NATIONAL BUREAU OF STANDARDS REPORT

7842

PROJECTS and PUBLICATIONS

of the

APPLIED MATHEMATICS DIVISION

A Quarterly Report

July through December 1962

<NBS>

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to government agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. Research projects are also performed for other government agencies when the work relates to and supplements the basic program of the Bureau or when the Bureau's unique competence is required. The scope of activities is suggested by the listing of divisions and sections on the inside of the back cover.

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A complete listing of the Bureau's publications can be found in National Bureau of Standards Circular 460, Publications of the National Bureau of Standards, 1901 to June 1947 ($1.25), and the Supplement to National Bureau of Standards Circular 460, July 1947 to June 1957 ($1.50), and Miscellaneous Publication 240, July 1957 to June 1960 (includes Titles of Papers Published in Outside Journals 1950 to 1959) ($2.25); available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

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NBS PROJECT

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APPLIED MATHEMATICS DIVISION

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* Part Time   ** Postdoctoral Resident Research Associate   *** Guest Worker
°° Temporary appointment   ° On leave of absence

Contents

° Only unclassified material is included in this report.

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December 31, 1962

1. NUMERICAL ANALYSIS

RESEARCH IN NUMERICAL ANALYSIS AND RELATED FIELDS
Task 1101-12-11110/55-55

Origin: NBS   Authorized 8/29/54
Manager: Philip J. Davis
Full Task Description: July-September 1954 issue, p.1

Status: CONTINUED. P. Davis has completed and submitted to a
technical journal a paper entitled "Packing Inequalities for Circles"
which derives from complex variable and functional analysis various
inequalities satisfied by non overlapping discs lying in the unit disc.

P. Davis has in preparation a manuscript entitled "Additional Theorems
for Complete Quadratures" which extends to the complex plane some investi-
gations [See Proc. Am. Math. Soc. Vol. 4 (1953) pp 127-235] previously
carried out on the real line.

P. Davis, in collaboration with L. Joseph of 11.2 and M. Klein of
Division 3.08 has been conducting numerical experiments toward the
computation of highly multiple integrals. More specifically, he has
been attempting to compute the fourth and fifth virial coefficients of
an imperfect gas, utilizing a fairly arbritary interaction potential.
Despite a flurry of activity on this problem over the past five years
the numerical aspects of the problem can hardly be said to be solved
satisfactorily at the present time. Exploratory computations have been
made using Monte-Carlo methods and our experience has lead us to the
conclusion that even on a machine of the speed of the 7090 fairly
substantial blocks of time would be required. The problem of multiple
integration is still relatively uninvestigated and there is much to be
done theoretically, numerically, and on ad hoc problems.

P. Davis and K. Kloss have been working on minimum problems that
arise in the determination of quadrature rules of high demension. It
has been found that naive techniques of minimization are too inefficient
to be of much good.

F. W. J. Olver has completed a second paper on error bounds for
the asymptotic solutions in terms of Airy functions of second-order
ordinary linear differential equations in regions containing a turning
point, which gives extensions to complete asymptotic expansions and to

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complex variables. He is now investigating error bounds for J. C. P. Miller's algorithm for the computation of functions from recurrence relations.

O. Shisha has worked in the following areas: (i) Techebycheff approximation by rational functions and by polynomials, particularly from the computational point of view; (ii) Infrapolynomials with prescribed coefficients (including work with Prof. J. L. Walsh); (iii) Fractional order differences of the coefficients of polynomials (with Dr. G. T. Cargo); (iv) Inequalities between means (with Dr. G. T. Cargo).

S. Haber is preparing a survey of the theory of equidistribution mod one. He suggested the use of the sequences $(\{K^2\alpha\})$, α irrational, as quasi-random numbers in Monte Carlo quadrature, and showed that the usual "$1/\sqrt{n}$" error estimate can then be given a precise meaning.

W. Gustin and K. Kloss worked in the following areas: (i) Combinatorial problems. A new type of oriented block design which splits into several block designs was formulated. All solutions for the first few cases of a special design T_i (i = 1, 2, 3, ...) which splits into two Steiner triples were obtained by the computing machine. It is hoped that this data will implement insight into a general solution of the design T_i; (ii) Function maximization. A program was designed for searching out a maximum of a real function on an n dimensional cube as follows. The cube is first searched randomly, with maximal functional value and location thereof retained, until k consecutive points have been examined without improvement of the running maximum. Then around the best point so far obtained a cubical neighborhood of just such size as not likely yet to have been otherwise penetrated is randomly searched, again until consecutive unsuccess contracts the search neighborhood. Search ends after a certain number of such contractions, or can begin anew.

Maxine Rockoff has continued to study the numerical solution of the system of linear equations Ax = b resulting from a finite difference analog of the Dirichlet problem for Poisson's equation with an $O(h^4)$ estimate for the truncation error proposed by Bramble and Hubbard [Num. Math. Dec. 1962]. The approximation at irregular interior points is not of positive type. Here A = I-L-U where L and U are strictly lower and upper triangular matrices respectively. Define $\rho(H)$ to be the spectral radius of H. Let $\mathcal{L}_\omega = [I - \omega L]^{-1} [\omega U - (\omega-1)I]$ be the matrix defining the method of successive overrelaxation as developed by Young [Trans. Am. Math. Soc., 76, 1954.] L + U is neither symmetric nor non-negative, however S(L + U) < 1. It is shown that an ordering can be found such that $\mathcal{L}_1$ and L are non-negative. For this ordering it is shown that $\rho(\mathcal{L}_1) < \rho(L + U)$. Further, there exists an $\bar{\omega} > 1$ such that for $1 < \omega < \bar{\omega}$, $\rho(\mathcal{L}_\omega) < \rho(\mathcal{L}_1) - [\omega - 1] [1 - \rho(\mathcal{L}_1)]$. These results generalize parts of the results of Stein and Rosenberg [Journ. Lond. Math. Soc., 23, 1948]

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and Kahan [Ph.D. Thesis, Univ. of Toronto, 1958].

R. DeMar studied the following problems: 1. To find conditions of a sequence $\{a_n\}$ of real numbers in order that the class K of all entire functions satisfying

$$\limsup_{|y| \to \infty} |f(iy)| < \pi$$

be a uniqueness class for $\{\Delta^n f(a_n)\}$, i.e., in order that $f \in K$ and $\Delta^n f(a_n) = 0$, $n = 0, 1, 2, \ldots$ imply $f = 0$. The following theorem was proved:

If $\{a_n\}$ is a periodic sequence of period p with each period an arithmetic progression with difference $\beta < 0$, then K is a uniqueness class for $\{\Delta^n f(a_n)\}$ if and only if $\beta < 1/(p - 1)$. 2. The complex Pompeiu problem (in collaboration with Philip Davis). This is the problem of finding uniqueness classes for functionals defined on $L_2(B)$ by

$$\mathcal{L}_T(f) = \iint_B f(T(z))g(z)dxdy$$

for a given region B and function g where T ranges over some class G of Euclidean transformations. Results have been obtained for G a class of rotations of the plane; for G a class of translations, and for G a class including rotations and translations.

E. C. Johnsen has been investigating various combinatorial problems in the area of v, k, λ block designs, in particular questions with regard to the uniqueness of general cyclic designs and to the existence of special types of such designs. The investigation of the latter problem has been progressing steadily since it was started and its end appears in sight, at least in certain parts.

Publications:

(1) Packing Inequalities for Circles. P. Davis. To appear in the Michigan Journal of Mathematics.
(2) The invariance of symmetric functions of singular values. M. Marcus and H. Minc (The University of Florida). To appear in the Pacific Journal of Mathematics.
(3) On the maximum number of zeros in the powers of an indecomposable matrix. M. Marcus and F. May. Submitted to a technical journal.
(4) Multipliers of difference sets. M. Newman. Canadian J. Math 15, 121-124 (1963).
(5) The sum of the elements of the powers of a matrix. M. Marcus and M. Newman. To appear in the Pacific Journal of Mathematics.
(6) Lower bounds to eigenvalues using operator decomposition of the form

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B*B. N. W. Bazley and D. W. Fox (Applied Physics Laboratory, JHU).
To appear in Archive for Rational Mechanics and Analysis.

(7) Linear operations on matrices. M.Marcus. In manuscript.

(8) Infrapolynomials with prescribed derivatives at given points.
O. Shisha (with Prof. J. L. Walsh, abstract). Notices, American
Mathematical Society, Vol. 9, No. 4, August 1962, p. 315.

(9) Fractional order differences of the coefficients of polynomials.
O. Shisha (with Dr. G. T. Cargo, abstract). Notices, American
Mathematical Society, Vol. 9, No. 4, August 1962, p. 334.

(10) The zeros of infrapolynomials with prescribed values at given
points. O. Shisha (with Prof. J. L. Walsh). To appear in the
Proceedings of the American Mathematical Society.

(11) Bounds on ratios of means. O. Shisha (with Dr. G. T. Cargo). To
appear in the Journal of Research of the National Bureau of Standards.

(12) Zeros of polynomials and fractional order differences of their
coefficients. O. Shisha (with Dr. G. T. Cargo). To appear in the
Journal of Mathematical Analysis and Applications.

(13) Error bounds for first approximations in turning-point problems.
F. W. J. Olver. Submitted to a technical journal.

(14) Error bounds for asymptotic expansions in turning-point problems.
F. W. J. Olver. In manuscript.

(15) The segmental variation of Blaschke products. G. T. Cargo. To
appear in the Duke Mathematical Journal.

(16) Error analysis of Miller's recurrence algorithm. F. W. J. Olver.
In manuscript.

RESEARCH IN MATHEMATICAL TOPICS APPLICABLE TO
NUMERICAL ANALYSIS
Task 1101-12-11411/55-56

Origin: NBS   Authorized 8/13/54
Sponsor: Office of Naval Research
Manager: Morris Newman
Full Task Description: July-September 1954 issue, p. 5

Status: CONTINUED: M. Newman and J. Lehner initiated a study of the
Weierstrass points of the groups $\Gamma_o(n)$. It was shown that the cusps 0,
i,∞ of the fundamental region of $\Gamma_o(n)$ are always Weierstrass points of
$\Gamma_o(4n)$, $\Gamma_o(9n)$ in all cases for example when $n > 1$ is neither a prime nor
the product of two distinct primes and it was shown that the fixed
points of certain linear fractional transformations belonging to the
normalizer of $\Gamma_o(n)$ are always Weierstrass points of $\Gamma_o(n)$.

M. Newman proved that with three exceptions, any normal subgroup of
the modular group Γ is a free group. The exceptions are Γ^r ($r = 1,2,3$)
where Γ^r is the subgroup of Γ generated by the r th powers of the elements
of Γ.

Tables of genera for certain groups of linear fractional transformations
and of class numbers of positive binary quadratic forms have been computed
by E. Ordman and H. Fell, at the suggestion of M. Newman.

K. Goldberg and Jane Gager Reed continued their development of a model
of a certain type of competitive human behaviour, concentrating on an
attempt to randomize the input data sufficiently to achieve a random out-
put consistent with known results.

K. Goldberg continued his investigation of the coefficients of the
powers of the iterates of a formal power series. In this connection he
began an investigation of "symmetric function recursions" of the type

$$f_n(p_1,\ldots,p_n) = \sum_{i=1}^{n} K(p_1^{(i)},\ldots,p_m^{(i)}) f_{n-1}(p_1^{(i)},\ldots,p_{n-1}^{(i)})$$

where $p_r = \sum_{j=1}^{n} x_j^r$ and $p_r^{(i)} = p_r - x_i^r$.

K. Goldberg has derived several formulas for the coefficients in the
s-th power of the t-th iterate of a power series $f(z) = z + \ldots : \{f^t(z)\}^s$
$= z^s \sum_{n=o}^{\infty} a_n^{(s)}(t) z^n$. The starting point is the triangular matrix $M_f =$
$(a_{i-i}^{(i)}(1))$ which has the composition property $M_f M_g = M_{f(g)}$, and the new
result that log $M = DC_f$ where $D = $ diag $(1,2,\ldots)$ and C_f is a circulant:
$C_f = $ circ $(0,c_1, c_2,\ldots.)$. This leads to the formula

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$$a_n^{(s)}(t) = s \sum P_{\sum k_i} (1^{k_1}, 2^{k_2}, \ldots; s) \, c_1^{k_1} \ldots c_n^{k_n} \, t^{\sum k_i}/k_1! \ldots k_n!$$

summed over the partitions $k_1 + 2k_2 + \ldots + nk_n = n$, with 1^{k_1} denoting 1 repeated k_1 times, etc. and

$$P_m(x_1, \ldots, x_m; s) = \frac{1}{m!} \sum (s + x_1)(s + x_1 + x_2) \ldots (s + x_1 + \ldots + x_{m-1})$$

the sum taken over all permutations of $x_1, \ldots, x_m$. The problem thus reduces to an independent study of the coefficient of s^{m-k} in P_m; e.g. it is the coefficient of w^{k-1} in

$$\frac{1}{(m-k)!} \sum_{r=1}^{m-1} (-1)^{m-1-r} \, b_r^{(m)} \, \sum \prod_{i=1}^{r} (e^{wy_i} - 1)/wy_i$$

where the $b_r^{(m)}$ are positive integers and the interior sum is taken over all y_i which are the sum of distinctly indexed x_j such that $y_1 + \ldots + y_r = x_1 + \ldots + x_m$.

Publications:

(1) A note on modular groups. M. Newman. To appear in the Proceedings of the American Mathematical Society.

(2) The structure of some subgroups of the modular group. M. Newman. Illinois Journal of Mathematics, 6, 480-487 (1962).

(3) Note on a subgroup of the modular group. M. Newman and J. R. Smart (New York University). To appear in the Proceedings of the American Mathematical Society.

(4) Hadamard matrices of order cube plus one. K. Goldberg. In manuscript.

(5) Some free products of cyclic groups. M. Newman. Michigan J. Math. 9, 369-373 (1962).

(6) Two theorems on matrices. M. Newman. Journal of Research, NBS, Section B (Mathematics and Mathematical Physics) 66B, 3, 91-92 (1962).

(7) Bounds for cofactors and arithmetic minima of quadratic forms. M. Newman. To appear in the Journal of the London Mathematical Society.

2. MATHEMATICAL TABLES AND PROGRAMMING RESEARCH

MATHEMATICAL TABLES

The following long-range mathematical table projects are being carried in the Computation Laboratory. Progress continues as dictated by the relative priority in the overall program of the Laboratory and by available funds. All of the table projects were inactive during the past quarter because priority was given to the preparation of the forthcoming "Handbook of Mathematical Functions."

1102-40-11112/47-2   TABLES OF COULOMB WAVE FUNCTIONS

1102-40-11112/51-8   TABLES OF POWER POINTS OF ANALYSIS OF VARIANCE TESTS

1102-40-11112/52-37 TABLES OF SPHEROIDAL WAVE FUNCTIONS

1102-40-11112/52-57 TABLES OF THE SIEVERT INTEGRAL

HANDBOOK OF MATHEMATICAL FUNCTIONS
Task 1102-40-11421/57-216

Origin and Sponsor: National Science Foundation   Authorized 12/27/56
Manager: Irene A. Stegun
Full task description: October-December 1956 issue, p. 10

Status: CONTINUED. The entire volume is in press, with galley proofs received and checked for 24 of the 29 chapters.

AUTOMATIC CODING
Task 1102-11120/55/65

Origin: NBS   Authorized 9/29/54
Manager: J. Wegstein
Full Task Description: July-September 1954 issue, p. 11

Status: CONTINUED. K. Berk prepared illustrative test programs and recipes for using the IPL V and COMIT compilers. These compilers, along with simplified directions for their use on the NBS 7090 computer are now available as special research tools in heuristic programming, logical programming, and symbol manipulation.

The study of string languages continued. Translations of numerous simple mechanical languages have been examined in the course of searching

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for features which these translations have in common.

Publication:

(1) Revised Report on the Algorithmic Language Algol 60. J. Backus,
F. Bauer, J. Green, C. Katz, J. McCarthy, P. Naur, A. Perlis, H.
Rutishauser, K. Samelson, B. Vauquois, J. Wegstein, A. vanWijngaarden,
M. Woodger. To appear in Numerische Mathematik and the Communications
of the Association for Computing Machinery (January 1963).

3. PROBABILITY AND MATHEMATICAL STATISTICS

MISCELLANEOUS STUDIES IN PROBABILITY AND STATISTICS
Task 1103-12-11131/51-2

Origin: NBS   Authorized 7/1/50
Manager: Joan R. Rosenblatt
Full task description: July-September 1950 issue, p. 58

Status: TERMINATED. Studies hitherto reported under this task will in future be reported under Task 1103-12-11131/63-1259 (see page 11   ).

Janace Speckman is completing a study of unsatisfactory properties of confidence intervals based on small samples. For samples from a normal distribution with unknown standard deviation σ, Miss Speckman has obtained (1) the distribution of the half-lengths of the intervals and, (2) the (conditional) probability that a confidence interval of length $2r$ will fail to cover the mean. The probability that a confidence interval will miss including the true mean by an amount in absolute value at least $\Delta \sigma$ has been obtained for small sample sizes for the case of known σ as well as for the case of unknown σ.

Continuing his study on application of information theory to tests for contingency tables, H. H. Ku worked out a correction for the value of the information statistic for the case where zero frequencies are involved.

George Weiss has completed two papers: "An analysis of pedestrian queueing" and "Laguerre expansions of successive generations of a renewal process".

Publications:

(1) Selected bibliography is statistical literature, 1930-1957. VI. Theory of estimation and testing of hypotheses, sampling distributions, and theory of sample surveys. Lola S. Deming, Journal of Research NBS, 66B (Mathematics and Mathematical Physics), 109-151, July-September 1962.
(2) Roger Joseph Boscovich and the combination of observations. Churchill Eisenhart. To appear in Actes du Symposium International Roger Boscovich 1961.
(3) Tests for contingency tables and Markov chains. S. Kullback (George Washington University), M. Kupperman (George Washington University), and H. H. Ku. Technometrics 4, 573-608, November 1962.
(4) An application of information theory to the analysis of contingency tables, with a table of $2n \log_e n$, $n=1(1)10,000$. S. Kullback (George Washington University), M. Kupperman (George Washington University), and H. H. Ku. Journal of Research NBS, 66B, 217-243, October-December 1962.
(5) Convergence to normality of powers of a normal random variable. N. C. Severo and L. J. Montzingo, Jr. To appear in the Bulletin of the International Statistical Institute.

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(6) Estimation of dispersion parameters. W. A. Thompson, Jr. Journal of Research NBS, 66B, 161-164, October-December 1962.
(7) Precision of simultaneous measurement process. W. A. Thompson, Jr. Submitted to a technical journal.
(8) On the pedestrian queueing problem. George Weiss. To appear in The Bulletin of the International Statistical Institute.
(9) Laguerre expansions for successive generations of a renewal process. George Weiss. Journal of Research NBS 66B, 165-168, October-December 1962.
(10) A note on contingency tables involving zero frequencies and the $2\hat{I}$ test. H. H. Ku. Submitted to a technical journal.
(11) An analysis of pedestrian queueing. George Weiss. Submitted to a technical journal.

STUDIES IN THE MATHEMATICS OF EXPERIMENT DESIGN
Task 1103-12-11131/53-1

Origin: NBS   Authorized 10/15/52
Manager: J. M. Cameron
Full task description: October-December 1952 issue, p. 60

Status: TERMINATED. Studies hitherto reported under this task will in future be reported under Task 1103-12-11131/63-1259 (see page 11).
Marvin Zelen (U.S. Army Mathematics Research Center) has completed a paper on "The role of constraints in the theory of least squares". Work on this paper was begun at the Bureau.

Publications:

(1) Randomization and experimentation. W. J. Youden. To appear in the Annals of Mathematical Statistics.
(2) Factorial designs and the direct product. B. Kurkjian (DOFL) and M. Zelen. To appear in the Bulletin of the International Statistical Institute.

STUDY OF NONPARAMETRIC STATISTICAL TECHNIQUES
Task 1103-12-11131/56-170

Origin: NBS   Authorized 12/15/55
Manager: Joan R. Rosenblatt
Full task description: October-December 1955 issue, p. 14

Status: TERMINATED. Studies hitherto reported under this task will in future be reported under Task 1103-12-11131/63-1259 (see page 11).
The paper "On a rank sum test for outliers" by W. A. Thompson and T. A. Willke has been submitted for publication. This paper contains two-sided tables for the test.

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Publications:

(1) On a rank sum test for outliers. W. A. Thompson, Jr. and T. W. Willke.
    Submitted to a technical journal.
(2) The role of laboratories in round robins. W. J. Youden. To appear
    in Materials Research and Standards.

RESEARCH IN PROBABILITY AND MATHEMATICAL STATISTICS
Task 1103-12-1131/63-1259

Origin: NBS   Authorized 10/1/62
Manager: Joan R. Rosenblatt

Objective: To conduct mathematical research on the theory and techniques
of statistical inference and statistical design of experiments, and on
applications of probability theory, with special reference to problems
that arise in physical science and engineering experimentation; and to
disseminate the results of such work in the form of research papers, and to
of statistical methods, special tables, and other aids to applied statistics.
Background: Problems in physical science and engineering experimentation
require adaptation and extension of existing statistical theory and method
and new applications of probability theory to the development and analysis
of mathematical models. There is a continuing need for new experimental
arrangements suited to the needs of measurement and experimentation in
the physical sciences, and for the related development of methods of data
analysis. There is a growing parallel need for critical appraisals of the
performance of statistical techniques when underlying assumptions are not
exactly satisfied, and for guides for choosing among alternative techniques.
     Specific tasks will generally belong to one or more of the following
interrelated categories. (1) Design of experiments, (2) Nonparametric
statistical techniques, (3) "Practical properties" of statistical techniques,
including questions of power, efficiency, robustness, consequences of
misapplications, (4) Probabilistic models and statistical methods developed
for special needs in the physical sciences and in metrology, (5) Preparation
of tables, manuals, bibliographies, and other special aids for research work.
Comment: This task supersedes several whose objectives were more narrowly
specified, and which are terminated this reporting period. The tasks
terminated are:
     1103-12-11131/51-2 (Misc. studies in probability and statistics),
     1103-12-11131/53-1 (Studies in the mathematics of experiment design),
     1103-12-11131/56-170(Study of nonparametric statistical techniques).

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Status: NEW.
    (1) Design of Experiments. J. M. Cameron has written a paper on "An algorithm for obtaining an orthogonal set of individual degress of freedom for error". Based on the Gram-Schmidt orthonormalization procedure, the algorithm produces the coefficients of linear combinations of observations which can be used for computing an orthogonal set of individual degrees of freedom for error from a set of observations. The algorithm is applicable in the analysis of data from designed experiments, and especially in the analysis of residuals (deviations between observed and predicted values) when these are used to study the state of statistical control of a measurement process.
    Two additional notes by J. M Cameron treat computational problems arising in the analysis of designed experiments: "The generalized inverse of a real symmetric matrix", and "An easy method for computing the variance of a predicted value in a regression problem".
    (2) Nonparametric statistical techniques. The one-sided tables for the rank sum test for outliers have now been computed. In order to study the performance of this test, calculations of the power under various alternatives have been carried out by T. A. Willke. For comparison purposes similar power calculations for a standard parametric test and the maximum absolute deviate have also been done. A formal generalization of the rank sum test has been written out by which other parameters besides the mean can be tested with the same tables.
    (3) "Practical properties" of statistical techniques. John Van Dyke is completing a note on "Fitting $y = \beta x$ when the variance depends on x". Results are given concerning the selection of a method for estimating the slope of a straight line through the origin when the variance of y is proportional to x^p, and either p is not known, or p is known but is not an integer. The variance of the estimated slope, and the estimation of this variance, are considered.
    (4) Monograph on precision and accuracy. A monograph on the definition and evaluation of the precision and accuracy of measurement systems is in an early stage of preparation under the general direction of Churchill Eisenhart. The proposed monograph is to include sections on basic concepts of the statistical theory of errors, on fundamental principles and techniques of statistical inference, and on statistical methods useful for ascertaining whether a measurement process is in a state of statistical control, for detecting and identifying particular types of systematic error and components of random variation. The aim is to present a unified treatment of the problems arising in realistic definition and evaluation of the precision and accuracy of measurement processes for the calibration of measuring instruments and standards.

    Publication:

(1) An algorithm for obtaining an orthogonal set of individual degrees of freedom for error. J. M. Cameron. To appear in the Journal of Research

Status of Projects

NBS, Section B (Mathematics and Mathematical Physics).

MEASUREMENT OF RELIABILITY
Task 1103-12-11130/56-182

Origin: NBS   Authorized 3/23/56
Manager: Joan R. Rosenblatt
Full task description: January-March 1956 issue, p. 13

Status: CONTINUED. George Weiss completed a paper on a study of systems with spare parts in which it is assumed that the spare parts can fail in storage as well as in use.

Weiss has initiated a study of periodic inspection policies for systems with non-exponential reliability functions.

Joan R. Rosenblatt completed a revised and expanded version of her paper on "Confidence limits for the reliability of complex systems".

Albert Romano is studying mathematical models for the description of changes through time in the probability destributions of characteristics of (e.g.) electronic devices. The dependence of these distributions on age and stress level is being considered. Mathematical models of this type will be useful in connection with the design and analysis of "life test" experiments which provide measurements of characteristics of the devices under test in addition to lifetime data. In particular, he is investigating the applicability of a family of log-normal distributions for use in describing the effect of age and stress level on certain electrical characteristics of transistors.

Publications:

(1) Confidence limits for the realiability of complex systems. Joan R. Rosenblatt. To appear in the Proceedings of the Seminar on Statistical Theory of Reliability, U. S. Army Mathematics Research Center, University of Wisconsin, Madison.

(2) The reliability of a system in which spare parts deteriorate in storage. George Weiss. To appear in the Hournal of Research NBS, 66B, 157-160, October-December 1962.

(3) A survey of some mathematical models in the theory of reliability. George Weiss. To appear in the Proceedings of the Seminar on Statistical Theory of Reliability, U. S. Army Research Center, University of Wisconsin, Madison.

4. MATHEMATICAL PHYSICS

RESEARCH IN MATHEMATICAL PHYSICS AND RELATED FIELDS
Task 1104-12-11141/55-57

Origin: NBS   Authorized 9/1/54
Manager: W.H. Pell
Full task description: July-September 1954 issue, p. 27

Status: CONTINUED. A. Ghaffari is continuing the study of periodic
solutions of non-linear non-autonomous differential equations by the use
of the so-called "stroboscopic method" of Minorsky and the Mandelstam-
Papalexi (M.P.) method. Both methods are the same at the outset, but the
practical difficulties of obtaining quantitative results are, however,
quite different in the two methods. In the latter instance the existence
of a periodic solution is relatively simple to establish, but the question
of stability is more difficult to answer. In the stroboscopic method
the problem of stability is easy to study, but the formulation of the
conditions of periodicity leads to the application of the stroboscopic
procedure in which the constants of the linear solution appear as variables
of the transformation, and the major part of the calculations concerns the
determination of stationary values of these constants.

Dr. Ghaffari presented a paper at the International Congress of
Mathematicians, Stockholm, Sweden, August 15-22, 1962 which summarized the
application of the stroboscopic method to the Duffing equation with viscous
damping. Some results concerning conditions for existence and stability
of solutions were obtained.

Currently, the connection between the stroboscopic mathod and the
asymptotic methods of the Kryloff-Bogoliubov-Mitropolsky (K.B.M.) are
under study.

B. Bernstein, with E. A. Kearsley (6.05) and L. Zapas (6.05), have
completed a manuscript entitled "A Study of Stress Relaxation with Finite
Strain". In this paper two simple types of constitutive equations appro-
priate to materials exhibiting elasticity are presented, one applicable to
materials which are basically solid in nature and the other to fluid-like
materials. There are simplified versions of Green-Rivlin and Coleman-Noll
equations, with, however, additional assumptions which seem reasonable on
the basis of experience, and which yield constitutive equations simple
enough to be subjected to experimental verification. Mr. Zapas has
obtained preliminary experimental data which is in good agreement with the
theory of Bernstein and Kearsley.

A paper covering this investigation was given at the annual meeting
of the Society of Rhelology, Johns Hopkins University, Baltimore, Maryland,
Oct. 29-31, 1962. Dr. Bernstein also gave lectures on this work at
several universities.

Drs. L. E. Payne and J. H. Bramble are continuing their application of
bounding techniques to the approximate solution of problems in elasticity.
They have recently finished work on pointwise bounds for the classical

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plate problems, i.e., on the solution of

$$\Delta^4 u = f$$

subject to one of the following sets of boundary values

i) $u = g$, $\partial u / \partial n = h$

ii) $u = g$, $M(u) = h$

iii) $M(u) = g$, $Q(u) = h$

where M is the moment at the boundary and Q is the modified shear force condition of the Kirchhoff plate theory. The g and h are prescribed functions in each case satisfying rather liberal conditions.

More recent work is concerned with the effect of errors in the elastic moduli on bounds for the solutions of the Navier equations.

Publications:

(1) Some properties of the Hessian matrix of a strictly convex function. B. Bernstein and R. A. Toupin. Journal für die reine und angewandte Mathematik 210, 67-72 (1962).

(2) Conditions for second order waves in hypo-elasticity. B. Bernstein. To appear.

(3) On an extension of the stroboscopic method. A. Ghaffari. Abstracts of Communications of the International Congress of Mathematicians, p. 185, Stockholm, Sweden, August 15-22, 1962.

(4) On Rayleigh's nonlinear vibration equation. A. Ghaffari. To appear in the Proceedings of the Internation Symposium on Non-linear Vibrations. Sponsored by the Academy of Sciences of the Ukrainian SSR, Kiev, USSR, September 12-18, 1961.

(5) A. Ghaffari. Higher Approximations With the Stroboscopic Method. Proceedings of Second International Conference on Non-linear Vibrations, Warsaw, Poland, Sept. 18-21, 1962.

(6) L. W. Payne and J. H. Bramble. Pointwise Bounds in the First Biharmonic Boundary Value Problem. To appear in the Journal of Math. and Physics.

(7) J. H. Bramble and L. E. Payne. Error Bounds in the Pointwise Approximation of Solutions of Elastic Plate Problems. To appear in the Journal of Research NBS.

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DYNAMICS OF PLASMAS
Task 1104-12-11417/62-1157

Origin: NBS   Authorized 10/3/61
Sponsor: National Aeronautics and Space Administration
Manager: C. M. Tchen
Full task description: October-December 1961 issue, p. 12

    Status: CONTINUED. C. M. Tchen has continued his investigation on
plasma oscillations with collective correlation. Longitudinal oscillations
in an unbounded, rarefied plasma were studied by including the effects of
the correlation function. Since it is the collective behavior in the
plasma which sets up the oscillations, its roles both in the singlet
distribution function and in the pair correlation function were investigated.
The dispersion relation for oscillations was obtained, and the Landau
damping was calculated. A manuscript on this work is being prepared for
publication.
    C. M. Tchen and E. Minardi have made a study of the unsteady struc-
ture of the pair correlation function, by assuming a predominant self-
consistent field, as compared to the collisions. A manuscript is in pre-
paration.
    The problem of the expansion of a plasma into a vacuum in the presence
of a magnetic field is also under investigation from the magnetohydro-
dynamic approach by C. M. Tchen, W. L. Sadowski, and E. Minardi. The
possibility of solving the kinetic equation of the Vlasov type in one
dimension numerically is also being considered.

    Publications:

(1) C. M. Tchen. Collective Oscillations in Plasmas. To appear in the
     Czechoslovakian Journal of Physics.

PLASMA RESEARCH
Task 1104-12-11140/59-422

Origin: NBS   Authorized 6/30/59
Manager: C. M. Tchen
Full task description: April-June 1959 issue, p. 15

    Status: CONTINUED. Dr. C. M. Tchen is continuing his investigation
in the kinetic theory of plasmas. A kinetic equation valid for rapidly
varying plasmas has been derived. Its theory is based on an hierarchy
of equations for the distribution functions used earlier by Tchen (see
Phys. Rev. 114, 394(1959)) for the derivation of a kinetic equation for a
moderately varying plasma. The rapid processes involved in the correlation

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function modified the screening behavior of plasmas. The result degen-
erated to the earlier one for the special case of moderately varying
plasmas. A paper covering this development is in preparation.

Dr. Tchen has investigated the possibility of formulating a kinetic
foundation for the theory of turbulence, using the approach of BBGKY
equations. The three lengths (Kolmogoroff's microscale, vorticity scale,
and inertia scale) as formulated by the dissipation, viscosity, and energy
could be compared with the three scales in plasmas, and therefore the
BBGKY equations were possible for iterations and applied to turbulence,
considered as a system with weak but long range interaction. It was in-
tended to first derive some known results from this approach, find the
relation between the spectral function and the probability function, and
to clarify the relations between the temporal, spatial, and time-space
auto-correlation functions.

THEORY OF SATELLITE ORBITS
Task 1104-12-11441/62-1166

Origin: NBS
Sponsor: National Aeronautics and Space Administration
Manager: J. P. Vinti
Full task description: January-March 1962 issue, p. 12

Status: CONTINUED. J. P. Vinti is continuing his study of the orbits
of satellites with the aid of the gravitational potential associated with
his name.

The earlier method of handling the residual fourth harmonic in the
gravitational potential yielded Poisson terms in the element G. Choice of
a new set of Delaunay elements L, G. H. ℓ, g, and h eliminates Poisson
terms and leads to the following results.

H is constant, L equals a constant plus a short-periodic term
proportional to $\sigma \equiv J_4 + J_2^2$, and G equals a constant plus short periodic
and long-periodic terms proportional to σ. Each of the elements ℓ, g,
and h has a secular part independent of σ, secular and short-periodic
terms proportional to $\sigma/J_2 = 0(J_2)$. The long-periodic terms contain a
demoniator $\nu_2 - \nu_1 \approx 1 - 5H^2/ G''^2$, where ν_2 and ν_1 are respectively the
mean η - frequency and the mean ρ - frequency. Thus the critical ρ
inclination appears. (These terms disappear for the intermediate orbit,
for which $\sigma = 0$.)

The perturbation theory for these Delaunay elements has been carried
out by the von Zeipel-Brouwer method, with only the short-periodic terms
remaining to be found in detail as derivatives of a certain complicated

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function S_1.

The further solution consists in replacing, in Eqs. (8.2) and (8.3) of J. Vinti, NBS J. Res. <u>65B</u>, 169-201(1961), the quantities $t + \beta_1$ and β_2 by certain linear combinations of ℓ and g and solving these equations. A method is being developed for doing this by beginning with the solution for $\sigma = 0$, given in the above paper. This solution will yield the spheroidal coordinates ρ and η and thus the polar coordinates

r and θ. Substitution of a certain linear combination of ℓ, g, and h

into Eq. (8.50) of that paper will then yield the right ascension φ.

The constant orbital elements will then be a", e", I", ℓ_0'', g_0'', and h_0''.

Publications:

(1) J. P. Vinti. The Spheroidal Method for Satellite Orbits. To be published in Proceedings of the International Association of Geodesy.
(2) J. P. Vinti. The Spheroidal Method for Satellite Orbits. Notes, Summer Institute for Dynamical Astronomy, Yale Univ., July 19, 1962.

5. OPERATIONS RESEARCH

OPERATIONS RESEARCH
Task 1105-12-11115/61-546

Origin and Sponsor: NBS   Authorized 12/30/60
Manager: Alan J. Goldman
Full Task Description: October-December 1960 issue, p. 3

Status: CONTINUED. The following investigations in various fields
of operations research were carried out by members of the staff:

(i) Bernice Bender continued work on simplification rules for
Boolean functions, and continued preparation of a paper concerning her
recent investigation of essential-cell content.

(ii) Mrs. Bender and A. J. Goldman extended previous results on
overflow rate in a buffered sorting system.

(iii) A.J. Goldman participated in a survey of present and potential
Federal activity in the area of transportation research.

(iv) W. Sillars, C. Witzgall and A. J. Goldman continued investigating
mathematical models of distribution networks.

(v) D. Kleinman developed a computer program to simulate a particular
type of sorting divice. He also investigated the appearance of repeating
initial blocks of digits in the representation of numbers in (0,1) to
various bases.

(vi) A. J. Goldman is collaborating with M. Zelen (Mathematics Research
Center, U. of Wisconsin) on a paper dealing with least squares estimation.

(vii) C. T. Zahn, Jr. completed his paper on optimal approximations
of certain classes of binary relations by equivalence relations.

Publications:

(1) Covers and packings in a family of sets. J. Edmonds. Bulletin of
The American Mathematical Society. 68 (1962) pp. 494-499.
(2) A property of linear frequency modulation. A.J. Goldman. Proceedings
of the Institute of Radio Engineers. 50 (1962) p. 1711.
(3) The first run preceded by a quota. B. K. Bender and A.J. Goldman.
Journal of Research NBS, Section B (Mathematics and Mathematical Physics)
66B (1962) pp. 77-89.
(4) Black box maximization of circular coverage. Charles T. Zahn, Jr.
Journal of Research NBS, Section B (Mathematics and Mathematical Physics
66B (1962) pp. 181-213.
(5) Review of "Systems: Research and Design." A. J. Goldman. To appear
in Technometrics.
(6) "Recognition of completely mixed games." A. J. Goldman. To appear
in Journal of Research NBS, Section B (Mathematics and Mathematical
Physics), 67B (1963).

AIR DEFENSE
Task 1105-12-11415/61-544

Origin and Sponsor: U. S. Army Air Defense Command   Aurhorized 9/30/61
Manager: Lambert S. Joel
Full Task Description: July-September 1961 issue, p. 12

      Status: CONTINUED. L. S. Joel and C. T. Zahn, Jr. continued coding
the first simulation model. L. S. Joel and A. J. Goldman contiued
cooperation with members of Denver Research Institute on model formulation.
B. K. Bender examined some related mathematical problems.

COMBINATORIAL MATHEMATICS
Task 1105-12-11455-1205

Origin: NBS
Sponsor: Army Research Office (Durham)
Managers: Jack Edmonds & Christoph Witzgall

      Status: CONTINUED. John Mather and Jack Edmonds obtained the following
results (everything is semi-linear).
      A (finite) 2-complex can be immersed (locally imbedded) in E^3 if and
only if it can be imbedded in some 3-manifold. Sufficiency is based on two
rather surprising lemmas: (1) If a regular neighborhood N of the 1-sceleton
of a 2-complex k can be imbedded in E^3 then it can be imbedded so that, for
each 2-cell D of k, the annulus D∩N has "an even number of twists." (2)
The latter type (and only the latter type) imbedding of N can be extended
to an immersion of k. An easily verifiable combinatorial description is
given for such complexes. The Poincaré conjecture is equivalent to:
If a simply connected 2-complex can be immersed in E^3 then it can be
embedded in E^3 . The "immersotopy classes" of a graph in S^2 are
characterized; the corresponding result for k in E^3 is tentative.
      Jack Edmonds drafted a paper on his algorithm for maximum matchings
and related graph-theoretic material. C. Witzgall and C. T. Zahn, Jr.
began work on computer implementation of the algorithm, and developed
new variants and additional theoretical results.

6. MATHEMATICAL AND COMPUTATIONAL SERVICES

1102-40-11645/56-0166   SCF-LCAO SOLUTION OF SOME HYDRIDES
Origin and Sponsor: NBS, Section 5.9
Manager: P. J. Walsh
Full Task Description: January-March 1956 issue, p. 27
Status: Continued. Program tapes have been constructed for Hartree-
Fock SCF calculations of T_d, XH_4 and $C_{\infty v}$, XH molecules. Calculations
have been completed for five of the accessible molecules and is in
progress for others. A program tape for C_{2v}, XH_2 systems will shortly be
ready; the integral programs have been completed for this symmetry.

1102-40-11645/56-0186   MECHANICAL MEASUREMENTS OF GAGE BLOCKS
Origin and Sponsor: NBS, Section 2.5
Manager: B. S. Prusch
Full Task Description: July-September 1956 issue, p. 33
Status: Continued. Computations for 38 sets of gage blocks were completed.

1102-40-11647/58-0266   DEPOLYMERIZATION PROCESSES
Origin and Sponsor: NBS, Section 7.6
Manager: Maxine L. Rockoff
Full Task Description: July-September 1957 issue, p. 36
Status: Continued. See also description in April-June 1962 issue, p. 32,
under task 1102-40-11647/62-1209. Code has been completely checked.
Production runs have begun. Sponsor is analyzing computer results and
comparing them with experimental data.

1102-40-11645/58-0339   COMPUTATION OF VISCOELASTICITY PROPERTIES OF MATERIALS
Origin and Sponsor: NBS, Section 3.4
Manager: H. Oser
Full Task Description: January-March 1958 issue, p. 38
Status: Continued. A paper entitled "A Model for the Viscoelastic Behaviour
of Rubberlike Polymers Including Entanglement Effects" by R. S. Marvin
(Div. 6.05) and H. Oser was submitted to the NBS Journal of Research for
publication in the Oct.-Dec. 1962 issue.

1102-40-11645/58-0366   RADIATION PATTERNS OF ANTENNAS
Origin and Sponsor: U.S. Information Agency, Department of State
Manager: P. J. Walsh

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Full Task Description: April–June 1958 issue, p. 35
Status: Reactivated. Production runs were made and results submitted
to the sponsor.

1102-40-11645/58-0368 INTENSITY FUNCTIONS OF SCATTERED LIGHT
Origin and Sponsor: U. S. Army Signal Research and Development Laboratories
Manager: H. Oser
Full Task Description: July–September 1958 issue, p. 32
Status: Completed.

1102-40-11645/60-0476 GAS TUBE CHARACTERISTICS, II
Origin and Sponsor: Diamond Ordnance Fuze Laboratories
Manager: H. Oser
Full Task Description: October–December 1959 issue, p. 30
Status: Continued. A paper entitled: "Numerican Computation of the
Temporal Development of Currents in a Gas Discharge Tube" was written in
coauthorship with W. Börsch-Supan. It will appear in the Mathematical
Physics series of the NBS Journal of Research.
    Two talks were presented at the ACM–One-Day-Washington Symposium
("Computers in the Space Age"):
    (1) A. L. Ward and H. Oser: Solutions of Problems in Gaseous
         Electronics on Electronic Computers.
    (2) H. Oser, W. Börsch-Supan and A. L. Ward: Numerical Solution of
         the Equations of Electric Discharges in Gas Tubes.
Further investigations on the influence of various parameters in the time-
dependent equations are conducted by the sponsor.

1102-40-11645/60-0486 MORSE WAVE FUNCTIONS AND FRANCK-CONDON FACTORS
Origin and Sponsor: NBS, Section 3.0
Manager: Ruth Zucker
Full Task Description: January–March 1960 issue, p. 28
Status: Production runs were made and results submitted to the sponsor.

1102-40-11645/60-0513 RADIATIVE ENVELOPES OF MODEL STARS
Origin and Sponsor: National Aeronautics and Space Administration
Managers; P. J. Walsh and S. Haber (11.1)
Full Task Description: July–September 1960 issue, p. 23
Status: Incative.

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1102-40-11645/61-0530 SPECIMEN WAVE LENGTH
Origin and Sponsor: NBS, Section 9.4
Manager: L. Joseph
Full Task Description: July-September 1960 issue, p. 28
Status: Terminated. Trial runs indicated the objective was not feasible.

1102-40-11645/61-0531 HEAT TRANSFER IN CRYSTALS
Origin and Sponsor: NBS, Section 3.1
Manager: H. Oser
Full Task Description: July-September 1960 issue, p. 29
Status: Terminated. Production continued under direct control of the
sponsor.

1102-40-11645/61-0538 SPECTRAL REFLECTANCE
Origin and Sponsor: NBS, Section 9. 4
Managers: S. Haber (11.1) and P. J. Walsh
Full Task Description: October-December 1960 issue, p. 23
Status: Continued. New Programs were written and corrected and further
numerical experiments performed. Formulas using terms corresponding to
two distinct free-electron families were investigated and some were found
which gave a much better overall fit of the observed data that was
obtainable with formula containing only one free-electron term.

1102-40-11645/61-0540 DIFFUSION CALCULATIONS
Origin and Sponsor: Army Chemical Center
Manager: L. Joseph
Full Task Description: January-March 1961 issue, p. 21
Status: Terminated.   Production runs were made and results submitted
to the sponsor.

1102-40-11645/61-0556 TCHEBYCHEFF APPROXIMATION BY RATIONAL FUNCTIONS
Origin and Sponsor: NBS, Section 11.1
Manager: P. J. Walsh
Full Task Description: January-March 1961 issue, p. 22
Status: Terminated. Further work on this task will be described under
task 0055.

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1102-40-11645/61-0560 MUSCLE FLEXING
Origin and Sponsor: National Naval Medical Center
Manager: H. Oser
Full Task Description: April–June 1961 issue, p. 22
Status: Terminated.

1102-40-11645/62-1009 MONTE CARLO NEUTRON STUDIES
Origin and Sponsor: NBS, Section 4.3
Manager: Sally T. Peavy
Full Task Description: April–June 1961 issue, p. 21
Status: Continued. The special random number routine is checked and ready
for the sponsor. The interpolation routine is in the process of being
checked.

1102-40-11647/62-1022 CALCULATIONS FOR SPECTRUM OF DIPOLE RADIATION
Origin and Sponsor: Naval Research Laboratory
Manager: R. J. Arms
Full Task Description: April–June 1958 issue, p. 33
Status: Continued. A new code has been checked out. Results have been
submitted to the sponsor.

1102-40-11645/62-1027 NEW SYSTEM
Origin and Sponsor: NBS, Section 11.2
Manager: J. H. Wegstein
Full Task Description: July–September 1961 issue, p. 22
Status: Continued. A study of a monitor system for the disk memory,
7090 and 1410 computers indicated that it would not be practical to
develop a stored program system because of the large open-shop programming
requirements. The 1410 computer was acquired in December without the
disk memory.
     The IBM System (IBSYS) was obtained and tested by R. Herbold. Simple
example problems were run which will be available for a programmers guide
to the system. IBSYS and the Bell System are now available to programmers
but no further updating of the Bell System will be made in anticipation
of its eventual abandonment. R. Herbold prepared a card–to–tape, tape-
to–printer, tape-to-card, and accounting program to enable the 1410
to serve as a secretary computer for the 7090.

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1102-40-11645/62-1030 ELECTROCARIOGRAPHIC ANALYSIS
Origin: NBS, Section 12.5
Sponsor: Veterans Administration
Manager: R. J. Herbold
Full Task Description: April-June 1959, p. 29
Status: Continued. Statistical analysis runs were continued and results
are transmitted to the sponsor. An improved type monitor program is
being coded.

1101-12-11416/62-1091 BOUNDS FOR EIGENVALUES
Origin: Wright Patterson AFB
Manager: H. Oser
Full Task Description: October-December 1961 issue, p. 4
Status: Continued. The attempt to find bounds for eigenvectors
has been abandoned. Work on eigenvalue estimates for Lengendre's
differential equation with nonintegral coefficients continued.

1102-40-11647/62-1125 MATRIX COMPUTATIONS
Origin and Sponsor: NBS, Section 9.5
Manager: P. J. Walsh
Full Task Description: October-December 1961 issue, p. 25
Status: Terminated. Production runs continued under direction of the
sponsor.

1102-40-11647/62-1130 FALLOUT SHELTER COMPUTATIONS
Origin and Sponsor: Office of Civil Defense
Manager: D. I. Mittleman
Full Task Description: October-December 1961 issue, p. 25
Status: Continued. The calculation of protection factors for all submitted
buildings has been completed. Numerous summaries have been prepared and
others are in the process of being obtained.
    A report summarizing the details of the work performed at the
National Bureau Of Standards is being prepared.

1102-40-11647/62-1144 THERMAL BOUNDARY LAYERS
Origin and Sponsor: University of Maryland
Manager: H. Oser
Full Task Description: October-December 1961 issue, p. 26
Status: Terminated. Production runs for both the Blasius case and the
forced convection case were completed and the results have been submitted
to the sponsor.

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1102-40-11647/62-1155   MORTGAGE LOAN SURVEY
Origin and Sponsor: Federal Home Loan Bank Board
Manager: Ruth Zucker
Full Task Description: January-March 1962 issue, p. 24
Status: Continued. Three production runs were made for the July and
August survey and numerous tables were computed. In addition production
runs were made for the ensuing months.

    The production run for August involved 96 correlation tables using
a survey of 16449 data cards. The data cards were distributed into 3
categories, construction of new homes, purchase of newly-built homes
and purchase of previously occupied homes and later sub-divided into the
5 types of lending institutions. The correlation tables also showed
the distribution of loans among the 18 selected cities.

    The following fields of information, effective interest rate,
length of mortgage loan, purchase price of property, per cent of loans
to prices were divided into numerous ranges and the per cent of loan
distributed in each range was computed.

1102-40-11647/62-1171   HOSPITAL PROGRAM PLANNING
Origin and Sponsor: Veterans Administration, Mount Alto Hospital
Manager: Sally T. Peavy
Full Task Description: January-March 1962 issue, p. 26
Status: Terminated. Production runs continued under direction of
sponsor.

1102-40-11647/62-1174   IMPULSE CALCULATIONS
Origin and Sponsor: NBS, Section 30.0
Manager: A. Beam
Full Task Description: January-March 1962 issue, p. 26
Status: Terminated.

1102-40-11647/62-1176   NUMERICAL INTEGRATIONS
Origin and Sponsor: NBS, Section 15.2
Manager: D. Kaplan
Full Task Description: January-March issue, p. 26
Status: Terminated.

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1102-40-11647/62-1177   ANALYSIS OF VARIANCE
Origin and Sponsor: Diamond Ordnance Fuze Laboratories
Manager: Louis Joseph
Full Task Description: January-March 1962 issue, p. 27
Status: Terminated. Production runs of several complete factorial
designs were made. Results were turned over to the sponsor.

1102-40-11647/62-1178   LOGARITHMIC COEFFICIENTS
Origin and Sponsor: NBS, Section 5.3
Manager: R. J. Arms
Full Task Description: January-March 1962 issue, p. 27
Status: Inactive.

1102-40-11647/62-1179   CATALOGUE INFORMATION
Origin and Sponsor: Diamond Ordnance Fuze Laboratories
Manager: Ruth Varner
Full Task Description: January-March 1962 issue, p. 27
Status: Continued. 5007 titles of documents were submitted. Desired
was a permuted subject index of the key-word-in-context (KWIC) type.
Document titles were altered to conform to the format required to
Share distribution 1239. (Bell Labs Permutation Index Program).
     Each word in the title was permuted except those words predesignated
in the program as non-significant. The word was cycled to a fixed position
in the title and printed out with the corresponding test and document
identification number.
     The document cards were processed through the code and the permuted
subject index submitted to the sponsor.

1102-40-11647/62-1182   FOURIER INTEGRAL
Origin and Sponsor: Diamond Ordnance Fuze Laboratories
Manager: H. Oser
Full Task Description: April-June 1962 issue, p. 25
Status: Continued. Both parts of the program were tested out and found to
be quite satisfactory. A program deck was turned over to the sponsor who
will conduct the production runs hereafter.

Status of Projects

1102-40-11647/62-1188   STEPWISE REGRESSION
Origin and Sponsor: Ft. Belvoir, U. S. Army
Manager: P. J. Walsh
Full Task Description: April-June 1962 issue, p. 26
Status: Terminated. The results of the calculation using the SHARE
library code are correct. Production runs will be continued under the
direction of the sponsor.

1102-40-11647/62-1189   SEQUENTIAL METHODS TABLES
Origin and Sponsor: Quartermaster Research and Engineering Field
Evaluation Agency, U. S. Army
Manager: R. J. Arms
Full Task Description: April-June 1962 issue, p. 26
Status: Continued. Calculations of the confluent hypergeometric function
have been successful. The sponsor has received about one half of his
desired output.

1102-40-11647/62-1191   CAB TAPE CONVERSION
Origin and Sponsor: Civil Aeronautics Board
Manager: G. C. Ziegler
Full Task Description: April-June 1962 issue, p. 27
Status: Terminated

1102-40-11647/62-1193   SOLUTION TO SECOND ORDER PARTIAL DIFFERENTIAL
ELLIPTIC EQUATION
Origin and Sponsor: NBS, Section 3.08
Manager: P. J. Walsh
Full Task Description: April-June 1962 issue, p. 28
Status: Continued. Additional test runs are being made. The source
function will be introduced under the following condition:

$$S = \begin{cases} 1 & \text{for } x^2 + y^2 + z^2 \leq h\alpha \\ 0 & \text{for } x^2 + y^2 + z^2 > h\alpha, \text{ where } \alpha \text{ is an} \end{cases}$$

input parameter.

    Several production runs were made using the source function described
above.

    A third version of the code has been written and checked out.

Status of Projects

This new version solves the problem

$$\nabla^2 \Phi = - ke^{-c(x^2+y^2+z^2)} + e^{\Phi}$$

where k and c are input parameters. Some production runs have been made using this equation.

1102-40-11647/62-1196   HEAT OF ADSORPTION
Origin and Sponsor: NBS, Section 15.2
Manager: Ruth Varner
Full Task Description: April-June 1962 issue, p. 29
Status: Continued. The lattice liquid theory of adsorption by Pace has been extended from a three layer theory to a six layer theory to provide more accurate data in the two to three layer region of multilayer adsorption.

The population ratios, rate of change of population, and differential heats of adsorption for argon on carbon black were determined at 77.7°K.

A 7090 code was written to perform far needed calculations. Results were transmitted to the sponsor.

1102-40-11647/62-1201   UHF-TV
Origin and Sponsor: Federal Communications Commission
Manager: W. Hall
Full Task Description: April-June 1962 issue, p. 29
Status: Continued. The program for the original problem has been written and checked. Several production runs have been made on data as it has been forwarded from the field engineers. The analysis of this data have been submitted to the sponsor.

1102-40-11647/62-1202 ANALYSIS OF ION REACTION DATA
Origin and Sponsor: NBS, Section 13.6
Manager: Maxine Rockoff
Full Task Description: April-June 1962 issue, p. 30
Status: Terminated.

Status of Projects

1102-40-11647/62-1203 CYLINDRICAL SHOCK WAVE
Origin and Sponsor: NBS, Section 3.7
Managers: Sally Peavy and S. Haber
Full Task Description: April-June 1962 issue, p. 30
Status: Continued. Code has been completed and is in the process of
being checked out.

1102-40-11647/62-1204 LAPLACE AND FOURIER TRANSFORMS
Origin and Sponsor: NBS, Section 11.2
Manager: Maxine Rockoff
Full Task Description: April-June 1962 issue, p. 31
Status: Terminated

1102-40-11647/62-1206 CALCULATION OF AVERAGE THEORETICAL DEPRECIATION
RESERVES
Origin and Sponsor: Department of the Treasury
Manager: R. Herbold
Full Task Description: April-June 1962 issue, p. 31
Status: Terminated

1102-40-11647/62-1209 MIXED INITIATION OF DEPOLYMERIZATION
Origin and Sponsor: NBS, Section 7.6
Manager: Maxine Rockoff
Full Task Description: April-June 1962 issue, p. 32
Status: Terminated. Work under this task will be continued and reported
under task 1102-40-11647/58-0266.

1102-40-11647/62-1212 COLOR DIFFERENCES
Origin and Sponsor: NBS, Section 10.9
Manager: J. D. Waggoner
Full Task Description: April-June 1962 issue, p. 33
Status: Inactive.

Status of Projects

1102-40-11647/63-1218   INTEGRAL EVLAUATION
Origin: Diamond Ordnance Fuze Laboratories, Department of the Army
Sponsor: Diamond Ordnance Fuze Laboratories, Department of the Army
Manager: L. Joseph
Objective: To evaluate the following double integral as a function of η_c and ω/ω_m :

$$I = 4 \int_0^{\eta_c} d\eta \int_{\pi/2}^{3\pi/2} d\beta \frac{|\cos \eta \cos \beta| (\sin \eta \sin \beta + 1)^2 \sin^2 \eta}{(\sin \eta + \frac{\omega}{\omega_r} \sin \beta)^2 + (\cos \eta \cos \beta)^2}$$

where

$$0 < \eta_c \leq \pi/2$$

and

$$\frac{\omega_r}{\omega_m} = \sqrt{(\frac{\omega}{\omega_m})^2 + \frac{\sin^4 \eta}{4}} - \frac{\sin^2 \eta}{2} .$$

Background: The above integral arises in connection with relaxation phenomena for narrow line width ferromagnetic materials.

The use of the substitution $v = \sin \eta \sin \beta$ reduces the integral to the form:

$$I = 4 \int_0^{\eta_c} d\eta \cos \eta \sin \eta \int_{-\sin \eta}^{\sin \eta} \frac{(v+1)^2}{(1 + \frac{\omega_m}{\omega_r}) v^2 + 2 \frac{\omega}{\omega_r} v + 1} dv.$$

The integral with respect to v can be evaluated in terms of elementary functions. The resulting integral with respect to η can then be evaluated numerically.

The problem was transmitted by G. Jones (DOFL).

Status: NEW. Conpleted. A program has been written to evaluate the η

Status of Projects

integral using the Simpson's rule. Production runs have been made and
results have been given to the sponsor.

1102-40-11746/63-1219   SHOCK TUBE DATA   Authorized 6/27/62
Origin: Diamond Ordnance Fuze Laboratories, Department of the Army
Sponsor: Diamond Ordnance Fuze Laboratories, Department of the Army
Manager: L. Joseph
Objective: To process shock tube data in order to determine the half-width
of the β line of hydrogen under certain conditions.
Background: The half-width of the curve of intensity, I, versus wavelength
λ, is defined to be the difference between the two values of λ for which
the intensity is one-half the maximum intensity.
     The problem was transmitted by Harry Gieske (DOFL)
Status: New: A computer program was written to process data from a shock
tube. The program first fits a minimum distance straight line to certain
calibration data. Then this equation is used to transform film density
readings to intensity. The half maximum intensity is then obtained by
averaging the values of I corresponding to four different values of λ, two
of which give maxima and two of which give noise level. The two λ's which
yield half maximum intensity are then obtained by linear interpolation.
     Production runs have been made and results have been given to the
sponsor.

11-2-40-11647/63-1223   CARDIOVASCULAR DYNAMICS   Authorized 7/10/62
Origin: Univ. of Pennsylvania, Bockus Research Institute
Sponsor: Univ. of Pennsylvania, Bockus Research Institute
Manager: M. Rockoff
Objective: To develop a computer program which will test the validity of
a theoretical model of part of the cardiovascular system.
Background: It is desired to study the manner in which mechanical energy is
propagated through the cardiovascular system and how blood volume, flow and
pressure are controlled. Techniques have been developed and employed to measure
and record pressure and strain in intact living arteries. Also, a theoreti-
cal model has been developed which predicts the changes which will occur in
an arterial pressure wave as a function of frequency and distance.
     The problem was transmitted by Lysle H. Peterson (Univ. of Pennsylvania).
Status: New. The computational aspects of the problem have been analyzed
and an outline of a computer program to test the model has been submitted
to the sponsor.

Status of Projects

1102-40-11647/63-1228   SHOCK DISSOCIATION   Authorized 7/25/62
Origin: NBS, Section 3.7
Sponsor: NBS, Section 3.7
Manager: A. E. Gregg
Objective: To obtain shock profiles for nitrogen and for argon containing
the dissociating gas, tetrafluorhydrazine (N_2F_4), for selected values of

the shock Mach number, initial pressure, and mole per cent N_2F_4. The results

will provide thermodynamic data for the shocked gas mixtures both at the
shock front where no dissociation occurs, and at equilibrium where the dis-
sociation is essentially complete.
Background: This task is related to an investigation of the reaction kinetics
of the N_2F_4 dissociation process carried out by the method of shock wave

compression.
     The problem was transmitted by H. J. Davis (3.07).
Status: New. Completed. A program was written to obtain shock profiles
for nitrogen and argon containing a dissociating gas tetrafluorhydrazine.
     The results provided thermodynamic data for the shocked gas mixtures
both at the shock front where no dissociation occured and at equilibrium
where the dissociation was essentially complete.

1102-40-11647/63-1240   SECRET SERVICE FORGERY PROJECT   Authorized 9/10/62
Origin: Treasury Department, U.S. Secret Service
Sponsor: Treasury Department, U.S. Secret Service
Manager: M. Paulsen
Objective: To provide the Secret Service with information that will expedite
and make more efficient and feasible their task of finding and grouping
checks signed by the same forger.
Background: One method of identifying forged government checks was to examine
the idiosyncrasies of the signatures. Since the number of forged checks per
year added to those on file has become so voluminous this method was no longer
efficient or possible. Therefore an idea was conceived whereby all alphabetic
and numeric characters and the modus operandi could be classified in such a
way that data processing equipment could be utilized to group individuals
with respect to their handwriting characteristics.
     The problem was transmitted by J. L. Lewis(Treasury Department).
Status: New. Edit, update, compare and print routines have been written
and code checked. No production runs have been made to date.

1102-40-11647/63-1258   SPECTRAL ANALYSIS   Authorized 10/5/62
Origin: NBS, Section 15.03
Sponsor: NBS, Section 15.03
Manager: H. Oser

Status of Projects

Objective: To compute, automatically, all differences $v_i - v_j$ among pairs of bands in molecular spectra; to analyse these differences in terms of their density (differences per interval) and to report significant high density groups of differences. The high density groups and the density per interval information then will be the starting point for the spectroscopic analysis.
Background: Molecular emission spectra generally present a wealth of features, usually not well defined. The analysis of relating the frequencies to the molecular parameters is quite tedious and the use of an electronic computer seems indicated.
      The problem was transmitted by David Garvin (15.03).
Status: New. Completed. A Fortran program was written for integral frequencies, but was modified later to acc_mmodate fractional frequencies too. The program is checked out completely and has been turned over to the sponsor who will conduct the production runs.

1102-40-11647/63-1260   DENTAL RESEARCH   Authorized 10/4/62
Origin: NBS, Section 7.8
Sponsor: NBS, Section 7.8
Manager: H. Oser
Objective: To analyze stress-strain measurements of dental filling materials. In particular to determine quantitatively the deviations from linear behavior.
Background: Various theories have been proposed to describe the dependence of the rate of strain versus stress, a linear law, exponential laws and hyperbolic sine laws. It is the problem here to determine the law which fits the data best.
      The problem was transmitted by Philip L. Oglesby (7.8).
Status: New. A problem is presently being written which is to mechanize the analysis of the elastic behavior of dental materials.

1102-40-11647/63-1273   CRYSTAL GROWTH   Authorized 2/12/62
Origin: NBS, Section 8.5
Sponsor: NBS, Section 8.5
Manager: J. Quinones
Objective: To study the "Vapor-Phase Growth of Crystal Whiskers." From the usual assumption that whisker growth from the vapor occurs by a surface diffusion mechanism the following equation for the whisker growth rate has been derived:

$$\frac{d\ell}{dt} = \gamma \left\{ \sqrt{D\tau}\ \tanh\ (\ell/\sqrt{D\tau}) - \sum_{n=0}^{\infty} \frac{2D}{\ell}\ \frac{\exp\left\{ -\left[\left(\frac{2n+1}{2}\frac{\pi}{\ell}\right)^2 D + \frac{1}{\tau} \right] t \right\}}{\left[\left(\frac{2n+1}{2}\frac{\pi}{\ell}\right)^2 D + \frac{1}{\tau} \right]} \right\}$$

Status of Projects

Where γ, D, τ are the growth constant, the surface diffusion coefficient and
the re-evaporation time respectively. Solutions are discussed for appropriate
ranges of parameters. In particular, it is shown under what conditions
exponential growth should be observed and that for no re-evaporation:

$$\tau \to \infty, \quad \frac{d\ell}{dt} \to \sqrt{t} \quad \text{for large t.}$$ The stopping of growth due to
surface nucleation is considered.

Background: The data obtained from previous studies in this field (see A,
B) will be compared with the results obtained.

References:
  (A) R. Comer. J. Chem. Phys. 28, 457 (1958).
  (B) J. M. Blakeley and K. A. Jackson, J. Chem. Phys. 37, 428 (1962).
       The problem was transmitted by R.E. Howard and R.L. Parker(8.05).

Status: New. A Fortran code was written in which the differential equation
was solved by the Runge-Kutta method. Results for one set of data were
transmitted to the sponsors. This project has been temporarily suspended
by the sponsors.

1102-40-11647/63-1275 SECURITIES MARKET STUDY   Authorized 11/14/62
Origin: Securities and Exchange Commission
Sponsor: Securities and Exchange Commission
Manager: I. A. Stegun, R. Zucker
Objective: To edit data and prepare various tabulations on securities.
Background: In connection with the special study of the securities
markets, information has been obtained regarding specialists and other
member activities of the stock exchanges. In order to evaluate this
information, it is necessary to have analytical tabulations prepared by
the use of a computer. This problem was transmitted by Johnathan Levin
(SEC).
Status: New. Editing codes have been written and checked. Tabulation
codes are being checked out on small samples.

Status of Projects

1102-30-11647/63-1286 OPTIMAL MEDICAL EXAMINATION SCHEDULE
Origin: Maryland University   Authorized 12/12/62
Sponsor: Maryland University
Manager: J. Quinones
Objective: The purpose of this project is to set criteria, and to evaluate
policies for medical examinations for preclinically invasive tumors. This
is done by the solution of 4 equations with different values for the given
sets of parameters.

1) $\epsilon(\Delta, T) = \dfrac{\lambda^4}{6} \displaystyle\int_{T}^{\Delta} (A - BS + CX^2 - DX^3)\, e^{\lambda x}\, dx$

where $A = \dfrac{\Delta^3 e^{\lambda\Delta} (e^{2\lambda\Delta} + 4e^{\lambda\Delta} + 1)}{(e^{\lambda\Delta} - 1)^4}$ $B = \dfrac{3\Delta^2 e^{\lambda\Delta} (1 + e^{\lambda\Delta})}{(e^{\lambda\Delta} - 1)^3}$

$C = \dfrac{3\Delta\, e^{\lambda\Delta}}{(e^{\lambda\Delta} - 1)^4}$ $D = \dfrac{1}{(e^{\lambda\Delta} - 1)}$

$\lambda = 0.2 \quad \Delta = 1 \quad T = 0.1 \,(.1)\, .9$

$\lambda = 0.2 \quad \Delta = 1 \quad T = 0.2 \,(.2)\, 1.8$

2) $\epsilon(\Delta, T) = \epsilon,\, (\Delta, T) + \dfrac{\lambda^4}{6} \displaystyle\int_{0}^{T} e^{-3y}\, e^{\lambda y}(A - By + Cy^2 - Dy^3)\, dy$

with parameters same as in 1)

3) $\dfrac{G_4 (X_{k+1} - T) - G_4 (X_k)}{G_4 (X_{k+1}) - G_4(X_k)} = \epsilon$

where $G_4(X) = e^{-X} \left(1 + X + \dfrac{X^2}{2!} + \dfrac{X^3}{3!} + \dfrac{X^4}{4!}\right)$

$X_\bullet = 0,\ X_k \geq 60;\ \lambda = 0.2;\ T = 0.1,\ 0.5;\ \epsilon = 0.05,\ 0.1,\ 0.2$

Status of Projects

4) $X_{k+1}[G_4(X_k) - G_4(X_{k+1})] - \dfrac{4}{\lambda}[W(X_k) - W(X_{k+1})] = T$

where $G_4(X) = e^{-X}(1 + X + \dfrac{X^2}{2!} + \dfrac{X^3}{3!} + \dfrac{X^4}{4!})$, $W(X) = e^{-\lambda X}(1 + \lambda X + \dfrac{(\lambda X)^2}{2} + \dfrac{(\lambda X)^3}{6} + \dfrac{(\lambda X)^4}{24})$

$X_0 = 0, X_k \le 60;\quad \lambda = 0.2;\quad T = 0.25,\ 0.5,\ 0.75$

Background: It is assumed that a possibility of misdiagnosis exists which is a decreasing function of the time since inception of the disease. The simplest policy is periodic with period Δ. If it is assumed that diagnosis is perfect, and that the probability density for incidence is:

$$U(t) = \dfrac{\lambda^4 t^3}{6} e^{-\lambda t}$$

then the probability that a tumor will go undetected for a time T or greater is given by equation 1).

If the probability of misdiagnosis is taken to be e^{-3t}, then the probability for a tumor to remain undetected for a time T or greater is given by equation 2).

Finally, the optimum schedule of examination times t_1, t_2, ..., given a desired level of protection ϵ, is given by equations 3) and 4).

The problem was transmitted by George H. Weiss (Maryland University).

Status: New. Three Fortran codes were written, productions runs were made and the answers were transmitted to the sponsor. Completed.

7. STATISTICAL ENGINEERING SERVICES

COLLABORATION OF STATISTICAL ASPECTS OF NBS
RESEARCH AND TESTING

Task 3911-61-39951/51-1

Origin: NBS   Authorized 7/1/50
Managers: W. J. Youden, J. M. Cameron
Full task description: July-September 1950 issue, p. 60

    Status: CONTINUED. During this period members of the Section
provided statistical assistance and advice to a number of Bureau personnel.
The following are representative examples:
    (i) Joan R. Rosenblatt continued to collaborate with G. L. Howett
of the Photometry and Colorimetry Section on statistical aspects of the
experimental program of the Committee on Uniform Color Scales of the Optical
Society of America.
    (ii) A study of the behavior of measurements from the calibration
of mercury in glass thermometers was begun by Dr. Eisenhart and Janace
Speckman in cooperation with Mrs. Massie of the Temperature Physics
section. The purpose of the study is to ascertain from a detailed
statistical analysis of several years data whether there is evidence of
non-homogeneity of variance or any other such phenomena that might affect
the precision and accuracy of the process.
    (iii) George Weiss is collaborating with M. M. Siddiqui (NBS Boulder
Laboratories) in work on a distribution function for received radio
signals through a medium in which scattering is significant.
    (iv) Collaboration with the Mass and Scales Section continued with
work being carried on in the preparation of a program for automatic
calculation of results of calibration.
    (v) Work was begun by W. J. Youden on the construction of classes
of paired designs for use in calibrations. As an example, items A, B,
C, D, E, and F are calibrated against a standard S, by making the 9
comparisons given by the line segments in the diagram, i.e., by AB, BC,
AS, CS, SE, etc.
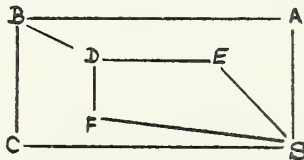
All comparisons with the standard have the same precision. Wear on the
standard is minimized because B and D are calibrated indirectly.

    Publications:

(1) On the realistic measurement of precision and accuracy. Churchill
    Eisenhart. ISA Proceedings of the Eighth National Aero-Space

Status of Projects

Instrumentation Symposium, held in Washington, May 1962, pp. 75-83.
(2) Realistic evaluation of the precision and accuracy of instrument
calibration systems. Churchill Eisenhart. To appear in the
Proceedings of the 1962 Standards Laboratory Conference and the Journal
of Research NBS, Section C (Engineering and Instrumentation).
(3) Uncertainties in calibration. W. J. Youden. To appear in the Institute
of Radio Engineers Transactions--Instrumentation.
(4) The collaborative test. W. J. Youden. To appear in the Journal of
the Association of Official Agricultural Chemists.
(5) Realistic estimates of errors. W. J. Youden. Journal of the
Instrument Society of America 9, 57-58, October 1962.
(6) Mean first passage times and the dissociation of diatomic molecules.
Kurt Shuler (Institute for Defense Analysis) and George Weiss.
Submitted to the Journal of Chemical Physics.

STATISTICAL SERVICES
Task 1103-40-11625/58-346

Origin and Sponsors: Various Agencies   Authorized 3/31/58
Manager: J. M. Cameron
Full task description: January-March 1958 issue, p. 45

Status: INACTIVE.

Current Applications of Automatic Computer

This is a record of the use of the IBM 7090 for the period of
July 1 through December 31, 1962.

TASK NUMBER		TITLE	ASSEMBLY TIME	CODE CHECKING	PRODUCTION TIME	TOTAL TIME ON COMPUTER
NBS SERVICES			(M	I N	U T	E S)
51-0002	11.3	STATISTICAL ENGINEERING	7	14	197	218
54-0030	13.1	SPECTRUM ANALYSIS++	8	149	304	461
54-0031	13.1	SPECTRUM ANALYSIS++	21	38	24	83
54-0033	13.1	SPECTRUM ANALYSIS++	126	1230	1505	2861
54-0034	13.1	SPECTRUM ANALYSIS++	0	9	96	105
55-0055	11.1	RESEARCH IN NUMERICAL ANALYSIS	36	126	264	426
55-0056	11.1	RESEARCH IN MATHEMATICAL TOPICS	11	112	12	135
55-0065	11.2	AUTOMATIC CODING	1	52	5	58
55-0082	3.1	THERMOMETER CALIBRATION+	0	0	201	201
56-0131	2.2	CALCULATIONS IN OPTICS+	6	6	2	14
56-0166	15.0	SCF-LCAO SOLUTION OF HYDRIDES+	52	544	845	1441
57-0219	3.2	THERMAL PROPERTIES+	0	75	78	153
57-0236	3.8	SCF EIGENVALUES+	0	4	22	26
57-0250	2.1	SPECTROPHOTOMETRIC DATA+	4	40	37	81
57-0252	4.4	NEUTRAL MESON EXPERIMENTS++	84	825	776	1685
58-0256	10.6	COMPOSITE WALL STUDIES++	11	237	322	570
58-0266	7.6	DEPOLYMERIZATION PROCESSES	0	330	17	347
58-0272	3.7	EQUATION OF STATE++	154	668	170	992
58-0314	3.7	APPROXIMATIONS FOR GAS MIXTURES+	146	1020	212	1378
58-0339	6.5	VISCOELASTICITY PROPERTIES	0	0	4	4
59-0403	2.1	COMPUTATION OF COLOR FADINGS+	0	0	7	7
59-0433	2.1	COLOR OF SIGNALS++	16	15	30	61
59-0440	87.1	NUMERICAL MAPPING++	13	83	2	98
60-0449	2.1	SPECTRAL LINE COLORIMETRY+	0	0	1	1
60-0489	3.1	INVERSION OF LINE PROBE DATA+	0	33	6	39
60-0493	3.8	POISSON DISTRIBUTION FUNCTION++	21	225	433	679
61-0523	4.7	NEUTRON CROSS SECTION STUDIES++	4	51	7	62
61-0530	9.4	SPECIMEN WAVELENGTHS	0	0	1	1
61-0531	3.1	HEAT TRANSFER IN CRYSTALS	3	40	92	135
61-0538	9.4	SPECTRAL REFLECTANCE DATA	23	3	114	140
61-0559	3.1	THERMOCOUPLE CALIBRATION+	11	66	25	102
61-0571	15.4	NMR SPECTRUM+	0	2	33	35
61-0826	11.2	TRAINING+++	0	5	40	45
61-0995	11.2	ERROR DETECTION+++	0	15	41	56

Current Applications of Automatic Computer

TASK NUMBER		TITLE	ASSEMBLY TIME	CODE CHECKING	PRODUCTION TIME	TOTAL TIME ON COMPUTER
NBS SERVICES:			(M	I N	U T	E S)
62-1000	12.5	POST OFFICE OPERATIONS STUDY++	224	844	106	1174
62-1003	15.4	MOLECULAR SPECTROSCOPY+	30	299	25	354
62-1005	4.3	RADIATION INTERACTION++	35	424	164	623
62-1006	4.3	RADIATION INTERACTION++	0	68	0	68
62-1007	4.3	RADIATION SHIELDING++	6	280	25	311
62-1008	4.3	GAMMA RAY PENETRATION++	0	65	0	65
62-1009	4.3	MONTE CARLO NEUTRON STUDIES	4	14	0	18
62-1011	13.5	DISPERSION INTEGRALS++	0	3	13	16
62-1013	7.0	STATISTICAL METHODS++	4	8	6	18
62-1015	15.1	THERMAL FUNCTIONS++	15	8	5	28
62-1019	41.0	NBS PERSONNEL REPORT++	5	71	174	250
62-1020	3.3	EIGENVALUES+	0	0	144	144
62-1027	11.2	NEW SYSTEM	1	25	5	31
62-1028	11.2	GENERAL SUBROUTINES+++	0	8	2	10
62-1029	9.7	D-SPACING CALCULATIONS+	0	23	74	97
62-1033	9.7	CRYSTAL STRUCTURE CALIBRATION++	27	44	222	293
62-1034	30.0	PHOTOIONIZATION CROSS SECTION++	146	26	45	217
62-1035	7.7	CREEP DATA ANALYSIS++	20	53	51	124
62-1036	7.7	FILM THICKNESS++	0	0	52	52
62-1038	7.5	STANDARDIZATION ANALYSES++	3	12	3	18
62-1047	9.0	BLACK BOX COMPUTER SERVICE+	0	0	6	6
62-1055	8.4	ELLIPSOIDAL COMPUTATION++	0	6	1	7
62-1060	15.0	BLACK BOX COMPUTER SERVICE+	0	0	3	3
62-1064	2.4	GAGE BLOCK STUDIES++	0	0	24	24
62-1066	1.2	STANDARD CELLS++	0	0	14	14
62-1080	9.2	BLACK BOX COMPUTER SERVICE+	0	0	10	10
62-1081	9.1	BLACK BOX COMPUTER SERVICE+	0	0	9	9
62-1085	11.2	MATHEMATICAL SUBROUTINES+++	0	1	0	1
62-1089	9.6	ELASTIC CONSTANTS++	0	67	31	98
62-1101	9.6	BLACK BOX COMPUTER SERVICE+	0	0	18	18
62-1102	6.8	BLACK BOX COMPUTER SERVICE+	0	0	8	8
62-1107	6.5	OSCILLATING SPHERE++	0	0	16	16
62-1123	10.3	BLACK BOX COMPUTER SERVICE+	3	2	1	6
62-1125	9.5	MATRIX COMPUTATIONS	0	0	1	1
62-1133	5.0	CHEMISTRY CALCULATIONS++	0	0	7	7
62-1160	82.2	PREDICTION STUDIES++	6	254	167	427
62-1162	10.7	CEMENT AGING STUDIES++	33	68	140	241
62-1163	14.1	TRANSISTOR AGING BEHAVIOR++	141	273	94	508
62-1164	3.2	THERMODYNAMIC PROPERTIES++	0	1	12	13
62-1165	15.2	NMR SPECTRA ANALYSES+	0	0	33	33
62-1170	7.7	HIGH PURITY POLYMERS++	0	0	4	4
62-1178	5.3	LOGARITHMIC COEFFICIENTS+	0	43	28	71
62-1181	12.4	NTDC++	3	32	0	35
62-1185	10.3	HEAT TRANSFER CALCULATIONS+	206	314	125	645

Current Applications of Automatic Computer

TASK NUMBER		TITLE	ASSEMBLY TIME	CODE CHECKING	PRODUCTION TIME	TOTAL TIME ON COMPUTER
NBS SERVICES:			(M	I N U	T E	S)
62-1187	2.4	FRUSTRATED REFLECTIONS++	0	0	1	1
62-1193	3.8	ELLIPTIC DIFFERENTIAL EQUATIONS	1	93	211	305
62-1194	15.1	MEMBRANE TRANSPORT++	10	40	18	68
62-1195	7.2	LIGHT SCATTERING++	0	12	0	12
62-1196	15.2	EQUATIONS IN XY THETA	5	29	24	58
62-1199	7.8	COMPLEXITY CONSTANTS++	6	19	22	47
62-1202	13.6	ANALYSIS OF ION DATA	14	18	0	32
62-1203	3.7	CYLINDRICAL SHOCK WAVE	11	9	9	29
62-1210	2.5	THREAD FORK STRESS++	0	8	0	8
62-1211	12.5	TECHNICAL INFO RETRIEVAL++	1	24	0	25
62-1212	10.9	COLOR DIFFERENCES	3	21	0	24
62-1217	10.1	SHOESTRING DATA++	0	10	0	10
63-1222	7.1	DILATOMETRIC DATA CALCULATIONS++	0	24	0	24
63-1224	9.7	ATOM PACK++	91	0	90	181
63-1226	12.0	OTS - KWIC++	5	27	2	34
63-1228	3.7	SHOCK DISSOCIATION	0	101	0	101
63-1229	10.0	MORTAR BOND INVESTIG++	3	19	21	43
63-1230	15.2	LEAST SQUARES+	0	0	1	1
63-1231	13.0	BLACK BOX COMPUTER SERVICE+	5	14	7	26
63-1233	9.7	BLACK BOX COMPUTER SERVICE+	0	17	1	18
63-1234	10.3	VAPOR TRANSMISSION++	32	37	81	150
63-1237	3.1	PYROMETRY++	0	3	2	5
63-1238	10.3	CT TRUCK DATA ANALYSIS++	21	24	6	51
63-1241	12.5	IICASP++	3	52	0	55
63-1245	10.2	FIRE RESEARCH++	5	4	0	9
63-1248	15.4	CALCULATION OF FORCE CONSTANTS+	0	1	0	1
63-1250	12.0	KWIC++	13	41	0	54
63-1257	7.8	CALC OF CALCIUM PHOSPHATE++	0	12	22	34
63-1258	15.5	SPECTRUM ANALYSIS	1	81	4	86
63-1259	11.3	RESEARCH IN PROBABILITY++	8	7	14	29
63-1261	3.0	COMPOSITION MOLECULAR SPECTRA++	0	55	0	55
63-1263	15.5	LINEAR CLASSICAL SYSTEM++	28	0	25	53
63-1266	1.5	BLACK BOX COMPUTER SERVICE++	0	0	1	1
63-1273	8.5	CRYSTAL GROWTH	0	16	0	16
63-1276	14.2	INSTRUMENTATION++	0	25	0	25
63-1277	1.2	BLACK BOX COMPUTER SERVICE++	0	0	2	2
63-1278	4.7	TIME OF FLIGHT SPECTRUM++	2	21	1	24

Current Applications of Automatic Computer

TASK NUMBER		TITLE	ASSEMBLY TIME	CODE CHECKING	PRODUCTION TIME	TOTAL TIME ON COMPUTER
NBS SERVICES:			(M	I N	U T	E S)
63-1281	2.4	CORRECTION-SMEARING	2	3	1	6
63-1287	3.7	DATA ANALYSES OF GASES++	0	0	6	6
63-1288	10.3	TRUCK INFILTRATION++	0	4	0	4
63-1289	3.8	IONIZED GASES++	0	28	0	28
63-1290	3.0	MOLECULAR ENERGY LEVELS++	0	6	0	6
63-3003	11.2	TRAINING+++	13	61	0	74
63-3005	11.2	RESEARCH+++	6	149	28	183
63-3008	11.2	SECRETARYS ADMINISTRATION+++	60	679	28	767
63-3010	11.2	NEW SYSTEMS+++	0	36	3	39
	Totals	(NBS Services)	2019	11,183	8424	21626

NON-NBS SERVICES

58-0348	OOR	MACHINE TRANSLATION OF RUSSIAN	3	4	0	7
58-0366	USIA	RADIATION PATTERNS OF ANTENNAS	0	0	1	1
59-0407	DOFL	FOURIER COEFFICIENTS+	53	63	11	127
59-0409	FSLIC	BANK BOARD REPORTS++	98	1803	1549	3450
59-0425	CU	MOLECULAR ORBITALS+	0	11	80	91
59-0434	GC	PETROLOGICAL COMPUTATIONS+	0	69	109	178
59-0441	USRED	SYSTEMS ENGINEERING++	2	202	551	755
60-0457	PHA	PUBLIC HOUSING PROBLEM++	0	46	206	252
60-0476	DOFL	GAS TUBE CHARACTERISTIC II	0	0	764	764
60-0486	U ONT	MORSE WAVE FUNCTION++	1	2	61	64
60-0492	IMF	MONETARY RESEARCH REPORTS++	1	171	290	462
60-0506	WBANK	WORLD BANK REPORTS++	3	5	44	52
61-0532	GU	VIBRATIONAL ENERGY LEVELS+	0	32	13	45
61-0540	ACC	DIFFUSION CALCULATIONS+	12	23	90	125
61-0550	GWU	LOGISTICS RESEARCH++	14	135	6	155
61-0569	AGO	HUMAN FACTORS RESEARCH++	22	333	170	525
61-0830	BPR	HIGHWAY TRAFFIC STUDIES++	8	4	780	792
61-0849	BPR	HIGHWAY TRAFFIC STUDIES++	0	42	373	415
61-0865	BPR	HIGHWAY TRAFFIC STUDIES++	2	0	504	506

Current Applications of Automatic Computer

TASK NUMBER	TITLE	ASSEMBLY TIME	CODE CHECKING	PRODUCTION TIME	TOTAL TIME ON COMPUTER
NON-NBS SERVICES		(M	I N U	T E	S)
61-0902 BPR	HIGHWAY TRAFFIC STUDIES++	5	0	641	646
61-0903 BPR	HIGHWAY TRAFFIC STUDIES++	3	0	320	323
61-0945 WB	FORECASTING++	0	0	1125	1125
62-1004 BUSHP	RHOMBIC ANTENNAS+	0	15	3	18
62-1014 NIH	METABOLIC DISEASES++	200	262	495	957
62-1018 NRL	HYDROMAGNETIC PROBLEMS+	34	275	602	911
62-1021 DCH	HIGHWAY STUDIES++	151	845	8500	9496
62-1022 NRL	SPECTRUM OF DIPOLE RADIATION	25	42	79	146
62-1023 NSF	IMAGE PROCESSING++	0	240	197	437
62-1030 VA	ELECTROCARDIOGRAPHIC ANALYSIS	226	1047	741	2014
62-1032 QM	SUPPLY PROGRAMMING PROBLEMS++	0	0	5	5
62-1039 DOFL	BLACK BOX COMPUTER SERVICE+	0	0	1	1
62-1041 DOFL	BLACK BOX COMPUTER SERVICE+	0	0	7	7
62-1044 FCC	RADIO INTENSITIES++	1	0	46	47
62-1046 BPR	TRAFFIC PREDICTION++	92	234	174	500
62-1056 DOFL	PD ENGINEERING++++	1	9	157	167
62-1071 DOFL	RHINITIS STUDIES++	0	0	8	8
62-1073 DOFL	COMPLEX LEGENDRE FUNCTIONS++	0	17	571	588
62-1076 NAS	EVALUATION OF APPLICATIONS+	3	0	166	169
62-1091 WPA	LOWER BOUNDS TO EIGENVALUES	0	2	0	2
62-1095 NASA	CONSULTING SERVICES+	0	13	0	13
62-1096 DOFL	VULNERABILITY STUDY++++	3	76	554	633
62-1110 ICC	ICC SYSTEMS STUDY++	29	155	73	257
62-1113 DOFL	TRANSPORT ANALYSES++++	24	9	430	463
62-1115 DOFL	BLACK BOX COMPUTER SERVICE+	0	0	2	2
62-1119 BPR	HIGHWAY TRAFFIC STUDIES++	0	38	414	452
62-1121 CARIN	CARNEGIE INSTITUTE STUDIES++	2	35	57	94
62-1130 COENG	FALLOUT SHELTER COMPUTATIONS	10	158	1672	1840
62-1131 USIA	CANTILEVER RETAINING WALL++	27	23	0	50
62-1134 HARVU	STATISTICAL DECISION THEORY++	4	114	2	120
62-1140 VA	VA MEDICAL++	20	0	803	823
62-1141 COENG	FALLOUT SHELTER COMPUTATIONS	7	164	3284	3455
62-1144 UOFMD	THERMAL BOUNDARY LAYERS	4	31	133	168
62-1146 BPR	GRAVITY MODEL STUDIES++	0	1	68	69
62-1151 DARCO	STATISTICAL DECISION THEORY++	13	42	1	56
62-1154 AGO	MILITARY RESEARCH DATA++	0	0	26	26
62-1155 FSLIC	MORTGAGE LOAN SURVEY	3	44	229	276
62-1158 GC	MINERALOGY STUDIES++	18	58	145	221
62-1169 U ONT	ATOMIC COLLISIONS++	45	84	357	486
62-1171 VA	HOSPITAL PROGRAM PLANNING+	204	396	370	970
62-1172 PEACE	PEACE CORPS EVALUATIONS++	268	91	851	1210
62-1175 DOFL	ION DISTRIBUTIONS+	1	3	287	291
62-1177 DOFL	ANALYSIS OF VARIANTS+	0	2	8	10
62-1179 DOFL	CATALOG INFORMATION+	0	10	23	33
62-1182 DOFL	FOURIER INTEGRAL	0	0	41	41

Current Applications of Automatic Computer

TASK NUMBER		TITLE	ASSEMBLY TIME	CODE CHECKING	PRODUCTION TIME	TOTAL TIME ON COMPUTER
NON-NBS SERVICES:						
			(M	I N U	T E	S)
62-1183	DOFL	BLACK BOX COMPUTER SERVICE+	0	0	47	47
62-1188	FTBEL	STEPWISE REGRESSION+	0	0	6	6
62-1189	QM	TABLES FOR SEQUENTIAL METHODS	19	491	427	937
62-1197	UOFMD	HIGH ENERGY PHYSICS++	0	11	384	395
62-1201	FCC	UHF TV	12	124	306	442
62-1208	DOFL	TAPE LISTING++	0	0	37	37
62-1215	NASA	MISSILE SATELLITE++	0	701	554	1255
62-1216	BPR	ARIZONA++	8	44	325	377
63-1218	DOFL	INTEGRAL EVALUATION	8	21	3	32
63-1219	DOFL	SHOCK TUBE DATA	4	19	1	24
63-1220	DOFL	BLACK BOX COMPUTER SERVICE+	0	0	5	5
63-1221	BPR	RHODE ISLAND++	0	0	10	10
63-1225	OQMG	LINEAR AND NON LINEAR ESTIM++	8	44	0	52
63-1227	FTBEL	ARMY GENERATOR NOISE++	34	36	2	72
63-1232	NORAD	MISSILES++	28	22	0	50
63-1235	PHS	OXYGEN SAG PROGRAM++	10	0	4	14
63-1236	COMM	DATATROL++	213	24	35	272
63-1239	PHS	PUBLIC HEALTH SERVICE++	0	0	9	9
63-1240	TREAS	SECRET SERVICE FORGERY	11	216	2	229
63-1242	DOFL	NEWTON RING ANALYSIS++	0	17	12	29
63-1243	WSMAS	HIGHWAY STUDIES++	0	0	160	160
63-1246	PHS	SCREENING EVALUATION+	3	1	2	6
63-1247	DOFL	BLACK BOX COMPUTER SERVICE+	0	0	5	5
63-1251	DOFL	ERROR CALCULATIONS++	0	14	3	17
63-1253	GU	BLACK BOX COMPUTER SERVICE++	0	0	8	8
63-1254	DEFCO	HIGH FREQUENCY PROPOGATION++	0	28	73	101
63-1256	NCTA	TRANSIT STUDY++	0	16	559	575
63-1262	NRL	NUCLEONICS++	0	30	6	36
63-1264	NRL	NUCLEONICS++	10	46	1585	1641
63-1265	DOFL	MATHIEU FUNCTIONS++	1	18	0	19
63-1270	BPR	MODAL SPLIT PROCEDURE++	9	117	919	1045
63-1271	COMM	ECONOMICS STUDY++	1	3	11	15
63-1272	BPR	ROADS STUDY++	0	5	9	14
63-1274	FTBEL	NUCLEAR UTILITY SERVICES++	0	0	27	27
63-1275	SEC	SECURITIES MARKET STUDY++	3	35	121	159
63-1279	DOFL	MAGNETIC FIELD++	0	5	20	25
63-1282	DOFL	TANK COMPUTER PROBLEM++	1	2	0	3
63-1284	DOFL	STATISTICAL ANALYSIS++	0	0	2	2
63-1286	UOFMD	OPTIMAL EXAMINATION	0	44	0	44
		Totals (NON-NBS Services)	2025	9614	34949	46588
		TOTAL TIME FOR THE QUARTER (MINUTES)	4044	20797	43373	68214

Current Applications of Automatic Computer

  +   Problem programmed in the Computation Laboratory, production runs
       continued under direction of sponsor.

 ++ Problem programmed by the sponsor and run under his direction.

+++ Functions pertain to the internal operations of the Computation Laboratory.

++++ Classified task.

Lectures and Technical Meetings

Note: In general, copies of papers or talks listed in this section are not available from the National Bureau of Standards. If and when a paper is to be published, it will be listed in the section of this report on Publication Activities.

Applied Mathematics Division Lectures

PFIRSCH D. (Max-Planck Institute of Physics and Astrophysics). Microinstability in ihmomogeneous plasma. December 7, 1962.

EISENHART, C. (NBS, 11.03). Realistic Evaluation of the precision and accuracy of instrument calibration systems. August 8, 1962.

RHODES, I. (NBS, 11.0). A report on the progress of machine translation. November 30, 1962.

SCHATTEN, R. (NBS, 11.2) Some convexity problems. June 26, 1962. Computational Problems associated with norms in the space matrices. September 6, 1962.

YOUDEN, W. J. (NBS, 11.0) Measurement Agreement Comparisons. August 8, 1962. Judgement versus mathematics. July 31, 1962.

JOEL, L. S. (Division 12 Conference Room) The use of Macro Instructions on the 7090 Computer. September 25, 1962.

Seminar in Mathematics

A series of weekly seminars led by Dr. Seymour Haber with the cooperation of Dr. Oved Shisha, was conducted to cover the Princeton lecture notes, "Advanced Calculus" by H. K. Nickerson, D. C. Spencer, and N. E. Steenrod (D. Van Nostrand Co., 1959). July-December 1962.

Lectures and Technical Meetings

Papers and Invited Talks
Presented by Members of the Staff
at Meetings of Ourside Organizations

ALT, F. L.   Syntatic resolution of semantic ambiguities. Presented
            at IFIPS Congress 1962, Munich, Germany, August 28-31, 1962.

BERNSTEIN, B., KEARSLEY, E. A., AND ZAPAS, L. J. A theoretical and
            experimental investigation of finite deformation in
            viscoelastic media. Baltimore, Md., October 31, 1962.

BERNSTEIN, B. Some researches in finite visco-elastic deformation.
            University of Delaware, Newark, Delaware, Nov. 21, 1962.

EISENHART, C. On the realistic evaluation of the precision of a
            measurement process. Presented at the Annual Meeting of the
            American Statistical Association, Minneapolis, Minnesota,
            September 7, 1962.

EISENHART, C. Realistic evaluation of the precision and accuracy of
            instrument calibrations systems. Presented before the 1962
            Standards Laboratory Conference, National Bureau of, Boulder,
            Colorado, August 8.

GOLDMAN, A. J. Completely mixed matrix games. Presented at Howard University,
            Washington, D. C., December 8, 1962. Mathematics Association
            of America.

OSER, H., et. al. Numerical solution of the equations of electrical discharges
            in gas tubes. Presented at the Third Annual ACM Washington
            Symposium: "Computers in the Space Age", September 20, 1962.

RHODES, I. Automatic Dictionaries. Presented at the IFIPS Congress, 1962,
            Munich Germany, August 28-31, 1962.

RHODES, I. Machine translation by means of electronic computers. Presented
            at the John Wesley Powell Auditorium (Cosmos Club), Washington,
            D.C., November 9, 1962.

ROCKOFF, M. L. On the numerical solution of finite difference approximations
            which are not of positive type. Presented in Berkeley, California,
            January 24-28, 1963.

TCHEN, C. M.   (i) Kinetic equations of plasmas. Presented at the Aero-
            Space Corporation, Los Angeles, California, December 10, 1962.
            (ii) Interaction of the solar corpuscular stream with the
            Geomagnetic Field and Landau damping with collective correlations,
            Presented at the Jet Propulsion Laboratory, California Inst. of

Lectures and Technical Meetings

Tech., Pasadena, California, Dec. 11, 1962. (iii) Plasma
oscillations with the effects of correlations, Lawrence
Radiation Laboratory, Livermore, California - University of
California, December 13, 1962.

THOMPSON, W. A. Jr. and J. R. MOORE, (U.S. Army Ballistic Research
Laboratories), Non-negative estimates of variance components.
Presented before the Biometric Society, Minneapolis,
Minnesota. September 8, 1962.

THOMPSON, W. A. Jr. Precision of simultaneous measurement procedures.
Presented at the Eighth Conference on the Design of Experiments
in Army Research, Development and Testing, Walter Reed Army
Medical Center, Washington, D.C. October 25.

THOMPSON, W. A. and WILLKE, T.A. On a rank sum test for outliers.
Presented in Minneapolis, Minnesota before the American
Statistical Association, September 7, 1962.

VINTI, J. P. Some ideas about satellite orbits, with application to the
space program. Presented at Georgetown University, Washington,
D. C., November 19, 1962.

VINTI, J. P. The theory of the orbit of an artificial satellite. Presented
at Yale University Observatory, New Haven, Connecticut, July 19,
1962.

WEISS, George, A semi-markov description of the course of a disease.
Presented at the International Congress of Mathematics,
Stockholm, Sweden, August 1962.

WEISS, George, Car queueing at stop signs. Presented before the Operations
Research Society, Philadelphia, Pa. October 4, 1962.

WITZGALL, C. J. An algorithm for all-integer programming with quadratic
constraints. Presented at Princeton University, Fine
Hall, Princeton, N. J., November 19, 1962.

YOUDEN, W. J. A new ranking technique. Presented before the School of
Hygiene and Public Health, Johns Hopkins University, Baltimore,
October 1, 1962. (ii) Realistic estimate of errors in
measurement. Presented at the Annual Conference of the
Instrument Society of America, New York. October 18, 1962.
(iii) The collaborative test. Presented at the 76th Annual
Meeting of the Association of Official Agricultural Chemists,
Washington. October 16. (iv) The sample, the procedure,
and the laboratory. Presented before the American Chemical

Lectures and Technical Meetings

Society (South-eastern Pennsylvania Section), Philadelphia.
October 25. (v) Statistical analysis of experimental data
and design of experiments. Presented before the American
Society for Testing Materials (Committee B-4), Washington.
November 20. (vi) Picking winners and losers. Presented
before the American Society for Quality Control (Washington
Section), Washington. November 28.

ZAHN, C. T. Black box maximization of circular coverage. Presented at
Summer Meeting of SIAM at Vancouver, British Columbia,
August 30, 1962.

Publication Activities

1. PUBLICATIONS THAT APPEARED DURING THE PERIOD
   July - December, 1962.

1.2 Technical Notes, Manuals, and Bibliographies

Experimental statistics, Mary G. Natrella. ORDP 20-110-111,
112, 113, 114 by the Army Research Office, Durham, Duke Station
Durham, North Carolina, June 1962.

Selected bibliography of statistical literature, 1930 to 1957: VI
Theory of estimation and testing of hypotheses, sampling distributions
and theory of sample surveys, Lola S. Deming. Journal of Research
NBS, 66B, 1962, pp. 109-151.

1.3 Technical Papers

Safety levels in military inventory management. F. L. Alt.
Operations Research, 10, No. 6, Nov.-Dec. 1962, pp. 786-794.

Lower bounds to eigenvalues using operator decompositions of the
form B*B. N. W. Baxley and D. W. Fox. (Applied Physics Laboratory,
JHU). Archive for Rational Mechanics and Analysis, Vol. 10, 1962.

Conditions for second order waves in hypo-elasticity. B. Bernstein.
Transactions of the Society of Rheology, Vol. VI, 1962, 263-274.

A connection between Tauberian theorems and normal functions.
G. T. Cargo. Bulletin of the American Mathematical Society,
Vol. 68, No. 4., July 1962, 400-401.

Covers and packings in a family of sets. J. Edmonds. Bulletin
of the American Mathematical Society, 68, No. 5, 1962, 494-499.

Roger Joseph Boscovich and the combination of observations.
Churchill Eisenhart. Actes du Symposium International Roger
Boscovich 1961.

On the realistic measurement of precision and accuracy. Churchill
Eisenhart. Proceedings of the Eighth National Aero-Space
Instrument Symposium, Vol. 8, 1962, 75-83.

Publication Activities

Black Box maximization of circular coverage. Charles T. Zahn, Jr.
Journal of Research, NBS, Section B (Mathematics and Mathematical
Physics), 66B, 1962, pp. 181-213.

Infrapolynomials with prescribed derivatives at given points.
O. Shisha (with Prof. J. L. Walsh, Abstract). Notices, American
Mathematical Society, Vol. 9, No. 4, August 1962, p. 315.

Fractional order differences of the coefficients of polynomials.
O. Shisha (with Dr. G.T. Cargo, abstract). Notices, American
Mathematical Society, Vol. 9, No. 4, August 1962, p. 334.

Bounds on ratios of means. O. Shisha (with Dr. G.T. Cargo).
Journal of Research of the National Bureau of Standards, Vol. 66B,
No. 4, 1962. p. 169.

An application of information theory to the analysis of contingency
tables, with a table of $2n$, ℓn, n, n = 1(1) 10,000. S. Kullback
(George Washington University), M. Kupperman (George Washington
University), and H. H. Ku, Journal of Research, NBS, 66B, No. 4,
1962, 217-243.

Estimation of dispersion parameters. W. A. Thompson, Jr. Journal of
Research, NBS, Vol. 66B, No. 4, 1962, 161-164.

Laguerre expansions for successive generations of a renewal process.
George Weiss. Journal of Research, NBS, 66B, No. 4, 1962, 165-168.

The reliability of a system in which spare parts deteriorate in
storage. George Weiss. Journal of Research, NBS, 66B, No. 4, 1962,
157-160.

Memorial to Sir Ronald Aylmer Fisher: 1890-1962. W. J. Youden.
Journal of the American Statistical Association, 57, December 1962,
727-728.

Tests for contingency tables and Markov chains. Solomon Kullback
(George Washington University), Morton Kupperman (George Washington
University), and H. H. Ku. Technometrics 4, 573-608, November 1962.

On the realistic measurement of precision and accuracy. Churchill
Eisenhart. ISA Proceedings of the Eighth National Aero-Space
Instrument Symposium held in Washington, May 1962, 75-83.

Realistic estimates of error. W. J. Youden. Journal of the
Instrument Soceity of America, 9, 57-58, October 1962.

Publication Activities

On the maximum number of zeros in the powers of an indecomposable matrix. M. Marcus and F. May. Duke Journal of Mathematics, 29, 1962, 581-588.

A property of linear frequency modulation. A.J. Goldman. Proceedings of the Institute of Radio Engineers, 50, 7, July 1962, 1711.

The first run preceded by a quota. A. J. Goldman and Bernice K. Bender. Journal of Research NBS, Section 66B, (Mathematics and Mathematical Physics) July-September 1962, 77-89.

The invariance of symmetric functions of singular values. M. Marcus and H. Minc. (University of Florida). Pacific Journal of Mathematics. 12, 1, 1962, 327-332.

The sum of the elements of the powers of a matrix. M. Marcus and M. Newman, Pacific Journal of Mathematics, Vol.12, No. 2, 1962, 627-635.

Multipliers of difference sets. M. Newman. Canadian Journal of Mathematics, 15, 1963, 121-124.

Some free products of cyclic groups. M. Newman. Michigan Journal of Mathematics, 9, 1962, 369-373.

Note on subgroup of the modular group. M. Newman and J. R. Smart. (New York University). Proceedings of the American Mathematical Society, 14, 1963, 102-104.

The structure of some subgroups of the modular group. M. Newman. Illinois Journal of Mathematics, 16, September 1962, 480-487.

Two theorems on matrices. M. Newman. Journal of Research, NBS, 66B, July-September 1962, 91-92.

The realiability of a system in which spare parts deteriorate in storage. George Weiss. Journal of Research NBS, 66B, No. 4, 1962, 157-160.

Ranking laboratories by round-robin tests. W. J. Youden. Materials Research & Standards, 3, No. 1, January 1963, 9-13.

Collective correlation of plasma. C. M. Tchen. Proceedings of the Second National Conference of Electronics, Prague, Czechoslovakia, Vol. 5-6, 1962.

A model for the viscoelastic behavior of rubberlike polymers including entanglement effects. R. S. Marvin and H. Oser. Journal of Research NBS, Vol. 66B, No. 4, 1962, p. 171.

Publication Activities

Some properties of the Hessian matrix of a strictly conves function.
B. Bernstein and R. A. Toupin. Journal für die reine und angewandte
Mathematik 210, 67-72 (1962)

On an extension of the stroboscopic method. A. Ghaffari. Abstracts
of Communications of the International Congress of Mathematicians,
p. 185, Stockholm, Sweden, August 15-22, 1962.

On Rayleigh's nonlinear vibration equation. A. Ghaffari. Proceedings
of the International Sysmposium on Non-linear Vibrations. Sponsored by
the Academy of Sciences of the Ukrainian SSR, Kiev, USSR, September
12-18, 1961.

Higher approximations with the stroboscopic method. A. Ghaffari.
Proceedings of Second International Conference on Non-linear Vibrations,
Warsaw, Poland, September 18-21, 1962.

The spheroidal method for satellite orbits. J. P. Vinti. Notes,
Summer Institute for Dynamical Astronomy, Yale Univ., July 19, 1962.

2. MANUSCRIPTS IN THE PROCESS OF PUBLICATION

2.1 Mathematical Tables

Tables of Fourier transforms of absolutely continuous distribution
functions. Fritz Oberhettinger. To appear in the NBS Applied
Mathematics Series.

2.3 Technical Papers

Recognition of clauses and phrases in machine translation of languages.
F. L. Alt and Ida Rhodes. To appear in the Proceedings of the
International Conference on Machine Translation of Languages and
Applied Language Analysis, Teddington, England, September 6-8, 1961.

Pointwise bounds in the first biharmonic boundary value problem.
J. H. Bramble and L. E. Payne. Submitted to a technical journal.

The segmental variation of Blaschke products. G. T. Cargo. To
appear in the Duke Mathematical Journal.

Normal functions, the Montel property, and interpolation in H^{∞}.
G. T. Cargo. To appear in Michigan Mathematical Journal.

Ferroelectric switching and the Sievert integral. P. H. Fang
(Physical Properties Section) and Irene A. Stegun. Submitted
to a technical journal

Factorial designs and the direct product. B. Kurkjian. (Diamond
Laboratories) and M. Zelen. To appear in the Bulletin of the
International Statistical Institute.

Publication Activities

Realistic evaluation of the precision and accuracy of instrument calibration systems. Churchill Eisenhart. To appear in the Proceedings of the 1962 Standards Laboratory Conference and the Journal of Research NBS, Section C (Engineering and Instrumentation).

A note of contingency tables involving zero frequencies and the $2\hat{I}$ test. H. H. Ku. Submitted to a technical journal.

Confidence limits for the reliability of complex systems. Joan Raup Rosenblatt. To appear in the Proceedings of the Advanced Seminar on the Statistical Theory of Probability, U. S. Army Mathematics Research Center, University of Wisconsin Press.

Convergence to normality of powers of a normal random variable. N. C. Severo and L. J. Montzingo, Jr. To appear in the Bulletin of the International Statistical Institute.

Precision of simultaneous measurement procedures. W. A. Thompson, Jr. Submitted to a technical journal.

On the rank sum test for outliers. W. A. Thompson, Jr. and T. A. Willke. Submitted to a technical journal

Mean first passage times and the dissociation of diatomic molecules. Kurt Shuler (Institute of Defense Analysis)and George Weiss. To appear in the Journal of Chemical Physics.

Review of "Systems: Research and Design." A. J. Goldman. To appear in Technometrics.

"Recognition of completely mixed games." A.J. Goldman. To appear in Journal of Research NBS, Section B (Mathematics and Mathematical Physics), 67B,(1963).

A note on modular groups. N. Newman. To appear in the Proceedings of the American Mathematical Society.

Bounds of cofactors and arithmetic minima of quadratic forms. N. Newman. To appear in the Journal of the London Mathematical Society.

Modulary groups of t x t matrices. M. Newman and J. R. Smart (New York University). To appear in the Duke Mathematical Journal.

Packing Inequalities for Circles. P. Davis. To appear in the Michigan Journal of Mathematics.

Publication Activities

Linear operations on matrices. M. Marcus. In manuscript.

The zeros of infrapolynomials with prescribed values at given points.
O. Shisha (with Prof. J. L. Walsh). To appear in the Proceedings
of the American Mathematical Society.

Zeros of polynomials and fractional order differences of their
coefficients. O. Shisha (with G. T. Cargo). To appear in the
Journal of Mathematical Analysis and Applications.

Error bounds for first approximations in turning-point problems.
F. W. J. Olver. Submitted to a technical journal.

Error bounds for asympototic expansions in turning-point problems.
F. W. J. Olver. In manuscript.

Error analysis of Miller's recurrence algorithm. F. W. J. Olver.
In manuscript.

A survey of some mathematical models in the theory of realiability.
George Weiss. To appear in the Proceedings of the Seminar of Statistical
Theory of Reliability, U.S. Army Research Center, University of
Wisconsin, Madison.

On the pedestrian queueing problem. George Weiss. To appear in
the Bulletin of the International Statistical Institute.

An analysis of pedestrian queueing. George Weiss. Submitted to
a technical journal.

Randomization and experimentation. W. J. Youden. To appear in the
Annals of Mathematical Statistics.

Uncertainities in calibration. W. J. Youden. To appear in
the Institute of Radio Engineers Transactions -- Instrumentation.

To collaborative test. W. J. Youden. To appear in the Journal of
the Association of Official Agricultural Chemists.

An algorithm for obtaining an orthogonal set of individual degrees
of freedom for error. To appear in Journal of Research NBS,
Section B (Mathematics and Mathematical Physics).

Error bounds in the pointwise approximation of solutions of elastic
plate problems. J. H. Bramble and L. E. Payne. To appear in the
Journal of Research NBS.

Publication Activities

The spheroidal method for satellite orbits. J. P. Vinti. To appear
in Proceedings of International Association of Geodesy.

Conditions for record order waves in hypo-elasticity. B. Bernstein
To appear in Journal of Mathematics and Physics.

Collective oscillations in plasmas. To appear in the Czechoslovakian
Journal.

Pointwise bounds in the first biharmonic boundary valve problem.
L. W. Payne and J. H. Bramble To appear in the Journal of Mathematics
and Physics.

THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its major laboratories in Washington, D.C., and Boulder, Colorado, is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant publications, appears on the inside of the front cover.

WASHINGTON, D. C.

Electricity. Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics. High Voltage.

Metrology. Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Scale. Volumetry and Densimetry.

Heat. Temperature Physics. Heat Measurements. Cryogenic Physics. Equation of State. Statistical Physics.

Radiation Physics. X-ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

Analytical and Inorganic Chemistry. Pure Substances. Spectrochemistry. Solution Chemistry. Standard Reference Materials. Applied Analytical Research. Crystal Chemistry.

Mechanics. Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Rheology. Combustion Controls.

Polymers. Macromolecules: Synthesis and Structure. Polymer Chemistry. Polymer Physics. Polymer Characterization. Polymer Evaluation and Testing. Applied Polymer Standards and Research. Dental Research.

Metallurgy. Engineering Metallurgy. Microscopy and Diffraction. Metal Reactions. Metal Physics. Electrolysis and Metal Deposition.

Inorganic Solids. Engineering Ceramics. Glass. Solid State Chemistry. Crystal Growth. Physical Properties. Crystallography.

Building Research. Structural Engineering. Fire Research. Mechanical Systems. Organic Building Materials. Codes and Safety Standards. Heat Transfer. Inorganic Building Materials. Metallic Building Materials.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics. Operations Research.

Data Processing Systems. Components and Techniques. Computer Technology. Measurements Automation. Engineering Applications. Systems Analysis.

Atomic Physics. Spectroscopy. Infrared Spectroscopy. Far Ultraviolet Physics. Solid State Physics. Electron Physics. Atomic Physics. Plasma Spectroscopy.

Instrumentation. Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

Physical Chemistry. Thermochemistry. Surface Chemistry. Organic Chemistry. Molecular Spectroscopy. Elementary Processes. Mass Spectrometry. Photochemistry and Radiation Chemistry.

Office of Weights and Measures.

BOULDER, COLO.

Cryogenic Engineering Laboratory. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Cryogenic Technical Services.

CENTRAL RADIO PROPAGATION LABORATORY

Ionosphere Research and Propagation. Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services. Vertical Soundings Research.

Radio Propagation Engineering. Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation-Terrain Effects. Radio-Meteorology. Lower Atmosphere Physics.

Radio Systems. Applied Electromagnetic Theory. High Frequency and Very High Frequency Research. Frequency Utilization. Modulation Research. Antenna Research. Radiodetermination.

Upper Atmosphere and Space Physics. Upper Atmosphere and Plasma Physics. High Latitude Ionosphere Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.

RADIO STANDARDS LABORATORY

Radio Physics. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time-Interval Standards. Radio Plasma. Millimeter-Wave Research.

Circuit Standards. High Frequency Electrical Standards. High Frequency Calibration Services. High Frequency Impedance Standards. Microwave Calibration Services. Microwave Circuit Standards. Low Frequency Calibration Services.

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Electricity. Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics. High Voltage.

Metrology. Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Scale. Volumetry and Densimetry.

Heat. Temperature Physics. Heat Measurements. Cryogenic Physics. Equation of State. Statistical Physics.

Radiation Physics. X-ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

Analytical and Inorganic Chemistry. Pure Substances. Spectrochemistry. Solution Chemistry. Standard Reference Materials. Applied Analytical Research. Crystal Chemistry.

Mechanics. Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Rheology. Combustion Controls.

Polymers. Macromolecules: Synthesis and Structure. Polymer Chemistry. Polymer Physics. Polymer Characterization. Polymer Evaluation and Testing. Applied Polymer Standards and Research. Dental Research.

Metallurgy. Engineering Metallurgy. Microscopy and Diffraction. Metal Reactions. Metal Physics. Electrolysis and Metal Deposition.

Inorganic Solids. Engineering Ceramics. Glass. Solid State Chemistry. Crystal Growth. Physical Properties. Crystallography.

Building Research. Structural Engineering. Fire Research. Mechanical Systems. Organic Building Materials. Codes and Safety Standards. Heat Transfer. Inorganic Building Materials. Metallic Building Materials.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics. Operations Research.

Data Processing Systems. Components and Techniques. Computer Technology. Measurements Automation. Engineering Applications. Systems Analysis.

Atomic Physics. Spectroscopy. Infrared Spectroscopy. Far Ultraviolet Physics. Solid State Physics. Electron Physics. Atomic Physics. Plasma Spectroscopy.

Instrumentation. Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

Physical Chemistry. Thermochemistry. Surface Chemistry. Organic Chemistry. Molecular Spectroscopy. Elementary Processes. Mass Spectrometry. Photochemistry and Radiation Chemistry.

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Cryogenic Engineering Laboratory. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Cryogenic Technical Services.

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Ionosphere Research and Propagation. Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services. Vertical Soundings Research.

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Radio Systems. Applied Electromagnetic Theory. High Frequency and Very High Frequency Research. Frequency Utilization. Modulation Research. Antenna Research. Radiodetermination.

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