A Multilevel Approach to Identifying Criterion-Related Profile Patterns

Christopher David Desjardins, Yu-Feng Chang, & Mark Davison

Introduction

Profile analysis is the analysis of the elevation, variation, and configuration on subtests/scales on a test.

Score profiles arise when an examinee receives several scores on a battery of test or a psychological inventory.

A score profile can then be decomposed into **level** and **pattern** components.

Criterion-related profile analysis can be used to study the predictive validity of level and pattern components on outcome variables of interest.

When the behavior of individuals within organizations or schools is studied, the data have a nested structure.

Since the assumption of independence does not hold for individual students nested within the same school (Raudenbush & Bryk, 2002), multilevel models should be used to address this issue.

Research Problem

The purpose of this poster is to develop and demonstrate a multilevel framework to the profile analysis approach developed in Davison & Davenport (2002).

Methods

Data were collected for the MAP and MCA-II on 1,971 students in 4th grade from 41 MPS schools.

Four strands were used in calculating the total MCA-II score: (S1) Number Sense, (S2) Patterns, Functions, & Algebra, Data, (S3) Statistics, & Probability, & (S4) Spatial, Sense, Geometry & Measurement.

The level effect for an individual is defined as the mean score of the predictor score,

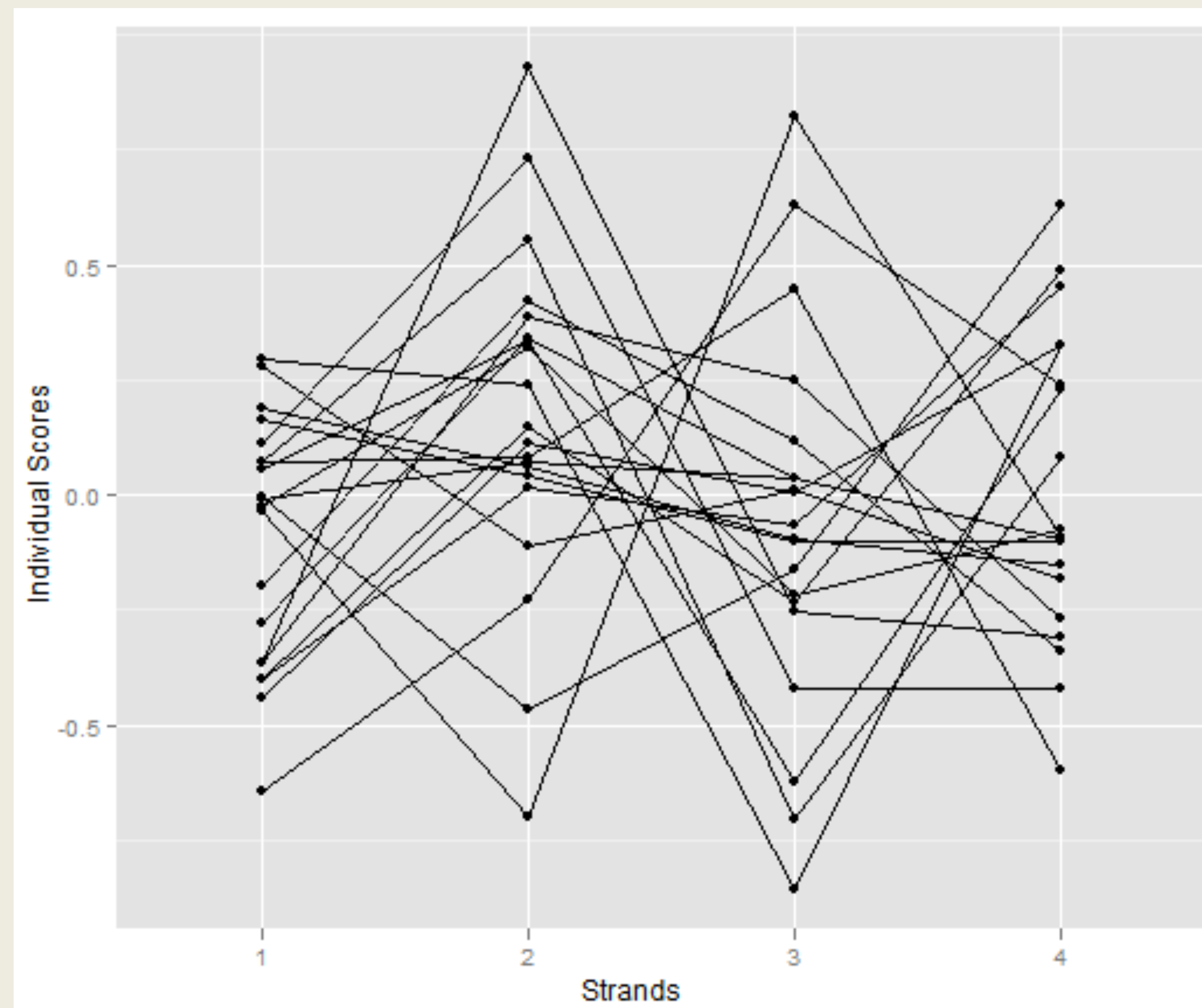
$$X_p = \frac{1}{v}\sum x_{pv}$$

where, v is the # of variables, in this case 4, and x_{pv} is the scores on v for individual p.

The pattern effect an individual is defined is a score vector which is the deviation of the individual's scores from the mean of the individual's scores,

$$x_p = x_{pv} - X_p$$

Figure 1 below, shows a random sample of individual's patterns on the 4 strands.



This represents the pattern in the without school effects.

In order to have a pattern that is controlled for school effects, we fit the following multilevel model:

$$E[Y_{ij}] = \beta_{0j} + \beta_{1j}S_{1ij} + \beta_{2j}S_{2ij} + \beta_{3j}S_{3ij} + \beta_{4j}S_{4ij}$$

$$\beta_{0j} = \gamma_{00} + \mu_{0j}$$

$$\beta_{1j} = \gamma_{10} + \mu_{1j}$$

$$\beta_{2j} = \gamma_{20} + \mu_{2j}$$

$$\beta_{3j} = \gamma_{30} + \mu_{3j}$$

$$\beta_{4j} = \gamma_{40} + \mu_{4j}$$

From this model, we calculated the covariance of the pattern effect controlled for school effects, Cov_{pv}.

Finally , we tested whether Cov_{pv} and X_p differed by school and compared this to a model with an intercept only.

Model fit was assessed using R^2, AIC, BIC, and testing of variance components was done using the likelihood ratio test.

Results

Model	R^2	BIC	AIC
Intercept-Only	0.7544	3613.93	3586.00
Cov_{pv} only	0.7547	3628.55	3589.35
X_p only*	0.7633	**3609.55**	**3570.45**
Cov_{pv} & X_p	0.7653	3631.57	3575.71

*refers to the best fitting model based on LRT.

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