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ABSTRACT

This report gives a general outline of the postdoctoral fellowship program offered by the Educational Testing Service (ETS) and describes the specific program designed for Dr. William Wiersma, director of the Center for Educational Research and Services at the University of Toledo, who was the only fellow during 1969-70. In addition to attendance at the Distinguished Visiting Scholars Lecture Series and the Research Seminar Series, Dr. Wiersma worked closely with Dr. Charles E. Hall of the ETS in developing a multivariate analysis of variance computer program. (Appendixes contained a paper: "The Geometric Construct of Multivariate Analysis of Variance" by Wiersma and Hall and lists of speakers for the Distinguished Visiting Scholars Lecture Series and the Research Seminar Series.) (RT)

FINAL REPORT

Project No. 9-0583
Grant No. OEG-0-9-400583-4588(010)

POSTDOCTORAL FELLOWSHIP PROGRAM IN EDUCATIONAL RESEARCH 1969-70

Robert L. Linn
Educational Testing Service
Princeton, New Jersey

June 1970

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

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Introduction

This report covers the activities in the Postdoctoral Fellowship Program at Educational Testing Service from July 1, 1969 through June 30, 1970. The Program is designed to provide for a limited number of outstanding individuals who hold the Ph.D. or Ed.D. degree a year of experience at Educational Testing Service designed to improve their capabilities to conduct sound educational research and to train others in research methods and procedures. During the year beginning July 1, 1969 one fellow participated in the program.

Description of the Program

The primary orientation of the Postdoctoral Program in Educational Research at ETS is toward providing each participant with a flexible program of experiences to increase his competence as a practitioner in the field of educational research or as a teacher of potential researchers. A major assumption of the Program is that the best training for educational research is actual participation in the planning and conducting of important and well-conceived research projects. It is further assumed that the broad program of research under way at ETS, together with the variety of opportunities for interaction among staff and between staff and visitors at ETS, provides an effective setting within which the participants may broaden and deepen their insights.

The Postdoctoral Program in Educational Research is the responsibility of the four Research Divisions at ETS -- The Developmental Research Division, the Division of Educational Studies, the Division of Psychological Studies and the Office of Computation Sciences -- which conduct research related to specific problems in schools and colleges. Projects within these Divisions cover the full range of the educational system from preschool through graduate school to continuing education in the professions, and involve a wide variety of research methods. Many of the projects are carried on in close cooperation with schools and colleges, offering research workers an opportunity to practice skills in diplomacy and communication as well as those in statistical analysis, experimental design, and theory construction.

It is planned that each of the participants will spend approximately two-thirds of his time working directly with one or more research teams on specific projects under way. The other third of his time is to be spent on a program of supplementary activities which draw on the over-all resources of ETS to round out his training experience. Each scholar is to plan the details of his particular program in consultation with the Director of the Program, a senior member of the Developmental Research Division.

One fellow participated in the Postdoctoral Fellowship Program at Educational Testing Service during the 1969-70 year. He was Dr. William Wiersma, Director of the Center for Educational Research and Services at the University of Toledo. Dr. Wiersma was at ETS during the nine month period beginning September 1, 1969. During his stay, the majority of Dr. Wiersma's efforts were directed toward the development of a good understanding of all phases of the use of multivariate analysis of variance, including the preparation of data for analysis, the computer runs and the interpretation of the computer output. In this endeavor, Dr. Wiersma worked quite extensively with Dr. Charles E. Hall who is a member of the ETS Office of Computational Sciences and who has had primary responsibility for the development of a versatile multivariate analysis of variance computer program. The depth of understanding of multivariate analysis of variance that Dr. Wiersma gained while at ETS is indicated by the manuscript included in Appendix A which he wrote in collaboration with Dr. Hall.

Among the special programs open to Dr. Wiersma were the Distinguished Visiting Scholars lectures and seminars and the Research Seminars. Announcements of these programs (Appendix B) were distributed to Dr. Wiersma and he was encouraged to participate to the extent that his schedule and interests permitted. Dr. Wiersma also attended the meeting of the American Psychological Association, the Invitational Conference on Testing Problems, and the American Educational Research Association.

There were no changes of staff involved with the program between the time of the preparation of the original proposal and the initiation of the Program. Thus, the staff available to work with Dr. Wiersma remained as outlined in the application for participation in the Program. The vast majority of Dr. Wiersma's time, however, was spent working with Dr. Charles E. Hall.

Evaluation of the Program

The original intent of the Program was to increase the supply of individuals capable of designing and conducting educational research and of training other researchers. Originally, three types of individuals were thought to be appropriate as candidates: (1) employees of school systems engaged in educational research who might profit from a refresher experience, (2) staff members in colleges and universities engaged in training educational specialists, and (3) specialists in subject areas other than education who wished to apply their methods to educational problems. Dr. Wiersma clearly qualified for the program in categories (2).

The Program at ETS was designed on the assumption that the best postdoctoral experience would be one involving active participation in ongoing research projects already under way at ETS, supplemented by individualized programs of study drawing on ETS resources such as the library, formal classes, scheduled lectures by visiting scholars, and the like. In general, the assumption seems to have been sound.

One limitation on flexibility was the necessity for a project to be funded in order that costs of data collection and processing might be met. Since Dr. Wiersma's interests were primarily in the application of multivariate statistical techniques some difficulty was encountered in finding on-going projects with appropriate needs at appropriate times. Two steps were taken to meet this problem. First Dr. Wiersma was able to obtain data that he had worked with at the University of Toledo that were appropriate for the application of multivariate analysis of variance. This solution had the added advantage of providing data with which Dr. Wiersma was already familiar and in which he already had an interest. The second step was the allocation of money from ETS research funds for his personal research. As of April 1, 1970, $1453 of this fund provided by ETS had been expended for computer and secretarial expenses. Dr. Wiersma conducted at least 15 multivariate analyses of variance with his own data. Some of these analyses will be included as examples in two chapters of a book Dr. Wiersma is preparing.

It is our judgment that Dr. Wiersma was equipped to profit from the type of program offered at ETS. As mentioned earlier the report presented in Appendix A provides partial support for this judgment.

Program Reports

1. Publicity

The Program Brochure, which is included in Appendix C, was distributed to ETS staff members with the suggestion that they tell their friends and acquaintances in colleges and school systems about the program and ask them to inform likely candidates.

2. Application Summary

a.	Approximate number of inquiries from prospective trainees	8
b.	Number of completed applications	3
c.	Number of first rank applications	3
d.	How many applicants were offered admission	3

3. Trainee Summary

a.	Number of trainees initially accepted in program	1
	Number of trainees enrolled at the beginning of program	1
	Number of trainees who completed program	1
b.	Categorization of trainees	
	(1) Number of trainees who principally are elementary or secondary public school teachers	0
	(2) Number of trainees who are principally local public school administrators or supervisors	0
	(3) Number of trainees from colleges or universities	1

4. Program Director's Attendance

a.	What was the number of instructional days for the program?	195
b.	What was the percent of days the director was present?	90%

5. Financial Summary

		Budget as Revised	Expended or Committed
a.	Stipends	$18,000	$18,000
b.	Trainee Travel	2,000	2,035
c.	Institutional Allowance	1,000	1,000
	TOTAL	$21,000	$21,035

APPENDIX A

Manuscript by

William Wiersma and Charles E. Hall

Submitted to *Psychometrika*, April 1970.

The Geometric Construct of Multivariate Analysis of Variance

William Wiersma and Charles Hall

Educational Testing Service   Educational Testing Service

ABSTRACT

The Geometrical Construct of Multivariate
Analysis of Variance

Multivariate analysis of variance (MANOVA) has been frequently used in the analysis of multi-response data. However, rarely is the underlying geometry of MANOVA discussed. In the present paper two cases for the one-way MANOVA are considered: (1) the case in which the number of significant canonical variates is less than the number of possible canonical variates, and (2) the case in which the number of significant canonical variates equals the number of possible canonical variates. The geometry of MANOVA's involving two or more factors is also discussed.

The Geometrical Construct of Multivariate Analysis of Variance

Many educational research problems involve more than one response secured from the subjects under study. One approach to the analysis of multi-response data is through a multivariate analysis of variance (MANOVA). The theoretical framework for this procedure has been in development for over 40 years (see, for example, Roy & Gnanadesikan, 1959). However, MANOVA has not been extensively utilized by educational researchers. There are probably several reasons for this lack of use, among them a lack of familiarity with the procedure, and the limited availability of computer programs.

Several authors have alluded to the apparent, if not obvious, applicability of MANOVA in educational research (e.g., Pruzek, 1969). It is a technique by which the responses to two or more dependent variables can be analyzed simultaneously and thus it includes the correlations that may exist between the dependent variables. In a MANOVA, the dependent variables are combined linearly to produce canonical variates. (Canonical variates are hypothetical variables made up of some linear combination of the real variables being analyzed. In essence, they correspond to factors of factor analysis.) The various groups or levels of the design are then differentiated in terms of their mean scores on the canonical variates. The significance of the mean canonical variate scores is then tested by Wilk's lambda criterion [or its F distribution approximations (Rao, 1965)], Roy's largest root criterion (Heck, 1960) or Hotelling's trace criterion (Pillai & Samson, 1959). The crux of the analysis is in the interpretation of the canonical variates and how the groups differ on them. Underlying this interpretation is a geometrical construct and that construct is the prime consideration of this discussion.

The MANOVA analysis provides for us, among other things, the number of canonical variates and a statistical estimate of how many are significant. Most computer programs designed to calculate MANOVA analyses, also provide adjuncts such as the attendant discriminant functions. Suppose we have a one-way MANOVA design, m levels and n dependent or criterion variables. Let NCVAR be the total number of canonical variates and SIGCV the number of significant canonical variates in the data.

In a MANOVA analysis the number of possible canonical variates is limited to the smaller of n, the number of dependent variables, or $m - 1$, the degrees of freedom associated with groups or levels. Therefore, in our notation NCVAR = min $(m-1,n)$.

There are two possible situations that can arise and we will refer to them arbitrarily as Case I and Case II. Case I is the situation in which SIGCV < NCVAR $\leq n$. We know that we have SIGCV canonical variates among the n real variables. Thus the differences between the m levels of the independent variable can be explained in terms of SIGCV < $m-1,n$ canonical variates.

Geometrically we can claim that the n dependent variables constitute an n-dimensional space. The m groups or levels are an $m - 1$ dimensional space (because there are only $m - 1$ ways in which the levels can be different, i.e., degrees of freedom). The n-dimensional dependent variable space and the $m - 1$ levels space overlap. In fact, if

$n < m - 1$ the dependent variable space lies completely within the levels space as an embedded subspace; conversely if $m - 1 < n$ the levels space lies completely within the dependent variables space. Regardless of whether $m - 1 < n$ or $n < m - 1$, the total number of canonical variates is NCVAR = min (n,m-1) and all the canonical variates lie inside the smaller dimensional space and is exactly that space. Geometrically we have a large dimensional space of n (or $m - 1$) dimensions in which there lies a smaller space of $m - 1$ (or n) dimensions which is also the space of the NCVAR canonical variates.

For Case I we have chosen SIGCV < NCVAR which says that the space of the significant canonical variates is smaller than the space of all the canonical variates. For Case I we have three vector spaces each embedded completely in the next larger. The significant canonical variates space (dimension SIGCV) is embedded in the total canonical variates subspace (dimension NCVAR = min (n,m-1)) which is in turn embedded in the larger space of dependent variables (dimension n) or, if $m - 1 > n$, the larger space of the levels (dimension $m - 1$).

Next we consider the relative orientation of these subspaces in the larger space. Suppose $n > m - 1$. Thus the largest space we have in our geometrical construct has n dimensions. The original dependent variables, however, are likely not to be orthogonal. They fall on dimensions in this space that are oblique. The NCVAR lie in an $m - 1$ dimensional space which does have all dimensions orthogonal. The original dependent variable scores are projected onto the $m - 1$ axis of the NCVAR space. (These projections are accomplished by the discriminant functions.)

The space of SIGC': is of fewer dimensions, say k , than m - 1 . K of its axes correspond exactly with k axes of the NCVAR space (e.g., coinciding a plane exactly within two of the dimensions of a cube). The projections of the discriminant scores of the m - 1 groups onto the k axes are far enough apart so that their differences are statistically significant. The (m - 1) - k dimensions of the NCVAR space that do not represent significant canonical variates are such that the corresponding projections onto them are not different enough to attain statistical significance. In essence, the information of group differences on the n dependent variables is successively transformed through projections until it is contained in the k -dimensional space. Thus the difference between the m levels of the design relative to the n original variables can now be explained in terms of the dimensions represented by the canonical variates. Obviously this is a desirable situation since we have accounted for all possible canonical variates in the real data. If k is much less than NCVAR we have considerable redundancy among the means of the groups.

Case II is the situation in which SIGCV = NCVAR; that is, all possible canonical variates are significant. Now SIGCV = min (m-1,n) , say m - 1 . This is an m - 1 dimensional subspace of n . The space of the SIGCV coincides exactly with the m - 1 dimensional space of NCVAR. We know that in the real data of the n dependent variables there exist <u>at least</u> k significant canonical variates. The information of the dependent variables is projected into these m - 1 dimensions. The limitations of the (sampling) design preclude the existence of additional canonical variates. The data of the n dependent variables are now collapsed via the discriminant function, a transformation, into the k dimensional subspace that provides the "best fit" within the limitations of the design. However, some of the information of the data may lie outside the dimensions of the SIGCV space. An obvious disadvantage of this case is that although we have the "best" set of canonical variates for the design, we may not have identified all the significant means variation that may exist in the original n variables. The relative orientation of the subspaces for Case II is like that of Case I, except that there is one less subspace in that the NCVAR and SIGCV spaces are in fact the same.

In summary, the difference between Cases I and II, as discussed above, is that in Case II the NCVAR = SIGCV space may contain only part (the major part) of the separation of group means. There <u>may</u> be extra dimensions outside the NCVAR = SIGCV space that have significant variance in group means but the NCVAR dimensions are too small in number to be able to encompass these, whereas in Case I all the significant means variance is in the SIGCV dimensions.

In many educational research situations we include more than one design factor in a single analysis. Indeed, one of the desirable characteristics of analysis of variance is its capacity to accommodate more than one design factor. This also provides the opportunity of investigating possible interactions among the factors. Correspondingly it is often desirable to include more than one factor in a MANOVA. What does this do to the geometry of the situation?

Suppose we have an analysis involving j design factors, $\ell_1, \ell_2, \ldots, \ell_j$ levels respectively. The total number of degrees of freedom associated with these variables is $\Pi \ell_i - 1$. Thus, in a MANOVA the maximum number of significant canonical variates that can appear among all the main effects and interactions is the minimum of $\Pi \ell_i - 1$ or n . Assume $\Pi \ell_i - 1 < n$. For the analysis of any main or interaction effect the maximum number of significant canonical variates possible is the df associated with that effect, say df_i. Within any one effect, i , the canonical variates are orthogonal and are at most df_i in number. However, across effects orthogonality of canonical variates is not insured, in fact orthogonality is extremely unlikely in most situations dealing with educational or psychological variables.

Suppose a total of k' significant canonical variates appear in a MANOVA involving $j > 1$ factors. This is the total number of significant canonical variates from all main and interaction effects. Let $k' < \Pi \ell_i - 1 < n$. Thus we know that the canonical variates are contained in a space of <u>no more</u> than k' dimensions; however, <u>it could be less</u> than k' -dimensional. If $n > \Pi \ell_i - 1$ the MANOVA provides the possibility of a $\Pi \ell_i - 1$ dimensional space for containing the n original dependent variables. From this it reduces the maximum dimension of the space containing the canonical variates to k' . As each main or interaction effect is being computed the significant canonical variates for that effect are orthogonal constructs in the k' -space. Each is actually a coordinate system of maximum dimension, the degrees of freedom of the effect, and actual dimension, the number of significant canonical variates associated with the effect. As we proceed through the various effects we are geometrically placing these coordinate systems in the k' -space.

The question now arises, "How many dimensions does this assortment of coordinate systems occupy?" The corresponding construct question of the MANOVA is "How many orthogonal canonical variates are needed to account for the differences among the levels of the factors?" One way to attain a measure of this is to reduce the analysis to a one-way MANOVA. In this case all cells indicated by the most detailed breakdown of the levels of the original j factors would come in as levels of the one factor. The number of levels would be $\Pi \ell_i - 1$ which is also the NCVAR. Suppose that this one-way MANOVA provides k significant (now orthogonal) canonical variates. If $k < k' \leq \min(\Pi \ell_i - 1, n)$ we know that the k' significant canonical variates from the original analysis can be contained in k dimensions.*

Consider the situation in which $n < \Pi \ell_i - 1$ and $n \leq k'$. This is the situation in which the number of significant canonical variates, totaled across all effects, is greater than the number of dependent variables, a seemingly impossible situation. Empirically such results can appear. What has happened to the geometrical construct?

Within any single effect, either main or interaction, the largest possible SIGCV $= \min(df_i, n)$. As was discussed earlier the SIGCVs of a single effect are orthogonal and hence occupy as many orthogonal dimensions. If $k' > n$ the basic space is still at most n-dimensional and therefore there is at least some redundancy among the k' significant

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*This conclusion is within the limits of statistical determination. Since the underlying distributions are approximated the statistical tests of significance, though considered adequate, are approximations.

canonical variates. Redundancy in terms of the analysis would mean that two or more canonical variates from different effects would tend to load heavily on the same dependent variables and are correlated. Geometrically, redundancy means that the dimensions representing two or more canonical variates are oblique. If we decide to reduce the factorial to a one-way analysis to obtain a measure of the number of dimensions, NCVAR = n . If k = SIGCV emerge and $k < n$, we then conclude that our SIGCV space can be contained in k -dimensions. If $k = n$, we have a Case II situation discussed earlier, and are subject to the limitations of that case.

In the geometrical construct of the MANOVA, the dimensions of interest are primarily those of the significant canonical variates, rather than either those of the original n variables or even the total possible canonical variates. In a one-way MANOVA all significant canonical variates are orthogonal. With two or more factors the significant canonical variates are orthogonal only within an effect, and the canonical variates of one effect may be oblique to those of another effect. Generally canonical variates are interpreted in terms of their correlations with the original dependent variables. The geometric construct does little for interpreting directly a specific canonical variate. Until MANOVA programs include the actual computation of canonical variate scores and the correlations between nonorthogonal canonical variates, this part of the interpretation is strictly ad hoc. Such scores are possible, although the algorithm for generating them is undoubtedly tedious to program. However, the geometrical construct does provide a general model for initiating the interpretation of a MANOVA.

REFERENCES

1. Heck, D. L. Charts of some upper percentage points of the distribution of the largest characteristic root. Annals of Mathematical Statistics, 1960, 31, 625-642.

2. Pillai, K. C. S., & Samson, P., Jr. On Hotelling's generalization of T^2. Biometrika, 1959, 46, 160-168.

3. Pruzek, R. M. Multivariate analysis of variance for 2^k and 2^{k-m} designs. Paper presented at the 1969 annual meeting of the American Educational Research Association, Los Angeles, California.

4. Rao, C. R. Linear statistical inference and its applications. New York: Wiley, 1965, 472.

5. Roy, S., & Gnanadesikan, R. Some contributions to ANOVA in one or more dimensions: I and II. Annals of Mathematical Statistics, 1959, 30, 304-340.

APPENDIX B

Distinguished Visiting Scholars

List of Research Seminar Speakers

EDUCATIONAL TESTING SERVICE

announces the seventh annual series of

public lectures by

DISTINGUISHED VISITING SCHOLARS

during the academic year

1969-70

You are cordially invited to attend these six lectures,

which will be given in the

ETS Conference Center

Rosedale Road

Princeton, New Jersey

8:15 P.M.

October 13, 1969

Dr. Kenneth E. Boulding
Institute of Behavioral Science
University of Colorado
Boulder, Colorado

November 3, 1969

Dr. Nevitt Sanford
The Wright Institute
Berkeley, California

December 1, 1969

Dr. Raymond B. Cattell
Laboratory of Personality
and Group Analysis
Department of Psychology
University of Illinois
Champaign, Illinois

January 19, 1970

Professor Howard S. Becker
Department of Sociology
Northwestern University
Evanston, Illinois

March 23, 1970

Dr. Urie Bronfenbrenner
Department of Child Development
and Family Relationships
College of Home Economics
Cornell University
Ithaca, New York

May 18, 1970

Dr. James S. Coleman
Department of Social Relations
The Johns Hopkins University
Baltimore, Maryland

1969-1970
ETS RESEARCH SEMINARS

Professor R. C. Oldfield
Edinburgh, Scotland

Professor Alick Elithorn
London, England

Dr. Peter Bentler
University of California
Los Angeles, California

Dr. Hubert M. Blalock, Jr.
University of North Carolina
Chapel Hill, N.C.

Dr. Florence L. Geis
University of Delaware
Newark, Delaware

Dr. Paul L. Wachtel
New York University
New York, N. Y.

Rosemary Williams
Educational Development Center
Newton, Massachusetts

Dr. David S. Holmes
University of Texas
Austin, Texas

Dr. Courtney B. Cazden
Harvard University
Cambridge, Massachusetts

Dr. Edward E. Sampson
University of California
Berkeley, California

Dr. David Hawkins
Institute for Advanced Study
Princeton, N.J.

Dr. Salvatore Maddi
University of Chicago
Chicago, Illinois

Dr. Melvin Tumin
Princeton University
Princeton, N.J.

James Jenkins
University of Minnesota
Minneapolis, Minnesota

Dr. Gene M. Smith
Massachusetts General Hospital
Boston, Massachusetts

C. Victor Bunderson
University of Texas
Austin, Texas

Warwick Elley
New Zealand Council for Educational Research
Wellington, New Zealand

Daniel Solomon
Institute for Juvenile Research
Chicago, Illinois

APPENDIX C

Program Brochure

Application Form

Certification Form

POSTDOCTORAL PROGRAM

IN

EDUCATIONAL RESEARCH

EDUCATIONAL TESTING SERVICE
Princeton, New Jersey 08540

POSTDOCTORAL PROGRAM IN EDUCATIONAL

Educational Testing Service offers a Postdoctoral Program in Educational Research, and may be named on applications for one of the National Postdoctoral Fellowships which will be awarded each fiscal year through the Educational Research Training Program of the United States Office of Education.

Description of the Program

The primary orientation of the Postdoctoral Program in Educational Research at ETS is toward providing each participant with a flexible program of experiences to increase his competence as a practitioner in the field of educational research or as a teacher of potential researchers. A major assumption of the Program is that the best training for educational research is actual participation in the planning and conducting of important and well-conceived research projects. It is further assumed that the broad program of research under way at ETS, together with the variety of opportunities for interaction among staff and between staff and visitors at ETS, provides an effective setting within which the participants may broaden and deepen their insights.

The Postdoctoral Program in Educational Research is the responsibility of the Developmental Research Division at ETS, which conducts research related to specific problems in schools and colleges. Opportunity is also provided to utilize the resources of the other three Research Divisions at ETS--the Division of Educational Studies, the Division of Psychological Studies, and the Division of Computation Sciences. Projects within these Divisions cover the full range of the educational system from preschool through graduate school to continuing education in the professions, and involve a wide variety of research methods. Many of the projects are carried on in close cooperation with schools and colleges, offering research workers an opportunity to practice skills in diplomacy and communication as well as those in statistical analysis, experimental design, and theory construction.

It is planned that each of the participants will spend approximately two-thirds of his time working directly with one or more research teams on specific projects under way. The other third of his time is to be spent on a program of supplementary activities which draw on the over-all resources of ETS to round out his training experience. Each scholar is to plan the details of his particular program in consultation with the Director of the Program, a senior member of the Developmental Research Division.

The selection of project assignments will be made in relation to the particular needs of the individual scholar and to the desirability of providing him with experiences in all phases of the research sequence--defining the problem, designing the study, collecting the data, analyzing the data, and preparing the report.

Supplementary Program

The supplementary program may include a variety of activities. Participants may have full use of the Carl Campbell Brigham Library at ETS, to review research literature and to use the Library's extensive collection in psychology, education, and related fields, and its comprehensive Test Collection. During the academic year there are seminars at which Distinguished Visiting Scholars or members of the ETS Staff present research problems or research findings. There are formal classes in such areas as factor analysis, test theory, or the measurement of nonintellectual factors. Periodically, there are classes in computer programming. There are also opportunities of a more informal nature. For example, a scholar may wish to become better acquainted with the process of test development and so may elect to spend some time working with a team in the Test Development Division. Or he may be interested in problems of scaling and equating tests and so may elect to spend a period of time in the Test Program Research and Statistics Division. Whatever the research question he may raise, there is a specialist on the ETS staff to whom it may be referred.

The potential leader in the field of educational research needs skill in preparing research proposals which will arouse appropriate interest and attract financial support, if he is to carry out research of high quality. As one aspect of the supplementary program, each participant will prepare a formal proposal for a research study which he expects to carry out on returning to his regular position.

APPLICATIONS

To the U.S. Office of Education

Educational Testing Service is one of the institutions eligible to receive funds under the Educational Research Training Program of the United States Office of Education and is therefore an institution which may be named on applications for one of the National Postdoctoral Fellowships which will be awarded each fiscal year.

Applications for participation in the USOE program during any fiscal year beginning July 1 should be filed by December 1 of the preceding year. Requests for application blanks and for additional information should be addressed to:

Research Training Branch
Bureau of Research
U.S. Office of Education
Washington, D. C. 20202

To Educational Testing Service

While ETS can provide no funds directly to scholars, candidates with financial support from sources other than USOE (e.g., private funds foundation grants, etc.) may make direct application to ETS for participation in the program. Letters of application should include a summary of academic background and work experience, the area in research which is of especial interest to the applicant, and the length of time he would like to spend at Educational Testing Service.

Applications for participation in the program during any fiscal year beginning July 1 should reach ETS by March 30. Applications or requests for additional information should be addressed to:

Director
Postdoctoral Program in
Educational Research
Developmental Research
Division
Educational Testing Service
Princeton, New Jersey 08540

EDUCATIONAL TESTING SERVICE

Educational Testing Service is a non-profit organization that conducts testing programs, publishes tests, provides evaluation, advisory, and instructional services, and engages in research. It has as its primary goal the discovery and development of human talent through the effective use of tests and measurement techniques.

9/68

Please complete this application and send to:

Director, Postdoctoral Fellowship
Program in Educational Research

EDUCATIONAL TESTING SERVICE
Princeton, New Jersey

Date ____________________

Miss
Mrs.
Name: Mr. ____

Address ______________________________ Tel. No. __________

Date of Birth ______________________ American Citizen? __________

Name of Nearest Relative ________________ Relationship __________

Address of Nearest Relative ____________________________________

Undergraduate Work:

College Attended ____________________________________

Major Field: ____________________ Minor Field: ______________

Date of Graduation: ______________ Degree Received: __________

Graduate Work:

Institution: ____________________________________

Field: ____________________________________

Approximate Dates: ______________ Degree Received: __________

Thesis Sponsor: ____________________________________

Thesis Title: ____________________________________

____

Institution: ____________________________________

Field: ____________________________________

Approximate Dates: ______________ Degree Received: __________

Dissertation Sponsor: ____________________________________

Dissertation Title: ____________________________________

____

Academic Honors, special awards, and offices: ____________________

____

____

List publications or special activities related to educational or social science research:

Work Experience:

Organization	Employed From	To	Description of Job

Give a resume of a project in which you have participated which is pertinent to your application for the Postdoctoral Fellowship in Educational Research:

Describe briefly one or two studies which you would like to do:

Have you taken any of the Educational Testing Service tests, and if so when?

College Entrance Examination Board________________________________ Month, Year__________

Graduate Record Examinations________________________________ Month, Year__________

National Teacher Examinations________________________________ Month, Year__________

Others: Name of test________________________________ Month, Year__________

Names and addresses of people who are familiar with your training and your work:

If your credentials are available from a Placement Office, please name the office:

Signature____________________

CERTIFICATION FOR POSTDOCTORAL FELLOWSHIPS IN EDUCATIONAL RESEARCH

POOR ORIGINAL COPY - BEST AV

In order to provide ETS and the U. S. Government with information necessary to determine the stipend for the postdoctoral fellowships in educational research for the fiscal year 1966-67, the following information must be certified by the home institution of each fellow:

1. The annual salary for the year 1965-66 and whether the salary is stated on a calendar year or academic year basis.
2. The annual salary to which the fellow would be entitled for the year 1966-67 were he to remain at the home institution instead of accepting the postdoctoral fellowship. This salary should be quoted on the same basis as the salary for the 1965-66 year and should be consistent with general institutional policy on salaries, that is, it should not constitute a special increase in anticipation of the fellowship.
3. The remuneration which the fellow will receive from the home institution while occupying the fellowship. This would include any sabbatical pay, retirement, insurance, and the like.
4. Certification that the fellow has been granted a leave of absence from the home institution and is eligible to return to the institution at the expiration of the fellowship.

1. ______________________ has been employed by ______________________
(name of fellow) (name of institution)
between July 1, 1965 and June 30, 1966 at an annual salary of $__________ and
that the salary covers (a) the academic year ___ or (b) the calendar year ___.

2. The corresponding salary for the year 1966-67 would be $__________ if the individual were to remain at the institution rather than to accept the fellowship.

3. During the period from __________ 1966 to __________ 1967 the individual will receive no remuneration, either real or in kind, from ______________________
(the institution)
other than ______________________
(specify each type of remuneration and appropriate money value thereof
for the time period)

4. ______________________ has been granted a leave of absence from __________
(name of fellow)
1966 through __________ 1967.

I certify that the above information is true and correct to the best of my knowledge and belief.

Name of Officer

Name of institution

Signature

Date

I, ______________________, certify that I am the ______________________ of the institution named herein; that ______________________ who signed this certificate on behalf of the institution, was then ______________________ of said institution; and that said certificate was duly signed for and in behalf of said institution by authority of its governing body.

______________________ (SEAL)
Signature