THE SIXTEEN PERSONALITY FACTOR QUESTIONNAIRE
AND THE
MOTIVATIONAL ANALYSIS TEST
IN THE
PREDICTION OF ACHIEVEMENT OF INSURANCE AGENTS

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Submitted for the Degree of

BACHELOR OF PHILOSOPHY

in

Psychology

at

THE UNIVERSITY OF WAIKATO
Hamilton, New Zealand
1973

ABSTRACT

The study investigates the implementation of a multiple regression model, a discriminant function, or a model based on an empirical scoring of standardized tests for the selection of insurance salesmen, utilizing the data available to a personnel consultant.

The low return of discriminating data from the Sixteen Personality Factor Questionnaire (16PF), and the Motivational Achievement Test (MAT), underlines the need for validity to be directly established on the particular selection situation. Consideration of the current research on the 16PF results in some doubt as to the evidence for the factor structure purported to give factorial validity to the test. Various selection models are presented which can provide a tentative basis for selection and for a continuing study of the selection procedure. While a firm decision should not yet be made a discriminant function utilizing empirical keying of published tests gives clear indications that the problem may be satisfactorarily resolved.

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Chapter I

INTRODUCTION

This paper is presented with reservations but without regrets. The intention of this study was to take the actual data used by a group of consulting psychologists involved in the selection of insurance salesmen and examine the various predictive models such as multiple regression, arbitrary weightings, specification equations, and discriminant function analyses that could be applied to the data. This approach took as a basic assumption that the tests utilized yielded stable variables with sufficient discriminative variance to mark the differences between groups of individuals classified in terms of their vocational effectiveness. If this stability had been available the study would have gone on to establish some hypotheses relating to the attributes of the successful salesman that could be examined in further studies. The assumption that the variables measured by the tests would provide some differences amenable to statistical decision was supported by three lines of reasoning. Eight out of nine personnel consultants with whom I have had discussions utilize the Sixteen Personality Factor Questionnaire as part of their routine data collection at selection interviews. The lack of formal validity studies undertaken by applied psychologists is as disconcerting as their belief in the validity of the instruments they use. The extensive use of this particular test establishes a prima facie case for the practical effectiveness of the instrument. This line of reasoning also includes the intelligence tests given. Secondly, the manuals that accompany the tests (Cattell, Horn, Sweney, and Ratcliffe, 1964; Cattell, Eber, and Tatsuoka, 1970; Tiffin, 1954) give clear indications that their authors consider that their instruments have validity for the prediction of occupational success; for example the manual of the Sixteen Personality Factor Questionnaire includes Cattell's form of regression equations in the specification equations which include some equations relevant to sales occupations. Rorer(1971) and Bouchard (1971) point out that this information is virtually useless because data regarding the sample, the method, the validity, and the error are not reported. In spite of various critical points such as these it was reasonable to assume that the tests gave results that could be expected to relate to criteria of job success. Thirdly, there is a sense in which Cattell's work on personality rests on the psychometric actualization of primary personality traits identified by factor analytic techniques from the responses of subjects to the questionnaires. These primary source traits in Cattell's scheme summarize large portions of the overt personality behaviour including areas of intelligence, emotional stability, and behaviours such as surgency and dominance. He claims that his tests provide the quickest way of measuring these factors available and that they have established predictive capacity (Cattell, Eber, and Tatsuoka, 1970).

On the assumption that the variables being manipulated were effective the study commenced with an examination of some regression models involving multiple regression and discriminant regression. The relative failure of these models involves us with the question of the quality of the independent variables and their ability to produce sufficient stable variance. The final answer to this question cannot be found from data established in the manner in which the data of this study was collected or from the size of sample involved in this study. Nevertheless certain rational arguments and some other evidence can be considered which reflects on the problems. The paper then develops a different prediction solution based on an empirical keying of the tests. The question of the stability and reality of the theoretical constructs should have been resolved prior to the utilization of the constructs and the tests in which they are represented in applied situations.

Chapter II

BACKGROUND INFORMATION

The Situation

The consultants were engaged by an insurance company to select it's life insurance agents from the applicants for positions with the company. In 1969, on their engagement by the company, the consultants obtained test data from the existing sales force, this data is concurrent in that the people tested were employed by the company at the time of testing. In the following two years the consultants tested applicants during the selection interview utilizing the Sixteen Personality Factor Questionnaire as a measure of personality; the Motivational Analysis Test as a measure of motivation; and the Science Research Associates Adaptability Test to measure intelligence. Biographical information was recorded however the lack of consistency and comprehensiveness of this part of the data restricted its usefulness. There appeared to be some prescreening of the sample tested as the consultants did not test people who failed to meet standards of behaviour in the job interview. No record of the exact number of applicants prescreened is available. The consultants did not utilize the data collected in the concurrent study to formulate a decision model. The basis used for selection was the applicant's score on what we will call the Prudential model. This model appears to have been derived in some manner from a factor analysis conducted for this earlier client.

This model will be discussed in a later chapter.

The Variables

The criterion variable chosen for this study was the total value of insurance sales made by the agent during his first twenty-six weeks as an agent with the company. The data was collected from the insurance company's records. Further refinement of criterion could be considered for other studies. Ideally staff turnover should be a second criterion, as this also is a problem in the industry, but the official dates of termination shown in the company's records do not necessarily coincide with the time at which an agent ceases to sell insurance for the company. However as the date when an agent ceases to sell insurance is reflected in the lower sales value he returns for the period it was felt that termination was at least partially contained within the criterion of sales. Consideration was given to utilizing the ratio of the number of calls to the number of sales but it was considered that the information could not be verified. It was concluded that for the purposes of this study the most valid criterion variable was the simple value of insurance sales. To evaluate the effect of extending the period of time over which the criterion variable was accumulated a *t*-test on the difference between the first and the second twenty-six weeks of the agents sales was calculated on the sales of the twenty-three men for whom data was available. The test showed that there was no significant difference between the sales of these men on their first and second twenty-six weeks of employment with the company ($\underline{t} = .81_{(p > .05)}$). The criterion variable is called sales for the remainder of this study.

The choice of predictor variables was determined by the data the consultants decided to accumulate in 1969. There are twenty-nine independent variables, or predictors in the study. These are age, education, IQ, the sixteen personality factors, and ten motivational factor scores.

Education (EDUC) was evaluated on a one to nine scale with one point being accumulated for each year, or for an estimated year equivalent, of education from the first year of secondary schooling onward.

Intelligence was measured on the Science Research Associates Adaptability Test coded SRA for the balance of this paper. This test is purportedly based on Thurstone's primary mental abilities but returns only a single measure of intelligence (Tiffin and Lawshe, 1954). The consultants have norms calculated on a local population. A brief evaluation of the test was undertaken and the results may be obtained from the author on request. On the total sample of all the men who applied for positions as agents the mean score on the test was 60.5% with a satisfactory standard deviation of 15.7%. The mean was 5% higher than the consultant's norms. The item analysis shows that this is a speeded test and consideration could be given to extending the time limit in order to make it a power test so as to ameliorate the effects of age. The manual gives instances of predictive validity for various occupations but no validity data for selling positions.

The Sixteen Personality Factor Questionnaire (16PF) returns fifteen personality factor scores and an intelligence measure. These are the most salient of the factors found by Cattell in the factorization of his personality sphere. The division of this sphere has been derived by the grouping of the three to four thousand terms normally used to describe different kinds of personality and the corresponding behaviour. (Cattell and Butcher, 1968). Table 1 is taken from The Handbook of the 16PF (Cattell, Eber, and Tatsuoka, 1970) and lists the source traits in terms of a bipolar description. The factor names in the left hand column will be used to describe these sixteen variables in this paper.

The Motivational Analysis Test (MAT) returns measures that cover a person's interests, drives and the strength of his sentiments and value systems. Cattell describes the domain of interests, attitudes, and motivation as dynamic psychology, postulating broad common motivational traits that fall into two categories "ergs" or instinctive patterns comparable with drives observed in other higher mammals, and "sentiments" or groupings of attitudes that focus on learned social institutions. He puts forward the concept of subsidiation which reflects the complicated network of

TABLE 1

The Primary Source Traits of the 16PF Questionnaire.

Factor	Low Sten Score Description (1-3)	High Sten Score Description (8-10)
A	Reserved, detached, critical aloof, stiff Sizothymia	Outgoing, warmhearted, easygoing, participating Affectothymia
B	Dull, Low intelligence (Crystallized, power measure)	Bright High intelligence (Crystallized,power measure)
C	Effected by feelings, easily upset, changeable Lower ego strength	Emotionally stable, mature, faces reality, calm Higher ego strength
E	Humble, mild, easily led, docile, accommodating Submissiveness	Assertive, aggressive, competitive, stubborn Dominance
F	Sober, tacturn, serious Desurgency	Happy-go-lucky, enthusiastic Surgency
G	Expedient, disregards rules Weaker superego strength	Conscientious, persistent, staid Stronger superego strength
H	Shy, timid, threat-sensitive Threctia	Venturesome, uninhibited, socially bold Parmia
I	Tough-minded, self-reliant, realistic Harria	Tender-minded, sensitive, clinging, over protected Premsia
L	Trusting, accepting conditions Alaxia	Suspicious, hard to fool Protension
M	Practical, down to earth concerns Praxernia	Imaginative, bohemian, absent-minded Autia
N	Forthright, unpretentious, genuine but socially clumsy Artlessness	Astute, polished, socially aware Shrewdness

(Continued on the next page.)

TABLE 1

The Primary Source Traits of the 16PF Questionnaire
(continued)

Factor	Low Sten Score Description (1-3)	High Sten Score Description (8-10)
O	Self-assured, placid, secure, complacent, serene Untroubled adequacy	Apprehensive, self-reproaching, insecure, worrying, troubled Guilt proneness
Q1	Conservative, respecting traditional ideas Conservatism of temperament	Experimenting, liberal, free thinking Radicalism
Q2	Group dependent, a joiner and sound follower Group adherence	Self-sufficent, resourceful, prefers own decisions Self-sufficiency
Q3	Undisciplined self-conflict lax, follows own urges Low self sentiment	Controlled, exacting will power socially precise, compulsive High strength of self sentiment
Q4	Relaxed, tranquil, torpid, unfrustrated, composed Low ergic tension	Tense, frustrated, driven, overwrought High ergic tension

(Adapted from Cattell, Eber, and Tatsuoka, 1970)

interaction between interests and attitudes within the individual. In his theory ergs and sentiments may be operationally isolated by the use of factor analysis. The MAT purports to measure ten drives and sentiments on four different instruments and to express the results in terms of integrated (realistically expressed) and unintegrated (tension producing) motivational units. (Cattell, Horn, and Butcher, 1962; Cattell and Horn, 1963; Cattell, Radcliffe, and Sweney, 1963) In general the validities for this test are factorial although in terms of this particular study one could assume that in constructing the Prudential model the consultants achieved some empirical validity. The assessment of this test is best given by two of the reviewers in The Seventh Mental Measurements Yearbook.

> "In summary, this inventory has some promise for intriguing future research on motivation. Recommended use in practical decisions must await validity, reliability, base rate and further normative data. Only true believing Platonists still staring at shadows in the cave will be impressed by the fact that all ten factors measured in this inventory have multiple correlations in the .90 between the subtests for each variable and the true factor." (Alker, 1971, p.110)

> "The reviewer would be more favourably impressed with the MAT if the manual presented data which show that: (a) these factors constitute important unitary dimensions of motivation; (b) the items are suitable measures of the factors on which they are scored and (c) the trait scales are substantially correlated with external criteria in a way which would be predictable from a knowledge of the scale names." (Comrey, 1971, p.111)

The ergs and sentiments are shown in table 2 together with the symbols that will be used through the remainder of the study.

In all cases we deal with the raw scores derived from the tests. No combinations of scores are utilized as these would inflate the correlations. Ninety-six items in the MAT however are forced choice items and score on either of two factors,so choice of one alternative determines the score on another variable,consequently the instrument is difficult to

TABLE 2

The Ten Dynamic Structures Measured by MAT

Factor symbol	Title of Factor	Description of Factor
Ma	Mating Erg	Strength of heterosexual or mating drive.
As	Assertiveness Erg	Strength of the drive to self-assertion, mastery, and achievement.
Fr	Fear (Escape) Erg	Level of alertness to external dangers.
Na	Narcism-comfort Erg	Level of drive to sensuous self-indulgent satisfaction.
Pg	Pugnacity-sadism Erg	Strength of destructive, hostile impulses.
Ss	Self-concept Sentiment	Concern about self-concept, social repute, and more remote rewards.
Se	Superego Sentiment	Strength of development of conscience.
Ca	Career Sentiment	Amount of development interests in a career.
Sw	Sweetheart-spouse Sentiment	Strength of attachment to wife (husband) or sweetheart.
Ho	Home-parental Sentiment	Strength of attitudes attaching to the parental home.

(Adapted from, Cattell, Horn, Sweney, and Radcliffe, 1964)

analyse. For the regression and the discriminant analysis this problem was ignored, when the items were directly correlated to sales only the two independent scoring keys were utilized giving 208 items that were independent in the MAT.

The Sample

The first sample group for this study is called salesmen and are the life insurance agents appointed by the company prior to the consultants commencing their activities in December of 1969. The twenty-three salesmen in this study consist of all those agents who provided full sets of biographical and test data for the consultant's concurrent study.

The second sample group are called the appointees and consist of the first twenty-three applicants for positions as insurance agents with the company who were appointed by the consultants using the Prudential model after the first of December 1969.

The applicants are defined as a third sample group for this study. They are a group of men drawn by use of a random number table from the population of rejected applicants for any reason nominated in the reports by the consultants. The reasons tend to relate to the consultants' assessment of the applicants ability to perform successfully the functions of a life insurance agent,e.g. the reason given may be the failure of the applicant to reach the standards set by the Prudential model.

The summary descriptive statistics for the dependent and the independent variables for each of the three samples are outlined in tables 3, 4, and 5 giving the values for the MAT, the 16PF, and the remaining variables respectively.

TABLE 3

MAT Summary Statistics for the
Salesmen, the Appointee, and the Applicant Samples

Factor	Salesmen		Appointees		Applicants	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Ca	20.17	3.22	19.91	2.61	20.29	2.92
Ho	17.13	2.45	17.26	4.10	16.79	2.97
Fr	12.69	2.38	12.65	2.18	13.91	2.52
Na	13.43	2.31	12.60	3.08	14.00	2.15
Se	32.26	5.51	32.39	5.31	33.79	5.30
Ss	62.00	7.44	59.52	5.87	62.16	8.22
Ma	17.21	3.78	16.39	3.22	16.04	2.94
Pg	12.31	2.92	12.82	3.45	13.37	3.17
As	16.65	2.62	15.00	3.04	14.95	2.11
Sw	15.21	2.19	15.30	2.67	15.79	3.58

TABLE 4

16PF Summary Satistics for the Salesmen, the Appointments, and the Applicant Sample

Factor	Salesmen		Appointees		Applicants	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
A	12.82	3.21	11.13	3.88	10.66	2.82
B	9.04	1.74	8.34	2.01	8.08	1.69
C	17.34	3.63	15.13	4.75	16.08	4.95
E	14.39	4.05	13.26	4.48	12.66	4.04
F	15.73	2.98	13.17	4.46	13.04	4.44
G	13.69	3.26	13.78	3.91	15.33	2.86
H	14.82	5.57	14.34	4.70	15.41	5.54
I	7.00	3.28	6.69	3.09	8.66	3.91
L	6.26	3.54	8.13	2.61	7.30	2.73
M	13.34	4.22	11.91	2.67	12.00	3.26
N	8.39	2.38	9.96	3.53	11.50	2.50
O	7.69	4.71	9.43	4.18	9.54	3.36
Q1	9.65	2.65	8.08	2.25	9.45	2.60
Q2	8.95	2.72	9.65	3.08	12.12	3.06
Q3	14.60	2.67	12.96	3.43	13.25	3.27
Q4	8.91	5.16	9.52	4.37	10.20	4.51

TABLE 5

The Remaining Independent Variables
Summary Statistics for the Salesmen,
the Appointee, and the Applicant Samples.

Variables	Salesmen		Appointees		Applicants	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
SRA	22.13	5.52	20.91	5.47	20.70	5.32
AGE	34.65	8.28	32.21	9.15	36.91	9.17
EDUC	4.95	2.24	3.30	1.25	-	-
SALES *	106.70	79.86	108.22	87.08	-	-

* in thousand dollars

Chapter III

A SELECTIVE REVIEW OF PAST WORK

A review of past studies in selection procedures is frustrating because many are inadequately reported apparently because the companies, consultants, or researchers are reluctant to share their findings with their competitors consequently some of the more essential details are not reported. The relevant papers for this dissertation fall into four broad categories. The first section of the review examines the importance of tests in personnel selection and the degree of success which can be expected to accompany their use. The theoretical issues that relate to notions of construct validity are then examined. Thirdly there is a cluster of studies relating directly to selection of salesmen including the reports of the Life Insurance Management Association that provide sundry useful details relating to the selection problems that this dissertation examines. The methodological issues of concurrent and predictive or longitudinal studies conclude the review.

Testing and Personnel Selection

There are ethical and scientific problems involved in psychological testing (Goodacre, 1958; Gellerman, 1961; Guion and Gottier, 1965) but some critics overlook the fact that the alternative methods are less rational precisely because they are not open to scientific analysis. Thus one of the advantages of psychometric instruments is that they produce data that is amenable to validation studies. It is possible that this quality of being open to critical analysis can mean that people may change the selection procedures they use toward clinical methods, because of controversy, when the alternative methods that are taken up are less valid than the previous procedures. So a few studies that compare the psychometric selection model with other methods are briefly reviewed.

Gordon (1967) tested clinical, psychometric, and work-sample approaches in the prediction of success in peace corps training. All three methods in this situation had equal validity but the psychometric approach was simpler and cheaper. Meehl is reported (Lindzey, 1965) as finding only one study in which clinical analysis has yielded more accurate predictions than predictions based on statistical decision rules. A review of forty-five studies found that predictions based on a combination of clinical and psychometric approaches were superior to the clinical method alone but that the purely statistical strategy achieves still better results. Thus the statistical procedures are not improved by the addition of clinical insight (Sawyer, 1966). These findings demonstrate the relative validity of psychometric procedures, and point to the need for careful research to develop sound models.

Some indication of the kinds of variables and tests that may be useful and the size of validity coefficients is found in Ghiselli's (1966) survey of the validity of occupational testing. He found that three kinds of measures contribute to the prediction of success in insurance selling, general tests of intellectual abilities such as the OTIS average .31 in their validity coefficients, personality measures which include inventories of interests such as the Strong Vocational Interest Blank and the Kuder Preference Blank as well as personality tests such as the Edwards Personal Preference Schedule and the Guilford-Zimmerman Temperament Survey have coefficients in the area of .27 validity, and the third category relates to tests of perceptual accuracy. The levels of validity reported by Ghiselli are somewhat lower than those frequently reported. This is because he achieved an average validity by converting the correlations to Fisher z scores averaging these and then converting them back to the reported coefficients. This analysis ignores differences between the studies, thus concurrent and predictive designs, studies with different standards involved in their criterion variables, and using different measures of varying reliability, were all lumped together. This probably tends to underestimate the magnitude of the relationships (Campbell, Dunnette, Lawler, Weick, 1970). Ghiselli concludes his review:

> "It is apparent that even the most optimistic supporter of tests cannot claim that they predict occupation success with what might be called a high degree of accuracy. Nevertheless in most situations tests can have a sufficiently high degree of predictive power to be of considerable practical value in the selection of personnel." (Ghiselli, 1966, p.127)

This review did not deal with multiple predictors.

Guion and Gottier (1965) observe that the validity of standardized personality and interest tests seldom achieve any effective magnitude and indeed are often insignificant. Campbell, Dunnette, Lawler, and Weick (1970) suggest that the contradictory findings of Ghiselli and Guion and Gottier are reconciled by noting that Ghiselli utilized studies that had developed specific predictive keys applicable directly to the situation under study. An example of this approach is reported by Nash (1965). He used one half of his sample to formulate a scoring key for the Strong Vocational Interest Blank that allowed for the predictive identification of effective managers it successfully cross validated on the remaining part of the sample.

The literature thus indicates that some difficulty could be expected in achieving good validities from the standardized personality measures but that acceptable validities have been achieved by the use of empirically derived keys.

Construct Validity

Construct validity involves the measurement of attributes or qualities which are "not operationally defined". (Cronbach and Meehl, 1955, p.282) No argument is offered against constructing tests to measure theoretical postulates. The empirical methods such as those utilized by Nash (1965) are the subject of much criticism within the literature especially from the advocates of construct validity. Loevinger (1957, p.94) is against empirical keying of test instruments. She argues that an experimental psychologist cannot be considered scientific if he collects data and simply reports it without seeking an explanation of the behavioural dynamics that account for the data. Her opinion is that only by attempting to achieve construct validity which involves the measurement of "real" traits will the test constructor make his contribution to psychology. Cattell (1946) is against specific validation. He believes that it comes from the demands of economy and efficiency and that it is devoid of proper scientific interest. He is committed to the construction of instruments that have application over a large population. But Lord (1955) reasons that the providing of information that enables accurate discrimination in terms of a specific decision and a specific person is a basic scientific concept. The reviews of Guion and Gottier (1965) and Hedlund (1965) show the failure of personality theory to develop constructs that can be translated into standardized measures and enable the prediction of performance. This evidence can only be construed as support for the empiricist's methodology.

If there are underlying unitary traits they must bear some relationship to consistent response patterns found in empirical keys. If turning on the light switch gives the light required then any lack of understanding of the laws of physics that partially account for the phenomena need not restrict its utilization. What is of vital importance in applied psychology is that the validity of our decisions be demonstrated for no amount of construct validity can take the place of empirical validity studies in selection procedures. It could be suggested that to be involved in the selection of personnel without being involved in validity studies must, in the present state of our instrumentation, be very close to a breach of the ethical standards of the American Psychological Association (1963). Ethical problems aside, what must be acknowledged is the reciprocity between theory and empirical study and it must be understood that the goal of psychological research is a correspondence between the two activities.

Studies of Salesmen

One of the problems in considering valid models relating to the sales professions is that there appears to be a common stereotype that defines the 'ideal' salesman. He is the man who can sell a refrigerator to an eskimo or in Cattell's terminology he scores highly on the L factor of the 16PF, which is taken as showing that he has a degree of resolution or hardness as distinct from being accepting and trustful, but the research is not clear on this, scoring the Gordon Personality Profile ipsatively, Hughes and Dodd (1961), showed that ascendancy had no relationship to performance.

Hughes and McNamara (1958), point to the diversity of people engaged in sales occupations. They studied salesmen working for IBM and report finding differences between salesmen of data processing equipment and electric typewriter salesmen on the Strong Vocational Interest Blank. They suggested that these differences occurred because the data processing group were in fact selling an intangible while the typewriter salesmen were able to demonstrate their merchandise. Findings of such differences must be carefully considered as Kennedy (1958) hypothesized that there would be a difference between salesmen selling high priced and lower priced cars but in fact his null hypothesis was accepted. These findings show that the concept of a universal salesman may not be supported and that there could be differences between people who are successful in different types of selling. Such differences as are found may not be sufficient to uniquely identify every different type of salesman. The Life Insurance Management Association or it's predecessors have been involved in selection studies since 1916. In 1938 the Association produced the Aptitude Index: it has a predictive scale based on personal history items and a scale that involves a test of interests and attitudes. Items on the former scale relate to marital status, recent occupations, educational level, present employment, organizational membership, financial status, a budget of living expenses, and the amount of life insurance owned (Kurtz, 1941). Guion (1965) reports that the index is in its seventh form and has been subject to continuous research and regular modification. The latest revision includes an assessment of the applicants factual information concerning life insurance.

Tanofsky, Shepps, and O'Neill (1969) studied biographical data by the use of pattern analysis. They found that this method provided a good basis for prediction of success in insurance selling. The advantage of the method is its clear identification of contributing variables, a combination of high prior income and more than two dependents at the time of application was descriptive of high producers. The disadvantage of this method is the large samples that are required to formulate the lattice. In terms of applied validation research undertaken by a consultancy practice samples of this size would be virtually unobtainable in New Zealand.

Baier and Dugan (1957) found that the amount of life insurance owned reflects the amount of insurance sold. Guion (1965) believes that this is a measure of the conviction the applicants have of the value of insurance rather than a measure of their own economic situation. The one thing that is quite clear from this group of research reports is that biographic data can contribute to the prediction of success in a sales career.

In an interesting study, Hughes (1956) looked at the responses of applicants to items such as, "Why do you feel you can achieve success as a life insurance agent?" He classified responses in terms of dominance in interpersonal relations, gregariousness, altruism, status and the desire for success, and belief in life insurance. A discriminant function on these categories gave a predictive validity of .29. Perhaps it would be possible to develop some multiple choice items that standardized these responses.

In a dissertation considering predictive validity it is worth noting that the Life Insurance Management Association mark all their test instruments in their centralized offices because a study by Hughes, Dunn, and Baxter (1956) showed that their selection models lost up to 12% of the predictive capacity when the marking of the documents was in the hands of district managers who were involved in the recruitment of agents.

Concurrent Validity

This dissertation involves both concurrent and predictive design. It is concurrent in the sense that the salesmen sample was tested after they had been appointed as representatives of the company and it is predictive in that the validation group, the appointees, were tested in the process of appointment. The problem with concurrent studies is that the group of people being tested may have developed those characteristics that are involved in validity equations by being employed in their present occupation. Kurtz (1941) states that a basic principle of selection research is that the measures developed must be evaluated by follow up research. As the 16PF manual (Cattell, Eber, and Tatsuoka, 1970) has a section that deals with the effects of motivational distortion on test scores and these effects are quite substantial it seems a reasonable extension of Kurtz's argument that ideally the situation from which the models are calculated should also be the same situation in which the model will be applied in future. Cameron (1963) notes that an assumption underlying experimental research is that the sample will not be changed by removal from the setting in which it actually occurs. But it is likely that the responses of an applicant under interview stress may be quite different from the responses of that same individual in the concurrent testing situation. Such differences in response patterns may be sufficient to prevent the finding of variables that will validate as motivational distortion may influence the magnitude of such differences and act to prevent the optimum choice of variables for a personnel selection model.

Chapter IV

MULTIPLE REGRESSION MODELS

General Principles of Multiple Regression

Multiple regression gives a least squares solution to the problem of estimating an unknown value from a set of predictor values. The unknown value has on past samples borne a known relationship to the predictor variables. It follows that the samples should be drawn from the same population.

The procedure examines the matrix of correlations between each of the predictor variables (R) and a vector of correlations between the predictor variables and the criterion variable (y). Given that we are dealing with standardized scores (z)

$$z = \frac{x - \bar{x}}{sd}$$

where x is the raw score on a given variable

and $$sd = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n}}$$

Then the problem is to establish a set of weights which can be applied to the scores of the predictor variables to minimize the error of estimation. The set of weights (b) is found by

$$b = R^{-1}y \qquad (1)$$

Thus the predicted value or the best estimate of the unknown score is given as

$$\hat{y} = Zb$$

where $\hat{y}$ is the vector of estimated standard scores.

To establish a measure of association between the criterion and the predictors we calculate the multiple correlation coefficient (R) by taking the inner product of the vectors y and b and finding the square root of the sum of this product. R^2 is the proportion of the total sum of squares accounted for by the regression equation. An intuitive insight into its value is obtained by noting that if all of the values in the vector of inner products of y and b (p) are positive then it is possible to assess the contribution of each particular variable to assessing y. This is known as the coefficient of separate determination (p/R^2).

Crocker (1972) discusses the properties of R and notes that the value of R approaches 1 as the number of predictors approaches one less than the sample size.

The significance of a regression equation may be evaluated by the variance ratio or the ratio of the predicted to the non-predicted variance against the F distribution.

$$F = \frac{R^2 / p}{(1 - R^2) / (n - p - 1)}$$

Where p is the number of predictor variables in the equation and also the number of degrees of freedom for the numerator and (n - p - 1) is the number of degrees of freedom for the denominator.

In this study all the regression equations are calculated directly from the raw score matrix (X) as distinct from the standardized scores. The apparent difference is that a constant is introduced to the resulting equation to adjust for mean values. Following the notation of Draper and Smith (1968) formula 1 is rewritten

$$b = (X'X)^{-1}X'y$$

where b is the least squares estimate of the b-weights,

X the matrix of predictor variables,

and y the vector of criterion observations.

Thus in matrix terms the equation for the estimated score is

$$\hat{y} = Xb$$

or in scalar notation

$$\hat{y} = b_0 + b_1x_1 \ldots\ldots\ldots b_nx_n.$$

An analysis of variance is calculated to show whether the amount of variance accounted for by the regression is significantly greater than the deviations from the regression. This null hypothesis is tested by an F ratio. The size of the validity coefficient, in this case R, is not the only indicator of the effectiveness of the equation with regard to the accuracy of prediction. A smaller validity coefficient may also have a smaller standard error of the estimate (Desalvo, 1971). Given equal validity coefficients it follows that the most accurate predictions will be made from models with the smallest standard error of the estimate so that differences in the validity coefficients are not the only indicators of predicitive accuracy. (McNemar, 1962)

An estimate of the efficiency that could be expected when the model is applied to future groups is given by Brogden (1946). Multiple regression models are used to select from a group of applicants those who will perform most efficiently on the criterion variable. If the top q% of the applicants on the criterion score are selected and their average performance is d units above the sample mean then the expectation is that by selecting the top q% of another sample group their mean on the criterion variable should be Rd units above the mean of the former group.

If the sample is small and we are concerned with the size of the prediction error then R^2 may be corrected to account for the loss of the degrees of freedom due to the incorporation of predictor variables. This correction is

$$R_c^2 = 1-(1-R^2)\,\frac{n-1}{n-p-1}$$

This means that R_c^2 is more directly related to the estimates of error variance. The formula is equivalent to

$$R_c^2 = \frac{s_y^2 - s_{y.x}^2}{s_y^2}$$

where $s_{y.x}^2$ is the estimated residual variance.

A problem seems to occur in the interpretation of this value in some psychologists' reports, for example Guion's (1965) handling of the Wherry-Doolittle formula. It seems that Wherry (1931) in the first article in which he dealt with this value failed to make clear to which of the different mean square error terms the formula applied. Darlington (1968) identifies three different error terms. The mean square error term of the sample on which the equation was developed; the mean square error for the whole population; and the mean square error of the equation in another sample drawn from the same population. R_c^2 is based on the second of these error terms thus it tends to overestimate the cross validity of the mean square due to the regression in other samples from the same population. Failure to make this distinction leads to the criticism that R_c^2 underestimates the error variance. (Guion, 1965)

Alternative estimates of the expected cross validation of the mean square error term have been offered by Lord (1950) and Nicholson (1948) as

$$\frac{n + p + 1}{n - p - 1} \cdot s_{y.x}^2 \quad .$$

There are many instances in the literature of substantial shrinkages of validity coefficients. Guttman (1941) considering the problem concluded that it appeared best to use as few predictor variables as possible to maintain the stability of the equation. In this paper the basis of comparison between regression models is R_c^2 our best estimate of the population value.

Stepwise Regression

The stepwise regression procedure was used to select a subset of the predictor variables for inclusion in a regression equation. This method is an extension of the forward selection procedure outlined in Draper and Smith (1966). The forward selection procedure determines the relative importance of variables available for entry into a regression equation by first taking the predictor variable that has the highest correlation with the criterion then adding as the next variable the predictor that shows the greatest statistically significant increment in the value of R^2. Efroymson's (1960) stepwise procedure re-examines at each stage the variables already in the equation and removes variables that have become superfluous due to new relationships established by subsequently added variables.

Draper and Smith (1966, p.172) state:

> "We believe this to be the best of the variable selection procedures discussed and recommend its use. However stepwise regression can be easily abused by the "amateur" statistician. As with all the procedures discussed sensible judgement is still required in the initial selection of variables and in the critical examination of the model through the examination of residuals. It is easy to rely too heavily on automatic selection performed in the computer."

Cooley and Lohnes (1971, p.57) go further:

> "We believe that stepwise regression is seldom appropriate in behavioural research because of the enormous hazards of capitalization on chance. At least the user of a stepwise procedure should demonstrate on a replication sample what the actual shrinkage of his multiple correlation is. McNemar gives a compelling example of capitalization on chance in the selection of "best" predictors (1962, p.185), and also gives a formula for estimating the shrinkage of multiple R (p.184). Since the formula predicts shrinkage only for ideal sampling conditions which almost never prevail in behavioural research, its use is no substitute for a replication sample demonstration in small sample studies."

This last issue we have dealt with in discussions on R_c^2. Two other issues emerge from these quotations,capitializations on chance relationships and the importance of replication by cross validation. The utilization of computer programs of the stepwise regression procedure will make it more probable that the wrong variable may enter a regression model only if all the variables in the correlation matrix are not theoretically equal. The decision rule that the program utilizes for the choice of variables is clearly laid out by Efroymson (1960) but if the researcher has a priori notions as to the relative importance of variables then the use of this method cannot be logically justified. Further if the instruments used to measure the variables are not equal in their reliability then the experimenter may wish to personally determine which variables enter the model. In the stepwise procedure no considerations are given to any chance or sampling fluctuations so the decisions are made on the relationships that are precisely expressed in the data. To argue that the relationship presented is not valid involves the giving of reasons that are not involved in the decision criteria. If the reasons offered are considered valid then the procedure should not be used. Alternatively if there are no compelling reasons that guide the preference of one variable over another then Efroymson's procedure is eminently suitable to guide selection. In this particular study there is no compelling reason to regard any variable as imperative in the model and so the stepwise procedure is methodologically viable.

The second issue that rises from Cooley and Lohnes' assessment of the stepwise regression procedures is the importance of replication. In a way it is remarkable that they felt the need to make this point at all. An article by N. C. Smith (1970), "Replication studies: a neglected aspect of psychological research" notes that psychologists have paid only a limited amount of attention to this basic principle of competent research so that in fact there are very few findings about which we can feel sure. Guion (1965, p.165) outlines cross validation in selection research:

> "Regardless of the model chosen, errors of measurement may cause shrinkage. Chance correlations of errors may influence the beta weights in multiple correlation .... Before any test battery is put to use as a selection system, therefore, cross validation is essential. Cross validation means that the battery is administered to a totally new sample, expected or predicted criterion levels are determined for each person, and expected performance is correlated with actual performance. This final correlation will almost always be lower than the original multiple R."

In this study these fluctuations will be observed and it could be alleged that they are predictable in view of the small sample size. However sample size is not the only source of variance and the small sample is partially balanced by the homogeneity of the group. They are employed in the same small country, by the same company, and in the same occupation. Barlett and O'Leary (1969) have noted that heterogeneous groups reduce the accuracy of prediction. They believe that the utility of the predictor variable is increased by separate validation on a large heterogeneous group. Surely the kind of design represented by a blocked factorial analysis of variance, i.e. where the subgroups are separately validated but these in turn are combined to meet the requirements of generality, is practical and goes some way to meeting the requirements of the applied psychologist and also the advocates of construct validity.

The Stepwise Model

The thirty variables collected concurrently on the salesman sample were subjected to stepwise analysis. The results were called the stepwise model. Efroymson's procedure as programmed by IBM for their statistical package (IBM, 1967) was utilized.

The first analysis gave a model with eight variables and an R_c^2 of .89. The t-ratio of the b-weight of the last variable entered, the 16PF factor Q1, failed to reach the .05 level of significance and so the model accepted contains seven variables. Two Mat variables, Ss and Pg, and five 16PF variables, B, C, F, G, and Q3, were included. All the b-weights were significant at the .01 level of confidence. The details of this equation are shown in table 6. The R_c^2 was a surprising .87 with the F ratio of the fit of the regression highly significant at 19.37 with 7 and 15 degrees of freedom. The residual standard deviation was $30,522 which was judged not to be excessive on such a small sample with a range on Sales from $12,600 to $303,300 and the mean sales for the salesmen group was $106,700.

TABLE 6

The Stepwise Regression Equation

Variable	B-Coefficent	Standard Error of B-Coefficent	t-Ratio*
Ss	41.07	11.03	3.73
Pg	-254.73	30.62	8.46
B	-136.99	39.70	3.69
C	152.52	20.57	7.38
F	-217.17	37.11	5.82
G	108.49	25.45	4.25
Q3	-201.43	34.86	5.84
Regression constant = 5078.35			

* $p < .05$

To provide a basis for comparison between different types of models all people selling $100,000 and above on total sales over the twenty-six week period were designated as satisfactory appointments. On this basis the salesmen sample could be divided into two groups, the ten men who sold above the cutoff point, and the thirteen men whose level of sales was below this point. The stepwise model correctly assigned twenty of the salesmen group a hit rate of 87%.

The scores of the appointees were then entered into the model in a cross validation check. The actual sales gave eight men in the high group and fifteen in the low. The predicted sales correctly classified twelve men six in either level, a hit rate of 52%. The model is clearly unsatisfactory and an examination of the residuals showed no systematic pattern.

The question to be investigated is why did this equation not cross validate? The important thing to note is that the failure to cross validate must be represented in the data we have on the two sample groups involved. In other words the reasons for the failure of the model can always be traced to differences that are represented in the data for the salesmen and the data for the applicants or in other words if the data is the same the equation will replicate, if the data is different the model will not replicate and the data can be examined for differences.

There are three steps involved in formulating the correlation matrix from which the model was calculated. At each stage some of the information contained in the original data is lost (Cattell, 1966). First the covariance matrix (D) is calculated.

$$D = \frac{1}{N} \sum_{i=1}^{N} (x_i - m)(x_i - m)' \qquad (2)$$

where m is the vector of means. Thus we have the sum of square and cross products of deviation scores divided by the number of subjects to achieve this value the value of the means are lost. The variance covariance matrix may be further simplified by standardizing the elements in the original data matrix. When this has been done the relation

$$D = R$$

pertains, as

$$R = \frac{1}{N} \sum_{i=1}^{N} z_i z_i'$$

thus the correlation is the average cross product of standard scores. At this point of abstraction the absolute values of the means and standard deviations have been removed from the matrix. With these distinctions in mind it seems that the differences in the data that cause the failure of the model will either be in the values of the means and their variances or in the relationships that are represented in the correlation matrix.

To trace the source of the variation the null hypothesis "that there are no significant differences between the means" was tested by a split plot analysis of variance as in Kirk (1968). One of the underlying assumptions of this design is that the subjects in the blocks constitute a random sample from the population, this is clearly violated. As the intention of this analysis was not to make inferences to another sample but to analyse the difference between these two samples as though they were the total population the failure to meet the requirements of this particular assumption does not prevent the drawing of the required conclusions. In the split plot design the subjects in any one block receive only one level of the treatment represented by that block but all the levels of the second treatment. In this case the two sample groups were blocked and the seven independent variables that were involved in the stepwise equation were assigned to the levels of the second factor.

TABLE 7

Analysis of Variance Table of the Factors in the Stepwise Regression Equation and the Salesmen and Appointee sample groups. (SPF-27, Kirk, 1968)

Source	Sum of Squares	df	Mean Square	F Ratio
Between Subjects				
Groups	105.65	1	105.65	4.74
S's within groups	1259.44	44	28.62	-
Within Groups				
Factors	90628.29	6	15104.72	1076.82 *
Factors x Groups	120.49	6	20.08	1.41
Factors x S's within groups	3741.26	264	14.12	-
Totals	95855.13	321		

* $p < .01$

Degrees of freedom for Giesser-Greenhouse conservative F test

Mean square for Factors 1,44
Mean square for Factors x Subjects within groups 1,44.

Homogeneity of variance was tested by Cochrane's C statistic (Kirk, 1968) and the value of C was .17 implying that the sample was homogeneous. The summary statistics for the cells are outlined in tables 3, 4, and 5. The analysis of variance table is shown in table 7. This latter table includes the Geisser-Greenhouse conservative F test degrees of freedom as the symmetry of the variance-covariance matrices were not tested. The F ratio which is of interest to this study refers to the groups and shows that there are no significant differences between the means of the salesmen group and the means of the appointees group. This also applies to

TABLE 8

Correlation Matrices of the Variables
Entering the Stepwise Regression Equation.
The Salesmen Sample is in the Upper Triangular Matrix
and the Appointee Sample Shown in the Lower Matrix.***

	Variables							
	Ss	Pg	B	C	F	G	Q3	SALES
Ss	-	01	-09	-16	23	41**	03	25
Pg	25	-	-04	21	-61	18	29	-39
B	53**	03	-	10	00	-24	-18	-22
C	05	-04	49**	-	-05	08	25	32
F	29	-27	46**	45**	-	19	06	10
G	31	-18	33	39*	41**	-	44**	42**
Q3	24	-39	27	43**	39*	38*	-	06
SALES	05	-19	-11	-02	19	11	20	-

* $p < .01$
** $p < .05$
*** Leading decimals ommitted.

the interaction mean square. It seems then that the failure to replicate does not occur because the means are different in the two sample groups.

Recalling that the weights that are applied to the raw scores are calculated $b = R^{-1}y$ it seems that the next values to examine for the failure to replicate are the values in the correlation matrix. The relevant correlation matrix is shown in table 8 with the correlations between the seven variables for the salesmen in the upper triangle and the correlations for the appointees in the lower triangular matrix. It is clear by inspection of the sales and predictor correlations that these relationships are not stable and with the exception of two cases significant. One of the explanations offered for variations in correlative relationships is that one of the groups of variables suffers from restriction in range. This is unlikely in this case as the means are not different. It would have been of interest to compare the scoring patterns with the groups on which the tests were normed but insufficient data is provided in the manuals. What is different between the two samples is that the relative ranking of individuals on the standard scales of measurement are not the same in the two sample groups. The factors measured by these seven variables do not maintain a consistent relationship to the criterion variable sales. As none of these relationships were stable but the means appear to be stable it was decided to consider the vectors of means of the groups as a basis for a selection model by the use of discriminant function analysis.

Seven other regression models were investigated including, the variables that were involved in the specification equation reported in The Handbook of the 16PF, the variables involved in the prudential model as specified in the next chapter, combinations suggested by Hughes' (1956) paper, and various variables considered important by the consultants. Further the reduced rank model outlined by Burkett (1964) was programmed and investigated. These models are not presented because they provided little further information relative to the amount of space required to report them adequately.

Chapter V

THE PRUDENTIAL MODEL

Before considering the discriminant analysis model, the prudential model a potential source of the variations in the correlation matrix was evaluated. This model was calculated by the consultants when they were acting for another insurance company and was applied to the data from the present client company's applicants to choose the appointees. No validity studies with reference to this model are available. The model is presented in figures 1 and 2 as it was used by the consultants. The procedure is that the sten score for the subjects are calculated on the MAT and the 16PF in the manner prescribed in the manuals. The sten value of each of the variables included in the model was given the value assigned from the standard score profiles. These values were added and the resulting score was compared to a cut off standard that represents estimated sales effectiveness. To ascertain the validity of this model a product moment correlation was run between the actual sales and the score on this prudential model of the appointee sample group. The correlation equalled .34 which was not significant.

As this model had been employed in the selection of the appointee sample group there could be some restriction in range on the scores of the variables that had entered the model. Accordingly the means on the three sample groups were tested using a split plot analysis of variance (SPF3.10, Kirk, 1968). The cell means are shown in tables 3, 4, and 5. The factors involved were Na, Se, Ma, As, and Sw from the MAT and A, B, F, L, and Q2 from the 16PF. Table 9 shows the analysis

FIGURE 1

The Prudential Model 16PF Standards

Variable	1	2	3	4	5	6	7	8	9	10
	STANDARD TEN SCORE (STEN)				Average					
A	.	.	1	2	2	3	4	4	5	5
B	.	.	1	2	2	3	4	4	5	5
C	.	.	.	.	.	.	.	.	.	.
E	.	.	.	.	.	.	.	.	.	.
F	8	7	6	5	4	3	3	2	1	.
G	.	.	.	.	.	.	.	.	.	.
H	.	.	.	.	.	.	.	.	.	.
I	.	.	.	.	.	.	.	.	.	.
L	1	2	3	4	5	6	7	8	9	10
M	.	.	.	.	.	.	.	.	.	.
N	.	.	.	.	.	.	.	.	.	.
O	.	.	.	.	.	.	.	.	.	.
Q1	.	.	.	.	.	.	.	.	.	.
Q2	.	.	1	2	3	3	4	5	6	7
Q3	.	.	.	.	.	.	.	.	.	.
Q4	.	.	.	.	.	.	.	.	.	.

FIGURE 2

The Prudential Model MAT Standards

Variable	STANDARD TEN SCORE (STEN) 1 2 3 4	Average 5 6	7 8 9 10
Ca	. + . + . + . +	. + .	+ . + . + . + .
Ho	. + . + . + . +	. + .	+ . + . + . + .
Fr	. + . + . + . +	. + .	+ . + . + . + .
Na	8 + 7 + 6 + 5 +	4 + 3	+ 2 + 1 + . + .
Se	11 + 10 + 9 + 7 +	6 + 5	+ 4 + 2 + 1 + .
Ss	. + . + . + . +	. + .	+ . + . + . + .
Ma	12 + 11 + 9 + 8 +	7 + 5	+ 4 + 2 + 1 + .
Pg	. + . + . + . +	. + .	+ . + . + . + .
As	. + . + 1 + 2 +	2 + 3	+ 4 + 4 + 5 + 5
Sw	5 + 5 + 4 + 4 +	3 + 2	+ 2 + 1 + . + .
Total Motivation	10 + 9 + 8 + 7 +	6 + 4	+ 3 + 2 + 1 + .
Integration	. + . + . + . +	. + .	+ . + . + . + .
Conflict	. + . + . + . +	. + .	+ . + . + . + .
Centricity	14 + 13 + 11 + 10 +	8 + 6	+ 5 + 3 + 1 + .
General Knowledge	. + . + . + . +	. + .	+ . + . + . + .

TABLE 9

Analysis of Variance Table of the Factors in the Prudential Model and the Salesmen, the Appointee, and the Applicant sample groups. (SPF-3.10, Kirk, 1968)

Source	Sum of Squares	df	Mean Square	F Ratio
Between subjects				
Groups	37.48	2	18.74	2.07
S's within groups	596.84	66	9.04	-
Within Groups				
Factors	31526.42	9	3502.93	310.26**
Factors x Groups	447.56	18	24.86	2.20
Factors x S's within groups	6719.39	594	11.29	-
Totals	39327.69	689		

** $p < .01$

Degrees of freedom for Giesser-Greenhouse conservative F test

Mean square for Factors 1,66
Mean square x subjects within groups 2,66

of variance table and leads to the acceptance of the null hypothesis that there are no differences arising from the three group means. Consequently that the application of the prudential model by the consultants in the selection procedure has not influenced the distribution of the scores and the appointee sample is not different from the salesmen sample. On this basis it appears unlikely that variation in the correlations are the product of the rigorous application of the prudential model. It must also be noted that the means of the rejected sample group are not significantly different on these ten variables from either the appointees or the salesmen.

Chapter VI

DISCRIMINANT ANALYSIS

General Principles of Discriminant Analysis

Multiple regression calculates a function that represented the relationship between the criterion variable and the predictor variable. Discriminant function analysis involves predictive estimation of group membership on the basis of regressing the differences among means of groups utilizing a weighted combination of predictor variables. (Fisher 1967) In this analysis the salesmen sample is divided into two groups. The group called "High-sales" consists of subjects who have sold more than $100,000 of insurance in the first twenty-six weeks of employment. The "Low-sales" group consists of subjects who have sold less than the $100,000 in the first twenty-six weeks of employment. The independent variables are identical to the twenty-nine independent variables outlined earlier in this dissertation.

The technical aim of the anlysis is to find a weighting vector which can be applied to the vector of scores of a person not in the sample groups so as to assign him to either the high or low groups with a given probability of error. Accordingly the vector of weights (w) is found which allows the correct assignation.

$$w = V^{-1}d \qquad (3)$$

where d is the vector of differences between pairs of independent variable means of the high-sales and the low-sales groups. V is the weighted average of the dispersion matrices of the two groups. The similarity between the formula for calculating the regression b-weights and the discriminant function analysis w-weights is quite clear. d refers to the distance between the means in the latter and k to the correlations between the criterion and the predictor variables in the former. The relationship of these two regression formulas is evident if we consider the relation,

$$D = R$$

pointed out earlier, which occurs when the variables entering the formula for calculating the variance-covariance matrix (formula 2) are standardized. The analyses thus differ in that regression acts on the correlation matrix from which the differences between the means and variances have been removed, the means being set at zero and the standard deviations at one consequently it is the relative relationships or averaged cross-products of standardized scores that are considered. Discriminant analysis takes into account the magnitude of the differences between each group.

An analogue to R^2 for this analysis is the Mahalanobis D^2. (Mahalanobis, 1936)

Calculated:

$$D^2 = d' V^{-1} d$$

$$D = \sqrt{D^2}$$

If each element of w is divided by D then the resulting weights can be applied to the original test scores and the resulting values totalled to equal a standardized discriminant function score that has unit within group variance. (Hope, 1968) Thus Mahalanobis' D is the distance between the groups on a vector that has unit standard deviation within the groups. The cutting score between the groups can be set a proportion of D, e.g. D/2 will be half the distance between the means. This proportion may be deducted from the standardized discriminant function scores and is a unit normal deviate thus the probability of misclassification can be evaluated by consulting a table of the proportions of the area under the normal curve.

The First Discriminant Model

The methodology followed for this analysis parallels the procedures utilized at the Industrial Relations Centre of the University of Minnesota. The studies involve the personal correlates of managerial effectiveness. (Mahoney, Jerdee, and Carrol, 1963; Mahoney, Jerdee, and Nash, 1960; and Mahoney, Sorenson, Jerdee, and Nash, 1963) They administered a series of tests to a large sample of middle management drawn from U.S. companies operating in the areas of manufacturing, finance, insurance, public utilities, agricultural products, and the wholesale trade. To provide a criterion the subjects were ranked on the basis of judged overall management competence by senior company executives. The sample was randomly halved to provide a cross validation sample and the scores of the first group were analysed in terms of their ability to discriminate between the top and the bottom groups of ranked managers. On the basis of the study a set of variables was chosen and these cross validated successfully on the remaining half of the sample. The crucial point is that the standardized keys on the test instruments were found to be unsatisfactory and the tests required the establishment of new scoring keys.

The sequence followed in developing the first discriminant function in this dissertation was controlled so as to simulate the probable judgements of an applied psychologist manipulating the data as it became available to him. The discriminant analysis program supplied in the Scientific Subroutines by IBM (1967) was put into an iterative cycle and enlarged to take up to thirty variables. The procedure adopted was that the common means and the standard deviations were calculated and compared with the group means, any variables whose group means were separated from each other by a distance that equalled .5 of the area under the normal curve was entered into the iterative discriminant analysis procedure. The eleven variables chosen are shown in table 10. The iteration involved the removal of the variable whose discriminant coefficients had the least difference when the high group coefficients were subtracted from the low group coefficients. This procedure continued until the percentage of misclassifications began to increase. The cyclic analysis was stopped with five variables remaining in the equation. Four MAT variables Ca (career), Pg (agression), As (mastery), and Sw (wife), and the 16PF variable G (expediency-conscientiousness were retained. Sw has the smallest contribution to the function but it's removal increased the missclassification from three to five people misplaced on the salesmen sample.

TABLE 10

Summary Statistics for Variables in the Discriminant Function Analysis

Variables	Salesmen				Appointees	
	High-Group Mean	High-Group S.D.	Low-Group Mean	Low-Group S.D.	High-G. Mean	Low-G. Mean
Ca	18.50	3.44	21.46	2.45	20.37	19.66
Se	30.38	3.89	33.57	5.84	-	-
Ma	17.90	4.19	16.07	2.82	-	-
Pg	11.00	3.49	13.00	2.65	11.12	13.73
As	17.00	2.40	13.38	3.17	16.12	14.40
Sw	16.40	2.38	14.07	2.40	16.37	14.73
E	14.83	5.21	13.17	3.42	-	-
F	15.90	4.39	13.50	3.47	-	-
G	15.20	2.78	12.85	3.77	15.00	13.13
H	16.16	4.60	13.57	5.23	-	-
SRA	32.16	6.77	34.25	4.22	-	-

The significance of the equation is tested from the generalized Mahalanobis D^2 (GMD^2) which is distributed as chi-square with m(q-1) degrees of freedom where m is equal to the number of variables and q is the number of groups. (T. W. Anderson, 1958) This chi-square examines the hypothesis that the mean values are the same in the high and the low groups for these variables. GMD^2 is equal to $21.17_{(5, p < .001)}$. The rejection of the null hypothesis at the .001 level of significance enables the postulation of a significant difference between these groups.

The actual equations for group membership are

DF1 = -52.48 + Ca.855 + Pgl.314 + Asl.203 + Sw2.674 + G.860

DF2 = -55.621 + Cal.361 + Pgl.715 + Asl.05 + Sw2.512 + G.372

where DF1 is the discriminant function for membership of the high-sales group and DF2 is the discriminant function for membership of the low-sales group. These functions correctly placed twenty of the twenty-three subjects in the salesmen group or 87% correctly placed. To validate the model the equations were applied to the appointee sample and the results showed that fourteen of the sample were accurately placed, or 61% correctly assigned. The chi-square value equals 9.87 which is significant at the .01 level and shows that the assignment under this equation is better than chance. In terms of practical significance this equation is not significant enough because nine people are misclassified.

Some indications as to the reasons for the inadequacy of the equation can be seen by examining the vectors of means that enter the model as they are shown in table 10. The means for the appointees sample divided into a high and a low sales group on the five relevant variables are shown. Though there are slight movements in the means the relationships are preserved in all cases except in the case of the MAT Ca variable. The means of this variable in the criterion groups have shifted significantly. The standard error of the mean (SE_m) for Ca in the high-sales and in the low-sales was .83 and .51 respectively. The movement in the mean values is convergent +1.87 SE_m and -1.80 SE_m respectively. The Ca factor purports to measure the maturity of the development of interest in a career. A sample of the questions from the MAT define the area of inquiry;

- An interesting essay to write would be on:

  Ca Success in business

  The best kind of citizen.

- All careers are becoming so crowded that one can no longer expect to "reach the top".

  Ca a. Very false

  b. False

  c. True

  d. Very true.

- Permanent Position Ca

  Wave

- Which type of school is least concerned with workers' learning the particular skills of jobs?

  a. Universities

  b. Correspondence Schools

  c. Vocational schools

  Ca d. Secondary schools.

When the content of these questions is considered in relation to the two different situations in which the samples were given the tests it seems plausible that the appointees in a job interview situation might be expected to answer in a different manner than if the questions had been asked of them in the concurrent situation. If this is true then the dangers of concurrent studies becomes apparent and the position taken by Kurtz (1941) on concurrent studies must be accepted i.e. that consecutive predictive studies are to be preferred. Cattell (1970) notes that questionnaires are open to distortion when they are employed without caution in different motivational situations.

That this is a fairly frequent occurrence is noted by O'Dell (1971) who found it necessary for his research on the 16PF to develop a random scoring measurement detection scale. Meredith (1968) studied deliberate faking toward the socially desirable response in the 16PF and found that the mean sten scores can move from the normal average of 5.5 within a range from 1.2 on some scales to 8.6 stens on other scales. The average movement of the means under conditions of motivational distortion is some 2.0 sten scores in magnitude which on average would involve some 34% of the population. Clearly motivational conditions should be kept as stable as possible.

The Second Discriminant Model

On the basis of these a posteriori considerations the discriminant model was recalculated with the Ca variable removed. Under these conditions the appointee sample can no longer be strictly regarded as a cross validation sample. Data from a further twenty-three appointees is being established but as it takes twenty-six weeks for the criterion data to be completed the sample was not ready for this dissertation.

The generalized Mahalanobis D^2 equalled 11.63 on the salesmen sample which is significant at the .02 level of confidence with 4 degrees of freedom. The discriminant function equations were

DF1 = -50.076 + Pg1.379 + As1.531 + Sw2.92 + G.921

DF2 = -49.526 + Pg1.818 + As1.572 + Sw2.903 + G.470.

Where DF1 again refers to the high-sales group of the salesmen sample and DF2 refers to the low-sales group of the salesmen sample. Of the salesmen sample group nineteen were correctly assigned giving a correctly assigned percentage of 82%. The appointments fared better under this equation than under the first discriminant analysis equation with sixteen correct placements and seven incorrect a correct placement of 69%. This is of some practical significance with the mean score of the selected group of applicants moving from average sales of \$108,220 to an average sale of \$140,720 for the twenty-six week period.

Some very tentative remarks may be made in relation to the four factors. The more successful salesmen tend to demonstrate the characteristics one would associate with a highly socialized person. They have a high score on measurements of consciousness (G), strength of drive to achievement and mastery (As), and tend to demonstrate attachment to their wife or sweetheart (Sw). This last variable is of interest as one of the consultants considers that a factor in making a salesforce more effective in this kind of selling is to discuss the problems of agency selling with the wives prior to appointment so that they can support their husbands during the difficult selling periods when the financial return is low. The low score on Pg or pugnacity tends to undermine the picture of "the foot in the door salesman". It appears from the data that he may be a well adjusted happily married man with a number of dependents, a high expectation of monetary gain, and an established personal capital. This picture is tentative but may provide a starting set of hypotheses for future studies.

At this point of the study it seems that four of the means contain valuable data for prediction and that only one of the correlations in the criterion to predictor correlation vector is significant at the .05 level. There have been different interpretations placed on this data, it appears that the importance of statistical significance in the multivariate analysis of correlation matrices is contentious. My view is that valid conclusions may be drawn from the data concerning the means but not the correlation matrix, because there are too few statistically significant relationships in the matrix and few of the correlations are stable across the two samples whereas the means are stable. It is because the data does not show the kind of stability and discrimination that one might expect from the test manuals that the next section examines the validity evidence that accompanies the Cattellian tests.

Chapter VII

CATTELL'S TESTS

Because of the failure of the stepwise model one may feel uneasy about the low correlations that are typically found in Cattell's data. Cattell (1959) argues that it is his intention to include independent unitary traits which will not intercorrelate highly but unfortunately these traits or factors do not have satisfactory correlations with criterion variable and it is thus difficult to imagine what it could mean to partial out variance from a nonsignificant correlation vector. Nor is it, contrary to Cattell's (1964) arguments, necessary to have low homogeneity coefficients for items that load on constructs in the area of personality research. Jackson (1971) has demonstrated in his development of the Personality Research Form that items can be written to measure constructs drawn from personality theory and yet still achieve psychometrically sound standards. His straightforward approach to problems in personality measurement tends to support the sense of dissatisfaction in the way in which Cattell's tests are functioning in this study. Whether Jackson's Personality Research Form will in fact do any better has yet to be demonstrated.

This dissertation was not formulated to examine the validity of the tests in relation to their construct validity. Thus the evidence assembled does not bear directly on questions of validity. However if we limit the problem of the validity in this chapter to the 16PF questionnaire then there is a body of published information that can be considered and the conclusions which are reached on the substantive nature of the 16PF will have some transitive value in considering the largely unresearched MAT.

Essentially there are two lines of evidence offered by Cattell for the validity of the 16PF. First, the correlation of the Q or questionnaire data such as responses on the 16PF and the L or life rating data and secondly, the validity of the tests said to rise from co-ordinated factor analyses.

Schaie's (1962) research is referred to in the 16PF handbook as part of the evidence for basic trait structure. The study examines the relationship of L and Q data but the research utilized the High School Personality Questionnaire (HSPQ) so any relationship between the 16PF and the HSPQ must at best be transitive. Her study gives correlations between scores on the HSPQ and rating data that was gathered from the supervisors of 43 institutionalized delinquent girls. The eleven correlations are very low and only one is significant at the .05 level. It is difficult to see how the study can be construed by Cattell as supportive evidence for an underlying trait structure. A study by Becker (1960) also found little match between behaviour ratings and the personality factors. There is a need for unequivocal evidence of the relationship between primary traits measured on the 16PF and behaviour.

The second line of evidence offered by Cattell relates to the factorial validity as "the validity measured by correlating the score with the pure factor". Consequently central to the conception of the 16PF and its validity is the author's commitment to factor analysis. Brody (1972) offers various criticisms of trait theory and shows that the problem of the instability of the factors or the difficulty of replication are central arguments against the kind of methodological position adopted by Cattell. Evidence of this instability emerges in papers given at the 1972 New Zealand Psychological Association Conference. Adcock, (1972) reports a study which examined fourteen primary personality factors with appropriate items selected from the 16PF. The number of factors to be rotated was decided by the Kaiser-Guttman criterion, but unfortunately 26 qualified. Ten were held to be 'non trivial' on the basis that the rest were multi-determined. Six of the twelve factors that are discussed were not marked by hypothesized items. The actual discussion is illuminating.

> "Only two of the expected factors have failed to appear here .... The absence of G or Ego-ideal is more difficult to understand since this was one of the factors which stood up better than most in our earlier studies of the 16PF." (N. Adcock, 1972, p.8)

Further, Adcock, Adcock, and Walkey, (1971, p.2) state

> "The evidence we have been considering seems to provide a damming indictment of the personality schema which Cattell and many others have devoted so much time to developing, but before we decide that the product of half a lifetime is crumbling about our ears, let us examine the position more fully. Certainly all the recent evidence seems to indicate that the items themselves do <u>not</u> define the factors to which they are alleged to relate, but one point that appears to have been overlooked is that the factors which do emerge are in many cases strikingly similar to the 16PF factors as described."

The above statements seem to show that the items are not found to load as they were expected to load. Of course in a sense this is not surprising when we consider that the matrix which expresses the linear components of the variance has zero values in all but the leading diagonals and so all the variables entering the basic data matrix affect the value. What is most disturbing is that investigators who have done a great deal of work in this area are unable to exercise predictive control over their variables. The reason for quoting at length these studies was to show that this confusion over the number of factors to be extracted is in fact a common problem, Rorer (1971) was even confused by the 1970 handbook for the 16PF as to the exact number of primary factors that Cattell had found, it could have been 16, 18, 19, 22, 23, or 28. This is a difficult problem for a test that establishes it's validity on the fidelity with which it represents the underlying factor structure. Nor is the number of factors to be rotated a minor matter as a few minutes with any standard computer program altering the number of factors rotated will show. Francis (1972) illustrated this, he constructed models that had two underlying factors distributed over ten variables. When five factors were extracted, all with eigenvalues greater than one, there was no resemblance to the true loadings. The conclusion is that factor analysis is only of use in psychological research when the number of factors is known. It seems then that the difficulties of factor replication outlined by Brody (1972) are secondary to the difficulties involved in providing evidence from factor analysis studies of the true underlying structure. Thus the problems of the Adcock studies may well lie in the illegitimate use of factor analysis by Cattell. What is meant by illegitimate is best defined from statements of Brody and Cattell. Brody (1972) uses the word "discover" in describing the activities of the factor analyst who attempts to reduce the correlation matrix into a number of hypothetical factors. The multivariate experimental psychology position (Cattell, 1959) contends that psychologists are aping the physical sciences in the imitation of univariate experimental methods without regard for the state and nature of psychological knowledge. Cattell believes that it is better to reduce the large number of possible variables <u>prior</u> to hypothesis and manipulative experiment arguing on the basis of experimental economy. Thus the experimenter is able to establish

> "What is the most stable and unambiguous simple structure discoverable in the body of questionnaire items which the various interlocking researches have shown to occupy a central and comprehensive space among questionnaire and personality rating variables."
> (Cattell, 1968, p.109)

The point here is that the word "discover" is not out of place in describing Cattell's use of factor analysis. But the dangers of utilizing repeated factor analysis to sustain theory have been clearly shown by Humphreys, Ilgen, McGrath, and Montanelli (1969), and Francis (1972). The former paper showed that ostensibly meaningful factors can be found from intercorrelated random error and Francis found that loadings for three nonexistent factors were reproduced in three independent samples with all the nonexistent factors having eigenvalues greater than one.

Cattell does not argue that the factor is any more than a pattern found in the loadings, yet these factors give rise to groupings of data behind which are postulated entities or in fact primary factors. These primary factors are reported in profiles without regard for measurement errors and in turn in psychologists' reports. Thus 'X' may be above average in aggression when he has a reported sten of 6.5. This is in spite of the fact that the standard deviations of the scoring patterns indicate that his true score may be between 4 to 8 stens. When the difficulties of assigning items to factor groups by the use of factor analysis is taken into account confidence in such judgements especially those based on a single test form must be greatly diminished. The adventure of "Tom Swift and His Electric Factor Analysis Machine" by Armstrong (1967) examines the hazards of the derivation of theory by means of factor analysis. The essential point of his saga is that if one is compelled to utilize factor analysis a minimal requirement is the stipulation of prior assumptions as to the nature of the relationships and the number of expected factors. Francis (1972) also notes that a prior specification of the number of factors is necessary before engaging in factor analysis.

The arguments of this section of the paper give some justification for the decision to depart from Cattell's grouping of his items because the evidence both empirical and rational for his grouping of the items in the questionnaire is not as substantial as could be desired.

Chapter VIII

EMPIRICAL METHODS

If the remarks of Adcock, Adcock, and Walkey (1971) on the unstable relation of the items in the 16PF to the factor scores are put alongside the failure of the stepwise model, because of the instability of the factor-score sales correlations, it seems reasonable to examine the data to ascertain the possible effectiveness of an empirically defined scoring key. The basic data of such an analysis is the correlation of the items in the tests directly to the criterion. The correlations, the mean scores, and the standard deviations of each item in the 16PF and the MAT are shown in the Appendices 3 and 4 respectively. It will be noted that there are only 208 items of the MAT reported this is because 96 of the items are scored in two directions and so only the independent measures are utilized. These are best identified as the items scored on the two major scoring keys supplied with the MAT. The correlations are Pearson's product moment or biserial as appropriate.

The Validated Empirical Scoring Key

The vectors of correlations in the appendices were considered and all the items that correlated higher than .30 with sales in the salesmen sample were identified. The choice of .30 as a cutoff score was arbitrary. This procedure gave 29 items from the 16PF and 32 items from the MAT. Each item was then scored so that it positively related to sales and the score of each salesman on the 61 items was accumulated to give what is called a sales-effectiveness score. As there are ten salesmen who sold more than the criteria of $100,000 the cutoff sales-effectiveness score was set at the value equivalent to the tenth ranked sales-effectiveness score, giving a cutoff of 62.5. On the basis of this criteria twenty of the salesmen were correctly assigned a correct classification of 87%. When the sales-effectiveness score was calculated for the appointees the same cutoff score predicted that eight of the twenty-three appointees would be high sellers. The same proportion as the actual high sales for this sample so the cutoff score was not altered. In this cross validation sixteen appointees were correctly assigned a correct classification of 69%. This is the same success rate as the second discriminant analysis function. The drop in successful assignment between the two samples is due to the instability of the relationship of many of the items to the sales. It is to be expected that there are many chance correlations in the sales-effectiveness score because only 61 items were selected from 394 potential items or a 3:20 choice ratio. Nevertheless the empirical method cross validated with the same success rate as the more formal second discriminant function model.

An Unvalidated Empirical Scoring Key

The empirical keying approach has one advantage over the utilizing of the existing constructs of the tests and that is that eventually one may be able to construct an instrument that can be given to prospective insurance agents in a much shorter time with the same validity; presumably if the items in the test are accurate predictors then some clues on the response patterns that discriminate successful salesmen must be latent in the responses to the questions. The problem is to remove the items that aren't stable. It is impossible to do this efficiently without considering the item to sales correlations for both sample groups and this means of course that the resulting model has not been cross validated. The best that can be done is that a start be made by selecting the most stable items from both tests over both sample groups and calculating the relationship of these items to sales in the form of a modified sales-effectiveness score and to reserve judgement on the validity of this procedure until the data being presently collected is available. Forty-six items were selected from the two tests and these are identified in the appendices 3 and 4. The total scores on these items correlated .89 to sales over both the salesmen and the appointee sample groups. Of the forty-six agents in the two samples the items identified thirty-nine, a correct assignment of 82%.

The stability of the sales-effectiveness score was shown by calculating the correlation of the score to sales for the salesmen sample, .89, and for the appointee sample .86. Before being available for use these items will need to be validated on another independent sample. In planning any further studies that may require consideration of items attempts should be made to secure a sample that can be divided into three groups so that the first two are available for the development of items and the third group for validation.

A Composite Model

There are various combinations of methods that may provide good selection models for example, a discriminant function that takes the total sales-effectiveness score for the 16PF items only and the three factors of the MAT that show stable differences between high and low performers namely Pg, As, and Sw. The means of the scores on Pg, As, and Sw are shown in table 10. The mean sales-effectiveness score for the high-salesman group was 35.5 and the mean score for the low-salesman group was 26.38 with the common standard deviation of 5.99. The Generalized Mahalanobis D^2 was 15.09 with 4 degrees of freedom, which is significant at the .01 level of confidence. This model correctly assigned eighteen out of twenty-three of the salesmen sample or 78% correctly assigned. When cross validated on the appointee sample the model successfully classifies twenty one of the twenty three appointees, or 91% of the sample group. There are reports of discriminant functions giving better classifications on replication than on the original data (Jenden, Fairchild, Mickey, Silverman, and Yale, 1972) but this is unusual. This equation must be regarded as not validated until the next sample of appointees eventuates. The actual model is,

$$DF1 = -62.92 + SE.9484 + Pg1.856 + As1.849 + Sw2.630$$

$$DF2 = -57.52 + SE.704 + Pg2.084 + As1.748 + Sw2.700$$

where DF1 is the function for the high-sales group and DF2 is the function for the low-sales group and SE is the sales-effectiveness score.

These last three models demonstrate that it should be possible to arrive at a good basis for selection using an empirically derived instrument. When biographical data relevant to the selection situation is included the efficiency of selection may be quite substantial. The advantage of these methods is that there are many different options available to the test constructor to improve the selection instruments. The disadvantages relate chiefly to the expense and time involved in establishing the efficiency of sets of items.

Chapter IX

CONCLUSION

The selection situation places the psychologist in a position of high moral responsibility. The decisions based on his models influence the pattern of the applicant's life and the welfare of the company that relies on his data. Therefore the procedures that provide the most stable findings are the only acceptable solutions. In view of these ethical implications the arguments for construct validity are unreasonable in that there is only one course of action open to the applied psychologist and that is to utilize the most effective predictors. Conversely it is also clear that ultimately the most effective predictors will be those that are clearly defined in theory. What is required is that the theoretical constructs be evidenced by experimental data to show that the variables postulated are significantly related to the criterion groupings. That is, that there are differences between the groups on the variables that allow them to contribute to the information available for making a decision. Such empirically established and verified variables may provide data for theory construction.

Considering the alternative models that are available for selection on the basis of this study it is clear that the Prudential and the stepwise model provide no evidence as to their accurate selection capacity. The second discriminant function is equal in it's selection capacity to the first empirically derived key. The choice between these two models is a matter of personal preference. But the accepted model should be viewed as a step in a continuing process of establishing a valid selection model because it can almost certainly be improved by the addition of sound biographical data. Given that the second set of empirically derived items validated my choice would be a model based on these items as it could free interview time for the establishment of experimental programs such as the introduction of tests that may be found to have more validity than the existing procedures. A total commitment of the interview time to the collection of data to service the existing models means that we are tactically committed to the present instrumentation and that beneficial changes in the selection model can only come from a complete disruption of the current selection procedures which makes the research an expensive undertaking. It is clear from the instability of the variable Ca in the discriminant function analyses that longitudinal studies in spite of the time and expense involved are more likely to return stable results than concurrent designs.

It is possible that substantial savings in testing time could be made by the development of specific test forms from the validated empirical scoring key and it's unvalidated counterpart. Two steps seem logical if this path is followed first the second set of items should be validated against another sample and then a correlation should be computed between the items as they are answered with the existing test instruments and the response patterns that occur when the items are structured into a shortened form. If the shortened form is tenable after these two issues have been resolved then some multiple choice items could be constructed to exploit the findings of Hughes (1956) involving the classification of responses to the question "Why do you think that you can achieve success as a life insurance agent?" these items which would have high face validity could be included in the form together with questions that relate to the subject's understanding of insurance principles and longitudinal validity studies conducted.

It is disconcerting to note that the SRA measure of intelligence is negatively related to sales in the salesmen (-.39) and bears no relationship to sales in the Appointee sample (.02). This is contrary to Ghiselli's finding that measures of general intelligence have an average validity of .31 in selling occupations. The size of the standard deviations indicate that there is a good spread of the scores and the mean is a little higher than the consultant's norms. Perhaps measures that isolate some of the better recognized components of intelligence such as verbal ability, spatial relations, and reasoning might provide data that relates better to the criterion.

The literature clearly indicates that accurately reported biographical data such as net worth, budget of living expense, insurance owned, number of dependents, age, and education could be exploited as potential variables to discriminate people that are likely to succeed as insurance agents. Such data should be collected in a manner that enables reliable numerical analysis to proceed.

With a data base of good biographical information and a validated sales-effectiveness score it would be possible to formulate models that bear a consistent relationship to the effective salesman. This information could in turn be studied with a view to understanding some of the social and psychological characteristics that distinguish a successful life insurance agent. Such an analysis would be premature on the data of this dissertation as the most effective items are not yet shown to be valid. The specific variables that distinguish the effective salesmen may provide the basis for a model that can develop from significant detail toward theoretical generalizations. Replication of this pattern of research over different occupations could have interesting implications for the study of the characteristic response behaviour of subgroups of people.

It is from the position outlined in the previous paragraphs that the discriminative model is seen to hold the greatest effectiveness. The fundamental argument that is advanced for the multiple regression model relates to it's scale free attributes that rest on the standardized scores that are used in the computation of the basic correlations. The quality of standardized measurement is not particularly important in personnel selection if the same instruments are used on the various sample groups to give numerical representation to the variables. One suspects after considering the 16PF, that outside the general measures of intelligence psychometric instrumentation has not reached the stage where we are able to compare measures on one scale with measures on another with any real certainty. (Soueif, Eysenck, and White, 1969) These problems aside it is disconcerting to ask other researchers and even mathematicians exactly what they think the average of the sum of the cross-products of standardized scores actually is. On the other hand it is conceptually simple for experimental psychologists to manipulate notions of significantly different distributions as are found in basic analysis of variance models. The concept that two or more groups are different from each other in respect to certain specified variables is fundamental to psychological research. From this position it is relatively easy to follow that discriminant analysis is optimizing these differences to arrive at the best possible group assignment in terms of the data. The fact that in this paper the multiple regression models were not successful while the discriminant models were is incidental to this argument. The argument simply is that the discriminant power of variables should be shown by factorial replicated analysis of variance and that these variables should enter our selection models rather than variables that represent very small partialled segments of the variance. A more advanced development of discriminant procedures is outlined by (Rulon, Tiedeman, Tatsuoka, Langmuir, 1967) however the retention of the simplest procedure for applied work is recommended.

The reservations of this dissertation are now fairly clear, they are that the paper only demonstrates that the most satisfactory solution to a selection problem of the type studied here is only likely to arise from a set of cyclic studies each commencing where the other left off. The lack of regrets is due to the study having shown that some predictive capacity can be demonstrated in the selection situation even when it involves small but fortunately homogeneous samples.

APPENDIX 1

Table of Correlations of Dependent and Independent Variables for the Salesmen Sample*

Variables	Ca	Ho	Fr	Na	Se	Ss	Ma	Pg	As	Sw	A	B	C	E	F
Ca	-	39	35	-33	40	26	-19	21	31	22	05	02	-42	-14	-16
Ho		-	20	01	53	25	-14	30	20	-10	12	07	03	45	-26
Fr			-	10	32	-41	-40	18	-17	00	-22	15	-10	13	-44
Na				-	-05	-50	04	11	-56	-39	-30	-05	-02	10	-14
Se					-	19	-42	08	-19	09	-03	-08	-25	07	-25
Ss						-	03	01	32	05	28	-09	-16	-22	23
Ma							-	00	02	-13	06	05	17	-23	04
Pg								-	05	-16	18	-03	20	22	-60
As									-	25	32	-10	-01	-04	07
Sw										-	30	-01	-01	-02	16
A											-	-17	-07	00	16
B												-	09	00	00
C													-	47	-05
E														-	00
F															-
G															
H															
I															
L															
M															
N															
O															
Q1															
Q2															
Q3															
Q4															
SRA															
AGE															
EDUC															
SALE															

* All correlations are presented without leading decimals

APPENDIX 1

Table of Correlations of Dependent and Independent Variables for the Salesmen Sample*
(continued)

Variables	G	H	I	L	M	N	O	Q1	Q2	Q3	Q4	SRA	AGE	EDUC	SALE
Ca	-05	-13	11	32	-10	03	26	08	-03	25	07	02	34	-13	-35
Ho	41	24	-03	19	-31	08	-22	04	-26	47	-44	01	59	10	-09
Fr	07	24	13	26	-27	30	-06	-04	40	25	11	29	26	-18	18
Na	-10	15	-19	01	01	28	05	07	11	07	23	46	36	36	-34
Se	25	-24	-02	-03	-36	25	-10	22	06	36	-16	26	41	01	-11
Ss	41	12	24	-16	-07	-41	-05	-14	-43	02	-28	-45	-05	00	25
Ma	-01	04	12	-18	44	04	12	-03	-06	-10	-17	35	05	46	18
Pg	18	17	23	14	-01	10	-33	20	01	29	-21	15	35	31	-39
As	25	15	-04	16	05	-11	-01	-13	-01	32	-05	-16	-20	-16	19
Sw	00	-17	-05	43	08	06	16	18	-06	-19	27	-29	-25	00	27
A	18	31	15	39	-29	05	16	01	-39	-01	00	-27	09	-11	-07
B	-24	-03	-26	-03	-05	-21	-16	-53	-14	-18	-20	55	-22	00	-22
C	08	40	-21	-29	33	-09	-79	-16	22	24	-59	19	-04	23	32
E	32	49	-03	19	-02	-19	-35	18	03	06	-33	-05	07	00	15
F	-19	18	24	-05	10	-50	25	-19	-34	-56	07	-22	-49	27	10
G	-	26	-11	26	-30	-21	-23	23	05	44	-25	-35	31	10	12
H		-	-08	16	-15	-44	-21	-15	-23	10	-37	04	17	12	04
I			-	-10	19	-10	12	14	-23	-31	07	-20	-22	-02	23
L				-	-47	-03	34	44	-13	04	39	-14	32	-12	16
M					-	-13	-12	-29	22	-19	10	32	-38	40	13
N						-	09	20	11	24	17	10	42	00	-15
O							-	14	-30	-50	61	-08	-10	-13	-17
Q1								-	19	06	14	-40	35	07	13
Q2									-	38	06	28	09	03	06
Q3										-	-32	05	66	13	-05
Q4											-	-07	-11	-16	-17
SRA												-	14	29	-39
AGE													-	10	-22
EDUC														-	42
SALE															-

* All correlations are presented without leading decimals.

APPENDIX 2

Table of Correlations of Dependent and Independent Variables for the Appointee Sample*

Variables	Ca	Ho	Fr	Na	Se	Ss	Ma	Pg	As	Sw	A	B	C	E	F
Ca	-	-07	01	-20	-46	-15	-11	-27	21	28	-17	-04	-05	-12	-29
Ho		-	04	-21	36	07	03	-16	-33	-04	22	-30	-65	-44	-09
Fr			-	04	-15	-01	36	-03	13	-10	-08	-04	12	06	41
Na				-	-37	-01	38	56	10	23	-13	-02	19	35	03
Se					-	09	-42	06	-60	-21	25	-12	-40	-22	-19
Ss						-	18	25	-14	-61	31	53	-05	39	29
Ma							-	07	20	13	27	07	18	06	33
Pg								-	-18	-16	25	35	-04	28	27
As									-	-07	-19	00	19	05	-17
Sw										-	-11	-52	01	-46	-11
A											-	04	-05	17	29
B												-	49	63	45
C													-	49	44
E														-	40
F															-
G															
H															
I															
L															
M															
N															
O															
Q1															
Q2															
Q3															
Q4															
SRA															
AGE															
EDUC															
SALE															

* All correlations are presented without leading decimals

APPENDIX 2

Table of Correlations of Dependent and Independent Variables
for the Appointee Sample*
(continued)

Variables	G	H	I	L	M	N	O	Q1	Q2	Q3	Q4	SRA	AGE	EDUC	SALE
Ca	-11	-13	-58	-61	-23	01	-25	09	-28	-15	-35	53	-33	-19	04
Ho	-19	-06	25	03	-48	-01	02	-31	-43	-22	-02	16	61	32	11
Fr	06	03	16	41	-09	-17	-02	16	07	-03	19	-11	08	-16	20
Na	-49	15	19	40	07	18	12	10	45	-36	52	-28	-06	-01	-02
Se	12	-18	40	01	02	-21	38	-19	-12	15	08	-07	45	-05	-12
Ss	31	12	24	20	24	-09	31	02	03	24	39	14	11	09	05
Ma	04	14	22	19	-26	-09	07	-03	-08	-15	35	-31	-11	04	41
Pg	-18	-01	25	22	08	00	34	-09	30	-39	48	-21	04	12	-19
As	-05	03	-32	02	-03	-06	-46	07	20	-20	-19	03	-13	25	21
Sw	-28	-06	-15	-39	-33	-01	-15	-28	-22	-12	-20	-05	-33	-01	15
A	38	32	13	03	-09	22	40	18	08	00	27	20	09	27	21
B	33	34	02	09	50	-08	-14	34	18	27	-01	30	-24	-16	-11
C	38	37	-18	12	59	22	-09	34	57	43	-05	-16	-56	-44	-02
E	16	43	-19	27	45	40	25	53	56	-08	29	-01	-10	-27	15
F	41	55	06	19	30	10	06	47	10	39	09	-05	-12	-24	19
G	-	38	08	-16	29	05	08	05	07	61	-20	00	-21	-19	11
H		-	04	26	51	12	00	26	18	28	06	-13	-02	-18	25
I			-	51	05	-47	03	-22	-04	18	30	-20	32	05	-22
L				-	38	-13	11	23	38	09	58	-41	30	-08	-15
M					-	-06	03	28	41	64	14	-18	-13	-29	-31
N						-	24	23	34	-25	-01	-09	-07	-15	07
O							-	14	15	-10	68	-33	08	-20	03
Q1								-	33	-01	35	13	-27	-16	-02
Q2									-	07	22	-40	-04	-17	-07
Q3										-	-16	-17	-22	-29	-19
Q4											-	-22	-02	-05	-11
SRA												-	-05	43	02
AGE													-	35	16
EDUC														-	-23
SALE															-

* All correlations are presented without leading decimals

APPENDIX 3

16PF Item Means, Standard Deviations, and Correlations of Items to Sales for the Salesmen and the Appointee Samples***

	Salesmen			Appointees		
Question Number	Mean	S.D.	Sales r Items	Mean	S.D.	Sales r Items
3	1.74	.54	09	.90	.91	04
4*	1.61	.50	40	1.60	.50	08
5	1.39	.89	18	1.15	.93	-13
6	.82	.77	-04	1.05	.60	09
7	.78	.85	-09	.75	.55	20
8	1.30	.93	-07	1.10	.96	-11
9	.87	1.01	02	1.45	.82	-15
10	1.04	.87	09	1.20	.61	19
11	.17	.49	-12	.20	.61	17
12	1.47	.89	-07	1.00	.97	-12
13	.56	.84	-07	.60	.88	01
14	1.09	.99	03	1.00	.91	-11
15	1.60	.78	10	.75	.96	-01
16	.17	.57	-05	.75	.85	-02
17	1.43	.84	-09	1.55	.68	-15
18* **	1.08	.99	-30	.55	.68	-11
19	.30	.70	03	.85	.98	35
20	1.65	.77	-06	1.00	1.02	-07
21						
22	.78	.99	-11	1.30	.92	-24
23	1.56	.84	-14	1.50	.60	-19
24	1.04	.97	01	1.35	.87	-17
25	.56	.84	-25	1.05	.94	10
26	.95	.97	26	.90	.96	-19
27	.43	.58	05	.60	.88	23
28	.96	.20	22	.95	.22	-16
29	.43	.84	-21	.55	.88	-06
30 **	1.30	.87	26	1.36	.79	16
31	1.56	.84	-06	1.35	.93	26
32	1.56	.76	09	1.25	.96	-04
33	1.00	.86	12	.85	.74	18
34*	1.20	.96	32	1.30	.86	-31
35	.72	.89	-06	1.00	.91	32
36	1.60	.71	-16	1.40	.82	-10
37	.84	.98	-24	.55	.82	00
38	.44	.76	14	.35	.74	20
39	1.20	1.00	11	.90	.96	-34
40	1.80	.57	01	1.15	.93	-34
41*	.36	.75	-43	.35	.67	29
42	1.44	.76	-13	1.65	.58	-09
43	.68	.85	-07	.80	.61	00
44	.60	.70	28	.80	.89	-18
45	1.24	.97	13	.75	.96	-09
46						
47* **	.52	.77	35	.58	.77	19
48	1.72	.61	13	1.35	.93	-11
49	.88	.97	-10	.80	.89	-25
50	1.12	.97	13	1.10	.91	-27

APPENDIX 3

16PF Item Means, Standard Deviations, and Correlations of Items to Sales for the Salesmen and the Appointee Samples (continued)

Question Number	Salesmen Mean	Salesmen S.D.	Salesmen Sales r Items	Appointees Mean	Appointees S.D.	Appointees Sales r Items
51*	.76	.92.	-39	1.00	.91	17
52	1.28	.97	-21	1.60	.75	32
53	.80	.40	-09	.80	.41	00
54	.88	.33	05	.90	.30	-73
55	1.60	.50	22	1.10	.96	-36
56 **	1.52	.82	12	1.24	.87	27
57	.36	.69	16	.40	.68	08
58	.72	.67	11	.65	.67	-11
59	1.92	.40	-12	.19	.44	02
60	.72	.84	-16	.90	.91	16
61	.95	.92	21	1.15	.93	17
62	.21	.59	-15	.70	.92	01
63	.43	.84	09	.40	.68	27
64	.95	.97	10	1.15	.98	-04
65*	1.13	.97	36	1.30	.92	09
66	1.47	.89	16	1.10	.85	-09
67	1.34	.93	-03	1.10	.96	37
68 **	.30	.70	-26	.15	.36	-29
69	.52	.84	-05	.95	.99	19
70	1.08	.99	01	1.05	.88	02
71*	.91	.99	31	1.10	.91	01
72*	.69	.92	-30	.80	.85	-10
73	1.86	.45	07	1.70	.65	-27
74	.60	.58	-15	.60	.68	-01
75	1.04	.82	26	1.00	.79	08
76*	1.56	.84	30	1.10	.99	.06
77	.47	.51	03	.40	.50	26
78 **	.91	.41	-20	.80	.41	-53
79*	1.73	.68	-32	1.30	.86	00
80*	1.39	.65	35	1.28	.54	04
81 **	1.17	.83	22	.86	.83	18
82* **	1.91	.28	32	1.50	.78	21
83*	.91	.99	-45	.85	.93	11
84*	1.56	.84	35	1.30	.89	03
85	1.26	.75	16	1.30	.73	21
86	1.47	.79	-11	1.30	.92	-06
87*	1.08	.99	-37	.97	.97	-07
88	1.17	.77	-13	1.25	.78	35
89	.21	.59	-13	.40	.68	-21
90	1.17	.98	-13	1.05	.99	09
91	.34	.71	12	1.15	.98	02
92	1.13	.91	10	1.15	.87	16
93	1.26	.86	-19	1.20	.89	05
94	.87	.86	-04	1.30	.92	-10
95	1.69	.70	25	.75	.96	-07
96	.65	.88	14	.85	.87	-03

APPENDIX 3

16PF Item Means, Standard Deviations, and Correlations of Items to Sales for the Salesmen and the Appointee Samples (continued)

Question Number	Salesmen Mean	Salesmen S.D.	Salesmen Sales r Items	Appointees Mean	Appointees S.D.	Appointees Sales r Items
97	.56	.78	-06	.65	.81	09
98	1.86	.45	02	.80	.89	-26
99	.73	.91	04	1.10	.96	-22
100 **	.43	.78	09	.45	.75	40
101*	1.86	.34	30	1.90	.30	03
102	.74	.54	-06	.80	.41	37
103* **	.47	.51	-31	.35	.48	-22
104*	1.69	.63	37	1.50	.60	-26
105	.91	.94	-02	.65	.93	-17
106 **	.82	.77	28	.82	.76	26
107	1.69	.70	14	1.45	.82	13
108	1.91	.41	-12	1.70	.73	11
109*	1.30	.97	36	1.69	.69	11
110	1.69	.70	13	1.40	.88	00
111	1.17	.88	05	.80	.83	-34
112	1.08	.99	-09	.60	.94	-21
113	.61	.83	-15	.90	.78	03
114 **	.91	.94	-25	1.17	.94	-27
115	.09	.41	-21	.45	.82	09
116	.52	.84	25	.90	.91	09
117*	.43	.78	-33	..90	1.02	-10
118	.04	.20	-25	.55	.82	33
119	.34	.77	-09	.85	.74	03
120	.74	.91	15	1.00	.91	13
121	1.43	.72	17	1.55	.60	19
122	.95	.97	26	1.15	.86	04
123	1.56	.58	-17	.90	.78	49
124	.30	.70	03	.70	.86	03
125	1.13	.81	-15	.35	.67	-05
126	1.13	1.01	10	.40	.82	06
127	.74	.54	-14	.80	.41	-15
128 **	.87	.34	19	.90	.30	25
129 **	1.65	.71	22	1.35	.93	30
130	1.04	.97	07	.85	.89	-27
131 **	1.21	.99	-21	1.02	.95	-19
132	.61	.89	-06	.35	.67	-37
133	.47	.66	19	.40	.68	-22
134	1.65	.64	21	1.35	.93	-22
135	1.26	.81	06	1.25	.85	23
136	.73	.86	-25	.95	.94	29
137	.69	.92	02	.85	.87	13
138	.17	.57	-09	.70	.86	-15
139	.78	.95	-03	1.60	.82	-35
140	.60	.94	-07	1.65	.74	12
141	1.78	.59	20	.75	.96	-18
142	.17	.57	-20	.95	.94	25

APPENDIX 3

16PF Item Means, Standard Deviations, and Correlations of Items to Sales for the Salesmen and the Appointee Samples (continued)

Question Number	Salesmen Mean	Salesmen S.D.	Salesmen Sales r Items	Appointees Mean	Appointees S.D.	Appointees Sales r Items
143 **	.39	.72	-25	1.26	.85	-23
144	.39	.78	-10	.75	.85	32
145*	1.34	.88	34	1.65	.73	02
146*	1.17	.83	-38	.80	.95	11
147	1.21	.95	05	1.55	.75	-21
148 **	1.91	.41	-12	.34	.70	-39
149*	.65	.64	-42	1.47	.58	-08
150*	.30	.63	-44	.65	.87	26
151	.86	1.01	-24	1.10	.96	35
152	.60	.49	-15	.55	.51	05
153* **	.78	.42	-43	.75	.44	-22
154	.154	.66	-01	1.75	.44	19
155	1.08	.94	-21	.95	.94	-03
156	1.52	.66	22	1.60	.68	-11
157*	.26	.68	40	.34	.67	08
158	1.60	.58	06	1.05	.94	33
159	.78	.79	11	.75	.78	17
160	1.56	.72	05	1.50	.76	05
161	1.00	.95	06	.60	.88	11
162	.47	.84	-15	1.26	.82	-25
163	.95	1.02	22	.65	.93	-03
164	.26	.68	-15	.95	.99	-03
165	.86	.96	01	.80	1.00	-21
166	1.13	.96	-08	.70	.86	-04
167	.47	.84	16	1.20	.95	08
168	.86	.86	15	.65	.82	22
169* **	1.08	.90	-32	.54	.78	-19
170	.86	1.01	-08	1.05	.94	23
171	.34	.77	-31	.85	.93	09
172	1.17	.98	-16	1.05	.68	06
173	.82	.71	-07	1.05	.68	-06
174	.82	.93	-17	1.25	.85	-09
175	.39	.78	-11	.20	.52	-17
176 **	1.73	.62	19	1.65	.70	24
177	.60	.50	01	.30	.47	40
178	.35	.48	-05	.40	.50	12
179	1.00	.95	24	1.65	.58	07
180	1.39	.78	10	1.60	.68	-17
181	.56	.89	04	1.40	.94	24
182	1.34	.48	22	1.50	.68	-02
183	2.00	.00	.00	1.65	.67	13
184	1.26	.86	23	1.45	.78	08
185	1.56	.66	19	1.70	.57	14
186* **	1.26	.86	30	1.47	.80	20

* Items in validated sales-effectiveness score
** Items in unvalidated sales-effectiveness score
*** All correlations are presented without leading decimals

APPENDIX 4

MAT Item Means, Standard Deviations, and Correlations of Items to Sales for the Salesmen and the Appointee Samples***

Question Number		Salesmen Mean	Salesmen S.D.	Salesmen Sales r Items	Appointees Mean	Appointees S.D.	Appointees Sales r Items
1		1.0	0.00	00	1.00	0.00	00
2		.78	.42	10	.76	.43	19
3		.65	.49	-28	.81	.40	05
4		.65	.49	07	.76	.43	-29
5		.43	.51	-26	.48	.51	09
6		.52	.51	-03	.52	.51	07
7*		.87	.34	-41	.90	.30	-01
8		1.00	.00	00	1.00	.00	00
9		.52	.51	21	.24	.43	13
10		1.00	.00	00	.90	.30	12
11*		.48	.51	-49	.57	.50	13
12		.48	.51	-10	.52	.51	20
13		.78	.42	-41	.57	.50	-03
14		.26	.44	-08	.52	.51	03
15*	**	.43	.51	28	.48	.51	33
16*		.56	.51	-47	.38	.50	29
17		.86	.34	-03	.95	.21	14
18		.95	.21	-11	.90	.30	-00
19		.04	.21	12	.23	.44	03
20		.34	.49	12	.38	.50	-25
21		.78	.42	-02	.52	.51	-23
22		.91	.29	-15	.86	.36	12
23		.82	.39	-18	.71	.46	08
24	**	.65	.49	-36	.76	.44	-38
25*		.78	.42	10	.62	.50	-38
26		.52	.51	14	.33	.48	-02
27		.21	.42	14	.38	.50	23
28		.43	.50	-26	.66	.48	03
29		.26	.45	08	.28	.46	-22
30		.17	.38	20	.24	.43	-38
31		.91	.28	05	.90	.30	17
32		.61	.49	-00	.66	.48	-13
33	**	.47	.51	19	.19	.40	30
34		.09	.28	17	.04	.21	-03
35*		.82	.38	30	1.00	.00	00
36		.61	.49	-02	.35	.48	28
37		.21	.42	-20	.14	.35	16
38		.34	.48	20	.43	.50	14
39		.74	.44	-04	.43	.50	45
40		.91	.29	-29	.90	.30	12
41		.04	.20	12	.09	.30	-25
42		.82	.38	23	.76	.43	03

APPENDIX 4

MAT Item Means, Standard Deviations, and Correlations of Items to Sales for the Salesmen and the Appointee Samples ***

(continued)

Question Number	Salesmen Mean	Salesmen S.D.	Salesmen Sales r Items	Appointees Mean	Appointees S.D.	Appointees Sales r Items
43*	.61	.50	.39	.28	.46	14
44	.13	.34	-08	.33	.48	06
45	.13	.34	24	.19	.40	08
46 **	.65	.48	24	.52	.51	24
47	.82	.38	-06	.71	.46	-22
48	.78	.42	-17	.57	.50	-21
49	2.39	.72	11	2.28	.64	07
50	2.00	.60	16	2.14	.57	42
51	.34	.64	02	.57	.81	19
52*	1.08	.66	-37	1.19	.87	03
53	1.08	.79	-09	1.14	.79	-05
54	2.00	.79	-04	1.90	.88	-02
55	.82	.98	-05	1.19	1.32	-25
56	1.61	.94	13	1.85	.96	23
57	1.65	.94	-05	1.85	.72	27
58	2.08	.84	-10	2.04	.92	-06
59	2.39	.65	-00	2.61	.80	-15
60 **	.91	1.27	-27	.80	1.20	-22
61	2.56	.58	12	2.09	.76	10
62*	1.39	.94	58	1.66	.79	04
63	2.04	.87	-06	1.95	.74	-03
63	2.26	.68	-18	1.85	.72	07
65	.73	1.13	24	..38	.80	11
66	1.26	.68	-15	1.14	.72	20
67*	1.43	.99	-47	1.33	.79	23
68	.95	1.02	-06	1.00	1.09	15
69	2.00	1.04	08	2.00	.89	-06
70	1.17	.88	11	1.41	1.02	-07
71	2.39	.78	-04	2.76	.43	-07
72	.69	.97	-12	.52	.81	-20
73	1.73	1.05	13	1.38	1.16	-07
74	2.08	.90	-11	1.80	1.32	16
75*	1.39	.89	19	.95	.92	35
76	1.56	.89	05	1.38	.74	08
77	1.95	.70	22	2.00	.70	13
78	1.52	.79	-22	1.23	.76	-09
79	2.60	.58	-05	2.23	.94	07
80	.73	.75	10	.80	.74	-18
81	1.26	1.09	-10	.71	1.00	17
82	1.95	.63	10	1.57	.97	-02
83	.34	.64	-08	.57	.81	08
84* **	.91	.99	31	1.19	.87	26

APPENDIX 4

MAT Item Means, Standard Deviations, and Correlations of Items to Sales for the Salesmen and the Appointee Samples ***
(continued)

Question Number	Salesmen Mean	Salesmen S.D.	Salesmen Sales r Items	Appointees Mean	Appointees S.D.	Appointees Sales r Items
85*	2.43	.72	34	2.42	.81	07
86	2.69	.76	-14	2.66	.48	31
87	2.08	.66	-01	2.14	.72	38
88	2.21	.99	-27	2.19	1.03	27
89	2.43	.72	-03	2.04	.92	-13
90* **	1.30	1.01	-31	1.00	.77	-28
91*	1.17	1.15	-34	1.00	.89	04
92	1.65	1.11	28	1.61	1.07	-16
93	1.73	1.17	-10	1.42	1.02	-04
94* **	2.39	.94	-34	1.90	.88	-24
95	1.21	.90	11	1.23	1.09	00
96	1.21	.99	08	1.38	.97	16
97	2.78	.51	10	2.19	1.07	04
98*	1.52	1.23	39	1.52	1.07	-05
99	2.65	.49	14	2.61	.74	-26
100	2.73	.69	-06	2.71	.71	-13
101	1.21	.85	13	1.14	.85	-13
102	1.04	.82	-25	.90	.83	-09
103*	1.95	.82	30	1.71	1.00	11
104	1.65	.88	-23	1.90	.62	49
105	.95	.20	02	.95	.21	13
106	.52	.51	01	.33	.48	-16
107*	.73	.44	-56	.71	.46	00
108* **	.82	.38	-43	.71	.46	-21
109*	.26	.44	-81	.19	.40	09
110	.43	.50	-18	.57	.50	36
111	.82	.38	-11	.90	.30	-18
112	.95	.20	-12	.85	.35	-03
113*	.34	.48	-39	.42	.50	23
114	.08	.28	15	.14	.35	28
115	.52	.51	-14	.42	.50	-29
116	.39	.49	-14	.71	.46	-24
117	.34	.49	-24	.33	.48	28
118	.69	.47	-18	.71	.46	-11
119	.39	.49	16	.38	.49	14
120	.43	.50	14	.47	.51	05
121	.86	.34	07	.57	.50	10
122	.43	.50	03	.33	.48	-11
123	.26	.44	00	.33	.48	-35
124	.52	.51	09	.61	.49	00
125	.95	.20	01	.80	.40	17
126	.86	.34	07	.71	.46	-29

APPENDIX 4

MAT Item Means, Standard Deviations, and Correlations of Items to Sales for the Salesmen and the Appointee Samples ***
(continued)

Question Number	Salesmen Mean	Salesmen S. D.	Salesmen Sales r Items	Appointees Mean	Appointees S. D.	Appointees Sales r Items
127	.65	.48	12	.95	.21	21
128* **	.04	.20	41	.09	.30	49
129*	.69	.47	57	.71	.46	-38
130	.43	.50	-12	.66	.48	06
131	.39	.49	-03	.66	.48	-18
132	.39	.49	-26	.85	.35	-39
133	.52	.51	29	.28	.46	-16
134	.08	.28	04	.57	.50	43
135 **	.56	.50	-21	.38	.49	-17
136	.60	.49	-17	.66	.48	14
137	.30	.47	20	.14	.35	03
138 **	.43	.50	-25	.52	.51	-21
139	.43	.50	-07	.76	.43	14
140	.26	.44	-06	.57	.50	-26
141*	.08	.28	47	.00	.00	.00
142	.00	.00	00	.00	.00	00
143 **	.39	.49	-29	.33	.48	-37
144*	.43	.50	-43	.80	.40	-02
145	.09	.28	10	.09	.30	-17
146	.60	.49	17	.57	.50	-23
147*	.78	.42	-31	.66	.48	03
148	.47	.51	-19	.52	.51	00
149	.78	.42	-15	.76	.43	12
150	.73	.44	23	.80	.40	15
151	.43	.50	16	.42	.50	-33
152	.86	.34	16	.61	.49	02
153	.30	.47	09	.38	.49	-11
154	.04	.20	-02	.00	.00	00
155	.39	.49	-13	.33	.48	24
156	.39	.49	05	.42	.50	32
157	.26	.44	17	.38	.49	-17
158* **	.60	.49	-55	.76	.43	-27
159	.86	.34	-01	.71	.46	08
160 **	.91	.28	-26	.81	.40	-19
161	.13	.34	-27	.14	.35	42
162	.65	.48	-24	.52	.51	22
163 **	.86	.34	23	.85	.35	29
164	.52	.51	01	.71	.46	-37
165	.39	.49	-18	.52	.51	56
166	.86	.34	-02	.66	.48	-08
167	.34	.48	13	.19	.40	-27
168	.86	.34	-24	.90	.30	25

APPENDIX 4

MAT Item Means, Standard Deviations, and Correlations of Items to Sales for the Salesmen and the Appointee Samples ***
(concluded)

Question Number	Salesmen Mean	Salesmen S.D.	Salesmen Sales r Items	Appointees Mean	Appointees S.D.	Appointees Sales r Items
169	.82	.38	21	.80	.40	-23
170	.47	.51	-13	.14	.35	01
171* **	.21	.42	-33	.09	.30	-17
172	.91	.28	-17	.80	.40	25
173	.82	.38	-29	.76	.43	-17
174*	.52	.51	32	.52	.51	29
175 **	.04	.20	-20	.14	.35	-24
176	.47	.51	-13	.28	.46	25
177	.73	.44	21	.80	.40	12
178	.65	.48	-15	.71	.46	26
179* **	.43	.50	33	.47	.51	33
180	.60	.49	-05	.61	.49	38
181	.43	.50	-23	.38	.49	12
182	.47	.51	17	.61	.49	-22
183	.26	.45	-09	.28	.46	32
184	.86	.34	-05	.71	.46	33
185	.21	.42	09	.09	.30	18
186	.34	.48	-25	.19	.40	-14
187	.30	.47	-20	.28	.46	02
188	.21	.42	-04	.19	.40	18
189	.34	.48	04	.23	.43	-03
190	.43	.50	09	.52	.51	-30
191	.56	.50	-05	.66	.48	20
192	.60	.49	-01	.61	.49	02
193	.13	.34	-18	.28	.46	-48
194	.95	.20	-11	1.00	.00	.00
195	.08	.28	11	.09	.30	03
196*	.56	.50	41	.61	.49	-05
197	.73	.44	02	.90	.30	31
198	.91	.28	21	1.00	.00	00
199*	.17	.38	32	.14	.35	-18
200	.78	.42	02	.33	.48	-32
201	.60	.49	-12	.57	.50	-37
202	.78	.42	22	.62	.49	-14
203	.73	.44	-03	.80	.40	32
204	.82	.38	00	.76	.43	05
205	.65	.48	10	.71	.46	14
206 **	.34	.48	21	.23	.43	18
207	.69	.47	-17	.85	.35	27
208	.60	.49	-13	.61	.49	09

* Items in sales effectiveness score
** Items in the unvalidated sales effectiveness score
*** All correlations are presented without leading decimals

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