R E P O R T R E S U M E S

ED 015 494 CG 001 000

LEVEL OF ASPIRATION AND MODELS APPLICABLE TO THE PROBLEM OF CHOICE OF CAREER.

BY- HUTCHINSON, THOMAS E.
HARVARD UNIV., CAMBRIDGE, MASS.

REPORT NUMBER HARVARD-NEEDS-NEWTON-TM-3
EDRS PRICE MF-$0.25 HC-$1.56 37P.

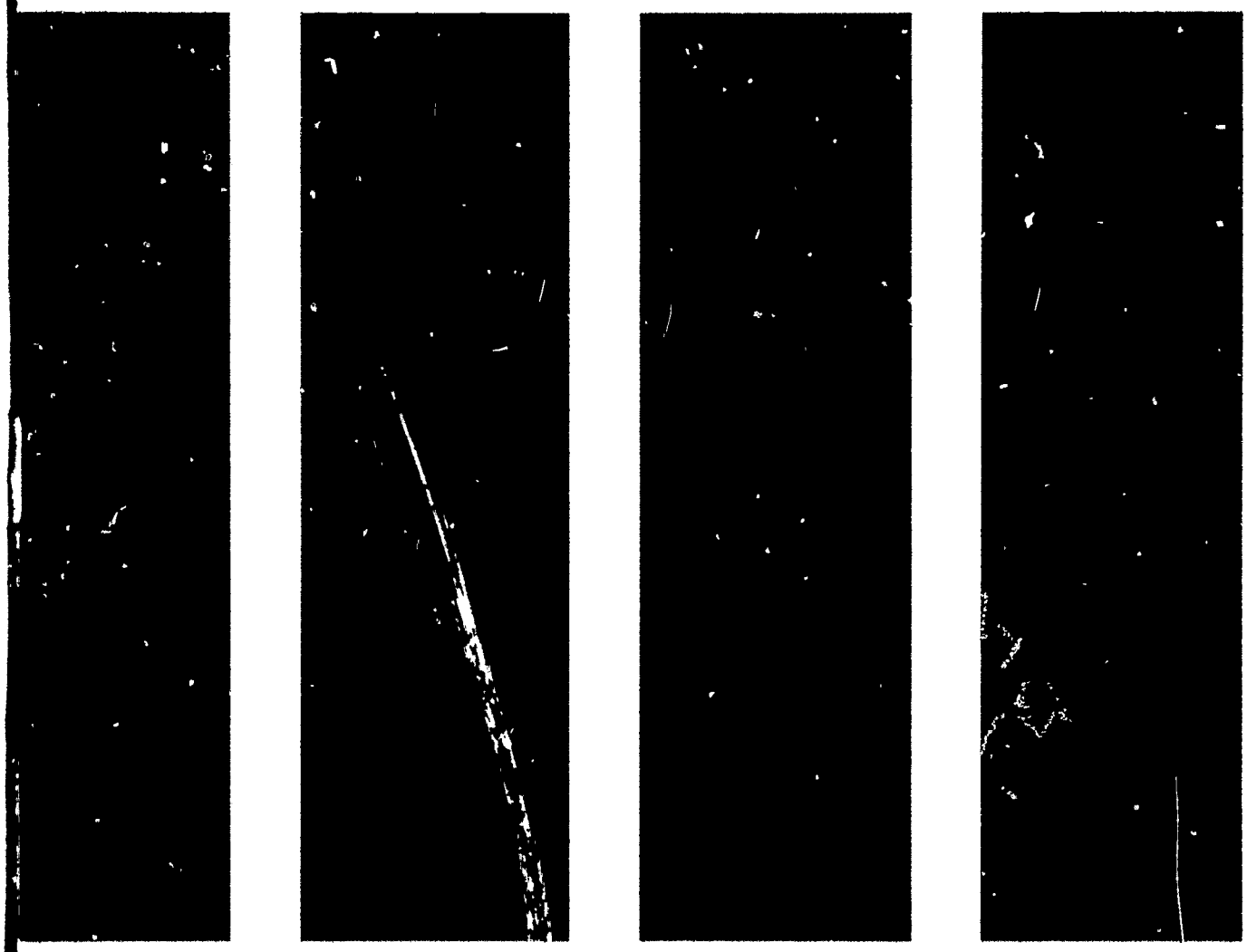
DESCRIPTORS- RESEARCH, *MODELS, *CAREER CHOICE, INFORMATION PROCESSING, *COMPUTERS, ASPIRATION, JOB ANALYSIS, JOB SATISFACTION, COUNSELING, *VOCATIONAL COUNSELING, *STATISTICAL ANALYSIS,

REGRESSION ANALYSIS, DISCRIMINANT ANALYSIS, AND A COMBINATION OF THESE STATISTICAL MODELS CANNOT PROVIDE INFORMATION APPROPRIATE TO INDIVIDUAL CAREER CHOICE THROUGH VOCATIONAL GUIDANCE. THESE MODELS IGNORE INDIVIDUAL VARIANCE IN ASPIRATION LEVELS AND MEANINGFUL DIMENSIONS OF JOB SATISFACTION. CENTOUR ANALYSIS PROVIDES FOR BOTH THROUGH USE OF FLEXIBLY DETERMINED SUBGROUPS. THOSE VARIABLES BELIEVED TO DISCRIMINATE AMONG THE FLEXIBLY DETERMINED SUBGROUPS OF THE VOCATIONAL GROUPS ARE USED TO ARRIVE AT CENTOUR SCORES WHICH DESCRIBE AN INDIVIDUAL'S POSITION WITH RESPECT TO THE SUBGROUPS. THIS MODEL, USED IN A VOCATIONAL SELF-CLASSIFICATION INFORMATION SYSTEM, ALLOWS THE INDIVIDUAL TO COMPARE HIMSELF WITH MANY VARIED VOCATIONAL GROUPS AND COMBINATIONS OF GROUPS WHILE HE HIMSELF DEFINES (IN PART) THE COMPOSITION OF THE GROUPS. THE COUNSELOR IS GIVEN PSYCHOLOGICAL INFORMATION ABOUT THE COUNSELEE AND OPPORTUNITIES FOR COUNSELING WHICH ARE NOT PRESENTLY AVAILABLE. LIMITATIONS OF THE SYSTEM ARE COST AND TIME FACTORS AS WELL AS THE TREMENDOUS NUMBER OF VOCATIONAL CATEGORIES WHICH EXIST. (AUTHOR/SK)

Level of Aspiration and Models Applicable to the Problem of Choice of Career

THOMAS E. HUTCHINSON

Technical Memorandum: 3



Harvard-NEEDS-Newton

Information System for Vocational Decisions

LEVEL OF ASPIRATION AND MODELS APPLICABLE TO THE PROBLEM OF CHOICE OF CAREER

THOMAS E. HUTCHINSON

Technical Memorandum: 3

Harvard-NEEDS-Newton Information System for Vocational Decisions

CG 001 000

TABLE OF CONTENTS

LIST OF FIGURES

Introduction

The Purposes of This Paper—An Overview

THE PURPOSES of this paper are:

1. To specify some of the requirements of a statistical model applicable to the problem of choice of career.
2. To show some of the limitations of statistical models previously used to provide career classification information.
3. To propose a statistical classification model which is more appropriate to the problem of choice of career.
4. To explore some of the characteristics, advantages, limitations, and theoretical and practical problems associated with the proposed model.
5. To suggest some initial approaches to demonstrate the power of the suggested model to provide the information which it claims to provide.

Analysis of the Problem

The personal decision about which career to pursue should be based on two types of information. (Tiedeman and Field, 1964, pp. 3-5). Outside information is a knowledge about the world of things and actions. In the problem of choice of career outside information consists of such items as occupational information, interests, aptitudes, and educational opportunities. There is a wealth of outside information available. It fills bookshelves and periodicals alike. The quantity of this information is overwhelming.

There is, however, a kind of information which is rarely available in useable form and even less often brought to bear on the problem of choice of vocation, e.g. the basis an individual uses in selecting one course of action from a set of alternatives. Information of this type has been labeled "inside information" (Tiedeman and Field, 1964, pp. 3-5). While studies have been done on the role of desired rewards in career choice

(Olive, 1964; San Diego . . ., 1964; Jones, 1965) nothing has been attempted in bringing into play any of the individual's inside information in a statistical classification model.

In order for the individual to make systematic use of some of his inside information these data must not remain internal. The inside information must be made explicit and thereby made external where it is in a position to be combined with other outside data in order to arrive at a decision. If the individual were to specify his inside information, then this specification would be an outside approximation of these internal data. This outside approximation would be outside information.

While it would be desirable to bring to bear all of the bases that an individual uses in decision-making, the process is too complex. Exactly what else should be included in addition to the provisions for this kind of information as made in this model must await further knowledge of the decision-making process. Up to now, however, there has been no provision for utilizing even a small amount of inside information. The proposed model will provide explicitly for at least some of this kind of information.

The current need for an information system in vocational guidance is made clear by Tiedeman and Ellis (1965). Their suggested system intends to help the individual to make his decisions rationally. In order to accomplish this aim, some inside information must be provided for in such a way that it can be meaningfully combined with outside information.

In specifying the counselee's criteria for selection of a career (an outside approximation of some of his inside information) we need two concepts. The first is the concept of dimension of job satisfaction. The second is the concept of level of aspiration.

A dimension of job satisfaction is here defined as a measurable personal goal related to work, such as the amount of money earned per year, or the amount of time spent in vigorous physical labor. Level of aspiration is here defined as that point along a dimension of job satisfaction which separates the desired from the not desired for an individual counselee. Some inside information may be specified by his determination of what dimensions of job satisfaction are significant to him and his selection of level of aspiration along each of these dimensions. How this information can be meaningfully combined with outside information in supplying classification information will also be shown.

Regression Analysis

During World War II the need for obtaining the most efficient use of the available personnel created an interest in the classification problem. The statistical models used were most often regression models (Tiedeman in Tiedeman, Rulon, and Bryan, 1951, p. 167). Although discriminant analysis has also been used, regression analysis continues to be extensively employed.

One recent set of regression models has been proposed by Cronbach and Gleser (1965). These models employ a cost utility technique where the predicted utility of a classification and the cost of a misclassification are combined in such a way as to maximize the utility and minimize the risk of loss. However, they point out that these models are designed for institutional decisions.

> Institutional decisions such as selection of employees may be distinguished from individual decisions. . . . In the typical "institutional" decision, a single person makes a large number of comparable decisions. (Cronbach and Gleser, 1965, p. 7)
>
> . . . our report deals almost entirely with institutional decisions. (Cronbach and Gleser, 1965, p. 9)

These models differ in intent from the purpose of enabling the individual to classify himself.

The problem lies in the imposition of a desired rewards system in the model (that the individual should choose the vocation yielding the *highest predicted utility/lowest predicted risk*). The imposed desired rewards may not coincide with the desired rewards of some individuals. Sorenson (1965) outlines a system where regression analysis is used to predict a set of criteria. This leaves the individual free to decide whether the predictions are satisfactory or not. However, in this system the inside information remains inside. The bases the individual uses in deciding whether or not he likes the predictions remain implicit.

Regression is unsuited for making individual decisions and does not help to bring inside information outside. In addition, Tiedeman and Sternberg (1952) have shown that regression may fail to discriminate in some situations where discriminant analysis succeeds.

Discriminant Analysis

The usual application of discriminant analysis to the classification problem is accomplished by choosing a sample from each of a number of class-

es. The analysis is performed among the groups where each group is one of the selected samples.

Cronbach and Gleser (1965, p. 115) have objected to the use of discriminant analysis for classification purposes. Their objection is that discriminant analysis ignores distinctions within the groups. That is, we may find out whether the counselee looks more like a dentist or a carpenter, but we have no information about his relative prospects for success within each group.

Discriminant analysis does determine a new set of dimensions which maximize the among groups variation and minimize the within groups variation (Rulon, 1956, p. 23). Therefore, once the groups have been selected, the discriminant procedure does focus upon among groups differences at the expense of within groups differences.

When discriminant analysis is applied in this manner there is no opportunity for the use of inside information. We can say how much the counselee looks like each of the vocations. The counselee may say, "Although I look a little more like a carpenter than a dentist, I would rather be a dentist." Does he look more like a successful dentist or a successful carpenter according to what the counselee's concept of success is?

This way of using discriminant analysis is inappropriate to individual choice of career. The model ignores distinctions within groups and fails to provide for inside information.

A Combination Approach

Tatsuoka (1957) created a model that combines regression and discriminant analysis in a classification model. While his application was to the problem of choice of college major one can easily see how it could be applied to choice of career. His procedure requires that a cutting point be selected along some criterion dimension, such as, money earned per year. He then determines for the individual his joint probability of membership and success in each of the groups considered. The cutting point defines the division between success and failure.

Now, if the individual were permitted to select the cutting point, there would be some provision for the counselee's desired rewards, for some inside information. However, there is only one dimension of success available. There are people who prefer a white collar job at less money to a blue collar job at more money. Job satisfaction is multidimensional (Jones, 1965). If inside information is to be provided for, then the multidimensionality of job satisfaction must also be provided for in the model.

The use of a term, such as, "probability of group membership," assumes that the procedure predicts group membership. There is an implicit decision rule that the individual should or will choose the career that yields the highest joint probability. An implied decision rule is inconsistent with individual determination of career.

Tatsuoka's model is also inappropriate to individual determination of career. The procedure fails to account for multiple dimensions of job satisfaction and includes an implicit decision rule in the model.

Centour Analysis Among Flexibly Determined Subgroups

A Discriminant Limitation Considered

TAKE A LARGE SAMPLE from a population. Sort that sample into a number of groups. Run a discriminant analysis among the groups and differences within the groups will be minimized. This does not mean that any given differences that exist in the sample must be ignored.

The experimenter has it in his power to group the sample in any way. The experimenter may group the members of the sample according to the differences that he does not wish to ignore. Just because the sample contains plumbers and carpenters does not mean that this is the only way one is allowed to group the sample.

Perhaps there is no interest in differences between plumbers and carpenters, but in differences between successful people, and unsuccessful people. In this case divide the sample into these two classifications.[1] Perhaps one is interested in both dimensions of difference, success/failure and vocation. In that case divide the sample first into plumbers and carpenters, then divide the plumbers into successful plumbers and unsuccessful plumbers, and divide the carpenters into successful and unsuccessful carpenters. Now we have four groups instead of two and a

[1] This is called dichotomizing a continuum and is frowned upon. However, the proposed users of this model (vocational counselees) may not all be sufficiently sophisticated to use more than two classifications even though the model is capable of handling more categories. To insist on using three or more classifications could result in exceeding the sophistication of some users. This is more frowned upon since the analysis would no longer be information for these people.

discriminant analysis among the four groups will differentiate simultaneously on the basis of both dimensions.

This grouping procedure may be extended in the direction of additional dimensions, such as sex; and/or in the direction of additional numbers of levels, such as, very successful, successful, mediocre, unsuccessful, and very unsuccessful. The above mentioned limitation is a figment of the imagination or lack of imagination. In general, the supposed limitation of discriminant analysis is solved by grouping the sample according to the differences of importance.

The Model Requirements

A vocational classification information system and the model on which it is based should provide for inside information in the form of multiple dimensions of job satisfaction and level of aspiration. The model should avoid implicit decision rules. It has been shown that regression models are inappropriate and that those discriminant models and combination models that have been used in self-vocational-classification are also inappropriate.

However, if a discriminant model could be devised that would provide for level of aspiration, grouping according to the differences of importance, multiple dimensions of job satisfaction, and no implied decision rule; then it would be applicable to this problem.

Now the question is whether discriminant analysis is a necessary procedure. Beaton (1964, Chapter 9, p. 6) has shown that with the advent of high speed computers short cut procedures are not necessary or desirable. Reduction of dimensionality is no longer an important consideration in a situation where the computations may be done by so speedy and reliable a process. Classification may be done in the original test space.

A problem, in addition to those mentioned above, arises from the desire to provide for some inside information. If some of the individual's inside information is to be provided for, the significant differences among vocations must be those differences which are of significance to that individual. In other words, a model must be developed in which we do not know in advance what the differences of importance are.

These requirements are met by a two-stage design where the first stage provides for flexible grouping according to the important differences and where the second stage is centour analysis among the groups formed by the first stage.

The First Stage—Flexible Grouping

The first stage of the model divides the samples (for example, a sample from each vocation) into subgroups according to the differences of significance. This is accomplished through the use of grouping variables.

Grouping Variables

Grouping variables are measurements that are used for the express purpose of providing a basis on which to form subgroups from the samples. Each grouping variable may be thought of as a dimension. There should be a dimension provided for every possible difference of interest. The dimensions to be provided might be determined by a prior study of the problem to which the model is to be applied. There must be a score on each dimension for each member of the samples.

An individual may then select those dimensions which are important to him and he may ignore other dimensions. Any individual may do this since, in theory, all possible dimensions are provided. This selection defines a space to be hereafter called the grouping space.

The Grouping Space

The dimensions selected define a grouping space of signficance to the individual. Along each dimension the individual selects a cutting point which is to represent a point of importance. These cutting points then define two areas in the grouping space. The individual is interested in the differences among the subgroups defined by being in one or the other of these two areas.

Each member of each sample is located in the grouping space as a point defined by his scores on the selected grouping variables. That part of each sample which falls above all the cutting points on all the dimensions becomes one subgroup. The remaining part of the sample, in which the members are below the cutting point on one or more dimensions, becomes the second subgroup. Thus, each sample is divided into two subgroups according to the differences of significance to the individual.

By using two or more cutting points per dimension the samples may each be divided into three or more subgroups. This is accomplished by setting the highest set of cutting points and removing the subgroups that fall above those cutting points on all dimensions. Then the next lower set of cutting points are specified and again the subgroups that

are above all of these cutting points are removed. This process is continued until all the sets of cutting points have been used. Then the last subgroups are removed. The members of these last subgroups are below the lowest cutting point on one or more dimensions.

The Second Stage—Centour Analysis

The first stage of the model defines the subgroups. The subgroups are then placed in a centour variable space. A second set of variables, called the centour variables, are used to arrive at centour scores. The scores on the centour variables of an individual who is not a member of the original sample may be used to arrive at centour scores for the individual for each of the subgroups.

Centour Variables

There are two types of centour variables used. The first kind are those that are never used in grouping. The second kind are variables that are sometimes used in grouping, but which were not used for this purpose in the particular analysis in question. Both kinds of variables are measures believed to discriminate among flexibly determined subgroups.

Measure of Discrimination Power

The power of the centour variables to differentiate among the defined subgroups is evaluated by computing Λ. This is used in the test of significance for discriminant analysis and multivariate analysis of variance (Cooley and Lohnes, 1962, p. 118). In this instance the statistic Λ is used as a description of the confidence we may have that the centour scores obtained by this procedure are not chance scores, but represent a differentiation of the position of an individual from the position of the various subgroups. The value of Λ necessary for sufficient confidence will have to be determined by experimentations.

Centour Scores

Centour scores are then computed. A centour score represents in quantitative terms the position of an individual with respect to the space occupied by a subgroup. Thus, the individual's centour scores, one for each subgroup, represent his position in the centour space as compared to the space occupied by each of the subgroups (Cooley and Lohnes, 1962, p. 136).

Outline of the Model with a Geometric Interpretation

1. A substantial sample is drawn from each population of significant interest.

2. For each member of each sample measures are taken on the grouping and centour variables.

3. The dimensions of the grouping space are defined by the individual's choice of grouping variables. In Figure 1 (see page 10) the grouping space is two dimensional. The individual may choose to leave out some dimensions.

4. The individual then specifies his choice of cutting points along each selected dimension (see Figure 2, page 11).

5. In a two-space, for each dimension, a line is drawn perpendicular to that dimension at the cutting point. In a three-space a plane would be drawn perpendicular to the dimension and in a space of four dimensions or greater a hyperplane would be so drawn.

The locations of these lines or planes define two areas (see Figure 3, page 11). The clear section is one area and the shaded section is a second area. These areas may be labelled according to the nature of the problem.

Figure 4 (see page 12) shows the subspaces formed by three intersecting planes in a three-space.

6. The sample groups are then placed in the grouping space (see Figure 5, page 12). Each member's positions on the various axes define a point in that space.

Those members of a group that fall into the shaded area become one subgroup and the remaining members who fall into the unshaded area become a second subgroup. In this illustration each group has been divided into two subgroups.

7. The centour variable space is defined by the axes of the centour variables. This space will have as many dimensions as there are centour variables. Figure 6 (see page 13) shows the centour variable space as a two-space defined by a choice of two centour variables.

8. The subgroups are then placed in the centour variable space (see Figure 7, page 13). Each member of each subgroup is located in the centour variable space as a point defined by his score on each of the centour variables.

9. In this space Λ is computed and treated as a descriptive statistic. This will determine whether these subgroups are sufficiently differ-

entiated by these variables. The test is to see whether the groups occupy different subspaces of the centour variable space.

10. Member scores along these axes allow maximum accuracy of classification of the members of the total sample on these variables. No linear combination of these variables will yield a higher accuracy of classification.

11. By the use of the centour variables the scores of an individual, not a member of the original samples, are used to find his position in the centour variable space. The individual's scores on the centour variables are used to determine a centour score for each subgroup.

12. By comparing the individual's position with the location of each of the groups it is possible to say in quantitative terms (centour scores for each group) how much he looks like the members of each group. For a geometric interpretation of centour scores see Cooley and Lohnes (1962, p. 136-137).

Figure 1.
The Grouping Space

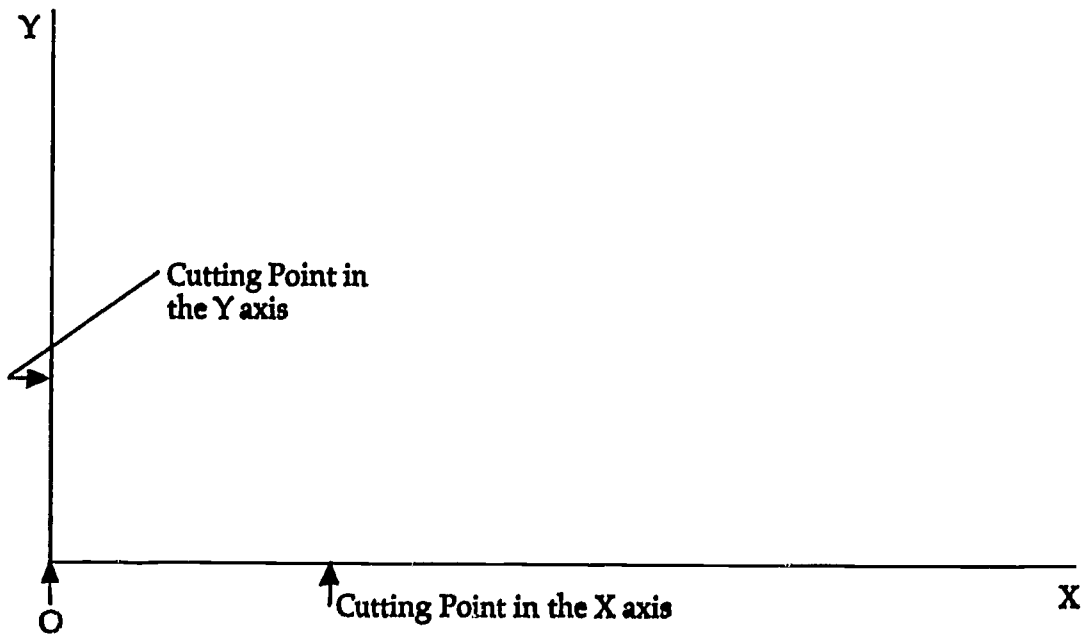


Figure 2.
Cutting Points in the Grouping Space

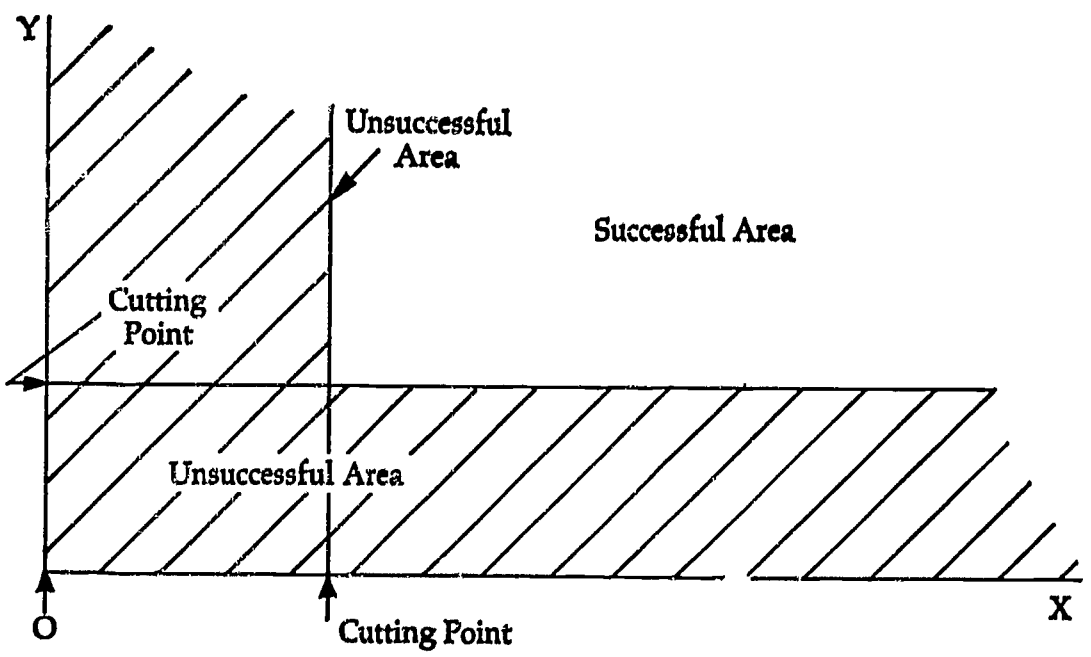


Figure 3.
Areas of the Grouping Space

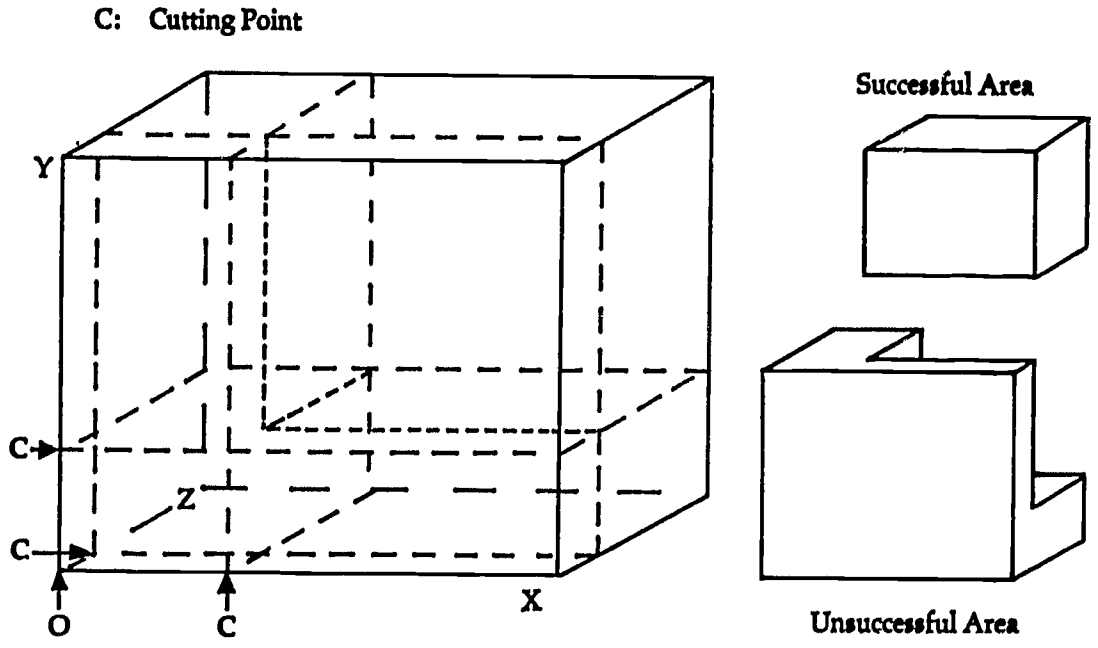


Figure 4.
Subspaces in a Three Dimensional Grouping Space

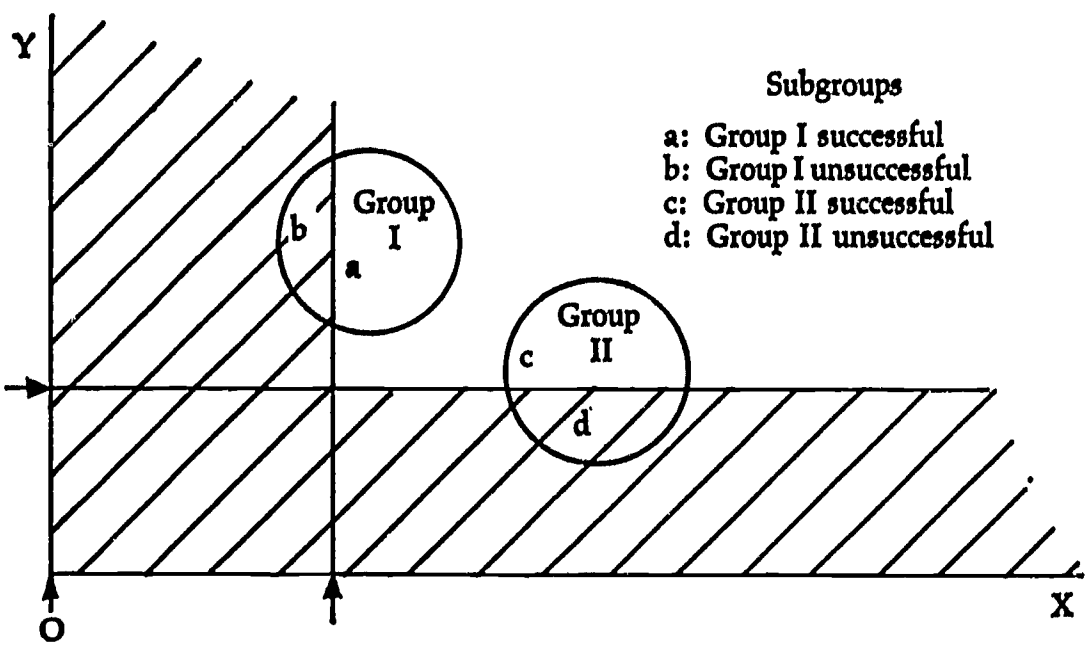


Figure 5.
Sample Groups in the Grouping Space

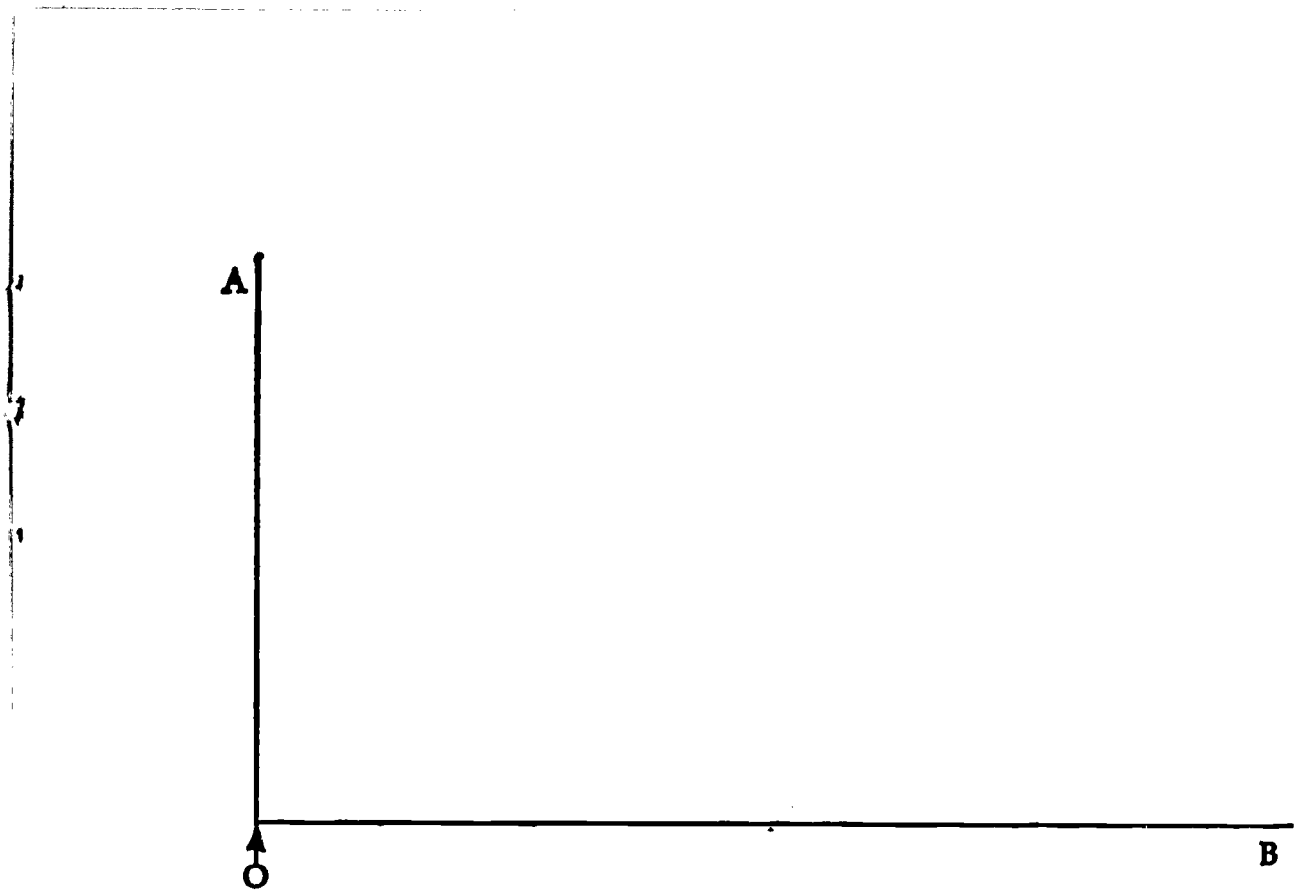


Figure 6.
The Centour Variable Space

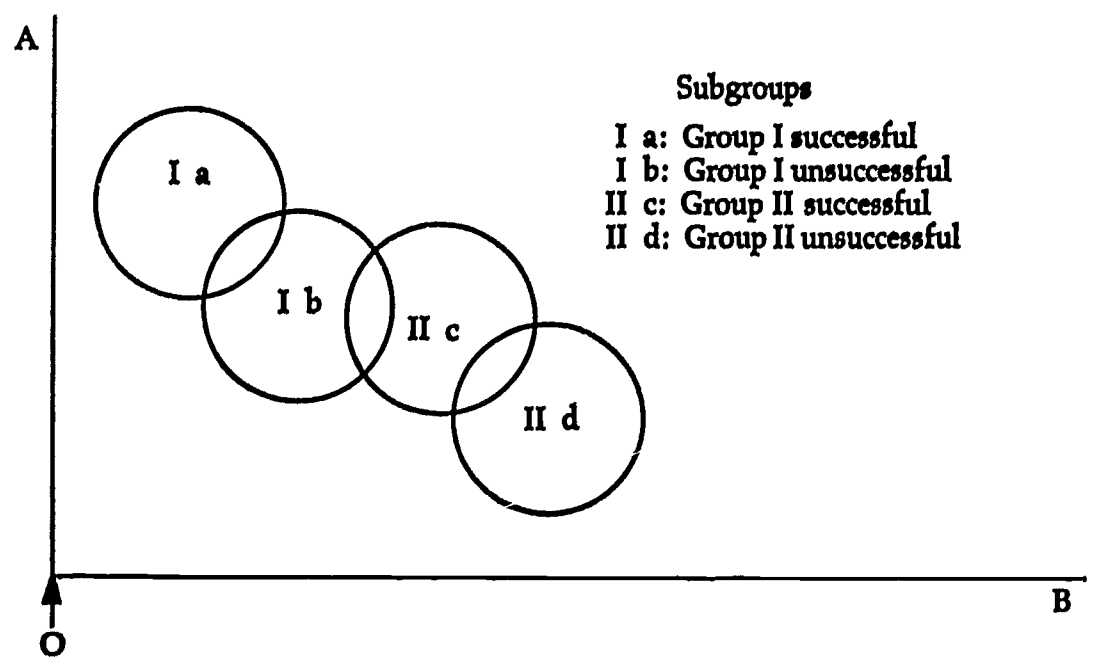


Figure 7.
The Subgroups in the Centour Variable Space

Advantages of the Model

The characteristics of the model will now be compared to the requirements of the problem. The purpose is to indicate the extent to which the model fits the model requirements discussed above.

Multiple Dimensions of Importance

This model does provide explicitly for multiple dimensions of importance. Further, it is possible for the individual to select only those dimensions that he considers to be significant to him. Thus, the individual defines the area of importance.

Differences of Importance

The individual selects the cutting points for each dimension. By so doing not only has he specified the area of significance, but also he defines the subareas that are to be differentiated. Thus, he determines the formation of subgroups according to the differences of importance to him.

No Implicit or Explicit Decision Rule

There is no decision rule built into the model. It might appear that there is an implicit rule, that the individual not a member of the total sample should be classified into that subgroup which he looks most like. However, this is not the case.

If such a rule were valid at all, it would be valid only if it were not possible for the individual to change prior to the time at which he must actually be classified. Therefore, if there is any time between the analysis and the actual classification there is no decision rule.[1] Further, it is possible for the individual to redefine the dimensions and cutting points of importance. The analysis would then give different results. There is no rule in the model, implicit or explicit, for preferring one set of selections over another.

No Inconsistent Information

Since no predictions are involved there is no chance for inconsistent information to be part of the output. The analysis will not predict that an individual will earn minus money or work more than all the time with

[1] This is also true of the models discussed earlier. However, those models were developed and have been used for the purpose of making the decision rather than for the purpose of supplying information.

people. The fixed natural limits of the various scales employed cannot be exceeded.

Provides Potential for More Information

Rulon (in Tiedeman, Rulon, and Bryan, 1951, p. 175) pointed out the desirability of making many different kinds of comparisons. Each comparison provides new information. Further, this new information is in each case different from information that can be supplied by correlation techniques. This model, by providing for a choice of comparisons to be made, enables the individual to get more information by successive contacts with the model than can be supplied by any other existing technique.

A Limitation of the Model

The model is limited in the grouping process by not permitting a simultaneous study of the interaction of the dimensions of interest. This limitation shall be considered in the situation where the individual makes one and only one contact with the system.

The individual might select a cutting point at one standard deviation above the mean on the first dimension and select a cutting point at one standard deviation below the mean on the second dimension. He may feel that reversing the cutting points would describe subgroups of as much interest to him as the subgroups defined by the first set of cutting points. In the used once case the system cannot provide comparisons based on both combinations of cutting points at the same time.

This limitation may be a necessary one. One way to provide for simultaneous comparisons as described above would be to divide each group into four subgroups. If a set of five cutting points per dimension were selected with an alternative set of five cutting points, 25 sub-groups would be required. If there were two cutting points and seven alternate sets, 256 subgroups would be required for each group entered into the grouping space. It would require samples of fantastic size to allow sufficient members of each subgroup for the analysis to mean anything.

Another way to overcome the above mentioned problem would be to have the counselee specify all of his alternative sets of cutting points and provide in the model a linear equation which would describe a surface separating the subspaces of success and failure. However, such a procedure puts the model builder back into the decision rule business.

The model builder's linear equation is not likely to correspond exactly with the counselee's equation should the counselee specify it (or be able to specify it).

We could ask the counselee to specify his equation for the interaction of cutting points along the selected dimensions of job satisfaction. The difficulty with this procedure is that few if any counselees would be sufficiently competent.

The proposed solution (contained in the next section) is by necessity statistically unsophisticated. An adequate model cannot exceed the sophistication or the user nor can it merely introduce a decision rule into a novel location in the model.

Centour Analysis Among Flexibly Determined Subgroups[1] as Applied to the Problem of Choice of Career

IN APPLYING THIS MODEL to the problem of choice of career the individual is a vocational counselee. The grouping variables are dimensions of job satisfaction. The samples are samples from vocational groups. The centour variables are those variables believed to discriminate among flexibly determined subgroups of the vocational groups. The model limitation becomes a classification information system advantage.

Multiple Use as a Solution to a Model Limitation

The student may feel that he is successful if he earns $4,000 and does not have to do any mathematics, but that if he has to spend half of his time doing mathematics problems then he must earn $6,000 to consider himself successful.

The simultaneous study of interaction of the job satisfaction dimensions is not possible with this model if the information system is used

[1] It is likely that all potential aspects of the model could not be used in practice because of prohibitive costs. It is also likely that we can do more in these indicated directions than has been done and that we may be able to go even further in the foreseeable future. In a practical application the potential of the model is reduced to what is possible now given the hardware available and the costs involved.

once. There is no limitation, however, on the number of times that the student may use the system. The student may use the $4,000 and no-computations cutting points on the first analysis. He may use cutting points of $6,000 and one-half-time-doing-computations on the second analysis. By comparing the results from the two analyses he has in effect studied the interaction of these dimensions for the selected cutting points.

It would also be possible to study such interactions systematically. The amount of time spent doing computations can be held constant while the amount of money earned per year is varied from a low point to a high point by specific intervals. Then the cutting point for the amount of time spent doing computations can be increased by some specific interval and the cutting point for money may again be systematically varied. The results might then be introduced into other programs for further analysis.

The interaction limitation is not a crucial one since it is surmountable. In fact, one of the advantages of the system in providing career information in a guidance situation is the capacity for and usefulness of multiple contacts with the system. Tiedeman and Ellis (1965, p. 1-9) describe this advantage.

The Classification Information System

Take a large sample from the population of working persons. A number of measures are taken of this sample. These measures are scores on grouping and centour variables. The system provides for grouping this sample according to the differences which are important to the individual vocational counselee.

In the centour variable space centour scores are found for this individual. A test of significance of the discrimination power of the variables is employed. Statements such as, "Compared to successful carpenters, unsuccessful carpenters, and successful plumbers, you look most like an unsuccessful plumber," would become possible. It would also be possible to specify why the student doesn't look more like a successful plumber.

The First Stage—Flexible Grouping

The first stage selects from the sample those groups in which the counselee is interested. This stage further subdivides these groups into subgroups according to the within groups differences of importance to the student.

Screening Variables

Screening variables are those variables that are used to select groups for further consideration. The vocation name would be a screening variable as would be the sex of the sample member. If the counselee was interested in male carpenters and plumbers the screening variables would be male, carpenter, and plumber. The data processing equipment would then screen out all members of the sample who do not fit this description. There would now be two groups, male plumbers and male carpenters.

Grouping Variables

Grouping variables are those that divide the groups into subgroups. These variables would each represent a dimension of job satisfaction, such as, amount of money earned per year, amount of time spent working alone, or amount of time spent doing computations.

If the counselee is interested in successful and unsuccessful male plumbers and carpenters and he specified that to be successful he must earn $5,000 a year, then the data processing equipment would separate the groups into the following classifications: unsuccessful male plumb rs, successful male plumbers, unsuccessful male carpenters, and successful male carpenters. Successful plumbers and carpenters would be those who earned $5,000 or more per year. Unsuccessful plumbers and carpenters would be those that earned less than $5,000 per year.

The Grouping Space

The counselee may wish to use more than one dimension of job satisfaction. In this case the division of the groups will be effected by having the counselee specify for each dimension used that level below which he would consider himself to have failed in his expectations. If a member of one of the screened groups is at or above this level of aspiration on each of the scales then he is placed in the successful subgroup. The remainder comprise the unsuccessful subgroup.

Ideally it would be better to have each dimension separately used to define a subgroup. Then discriminations between male carpenters who work alone more than half the time and make $5,000 or over, male carpenters who work alone more than half the time and make under $5,000, male carpenters who work alone half the time or less and make $5,000 or over, etc., would be possible. However, if one had ten job satisfaction dimensions this would split each screened group into 2^{10} subgroups.

Also a dichotomy is not the only possible way to divide each screened group. The screened group could be divided into any number of subgroups, such as, very successful, successful, mediocre, unsuccessful, and very unsuccessful. The student would first specify his level of aspiration for very successful and the groups would be separated into very successful and less than very successful. Then the student would specify his level of aspiration for successful and further divide the less than very successful group into two parts, successful and less than successful. This process would be carried out until there were five subgroups for each screened group. If each dimension were allowed independence we would have 5^{10} subgroups instead of five.

There are three reasons why independence of dimensions cannot be allowed at the present time. First, we would have to provide enough people in the sample to allow for 5^{10} subgroups of male plumbers. Second, it would be very difficult to interpret the results on a comparison of 5^{10} subgroups. Third, we do not have the data processing equipment to handle 5^{10} subgroups. At the present time all the possible interactions of dimensions of job satisfaction cannot be studied simultaneously.

Options

This first stage is a flexible grouping model based on the individual counselee's decisions. Each provision for a counselee decision is an option. These options are: selection of the screening variables, selection of the grouping variables, selection of the number of subgroups, selection of cutting points, and selection of which subgroups to retain.

Selection of Screening Variables. The counselee has the option to include all of the vocational groups in the analysis or to select any number and combination of groups. He may also decide to compare himself with those members of the total sample who are of his sex or with all members regardless of sex. Other screening variables might be provided. In general these would be organismic variables, such as, sex or height.

Selection of Grouping Variables. The counselee may elect to include all or any number and combination of dimensions of job satisfaction. He may elect to use the dimensions of the amount of money earned per year and the amount of time spent working alone and to leave out the others, such as, the amount of time spent doing computations.

Selection of the Number of Levels for Grouping Variables. The counselee may choose to use from one to N cutting points per dimension which

results in two to N + 1 subgroups for each screened group. For example, he may want successful and unsuccessful groups in which case there would be one level of aspiration specified for each dimension and two subgroups per screened group.

Selection of Cutting Points. It is the counselee's right to select the cutting points. He may specify his level of aspiration for the amount of money earned per year as $4,000, $7,000, $20,000 or any other amount he desires.

Selection of Vocational Subgroups. The counselee may elect to compare himself with some of the subgroups defined by the grouping process and not with others. Thus, he may compare himself with successful male carpenters and successful male plumbers and not compare himself with the unsuccessful subgroups.

Selection Interaction

It is possible for one individual to obtain a very large number of solutions depending upon his use of the options available. If there are 50 vocational groups, nine dimensions of job satisfaction, sex as a screening variable, and nine possible cutting points per dimension (but only one set allowed at a time) and he does not elect to drop any subgroups, then the total number of solutions would be $50^{50} \times 3 \times 10^{10} \times 10^{10}$. It is for this reason that it is not suggested to run all possible solutions and put them in a reference book for counselee and counselor use.

The Second Stage—Centour Analysis

The subgroups defined by the first stage are now placed in a centour variable space. These variables are of two types: variables never used in grouping, and variables sometimes used in grouping, but which were not used in grouping in the analysis in question. The centour variables are used to arrive at centour scores which describe the individual's position with respect to the subgroups.

Variables Never Used in Grouping

These variables are aptitude, attitude, and achievement variables which there is reason to believe discriminate between subgroups. For example, there could be scores on mathematics achievement, mathematics attitude, and mathematics aptitude included as centour variables.

Variables Sometimes Used in Grouping

If the counselee chooses to have all members of the vocational group included regardless of sex, then the sex variable would be included as a centour variable. If a subject was comparing female carpenters with female teachers the sex variable would not discriminate between groups, but if the student was comparing carpenters and teachers regardless of sex then it is expected that the sex variable would be a powerful discriminator.

Other variables could also fall into this category, such as height, weight, etc. To be an officer in an armed service one must be 5'4" or taller. This variable would also distinguish between some professional athletes and other kinds of occupations for some individuals.

Computation of Differentiation

The computation of sufficient differentiation among subgroups is performed in the centour variable space. If the value of $\_\Lambda\_$ is not large enough (as determined by prior experimentors) centour variables to discriminate among the subgroups is not sufficient to have any faith in differences among the centour scores found.

Computation of Centours

The computation of centour scores for the individual counselee is performed in the centour variable space. These scores represent the percent of the members of a given subgroup who fall further away from the group center than the student does (Cooley and Lohnes, 1962, p. 136). Thus, we can say how much he looks like each of the subgroups in quantitative terms.

Further Analyses

Additional analyses may be done at the option of the individual, such as, to indicate along each centour variable the counselee's percentile score as compared with some selected subgroup. Thus, if he doesn't look like a successful chemist such an analysis would provide diagnostic information as to why he doesn't look more like a member of this subgroup. We also might be interested in the position of the subgroup centroids with respect to the centour variables and the power of each centour variable to differentiate among the subgroups.

Outline of the System with a Data Processing Interpretation[1]

1. A substantial sample is drawn from the members of each vocation.

2. For each member of the total sample measures are taken of screening, grouping, and centour variables. This information is stored in a data bank; perhaps with each vocation on a separate disk. These disks may be numbered (see Figure 8, p. 23).

3. The counselee selects the screening variables. These variables screen out those members of the total sample who are not to be included in the analysis. For each screening variable he makes his selection by typing the appropriate information on a console according to directions (see Figure 9, p. 23). (The directions given are not to be considered sufficient for counselees: but rather, sufficient for readers.) Then the counselee selects the vocational groups with which he wants to compare himself (see Figure 10, p. 24).

The computer then reads from disks one and four. It tests for the screening variables and writes on a tape those members (with their scores) of the total sample that are to be used in the analysis (see Figure 11, p. 24).

4. Meanwhile, back at the console, the counselee specifies the number of cutting points to be used per dimension of job satisfaction (see Figure 12, p. 24). Then the counselee specifies his dimensions of job satisfaction and his level of aspiration along each dimension (see Figure 13, p. 25). (For some of the dimensions of job satisfaction it would be necessary to provide the counselee with the opportunity to specify the direction of the scale, i.e., for some students, doing computations may be desirable while for others doing computations may be undesirable.)

The computer then reads from the tape on which the screened groups are written. It compares the grouping variable scores of each member with the selected cutting points and separates each group into two or more subgroups corresponding to the counselee's definition of the boundaries between subgroups (see Figure 14, p. 25).

5. The members of the subgroups along with their scores on the centour variables are then read into the computer and Λ is computed. It is tested for effectiveness and if Λ is sufficiently large the program continues. If it is not large enough the program prints a message and stops (see Figure 15, p. 25).

6. The counselee then specifies his I.D. number (see Figure 16, p. 26).

[1] The system would require time sharing methods so that costs could be minimized.

The computer reads in the centour variable scores for this individual and prints out his centour scores for each of the subgroups (see Figure 17, p. 26).

7. The counselee may then specify that he wants a further analysis (see Figure 18, p. 26). The computer then does a diagnostic analysis and prints out the student's percentile scores along each centour variable with respect to that subgroup. It also prints the percentile and raw scores for the subgroup centroid and the student's raw scores for each centour variable.

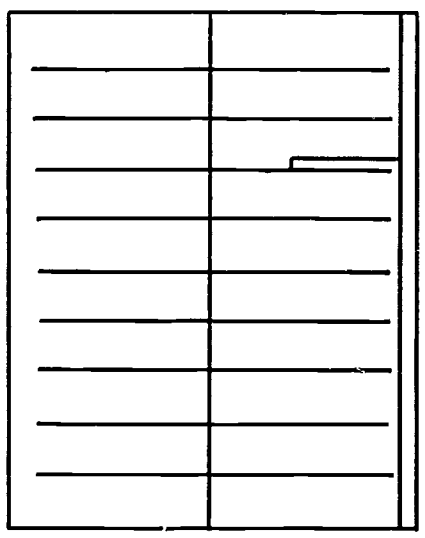


Figure 8
Disk Storage

Figure 9.
Selection of a Screening Variable

DIRECTIONS

1. Type SEX, Then choose and type MALE or FEMALE or ALL

COUNSELEE TYPES

SEX, MALE .

Figure 10.
Selection of Vocational Groups

DIRECTIONS

10. Type VOCATION, Then choose and type the numbers corresponding to the vocations you want included.

1 Carpenters
2 Doctors
3 Lawyers
4 Plumbers
.
.
.

COUNSELEE TYPES

VOCATION, 1, 4

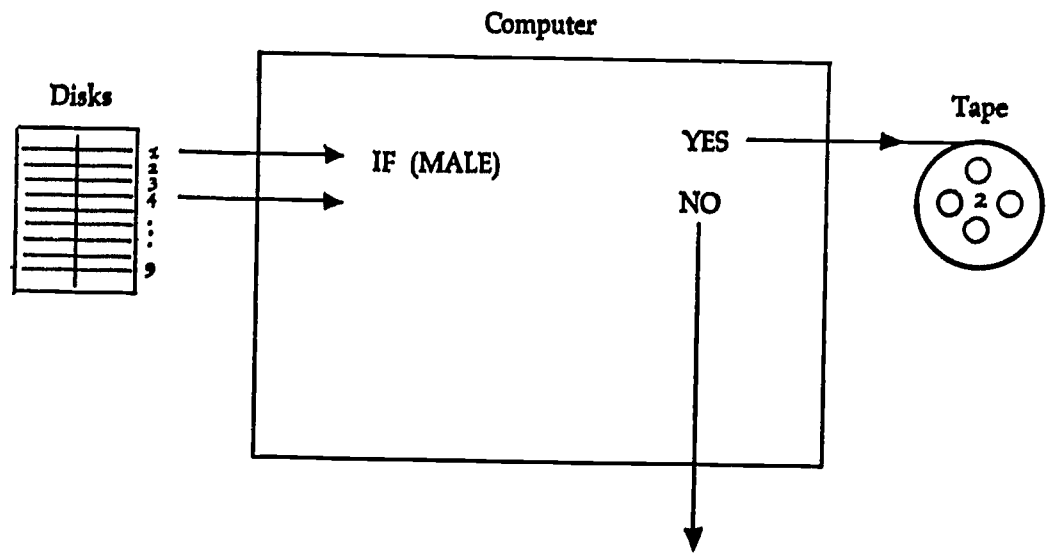


Figure 11.
The Screening Process

Figure 12.
Specification of the Number of Cutting Points

DIRECTIONS

11. To select the number of cutting points to be used per dimension of job satisfaction, type POINTS, Then type the number of cutting points that you want from 1 to 5.

COUNSELEE TYPES

POINTS, 1

Figure 13.
Selection of Dimensions and Levels of Aspiration

DIRECTIONS

12. Type DIMENSIONS, Then type the numbers corresponding to the dimensions you want used and in brackets, ( ), your level of aspiration for each dimension.
    1. Money $1,000 $2,000 $3,000 . . . $100,000
    2. Time Spent Working Alone .1 .2 .3 . . . 1.
    3. Time Spent Doing Computations .1 .2 . . . 1.

COUNSELEE TYPES

DIMENSIONS, 1(4000), 3(.5)

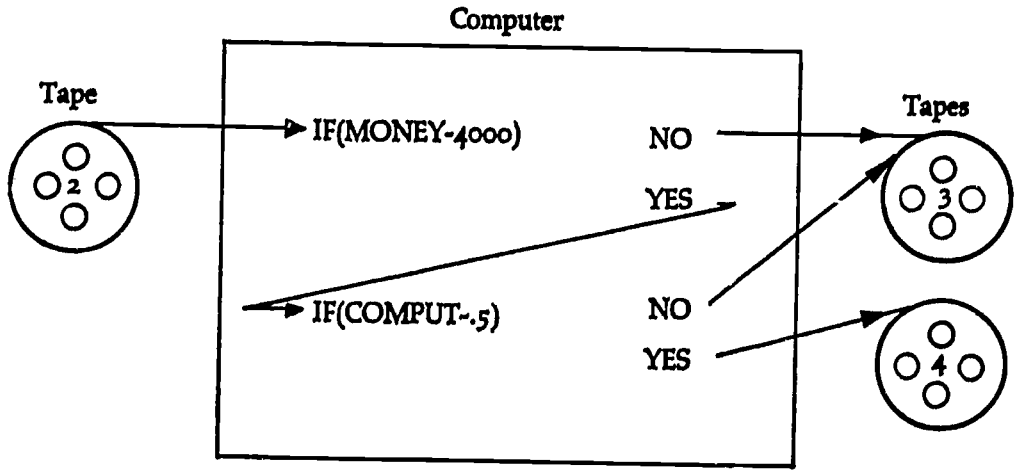


Figure 14.
Flexible Grouping

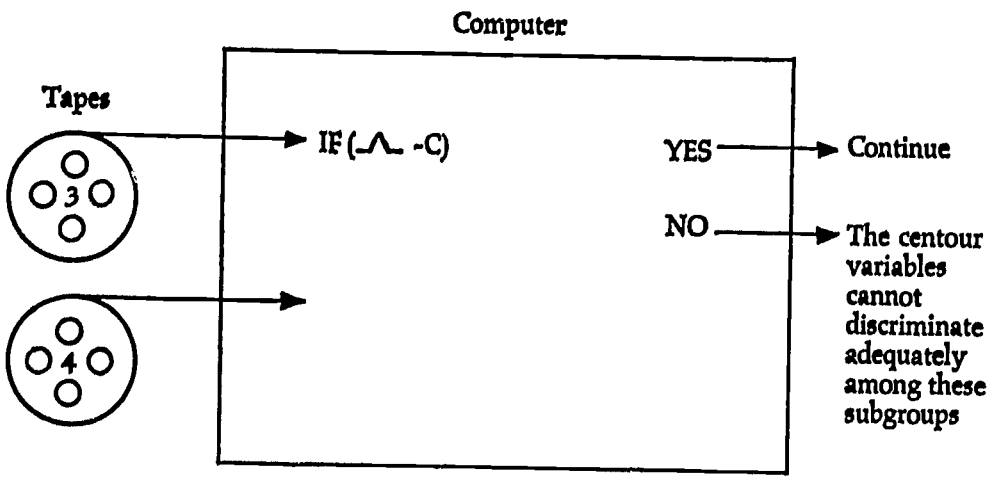


Figure 15.
Test of Differentiation

Figure 16.
Specification of I.D. Number

DIRECTIONS

13. Type I.D. NUMBER, Then type in your I.D. number.

COUNSELEE TYPES

I.D. NUMBER, 100120

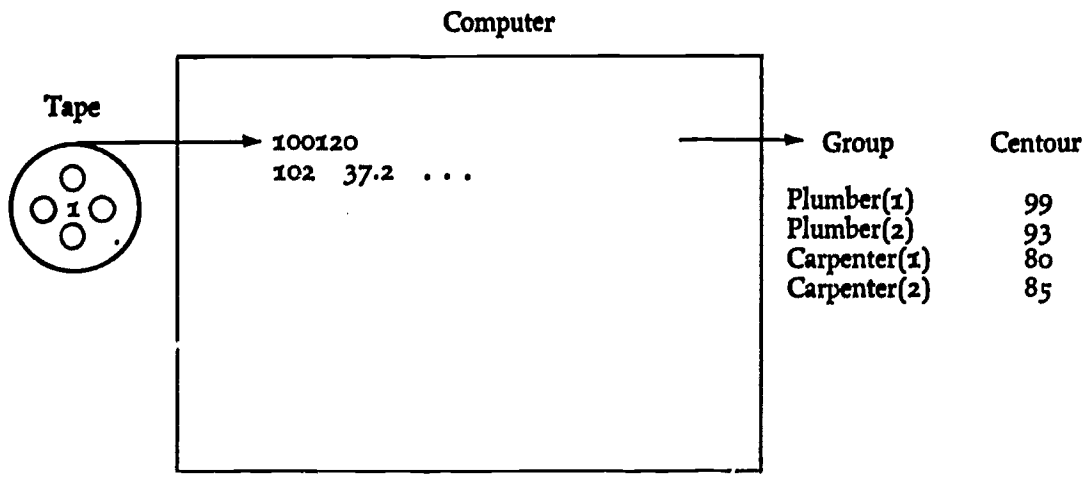


Figure 17.
Computation of Centour Scores

Figure 18.
Selection of Further Analyses

DIRECTIONS

16. Type DO DIANAL, Then type in names of the subgroups for which you want a diagnostic analysis of your position.

COUNSELEE TYPES

DO DIANAL, CARPENTER (1)

Advantages of the Classification Information System

The characteristics of the system will now be compared to the requirements of the problem. The purpose is to demonstrate the extent to which the system fits the problem of choice of career through guidance in education.

Provides Practice in Decision Making

The model limitation on simultaneous study of the interactions of job satisfaction dimensions may not be a limitation on the applicability of the system to the problem. The model limitation is resolved by successive contacts of the counselee with the system. Successive contacts, in turn, provide practice in decision making since at each application there are a number of options where the individual must make selective choices.

The system could be introduced into a decision making curriculum at three levels. First, it provides practice in making decisions on the choice of options where these decisions may be studied and evaluated by the student with his counselor. Second, it could be integrated into a process where the student chooses a vocation and the system provides a payoff. Third, it could be used to identify vocations for which the individual has both aptitude and interest prior to his asking for occupational information. Thus, his use of a more general information system could be less random; and it would be more likely that the output of the vocational information system would be of interest and pertinent to the counselee, i.e., the more likely the individual would receive immediate positive reinforcement for using the more general system.

Multiple Dimensions of Job Satisfaction

This system does provide explicitly for multiple dimensions of job satisfaction. Furthermore, it is possible for the counselee to select only those dimensions that are important to him. Thus, the counselee defines the area where success and failure are measured rather than having this area specified for him, such as, if the only dimension was money or usefulness to his comrades.

Individual Determination of What Success Is

The individual counselee selects his level of aspiration for each dimension. By so doing not only has he specified the area within which success and failure are to be measured, but also defines what parts of the area are to be unsuccessful or successful or some other such labels. Thus, whether he looks like a successful or unsuccessful plumber depends in part upon his concept of success, upon his desired reward, rather than on some standard imposed upon him.

Provides Psychological Information

When the counselee specifies the dimensions of job satisfaction and his level of aspiration, the data processing equipment records these decisions. This provides the counselor with a mapping of the student's conscious desired reward in relation to work. Other decisions as recorded by the individual's use of the options available may provide clues to his preconscious functioning; such as, when he chooses the groups to be compared with there must be some reason for his not choosing the other groups.

Union of Outside Information and Some Inside Information

Some inside information in the form of the counselee's decisions on the use of options is combined with outside information in the form of measures taken on the members of the total sample and measures on the counselee to arrive at a set of scores. Each score is a combination of both kinds of information. Moreover, some inside information has been brought outside by forcing the counselee to make his desired reward explicit.

Provides Opportunities for Counseling

Each decision that the counselee makes becomes an opportunity for counseling. For example, if he does not select to compare himself with doctors we ought to find out what his basis is for not selecting them. This basis could be erroneous, such as a very bright young man whose family is poor. If he is able enough, he might qualify for scholarship help. The basis for not selecting a group may be erroneous. Such errors should be removed by presenting the correct information.

A similar opportunity for counseling arises in his choice of dimensions of job satisfaction. The counselee might not choose money as a dimension. The counselor might then explore with the counselee whether or not he really doesn't care how much money he makes. The use of the options may provide cues to what additional information is pertinent to this individual.

The counselee's choice of cutting points along each dimension would provide counseling opportunities. For example, the counselee selects one cutting point for each dimension and the results of the analysis show that he doesn't look much like any of the successful groups. It may be that his levels of aspiration are too high. It could also happen in the

reverse, that his levels of aspiration are too low, and here the counselor might suggest that the individual could well afford to raise his goals.

Information vs. Determination

If the counselee looks like a successful plumber and looks like an unsuccessful artist this does not mean that he should definitely pursue a career as a plumber and should definitely not try to become an artist. It only means that at the present time he doesn't look like what successful artists look like and he does resemble successful plumbers as a group. The fact that he looks like any kind of artist is important. This is information. There is no prediction involved.

If he decides to become an artist anyway then he is aware that he is different from most successful artists and that perhaps he should try to cultivate those attributes of successful artists in which he is different. It also may be that he would look like a successful artist if he was willing to revise his standards of success.

A more meaningful danger sign would be if he looked very little like any kind of artist, either successful or unsuccessful. Revising his standards would not change the results very much. Only changing what he looks like (probably a great deal) would change the extent to which he looks like an artist. The direction of desirable change could be suggested by further analysis.

No Decision Rule

This system provides no decision rule. It does not pretend to tell the student what he "ought" to be. There is no prediction of success involved. The system only provides information about where he stands now and information about the trip he has to travel if he chooses any particular vocational destination. Properly used, the system cannot become a crutch—the choice remains with the student and also the responsibility for the results of his decisions remains his.

No Inconsistent Information

Since no predictions are involved there is no chance for inconsistent information to be part of the output. The analysis will not predict that the counselee will work less than no time with people or spend more than all the time doing computations. The fixed natural limits of the various scales employed cannot be exceeded.

Provides Potential for More Information

Rulon in Tiedeman, Rulon, and Bryan (1951) pointed out the desirability of making many different kinds of comparisons. Each comparison provides new information. Furthermore, this new information is in each case different from the other information and different from the information that can be applied by correlation techniques. In the usual system the choices are fixed by the system, that is, by the constructor of the system. Different comparisons are impossible. In this system the counselee may compare himself with plumbers and carpenters, then with successful plumbers and unsuccessful plumbers. He may make a very large number of different comparisons (see p. 20).

Avoids Erroneous Information

The system builder's concept of success may be different from the counselee's concept. If the model builder determines success and the individual looks like a successful plumber he looks like a successful plumber to the model builder. The system says, "You look like a successful plumber." However, if what is successful to the model builder is unsuccessful to the counselee then the individual has been led to believe that he looks like a successful plumber when, in fact, he looks like an unsuccessful plumber. That is, the counselee looks like an unsuccessful plumber to himself.

Limitations of the System

There would be limitations on the system in a practical application. These would fall into two groups: limitations imposed by the capacity of the data processing equipment, and limitations imposed by the size and scope of the sample.

Each vocational group can be split into many subgroups prior to the centour analysis. If the subgroups were so numerous as to provide zero or only one member in a subgroup no centour scores would be available for that group. Further, unless each subgroup has a substantial number, then the comparisons would be weak in their potential capacity to be generalized to other individuals (Campbell and Stanley in Gage, 1963, p. 189).

The capacity of the data processing equipment could be exceeded by too large a number of subgroups. If the limits of the hardware were ex-

ceeded the results would be erroneous or the system might generate no results.

The practical limitations could be controlled for by placing limitations on the counselee's exercise of the options. For example, he might be allowed to use from one to no more than five sets of cutting points. It might, however, be determined to let the counselee exceed the limitations of the machinery, thus, to learn its limits.

Summary

IT HAS BEEN SHOWN that regression analysis, discriminant analysis, and a combination of these statistical models are inappropriate to providing information for individual determination of career through vocational guidance. These models ignore the variance among individuals in the level of aspiration and/or the choice of meaningful dimensions of job satisfaction. While these models may be appropriate to the decisions made by a personnel manager, a labor coordinator in a totalitarian state, or to personnel classification in a military service (where this kind of variance among individuals is of secondary importance), they do not yield appropriate information for civilians in a free society.

A model appropriate to the problem of choice of career must provide for some of the individual's inside information. The counselee must be enabled to specify the dimensions of job satisfaction that are significant to him. He must be allowed to establish his own level of aspiration along each of these dimensions as the dividing line between success and failure.

Centour analysis among flexibly determined subgroups is a model which provides for individual determination of level of aspiration and selection of dimensions of job satisfaction. The use of this model in a vocational self classification information system would provide the individual with the opportunity to compare himself with many varied vocational groups and combinations of groups where the counselee defines in part the composition of the groups. The system provides the counselor with psychological information about the counselee and provides the counselor with opportunities for counseling not presently available.

There are a number of practical problems associated with developing such a system, not the least of which are cost and the tremendous number

of vocational catagories which exist. It is, however, my belief that all these problems can be adequately solved in the forseeable future.

References Cited

1. Beaton, Albert E., *The Use of Special Matrix Operators in Statistical Calculus*, Harvard Graduate School of Education (Unpublished Doctoral Dissertation), 1964.
2. Cooley, William W., and Lohnes, Paul R., *Multivariate Procedures for the Behavioral Sciences*, John Wiley and Sons, Inc., New York, 1962.
3. Cronbach, Lee J., and Gleser, Goldine C., *Psychological Tests and Personnel Decisions*, Second Edition, University of Illinois Press, Urbana, 1965.
4. Gage, N. L., Editor, *Handbook of Research on Teaching*, Rand McNally and Company, Chicago, 1963.
5. Jones, Kenneth J., "Occupational preference and social orientation," *Personnel and Guidance Journal*, Vol. 43, Feb. 1965.
6. Olive, Lois E., "The relationship of values to the perception of activities involved in an occupation," *Journal of Counseling Psychology*, Vol. 11, Fall 1964.
7. Rulon, Phillip J., *Multiple Discriminant Analysis* (mimeo), A paper delivered at the I.B.M. Scientific Computing Seminar, Endicott, New York, June 18-22, 1956.
8. San Diego State College Foundation, "Status images: their nature and relation to selection of college major and occupations; report on a study by San Diego State College Foundation," *Journal of College Placement*, Vol. 25, October 1964.
9. Sorenson, Richard C., *Development and Evaluation of a Matrix Transformation Useful in Personnel Classification* (mimeo), University of Washington, 1965.
10. Tatsuoka, Maurice M., "Joint-probability of membership and success in a group: an index which combines the information from discriminant and regression analyses as applied to the guidance problem," *Harvard Stuaies in Career Development*, No. 6, Center for Research in Careers, Graduate School of Education, Harvard University, October, 1957.
11. Tiedeman, David V., Rulon, Phillip J., and Bryan, Joseph G., "The multiple discriminant function—a symposium," *Harvard Educational Review*, Vol. 21, Spring 1951.
12. Tiedeman, David V. and Sternberg, Jack J., "Information appropriate for curriculum guidance," *Harvard Educational Review*, Vol. 22, Fall 1952.
13. Tiedeman, David V. and Field, Frank L., "Measurement for Guidance," *Harvard Studies in Career Development*, No. 31, Center for Research in Careers, Graduate School of Education, Harvard University, July 1964.
14. Tiedeman, David V. and Ellis, Allan B., *An Information System for Vocational Decisions* (mimeo), A proposal submitted to the U.S. Commissioner of Education, 1965.