DOCUMENT RESUME

ED 427 055	TM 029 436

AUTHOR	Shelton, Matthew
TITLE	Basic Concepts in Profile Analysis of Means.
PUB DATE	1998-11-05
NOTE	15p.; Paper presented at the Annual Meeting of the Mid-South Educational Research Association (27th, New Orleans, LA, November 4-6, 1998).
PUB TYPE	Reports - Evaluative (142) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Data Analysis; Psychology; *Research Methodology; *Scores; *Statistics
IDENTIFIERS	*Means (Mathematics); *Profile Analysis Approach

ABSTRACT

There has been an ongoing debate concerning the usefulness of a statistical technique called profile analysis. Profile analysis is a data analysis process that identifies patterns in a battery of test scores. The use of profile analysis is generally supported by clinicians in the field who are using profile analysis to help determine group differences. The theoretical basis of profile analysis is described, and its implications are discussed. Psychologists who tend to focus on the relationships among groups of subjects tend to support the clinical practice of profile analysis, while statisticians who focus on the relationship between variables generally oppose the practice. (Contains three tables and nine references.) (SLD)

Basic Concepts in Profile Analysis of Means

Matthew Shelton

Texas A&M University

Paper presented at the annual meeting of the Mid-South Educational Research Association, New Orleans, November 5, 1998.

Abstract

There has been an ongoing debate concerning the usefulness of a statistical technique called profile analysis. Profile analysis is generally supported by clinicians in the field who are using profile analyses to help determine group differences. This paper describes the theoretical basis upon which profile analysis is based and discusses its implications.

Basic Concepts in Profile Analysis of Means

Profile analysis is a rather broad term that is used to describe a data analysis process which identifies patterns in a battery of test scores. The scores can either be from different sub-scales of one instrument or test scores obtained from several different instruments. Profile analyses can be extremely helpful in identifying group differences from data when traditional statistical analysis may not be able to detect these differences.

Gardner (1970) discussed the usefulness of profiles in the field of psychology. He stated that "the old Chinese saying that a picture is worth one thousand words is especially applicable to test profiles" (p.1). Profiles are a convenient way of representing test scores in a graphical manner that enables practitioners to see the over-all performance of an individual or group of individuals at a glance. Traditionally, profiles show the individual tests or sub-tests along one axis of the graph, usually the x-axis, and the score values along the other axis, usually the y-axis. This enables practitioners to look at the scores as a whole and see the relative strengths and weaknesses of the individual or the particular group of individuals.

Meehl (1950) clearly demonstrated the basic concept of looking at patterns of scores. Clinicians can use this information to identify differences between profiles that were not evident through examining the scores or means alone. Meehl stated that "one of the most important words in the vocabulary of clinicians is the word 'pattern'" (1950, p. 165). Clinicians tend to conceptualize things in terms of totalities, organizations, and configurations. Meehl gives a very simplistic example of how a set of data, when analyzed at a singular level with the criterion, may have different results than when that same data are analyzed simultaneously with the criterion. The contradictory results often obtained from the use of the two different methodologies has been named "Meehl's paradox" (von Eye, 1990).

Meehl's Paradox

Meehl's paradox is based on a hypothetical data set that he generated during a preliminary oral exam (Meehl, 1950). He posed this question:

> Consider two dichotomously scored test items, which we wish to use in predicting a dichotomous criterion. Let us ignore sampling errors and confine the discussion entirely to parameters. Suppose that the dichotomous criterion is, say, 'schizophrenic' versus 'normal.' For the present purpose the question as to whether some continuous variable or set of variables actually underlies such a clinical dichotomy is irrelevant. Suppose now that (in the supply) each of the two items has exactly 50 percent difficulty within each category, so that half of the schizophrenics and half of the normals answer each of the items 'true' and half of each group answer each item 'false.' Under these circumstances, any of the usual methods of item analysis

> (phi-coefficient, significance of difference of proportions, tetrachoric *r*, and so forth) will show both items to have 'zero validity' for the criterion, and they will be eliminated. Under such conditions, is it possible to predict the criterion solely upon the basis of the response to those two items, and if so, how well could it theoretically be predicted? (p. 166)

In Meehl's (1950) example, all normal persons answer the two questions in the same way, either TT or FF. Although given normal individuals they are consistent in their answering of the two questions, the groups on the average do not have any tendency to answer the questions either true or false. However, suppose all of the schizophrenics in the example also did not have any tendency to answer the questions either true or false, but did answer all of the questions oppositely. That is, they answered them either TF or FT. Although there is obviously some differences in how the two groups are responding, each question alone has no discriminating power, because in both groups on both items half the responses are T and half are F.

Meehl evaluated both answers simultaneously or in other words configurally. He looked at all possible combinations of true and false, which include TT, FF, TF, and FT. He demonstrated that any person who answers the questions in the same way is predicted to be normal while any person who answers the questions in the opposite way is predicted to be schizophrenic. In this particular hypothetical case, there is perfect predictability of the dichotomous criterion on the basis of the two items, even though each item has zero validity.

Differences in Profile Analysis

Meehl's Paradox points to the fact that there can be alternative ways to analyze data. Davidson (1996) purported that a row perspective (or a configural perspective) and a column perspective (an emphasis on a single variable) are two fundamentally different ways of interpreting data. He stated that most of the psychometric models are column oriented and most of the clinical models are more row oriented. Davidson argued that neither the psychometric model or the clinical model is better, they are simply two different ways of viewing the data.

The intended use of the results from the analysis of the data has a lot to do with what type of analysis is preferred (Stanton & Reynolds, 1998). Statisticians usually adopt a column perspective (or an emphasis on a single variable) because they believe that the best prediction of the criterion measure will be achieved through a "linear combination of the relevant test variables" (Stanton & Reynolds, 1998, p. 4). Conversely, clinicians most often adopt a row perspective because they are not so much concerned with the relationship between individual variables "as they are interested in identifying the most salient characteristics that distinguish one group of subjects from another" (p. 4). For example, clinicians may want to distinguish between good and bad candidates for a certain job or be able do distinguish children with learning disabilities form normal students.

Stanton and Reynolds (1998) pointed out that "score profiles" are the most common way that test results are reported. Thus, psychologists have become somewhat conditioned to recognize the associations among particular profile patterns and the outcomes of their clinical assessments. Psychologists who have repeated exposure to the same test or test battery over a period of time often develop certain patterns that they look for to distinguish different groups. Stanton and Reynolds (1988) argued that, "Such anecdotal data may or may not be accurate as recalled by the psychologist leading to efforts directed at empirical validation of such inferences" (p. 4).

Comparing Profiles

Stevens (1996) discussed the practical procedures for comparing profiles obtained from two or more different groups on a battery of test scores including interest, achievement, and personality. There are three basic questions that must be answered in the process of profile analysis. These questions are:

1. Are the profiles parallel? If the answer to this is yes for two groups, it would imply that one group scored uniformly better than the other on all

variables.

2. If the profiles are parallel, are they coincident? In other words, did the groups score the same on each variable?

3. If the profiles are coincident, are the profiles level? In other words, are the means on all variables equal to the same constant. (Stevens, 1996, p. 436)

When examining the profiles, if they are not found to be parallel, there is a group-by-variable interaction. This means that there is some variable that group performance is dependent on. Table 1 depicts two parallel profiles while Table 2 depicts two non-parallel profiles.

Srivastava (1987) used slightly different terminology to describe the three questions described by Stevens (1986). Srivastava refers to them as the three mathematical hypotheses known in the literature as "parallelism," "level hypothesis," and "no conditional variation." Srivastava described the process as first looking at the system as a whole by examining the slopes of the line segments making up each profile. He describes the next hypothesis as looking for a "level hypothesis" or as he calls it no "column" effect. He refers to the final step as no "row" effect. He describes these second two hypotheses as two-way analysis of variance.

Stevens (1986) used an example of how a profile analysis would be completed to demonstrate the comparisons of profiles from two separate groups. Stevens analyzed a study of love and marriage in which a sample of husbands and wives were asked to respond to the following questions:

1. What is the level of passionate love you feel for your partner?
2. What is the level of passionate love that your partner feels for you?
3. What is the level of companionate love you feel for your partner?
4. What is the level of companionate love your partner feels for you? (p. 438)

The subjects were asked to respond to all four of the questions on a Likert-type scale where one was "none at all" and five was "a tremendous amount." The sample used for this example consisted of 30 husbands and 30 wives. The intended purpose of the study was to see if the profiles for the husbands and wives were parallel.

The author used the SPSSX control lines from Table 3 to run the profile analysis. First, Stevens ran the test of parallelism which indicated that parallelism was tenable at the .01 level. The exact probability was .057 which is greater than .01. After the first question is successfully answered, the question of whether the profiles are coincident arises. The profiles were found to be coincident at the .01 level and thus any differences in husband and wives on the four variables can be considered due to sampling error. The exact probability was .196 which is greater than .01. Finally, the data were analyzed to answer the question of equal scale means. The test of equal scale means indicated that it was not tenable. The probability was 0.00 which is less than .01. This means that wives and husbands did not average exactly the same on each one of the scales.

This technique demonstrates how profile analysis can be use to identify differences between profiles of different groups. Stevens (1986) did give one warning regarding the use of profile analysis. Since profile analysis looks for differences in the shape of the profile, it is very important that the different scales are scaled similarly. If a profile uses three scales that are scaled from one to 10 and a fourth that is scaled from one to 50, any perceived differences in profile appearance could be solely due to the scaling artifact. The best way to deal with this problem is to convert tests that are scaled differently to standard scores before proceeding to profile analysis.

Conclusion

Although profile analysis is not commonly accepted by most statisticians, it can be a useful way of analyzing data. The controversy over the usefulness of profile analysis stems mainly from opposing views concerning the most important unit of analysis (Stanton & Reynolds, 1998). Psychologists who tend to focus on the relationships among groups of subjects tend to support the clinical practice of profile analysis while statisticians who focus on the relationship between variables generally oppose the practice.

Even though profile analysis is a somewhat controversial topic, its use is becoming increasingly popular. Several major figures, particularly from the field of school psychology, have begun to advocate for the use of profile analysis. Kaufman (1994) supports its use with WISC profiles. It has also been suggested for use with such tests such as the Peabody Individual Achievement Test and The Test of Language Development (Reynolds & Gutkin, 1980; Reynolds, 1983). Profile analysis is proving to be a useful tool for clinicians and will probably continue to gain support from practitioners who are using it to help distinguish between group differences.

References

Davidson, M. L. (1996, August). Multidimensional scaling interest and aptitude profiles: Idiographic dimensions, nomethetic factors. Paper presented at the annual meeting of the American Psychological Association, Toronto, Canada.

Gardner, E. F. (1970). Interpreting achievement profiles: Uses and warnings. Measurement in Education, 1 (2), 1-11.

Kaufman, A. S. (1994). Intelligent testing with the WISC-III. New York: Wiley.

Meehl, P. E. (1950). Configural scoring. Journal of Consulting Psychology, 14, 165-171.

Reynolds, C. R. & Gutkin, T. B. (1980). Statistics Related to Profile Interpretation of the Peabody Individual Achievement Test. Psychology in the Schools, 17, 316-319.

Reynolds, C. R. (1983). Statistics for the enhancement of profile analysis on the Test of Language Development-Primary. Psychology in the Schools, 20, 5-9.

Stanton, H. C. & Reynolds, C. R. (1998, August). Configural frequency analysis as a method of determining Wechsler profile types. Paper presented at the annual meeting of the American Psychological Association, San Francisco, CA.

Stevens, J. (1996). Applied multivariate statistics for the social sciences (3rd ed.). Hillsdale, NJ: Erlbaum.

von Eye, A. (1990). Introduction to configural frequency analysis. New York: Cambridge University Press.

Table 1

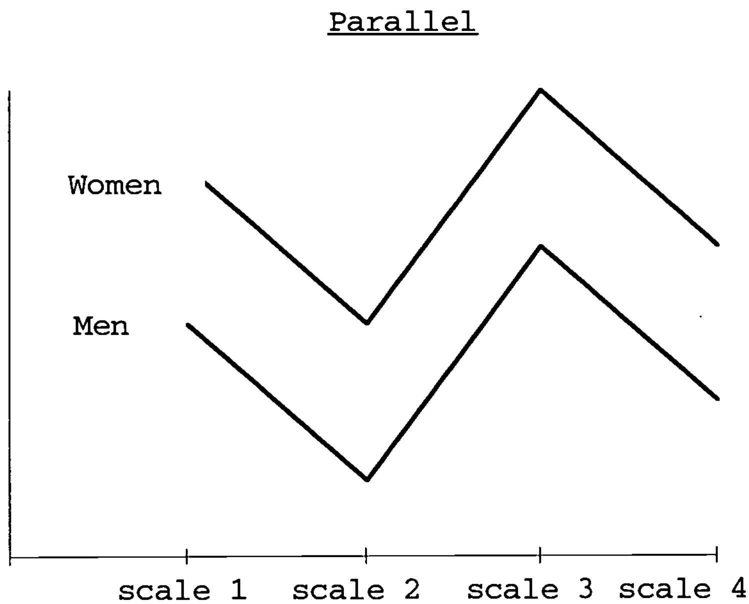

Table 2

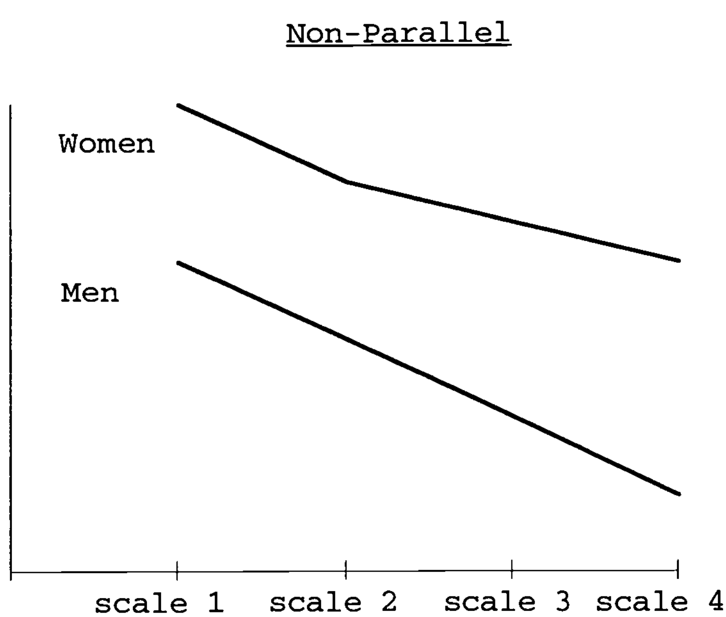

Table 3

CONTROL LINES FOR SPSSX PROFILE ANALYSIS

```
TITLE 'PROFILE ANALYSIS ON HUSBAND AND WIFE RATINGS'
DATA LIST FREE/SPOUSE PASSYOU PASSPART COMPYOU COMPPART
LIST
BEGIN DATA
     DATA LINES
END DATA
REPORT VARS=PASSYOU PASSPART COMPYOU COMPPART
BREAK=SPOUSE/
SUMMARY=MEAN/
MANOVA PASSYOU TO COMPPART BY SPOUSE (1,2)
     TRANSFORM=REPEATED/
     RENAME=AVERAGE DIF2AND1 DIF3AND2 DIF4AND3
     PRINT=TRANSFORM
     ANALYSIS=(DIF2AND1,DIF3AND2,DIF4AND3/AVERAGE)
     DESIGN
```

TM029436

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement (OERI)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE
(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: BASIC CONCEPTS IN PROFILE ANALYSIS OF MEANS

Author(s): MATTHEW SHELTON

Corporate Source:	Publication Date: 11/5/98

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic/optical media, and sold through the ERIC Document Reproduction Service (EDRS) or other ERIC vendors. Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce the identified document, please CHECK ONE of the following options and sign the release below.

[X] Sample sticker to be affixed to document

Check here Permitting microfiche (4"x 6" film), paper copy, electronic, and optical media reproduction

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
MATTHEW SHELTON
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Level 1

Sample sticker to be affixed to document [ ]

or here Permitting reproduction in other than paper copy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY
Sample
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Level 2

Sign Here, Please

Documents will be processed as indicated provided reproduction quality permits. If permission to reproduce is granted, but neither box is checked, documents will be processed at Level 1.

"I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce this document as indicated above. Reproduction from the ERIC microfiche or electronic/optical media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries."

Signature: Matthew Shelton	Position: RES ASSOCIATE
Printed Name: Matthew Shelton	Organization: TEXAS A&M UNIVERSITY
Address: TAMU DEPT EDUC PSYC COLLEGE STATION, TX 77843-4225	Telephone Number: (409) 845-1831
	Date: 11/15/98