10.234568 | 0. | 10.000000 | 5.2345679 | 5.0000000 | 15.000000 |
| 11.234568 | 30.000000 | 40.000000 | 6.2345679 | 14.000000 | 24.000000 |
| 12.234568 | 5.0000000 | 15.000000 | | | |
| 13.234568 | 7.0000000 | 17.000000 | | | |
| 14.234568 | 8.0000000 | 18.000000 | | | |
| 15.000000 | -25.000000 | -15.000000 | | | |

**********

THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO

0.

**********

RESULTS FROM COUNT COMMAND. COL 9 CONTAINS NO. OF VALUES IN COL 4. COL 10 CONTAINS THE NO. OF VALUES OF COL 6.
THE COUNT BEGINS AT THE FIRST NON-ZERO VALUE STARTING AT NRMAX AND GOING TO ROW 1.

| COLUMN 4 | COLUMN 6 | COLUMN 9 | COLUMN 10 |
|---|---|---|---|
| 20.000000 | 0. | 15.000000 | 11.000000 |
| 14.000000 | 2.2345679 | 15.000000 | 11.000000 |
| -24.000000 | 3.2345679 | 15.000000 | 11.000000 |
| 4.0000000 | 4.2345679 | 15.000000 | 11.000000 |
| 5.0000000 | 5.2345679 | 15.000000 | 11.000000 |
| 14.000000 | 6.2345679 | 15.000000 | 11.000000 |
| 12.000000 | 2.2345679 | 15.000000 | 11.000000 |
| 0. | 3.2345679 | 15.000000 | 11.000000 |
| 0. | 4.2345679 | 15.000000 | 11.000000 |
| 0. | 5.2345679 | 15.000000 | 11.000000 |
| 30.000000 | 6.2345679 | 15.000000 | 11.000000 |
| 5.0000000 | | 15.000000 | 11.000000 |
| 7.0000000 | | 15.000000 | 11.000000 |
| 8.0000000 | | 15.000000 | 11.000000 |
| -25.000000 | | 15.000000 | 11.000000 |

**********

THE FOLLOWING TWO NUMBERS SHOULD BE 15 AND 11.

| | |
|---|---|
| 15.000000 | 11.000000 |

**********

RESULTS FROM COUNT COMMAND. COL 9 CONTAINS NO. OF VALUES IN COL 4. COL 10 CONTAINS THE NO. OF VALUES OF COL 6.
THE COUNT BEGINS AT THE FIRST NON-ZERO VALUE STARTING AT NRMAX AND GOING TO ROW 1.
RESULTS FROM CLOSE UP COMMAND. THE VALUE 14.0 IS REMOVED FROM COL 4.
THE VALUE 30.0 IS REMOVED FROM COLUMNS 4 AND 5, AND 15. FROM COLUMN 9.

| OLD COL 4 | NEW COL 4 | OLD COL 5 | NEW COL 5 | OLD COL 9 | NEW COL 9 |
|---|---|---|---|---|---|
| 20.000000 | 20.000000 | 30.000000 | 24.000000 | 15.000000 | |
| 14.000000 | -24.000000 | 24.000000 | -14.000000 | 15.000000 | |
| -24.000000 | 4.0000000 | -14.000000 | 14.000000 | 15.000000 | |
| 4.0000000 | 5.0000000 | 14.000000 | 15.000000 | 15.000000 | |
| 5.0000000 | 12.000000 | 15.000000 | 24.000000 | 15.000000 | |
| 14.000000 | 0. | 24.000000 | 22.000000 | 15.000000 | |
| 12.000000 | 0. | 22.000000 | 10.000000 | 15.000000 | |
| 0. | 0. | 10.000000 | 10.000000 | 15.000000 | |
| 0. | 5.0000000 | 10.000000 | 10.000000 | 15.000000 | |
| 0. | 7.0000000 | 10.000000 | 40.000000 | 15.000000 | |
| 30.000000 | 8.0000000 | 40.000000 | 15.000000 | 15.000000 | |
| 5.0000000 | -25.000000 | 15.000000 | 17.000000 | 15.000000 | |
| 7.0000000 | | 17.000000 | 18.000000 | 15.000000 | |
| 8.0000000 | | 18.000000 | -15.000000 | 15.000000 | |
| -25.000000 | | -15.000000 | 0. | 15.000000 | |

**********

THE FOLLOWING VALUES SHOULD BE 58. 30. AND 225.0

| | | |
|---|---|---|
| 58.000000 | 30.000000 | 225.00000 |

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE NOS. START WITH 1.23456789 IN STEPS OF 1.0 UP TO 15. STORE IN COL 3
SET THE FOLLOWING NUMBERS IN COLUMN 4
20.0 14.0 -24.0 4. 5. 14. 12. 0.0 0.0 0.0 30. 5. 7. 8. -25.0
ADD THE CONSTANT 10. TO COLUMN 4 AND STORE RESULT IN COL 5
DUPLICATE 2 TIMES THE ARRAY IN ROW 2 OF COL 3 N=5 M=3 START STORING ROW 2 COL 6
TITLE1 RESULTS FROM DUPLICATING 2 TIMES THE VALUES IN A 5X3 ARRAY
TITLE2BEGINNING IN ROW 2 COL 3. RESULTS ARE STORED BEGINNING IN
TITLE3ROW 2 COL 6. COLS 3-5 WERE DEFINED BY GENERATE, SET AND ADD
TITLE4COMMANDS. COLS 6-8 WERE DEFINED BY DUPLICATE COMMAND.
PRINT  COLUMNS  3  4  5  6  7  8
MSUB MATRIX A BEGIN IN ROW 2 COL 3 5X3 MINUS MATRIX B BEGIN IN 2 6 5X3 STORE 2 9
MSUBTRACT A BEGIN IN 7 6 5X3 MINUS MATRIX B BEGIN IN ROW 2 COL 3 5X3 PUT 2 12
SMPROPERTIES OF MATRIX BEGIN IN ROW 2 COL 9 5X6 STORE PROPERTIES IN COL 15
SPACE
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUE SHOULD BE CLOSE TO OR EQUAL TO ZERO
SPACE
ABRIDGE ROW 11 OF COLUMN 15
SPACE
NOTE ***************************************************************************
COUNT THE LENGTH OF COLUMN 4 AND VECTORIZE COUNT IN COLUMN 9
COUNT THE LENGTH OF COLUMN 6 AND VECTORIZE COUNT IN COLUMN 10
TITLE1 RESULTS FROM COUNT COMMAND. COL 9 CONTAINS NO. OF VALUES IN
TITLE2 COL 4. COL 10 CONTAINS THE NO. OF VALUES OF COL 6.
TITLE3 THE COUNT BEGINS AT THE FIRST NON-ZERO VALUE STARTING AT NR
TITLE4MAX AND GOING TO ROW 1.
PRINT COLUMNS 4  6  9  10
SPACE
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING TWO NUMBERS SHOULD BE 15 AND 11.
SPACE
ABRIDGE ROW 1 OF COLUMNS 9 AND 10
SPACE
NOTE ***************************************************************************
MOVE THE VECTOR START IN ROW 1 OF COL 4 WHICH IS 15 BY 1 STORE IN ROW 1 COL 11
MOVE THE VECTOR START IN ROW 1 OF COL 5 WHICH IS 15 BY 1 STORE IN ROW 1 COL 12
MOVE THE VECTOR START IN ROW 1 OF COL 9 WHICH IS 15 BY 1 STORE IN ROW 1 COL 13
CLOSE UP ROWS HAVING THE VALUE 14.0       IN COLUMN 4
CLOSE UP ROWS HAVING THE VALUE 30.0       IN COLUMNS 4 AND 5
CLOSE UP ROWS HAVING THE VALUE 15.0  IN COLUMN 9
NEW PAGE
NOTE RESULTS FROM CLOSE UP COMMAND. THE VALUE 14.0 IS REMOVED FROM COL 4.
NOTE THE VALUE 30.0 IS REMOVED FROM COLUMNS 4 AND 5, AND 15. FROM COLUMN 9.
SPACE
FORMAT C (6(A6,A3))
READ C 1  23***34
    1 DATA CARD(S) READ BUT NOT LISTED
FORMAT D (4X,A6,A3,6X,A6,A3,7X,A6,A3,5X,A6,A3,7X,A6,A3,6X,A6,A3)
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    RESET  1
    NPRINT D 23***34
    RESET  15
    SPACE
    NPRINT  COLUMNS 11 4 12 5 13 AND 9
    SUM COLUMN 11 STORE IN COLUMN 14
    SUM COLUMN 12 STORE IN COLUMN 15
    SUM COLUMN 13 STORE IN COLUMN 16
    SUM COLUMN  4 STORE IN COLUMN 17
    SUM COLUMN  5 STORE IN COLUMN 18
    SUM COLUMN  9 STORE IN COLUMN 19
    SUBTRACT  COLUMN 17 FROM COLUMN 14 STORE IN COLUMN 20
    SUBTRACT  COLUMN 18 FROM COLUMN 15 STORE IN COLUMN 21
    SUBTRACT  COLUMN 19 FROM COLUMN 16 STORE IN COLUMN 22
    SPACE
    NOTE ***************************************************************************
    SPACE
    NOTE THE FOLLOWING VALUES SHOULD BE 58. 30. AND 225.0
    SPACE
    ABRIDGE ROW 1 OF COLUMNS  20   21   AND 22
    SPACE
    NOTE ***************************************************************************
```

CENTIMETER-GRAM-SEC SYSTEME-INTERNATIONALE PHYSICAL CONSTANTS

| | CGS | SI | |
|---|---|---|---|
| PI | 3.141593+00 | 3.141593+00 | PI |
| E | 2.718282+00 | 2.718282+00 | BASE OF NATURAL LOGS |
| C | 2.997925+10 | 2.997925+08 | SPEED OF LIGHT IN VACUUM |
| Q | 1.602100-20 | 1.602100-19 | ELEMENTARY CHARGE |
| N | 6.022520+23 | 6.022520+23 | AVOGADRO CONSTANT |
| ME | 9.109100-28 | 9.109100-31 | ELECTRON REST MASS |
| MP | 1.672520-24 | 1.672520-27 | PROTON REST MASS |
| F | 9.648700+03 | 9.648700+04 | FARADAY CONSTANT |
| H | 6.625600-27 | 6.625600-34 | PLANCK CONSTANT |
| ALPHA | 7.297200-03 | 7.297200-03 | FINE STRUCTURE CONSTANT |
| QME | 1.758796+07 | 1.758796+11 | CHARGE TO MASS RATIO FOR ELECTRON |
| RINF | 1.097373+05 | 1.097373+07 | RYDBERG CONSTANT |
| GAMMA | 2.675190+04 | 2.675190+08 | GYROMAGNETIC RATIO OF PROTON (CORRECTED FOR H2O) |
| MUB | 9.273200-21 | 9.273200-24 | BOHR MAGNETON |
| R | 8.314300+07 | 8.314300+00 | GAS CONSTANT |
| K | 1.380540-16 | 1.380540-23 | BOLTZMANN CONSTANT |
| CONE | 3.741500-05 | 3.741500-16 | FIRST RADIATION CONSTANT |
| CTWO | 1.438790+00 | 1.438790-02 | SECOND RADIATION CONSTANT |
| SIGMA | 5.669700-05 | 5.669700-08 | STEPHAN-BOLTZMANN CONSTANT |
| G | 6.670000-08 | 6.670000-11 | GRAVITATIONAL CONSTANT |

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
CGS  USE PHYSICAL CONSTANTS IN CGS  SYSTEM
RESET  NRMAX TO 1
ADD *PI*   TO  0.0  STORE  IN 3
ADD *E*    TO  0.0  STORE IN 4
ADD *C*    TO  0.0  STORE IN 5
ADD *Q*    TO  0.0  STORE IN 6
ADD *N*    TO  0.0  STORE IN 7
ADD *ME*   TO  0.0  STORE IN 8
ADD *MP*   TO  0.0  STORE IN 9
ADD *F*    TO  0.0  STORE IN 10
ADD *H*    TO  0.0  STORE IN 11
ADD *ALPHA* TO 0.0 STORE IN 12
ADD *QME*   TO 0.0 STORE IN 13
ADD *RINF*  TO 0.0 STORE IN 14
ADD *GAMMA* TO 0.0 STORE IN 15
ADD *MUB*   TO 0.0 STORE IN 16
ADD *R*     TO 0.0 STORE IN 17
ADD *K*     TO 0.0 STORE IN 18
ADD *CONE*  TO 0.0 STORE IN 19
ADD *CTWO*  TO 0.0 STORE IN 20
ADD *SIGMA* TO 0.0 STORE IN 21
ADD *G*     TO 0.0 STORE IN 22
MTRANSPOSE  VECTOR IN 1,3 SIZE 1 X 20 STORE IN  1,1
SI    USE PHYSICAL CONSTANTS IN MKSA SYSTEM
ADD *PI*   TO  0.0  STORE  IN 3
ADD *E*    TO  0.0  STORE IN 4
ADD *C*    TO  0.0  STORE IN 5
ADD *Q*    TO  0.0  STORE IN 6
ADD *N*    TO  0.0  STORE IN 7
ADD *ME*   TO  0.0  STORE IN 8
ADD *MP*   TO  0.0  STORE IN 9
ADD *F*    TO  0.0  STORE IN 10
ADD *H*    TO  0.0  STORE IN 11
ADD *ALPHA* TO 0.0 STORE IN 12
ADD *QME*   TO 0.0 STORE IN 13
ADD *RINF*  TO 0.0 STORE IN 14
ADD *GAMMA* TO 0.0 STORE IN 15
ADD *MUB*   TO 0.0 STORE IN 16
ADD *R*     TO 0.0 STORE IN 17
ADD *K*     TO 0.0 STORE IN 18
ADD *CONE*  TO 0.0 STORE IN 19
ADD *CTWO*  TO 0.0 STORE IN 20
ADD *SIGMA* TO 0.0 STORE IN 21
ADD *G*     TO 0.0 STORE IN 22
MTRANSPOSE  VECTOR IN 1,3  SIZE  1 X 20 STORE IN 1,2
FORMAT F    (2A3,4X,16A3)
READ F 20 CARDS INTO COL 3 *** 20
   20 DATA CARD(S) READ BUT NOT LISTED
FORMAT B (5X,2A3,2X,1P2E15.6,5X,16A3)
TITLE1      CENTIMETER-GRAM-SEC    SYSTEME-INTERNATIONALE
```



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LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
    TITLE2   PHYSICAL CONSTANTS
    TITLE3                    CGS            SI
    PRINT B   COLS  3,4  1,2   5***20
```

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THE FOLLOWING IS AN EXAMPLE OF M(XAX') AND M(X'AX).

MATRIX A

| | |
|---|---|
| 1.00 | 3.00 |
| 2.00 | -4.00 |
| .00 | .00 |

MATRIX X

| | | |
|---|---|---|
| -2.00 | .00 | 5.00 |
| -1.00 | 5.00 | .00 |
| 3.00 | 1.00 | .00 |

MATRIX X'

| | | |
|---|---|---|
| -2.00 | -2.00 | -1.00 |
| .00 | .00 | 5.00 |
| -2.00 | .00 | .00 |

MATRIX B=XAX'
(X IS 3 BY 2, A IS 2 BY 2)

| | | |
|---|---|---|
| 4.0000000 | -28.000000 | -12.000000 |
| -18.000000 | -124.00000 | 4.0000000 |
| -10.000000 | 20.000000 | 20.000000 |

MATRIX C=X'AX
(X IS 2 BY 3, A IS 2 BY 2)

| | | |
|---|---|---|
| 10.000000 | -10.000000 | 8.0000000 |
| 0. | -100.00000 | -20.000000 |
| 10.000000 | -30.000000 | 4.0000000 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

0.

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
DIM        NUMBER OF ROWS=3  NUMBER OF COLUMNS=26
READ MATRIX A INTO COLUMNS 13 14  MATRIX X INTO 15***17 X TRANSPOSE IN 18***20
1.0  3.0  -2.0  0.0   -2.0   -2.0  -1.0  3.0
2.0 -4.0  -1.0  5.0    0.0   0.0 5.0 1.0
0.0  0.0   3.0  1.0    0.0   -2.0 0.0 0.0
M(XAX') A MATRIX IN 1,13 SIZE=2X2  X MATRIX IN 1,15 SIZE=3X2 STORE IN R=1 C=1
M(X'AX) A MATRIX IN 1,13 SIZE=2X2  X MATRIX IN 1,15 SIZE=2X3 STORE IN R=1 C=4
MMULT MATRIX X IN R=1 C=15 SIZE=3X2 BY MATRIX A R=1 C=13 2X2 STORE IN R=1 C=21
MMULT MATRIX XA IN R=1 C=21 SIZE=3X2 BY MATRIX X' R=1 C=18 2X3 STORE IN R=1 C=21
MMULT TRANSPOSE OF X IN R=1 C=18 3X2 TIMES A IN R=1 C=13 2X2 STORE IN R=1 C=24
MMULT MATRIX X'A IN R=1 C=24 SIZE=3X2 TIMES X IN R=1 C=15 SIZE=2X3 PUT R=1 C=24
MSCALAR THE ARRAY IN R=1 C=21 SIZE=3X6 BY -1.0 PUT ARRAY IN R=1 C=7
TITLE1 THE FOLLOWING IS AN EXAMPLE OF M(XAX') AND M(X'AX).
NEW PAGE
SPACE
NOTE MATRIX A        MATRIX X              MATRIX X'
SPACE
FORMAT D (8F8.2)
NPRINT D COLUMNS 13***20
SPACE
NOTE MATRIX B=XAX'                                  MATRIX C=X'AX
NOTE (X IS 3 BY 2, A IS 2 BY 2)                     (X IS 2 BY 3, A IS 2 BY 2)
SPACE  2
NPRINT COLUMNS 1***6
DIMENSION NROW=3 NCOL=12
ROWSUM THE ENTIRE WORKSHEET AND PUT IN COLUMN 1
AVERAGE COLUMN 1 AND STORE IN COLUMN 1
SPACE  2
NOTE ***************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLUMN 1
SPACE
NOTE ***************************************************************************
```

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CENTIGRADE FAHRENHEIT FAHR TO CENT CONVERSION FORMULAS

| COLUMN 1 | COLUMN 11 | COLUMN 12 | COLUMN 14 | COLUMN 24 |
|---|---|---|---|---|
| -10.000000 | 14.000000 | -9.9999998 | 14.000000 | -9.9999996 |
| -5.0000000 | 23.000000 | -4.9999998 | 23.000000 | -4.9999997 |
| 0. | 32.000000 | 0. | 32.000000 | 0. |
| 5.0000000 | 41.000000 | 4.9999998 | 41.000000 | 4.9999997 |
| 10.000000 | 50.000000 | 9.9999998 | 50.000000 | 9.9999996 |
| 15.000000 | 59.000000 | 15.000000 | 59.000000 | 15.000000 |
| 20.000000 | 67.999999 | 20.000000 | 67.999999 | 19.999999 |
| 25.000000 | 76.999999 | 25.000000 | 76.999999 | 24.999999 |
| 30.000000 | 85.999999 | 30.000000 | 85.999999 | 29.999999 |
| 35.000000 | 94.999999 | 35.000000 | 94.999999 | 34.999999 |
| 40.000000 | 104.00000 | 40.000000 | 104.00000 | 39.999999 |
| 45.000000 | 113.00000 | 45.000000 | 113.00000 | 44.999999 |
| 50.000000 | 122.00000 | 50.000000 | 122.00000 | 49.999999 |
| 60.000000 | 140.00000 | 59.999999 | 140.00000 | 59.999999 |
| 70.000000 | 158.00000 | 69.999999 | 158.00000 | 69.999998 |
| 80.000000 | 176.00000 | 79.999999 | 176.00000 | 79.999998 |
| 90.000000 | 194.00000 | 89.999999 | 194.00000 | 89.999998 |
| 100.00000 | 212.00000 | 99.999999 | 212.00000 | 99.999998 |

**********

THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0

*-4.6359168-07 0. *-8.5433324-07

**********

| ELEM. NO | ATOMIC WT: | ELEMENT |
|---|---|---|
| 5. | 10.81000 | BORON |
| 10. | 20.17900 | NEON |
| 15. | 30.97380 | PHOSPHORUS |
| 20. | 40.08000 | CALCIUM |
| 25. | 54.93800 | MANGANESE |
| 30. | 65.37000 | ZINC |
| 35. | 79.90400 | BROMINE |
| 40. | 91.22000 | ZIRCONIUM |
| 45. | 102.90550 | RHODIUM |
| 50. | 118.69000 | TIN |
| 55. | 132.90550 | CESIUM |
| 60. | 144.24000 | NEODYMIUM |
| 65. | 158.92540 | TEBIUM |
| 70. | 173.04000 | YTTERBIUM |
| 75. | 186.20000 | RHENIUM |
| 80. | 200.59000 | MERCURY |
| 85. | 210.00000 | ASTATINE |
| 90. | 232.03810 | THORIUM |
| 95. | 243.00000 | AMERICIUM |
| 100. | 253.00000 | FERMIUM |

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
GENERATE FROM -10. IN STEPS OF 5. THRU 50. AND STEPS OF 10. THRU 100. IN COL 1
CTOF OF COL 1 STORE IN COLUMN 11 CONVERT TO FAHRENHEIT
FTOC OF COL 11 STORE IN COLUMN 12 CONVERT TO CENTIGRADE
SUBTRACT    COL 1 FROM 12 STORE IN COLUMN 13
MULTIPLY COL 1 BY 1.8 MULT BY 1.0 ADD 32. STORE IN COL 14
DIV  5. BY 9. STORE IN COLUMN 8
SUBTRACT 32.0 FROM COL 11 MULT BY COL 8 ADD 0.0 STORE IN COL 24
SUBTRACT 1 FROM 24 STORE IN COLUMN 25
TITLE1   CENTIGRADE       FAHRENHEIT    FAHR TO CENT       CONVERS
TITLE2ION FORMULAS
PRINT  1,11,12,14,24
SUBTRACT COL 11 FROM COL 14 STORE IN COL 15
AVERAGE COL 15 STORE IN COL 15
AVERAGE COL 13 STORE IN COL 13
AVERAGE COL 25 STORE IN COL 25
SPACE  2
NOTE ********************************************************************************
SPACE
NOTE THE FOLLOWING VALUES MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 COL 13 15 25
SPACE
NOTE ********************************************************************************
ERASE
ATOMIC MASSES STORE RESULTS IN COL 61
GENERATE FROM 1. IN STEPS OF 1. THRU *NRMAX* COL 2
SEPARATE COL 61 EVERY 5TH ROW START WITH ROW 5 STORE IN 3
SEPARATE COL  2 EVERY 5TH ROW START WITH ROW 5 STORE IN 4
RESET NRMAX TO 20
FORMAT E (2A6)
READ E 20 COLS 5,6
   20 DATA CARD(S) READ BUT NOT LISTED
TITLE1
TITLE2
NEW PAGE
NOTE ELEM. NO  ATOMIC WT:      ELEMENT
SPACE
FORMAT D (F5.0,3X,F12.5,5X,2A6)
NPRINT D COLS 4 3 5 6
```

THE FOLLOWING IS AN EXAMPLE OF M(AD) M(DA) AND M(V'A)

MATRIX A

| ROW/COL | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 1.00 | 6.00 | 3.00 |
| 2 | 2.00 | 3.00 | 2.00 |
| 3 | 3.00 | -1 00 | 1.00 |

MATRIX B DIAGONAL OF MATRIX B

| ROW/COL | 4 | 5 | 6 | 7 |
|---|---|---|---|---|
| 1 | 3.00 | .00 | .00 | 3.00 |
| 2 | .00 | -2.00 | .00 | -2.00 |
| 3 | .00 | .00 | 1.00 | 1.00 |

MATRIX C=MATRIX A TIMES THE DIAGONAL OF MATRIX B. COMMAND IS M(AD).

| ROW/COL | 8 | 9 | 10 |
|---|---|---|---|
| 1 | 3.00 | -12.00 | 3.00 |
| 2 | 6.00 | -6.00 | 2.00 |
| 3 | 9.00 | 2.00 | 1.00 |

MATRIX D=DIAGONAL OF MATRIX B TIMES MATRIX A. COMMAND IS M(DA).

| ROW/COL | 11 | 12 | 13 |
|---|---|---|---|
| 1 | 3.00 | 18.00 | 9.00 |
| 2 | -4.00 | -6.00 | -4.00 |
| 3 | 3.00 | -1.00 | 1.00 |



**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

.00

**********

| VECTOR V | | MATRIX A | | VECTOR V TIMES MATRIX A | | |
|---|---|---|---|---|---|---|
| 1.00 | 1.00 | 6.00 | 3.00 | -1.00 | 3.00 | 1.00 |
| -1.00 | 2.00 | 3.00 | 2.00 | .00 | .00 | .00 |
| .00 | 3.00 | -1.00 | 1.00 | .00 | .00 | .00 |

**********

THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0

.00

**********

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
READ THE FOLLOWING DATA INTO COLUMNS 1***7
1.0  6.0  3.0   3.0   0.0   0.0   3.0
2.0  3.0  2.0  0.0  -2.0   0.0  -2.0
3.0 -1.0  1.0   0.0   0.0   1.0   1.0
M(AD) MATRIX A IN R=1 C=1 SIZE=3X3 TIMES MATRIX COL 7 IN DIAGONAL PUT IN R=1 C=8
M(DA) MATRIX A IN R=1 C=1 SIZE=3X3 PREMULT BY MAT WITH DIAGONAL C=7 PUT R=1 C=11
TITLE1 THE FOLLOWING IS AN EXAMPLE OF M(AD) M(DA) AND M(V'A)
NEW PAGE
SPACE
NOTE MATRIX A
FIXED 2
MPRINT MATRIX IN R=1 C=1 SIZE 3X3
SPACE  2
NOTE MATRIX B                                                DIAGONAL OF MATRIX B
MPRINT MATRIX IN R=1 C=4 SIZE=3X4
SPACE   2
NOTE MATRIX C=MATRIX A TIMES THE DIAGONAL OF MATRIX B. COMMAND IS M(AD).
MPRINT MATRIX C IN R=1 C=8  SIZE=3X3
SPACE 2
NOTE MATRIX D=DIAGONAL OF MATRIX B TIMES MATRIX A. COMMAND IS M(DA).
MPRINT MATRIX D IN R=1 C=11 SIZE=3X3
MMULT MATRIX A IN R=1 C=1 SIZE=3X3 TIMES MATRIX IN R=1 C=4 SIZE=3X3 IN R=1 C=14
MMULTIPLY    B IN R=1 C=4 SIZE=3X3 BY MATRIX IN R=1 C=1 SIZE=3X3 PUT IN R=1 C=17
MSUB MATRIX IN R=1 C=8  SIZE=3X3 FROM MATRIX IN R=1 C=14 SIZE=3X3 INTO R=1 C=20
MSUB MATRIX IN R=1 C=11 SIZE=3X3 FROM MATRIX IN R=1 C=17 SIZE=3X3 INTO R=1 C=23
ROWSUM COLUMNS 20***25 AND STORE IN COLUMN 26
AVERAGE COLUMN 26 AND STORE IN COLUMN 26
SPACE  2
NOTE ************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
ABRIDGE ROW 1 OF COLUMN 26
SPACE
NOTE ************************************************************************
SET THE FOLLOWING VALUES IN COLUMN 27
1.0  -1.0  0.0
M(V'A) MATRIX IN R=1 C=1 SIZE=3X3 VECTOR IN COLUMN 27 PUT IN R=1 C=28
SPACE
NOTE VECTOR V        MATRIX A         VECTOR V TIMES MATRIX A
FORMAT C (F8.2,6F8.2)
NPRINT C COLUMNS 27 1 2 3 28 29 30
SPACE
ROWSUM COLUMNS 28 29 AND 30 AND STORE IN COLUMN 31
SUB  3.0 FROM COLUMN 31 AND STORE IN COLUMN 32
SPACE  2
NOTE ************************************************************************
SPACE
NOTE THE FOLLOWING VALUE MUST BE EQUAL TO OR NEAR 0.0
SPACE
```

LIST OF COMMANDS, DATA AND DIAGNOSTICS

```
ABRIDGE ROW 1  OF COLUMN 32
SPACE
NOTE ********************************************************************************
STOP
```

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## Index Of OMNITAB Commands Used

* Command is used more than three times; only first three uses are listed.

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