

# The Investigation of Initial Personality Attribute of The UKM-UDE Students Using Rasch Model

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*Abstract:-* The Rasch measurement model analysis is used in the current paper to better understand the impact of a double degree programme on the engineering students of Universiti Kebangsaan Malaysia. Through the analysis of the Big Five Inventory (BFI) using Rasch Model, data on the distribution of scores are highlighted to represent the condition of the double degree engineering students while they prepare before going to University of Duisburg-Essen. The features of Rasch Model in analysing the BFI items scored by the students are discussed. A comparison between Cronbach reliability and Rasch reliability is also presented. A person-item distribution map (PIDM) is also included to present the data in a more meaningful way.

*Key-Words:-* Rasch Measurement; UKM-UDE double degree programme students; initial personality

## 1 Introduction

The Universiti Kebangsaan Malaysia (UKM) in Malaysia and the University of Duisburg-Essen (UDE) in Germany have established a double-degree program since 2003. At the end of their studies, the students are awarded with a bachelor's degree from both universities. The major advantage of enrolling in the double degree programme is highlighted to provide the experience of learning in both UKM and UDE learning environments. Not only do the students have the opportunity of learning in two reputable universities but also the chance to be exposed to international cultures and surroundings. The present paper investigates the personality preparation taken by the participants (third year UKM engineering students) before taking the next step in completing their studies in UDE [1-5].

Previous studies on personality inventory of UKM-UDE double degree students (students who enrolled in the double degree programme between UKM and UDE) used traditional methods of statistics, such as descriptive analysis, size effect analysis, and non-

parametric analysis [1-6]. However, the current paper ventures to apply the Rasch model method to investigate the personalities of UKM-UDE students who went to UDE in September 2009.

## 2 Methodology

### 2.1 Instrument of research

The Big Five Inventory (BFI) was developed by a team of personality researchers, namely, John, Danahue, and Kentle in 1991 [7-9]. The BFI scale is known to have a consistency reliability between the values of .75 to .90, with an average of .80 [10-12].

### 2.2 Sample

The present study was conducted for 12 UKM students (male = 8, female = 4) who have opted to pursue their final year with a double degree programme and were due to fly to UDE in September 2009. Questionnaires of 44 items on personality were distributed to the students and the data were obtained as they were preparing for their travel to Germany. The UKM-UDE students are

assumed to be in a condition where their behaviour is affected by the intention to study in Germany. The results were analysed using *Winstep 3.68.2* software.

### 2.3 Rasch model analysis

The basic features of the Rasch model can be used for simple right-or-wrong, or dichotomous, data sets. One form of this approach, which is used in the current research, is the principle of Likert scale. This scale is often used to obtain attitude data. Likert scales share a number of common features regardless of which attitudes they assess, with possible responses that are usually expressed in a format such as: strongly disagree, disagree, neutral, agree, and strongly agree. Similarly, each Likert

scale item is provided with a statement of attitude, and the respondent is required to mark a response on the disagree-agree continuum. An uneven number of responses may be purposely included to force the respondents into choosing a positive or negative response. The Rasch modeling of Likert scale data has paved the way for more sensitive, powerful, and meaningful analysis of customer satisfaction data.

The answers, which are expected to reflect the personality of the students while in UDE, are justified using a five-point Likert scale. Scale-1 represents 'strongly disagree', which indicates the least degree of agreement of the students towards the statement, whereas scale-5 represents 'strongly agree', indicating the highest degree of agreement of the students towards the statement. The personality items used in the present study are shown in Table 1. Each statement/item is coded P1 to P44.

Table 1 The personality items

| CODE.ITEM                                   | CODE.ITEM                                          |
|---------------------------------------------|----------------------------------------------------|
| P1. Is talkative                            | P23. Tends to be lazy                              |
| P2. Tends to find fault with others         | P24. Is emotionally stable, not easily upset       |
| P3. Does a thorough job                     | P25. Is inventive                                  |
| P4. Is depressed, blue                      | P26. Has an assertive personality                  |
| P5. Is original, comes up with new ideas    | P27. Can be cold and aloof                         |
| P6. Is served                               | P28. Perseveres until the task is finished         |
| P7. Is helpful and unselfish with others    | P29. Can be moody                                  |
| P8. Can be somewhat careless                | P30. Values artistic, aesthetic experiences        |
| P9. Is relaxed, handles stress well         | P31. Is sometimes shy, inhibited                   |
| P10. Is curious about many different things | P32. Is considerate and kind to almost everyone    |
| P11. Is full of energy                      | P33. Does things efficiently                       |
| P12. Starts quarrels with others            | P34. Remains calm in tense situations              |
| P13. Is a reliable worker                   | P35. Prefers work that is routine                  |
| P14. Can be tense                           | P36. Is outgoing, sociable                         |
| P15. Is ingenious, a deep thinker           | P37. Is sometimes rude to others                   |
| P16. Generates a lot of enthusiasm          | P38. Makes plans and follows through with them     |
| P17. Has a forgiving nature                 | P39. Gets nervous easily                           |
| P18. Tend to be disorganized                | P40. Likes to reflect, play with ideas             |
| P19. Worries a lot                          | P41. Has few artistic interests                    |
| P20. Has an active imagination              | P42. Likes to cooperate with others                |
| P21. Tends to be quiet                      | P43. Is easily distracted                          |
| P22. Is generally trusting                  | P44. Is sophisticated in art, music, or literature |

The Rasch model provides a mathematical framework that will establish the pattern in the use of the Likert scale categories to yield a rating scale structure common to all the items on the scale. In Rasch philosophy, the data have to comply with the principle. Simply put, that the data have to fit the model. The Rasch measurement model is expressed as the ratio of an event being successful.

$$P(\theta) = \frac{e^{(\beta n - \delta i)}}{1 + e^{(\beta n - \delta i)}} \quad (1)$$

Where  $e$  = base of natural logarithm or Euler's number; 2.7183

$\beta n$  = person's ability

$\delta i$  = item or task difficulty

The model expresses the probability of obtaining a score based on a particular statement as a function of the size of the difference between the ability ( $\beta$ ) of the person ( $n$ ) and the difficulty ( $\delta$ ) of the item ( $i$ ). The Rasch exponential expression is a function of the logit model which results in a sigmoidal ogive and can be transformed into a simpler operation by reducing the indices using natural logarithm. This is represented as follows:

$$\ln[P(\theta)] = \beta_n - \delta_i \tag{2}$$

This logit transformation is for the purpose of obtaining a linear interval scale. It can be readily shown mathematically that a series of numbers irrespective of basis are not equally spaced, whereas equal separation is maintained in a log series which results in equal intervals [12]. This feature is shown in Table 2.

Table 2 Comparison of Numerical and Log Intervals

| Numerical series | log <sub>10</sub> | log <sub>e</sub> |
|------------------|-------------------|------------------|
| 1                | 0.000             | 0.000            |
| 2                | 0.301             | 0.694            |
| 5                | 0.699             | 1.609            |
| 10               | 1.000             | 2.303            |
| 20               | 1.302             | 2.997            |
| 50               | 1.699             | 3.912            |
| 100              | 2.000             | 4.606            |

The difference value between log<sub>10</sub>5 and log<sub>10</sub>2 is constant, and an equal distance is maintained between log<sub>10</sub>50 and log<sub>10</sub>20. A logit ruler which is the log-odd of an event taking place with the odd-of success for the current study is shown in Figure 1.

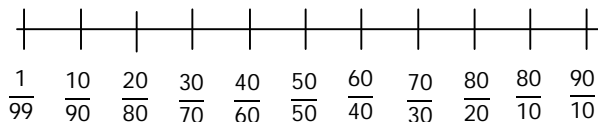


Fig. 1 Probabilistic Line Diagram

The logit ruler was developed for the purpose of measuring ability. The current study describes the personality changes in the UKM-UDE students.

### 3 Results and Discussion

The Rasch analysis provides a set of important information. Two major components involved in this particular survey or questionnaire are the ability of the person and the level of difficulty of the item, which is the personality criterion. Table 3 shows an analysis of the summary statistics on the results obtained.

Cronbach alpha has the limitation of providing only the overall test result but it can be at stake if we encounter a problem with the survey construct. As shown in the table, the value of Cronbach alpha (0.27) is very low compared with the acceptable value ( $\alpha = 0.7$ ). Rasch analysis also resulted in person and item reliability scores at 0.13 and 0.42. The low person reliability value indicates that the sample size is not enough to test discriminate the sample into enough levels for our purpose. Low reliability of an item means that the sample is not big enough to precisely locate the items on the latent variable.

In this recent study, the student separation,  $G = 0.38$ , is rather low and is not enough to separate them into several distinct performance levels. The value for the item or the survey question is also low ( $G = 0.84$ ) and also not enough to separate the items into different difficulty levels. Therefore, we can say that the students have the same level of perception towards their personality. The strata can be calculated using the formula:

$$\text{Strata} = \frac{(4 \times \text{student separation} + 1)}{3} \tag{3}$$

Figure 2 shows the person-item distribution map (PIDM) which indicates the distribution of the persons and the items along a vertical ruler (dashed line) measured using logit. The vertical line represents the order of the persons and items from the least to the best (from bottom to top). From the figure, we can see the items located on the left side arranged from the easiest (bottom) to the most difficult (top) item. The persons located on the right side are arranged from the least smart (bottom) to the smartest (top of the vertical line). At both sides of the centre of the vertical line is the letter “M”, which denotes the mean for the items and the persons. From the figure, we can get an overview of the perception of the students on their personality. As can be seen, items P31, P15, and P25 are located at the extremely difficult level, with no persons to the left of the map. This result indicates that based

on student perception, these items are beyond the current students' ability. Items P13, P21, P41, P29, P27, and P4 are situated at the extremely easy level

with no respondents as well indicated that the items are easy for them.

Table 3 Summary Statistics

TABLE 3.1 Personality ZOU916WS.TXT Nov 4 12:30 2011  
 INPUT: 12 Persons 44 Items MEASURED: 12 Persons 22 Items 5 CATS 3.68.2

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SUMMARY OF 12 MEASURED Persons

|                           | RAW SCORE | COUNT   | MEASURE | MODEL ERROR | INFIT |                    | OUTFIT |      |
|---------------------------|-----------|---------|---------|-------------|-------|--------------------|--------|------|
|                           |           |         |         |             | MNSQ  | ZSTD               | MNSQ   | ZSTD |
| MEAN                      | 65.4      | 19.8    | .32     | .24         | 1.00  | -.1                | .99    | -.1  |
| S.D.                      | 5.5       | 1.2     | .28     | .01         | .37   | 1.3                | .34    | 1.3  |
| MAX.                      | 76.0      | 22.0    | .71     | .26         | 1.51  | 1.6                | 1.43   | 1.4  |
| MIN.                      | 58.0      | 18.0    | -.23    | .22         | .43   | -2.3               | .43    | -2.3 |
| REAL RMSE                 | .26       | ADJ. SD | .10     | SEPARATION  | .38   | Person RELIABILITY | .13    |      |
| MODEL RMSE                | .24       | ADJ. SD | .14     | SEPARATION  | .58   | Person RELIABILITY | .25    |      |
| S.E. OF Person MEAN = .08 |           |         |         |             |       |                    |        |      |

VALID RESPONSES: 90.2%  
 Person RAW SCORE-TO-MEASURE CORRELATION = .67 (approximate due to missing data)  
 CRONBACH ALPHA (KR-20) Person RAW SCORE RELIABILITY = .27 (approximate due to missing data)

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SUMMARY OF 22 MEASURED Items

|                         | RAW SCORE | COUNT   | MEASURE | MODEL ERROR | INFIT |                  | OUTFIT |      |
|-------------------------|-----------|---------|---------|-------------|-------|------------------|--------|------|
|                         |           |         |         |             | MNSQ  | ZSTD             | MNSQ   | ZSTD |
| MEAN                    | 35.7      | 10.8    | .00     | .35         | 1.07  | .0               | 1.09   | .0   |
| S.D.                    | 9.7       | 2.7     | .56     | .11         | .69   | 1.2              | .70    | 1.2  |
| MAX.                    | 48.0      | 12.0    | 1.02    | .81         | 3.40  | 2.9              | 3.51   | 3.0  |
| MIN.                    | 13.0      | 3.0     | -1.40   | .29         | .39   | -1.7             | .46    | -1.6 |
| REAL RMSE               | .43       | ADJ. SD | .36     | SEPARATION  | .84   | Item RELIABILITY | .42    |      |
| MODEL RMSE              | .37       | ADJ. SD | .42     | SEPARATION  | 1.15  | Item RELIABILITY | .57    |      |
| S.E. OF Item MEAN = .12 |           |         |         |             |       |                  |        |      |

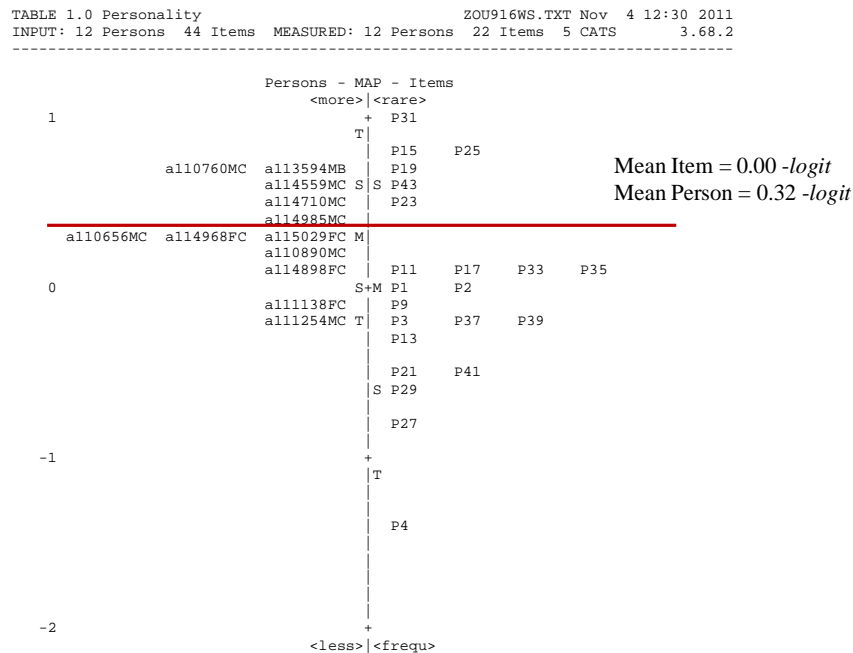


Fig. 2 Person-Item Distribution Map

Table 4 Item Measure Order

| TABLE 13.1 Personality                                              |             |       |         |            |            |      |             |      |                  |      |                  |      | ZOU916WS.TXT Nov 4 12:30 2011 |  |
|---------------------------------------------------------------------|-------------|-------|---------|------------|------------|------|-------------|------|------------------|------|------------------|------|-------------------------------|--|
| INPUT: 12 Persons 44 Items MEASURED: 12 Persons 22 Items 5 CATS     |             |       |         |            |            |      |             |      |                  |      |                  |      | 3.68.2                        |  |
| Person: REAL SEP.: .38 REL.: .13 ... Item: REAL SEP.: .84 REL.: .42 |             |       |         |            |            |      |             |      |                  |      |                  |      |                               |  |
| Item STATISTICS: MEASURE ORDER                                      |             |       |         |            |            |      |             |      |                  |      |                  |      |                               |  |
| ENTRY NUMBER                                                        | TOTAL SCORE | COUNT | MEASURE | MODEL S.E. | INFIT MNSQ | ZSTD | OUTFIT MNSQ | ZSTD | PT-MEASURE CORR. | EXP. | EXACT MATCH OBS% | EXP% | Item                          |  |
| 31                                                                  | 29          | 12    | 1.02    | .30        | .87        | -.3  | .88         | -.2  | -.03             | .26  | 16.7             | 35.1 | P31                           |  |
| 15                                                                  | 32          | 12    | .76     | .29        | .49        | -1.7 | .50         | -1.6 | .37              | .27  | 41.7             | 38.7 | P15                           |  |
| 25                                                                  | 32          | 12    | .76     | .29        | 1.02       | .2   | 1.04        | .2   | -.42             | .27  | 50.0             | 38.7 | P25                           |  |
| 19                                                                  | 33          | 12    | .68     | .29        | 1.77       | 1.9  | 1.78        | 1.9  | -.17             | .27  | 33.3             | 39.7 | P19                           |  |
| 43                                                                  | 34          | 12    | .59     | .29        | 1.44       | 1.2  | 1.46        | 1.2  | -.01             | .27  | 50.0             | 39.9 | P43                           |  |
| 23                                                                  | 35          | 12    | .50     | .30        | 1.14       | .5   | 1.15        | .5   | -.20             | .27  | 41.7             | 39.8 | P23                           |  |
| 11                                                                  | 39          | 12    | .15     | .30        | .48        | -1.5 | .48         | -1.5 | -.03             | .26  | 41.7             | 40.3 | P11                           |  |
| 17                                                                  | 39          | 12    | .15     | .30        | 1.14       | .5   | 1.15        | .5   | .40              | .26  | 25.0             | 40.3 | P17                           |  |
| 35                                                                  | 39          | 12    | .15     | .30        | .75        | -.6  | .78         | -.5  | .51              | .26  | 33.3             | 40.3 | P35                           |  |
| 33                                                                  | 40          | 12    | .05     | .31        | 1.05       | .3   | 1.07        | .3   | .38              | .26  | 58.3             | 40.4 | P33                           |  |
| 2                                                                   | 13          | 4     | .04     | .53        | 2.35       | 1.7  | 2.35        | 1.7  | .96              | .35  | .0               | 41.1 | P2                            |  |
| 1                                                                   | 30          | 9     | .01     | .36        | 1.55       | 1.2  | 1.47        | 1.1  | .67              | .27  | 22.2             | 40.4 | P1                            |  |
| 9                                                                   | 42          | 12    | -.14    | .32        | .80        | -.4  | .79         | -.4  | .31              | .25  | 33.3             | 40.5 | P9                            |  |
| 3                                                                   | 21          | 6     | -.23    | .45        | 3.40       | 2.9  | 3.51        | 3.0  | -.23             | .28  | 16.7             | 41.3 | P3                            |  |
| 37                                                                  | 43          | 12    | -.24    | .32        | .61        | -1.0 | .62         | -1.0 | .74              | .25  | 50.0             | 41.1 | P37                           |  |
| 39                                                                  | 43          | 12    | -.24    | .32        | .59        | -1.1 | .63         | -1.0 | .42              | .25  | 75.0             | 41.1 | P39                           |  |
| 13                                                                  | 44          | 12    | -.34    | .32        | .88        | -.2  | .88         | -.2  | .56              | .25  | 16.7             | 41.7 | P13                           |  |
| 21                                                                  | 45          | 12    | -.45    | .33        | .57        | -1.2 | .57         | -1.2 | .45              | .24  | 41.7             | 42.3 | P21                           |  |
| 41                                                                  | 45          | 12    | -.45    | .33        | .89        | -.1  | .95         | .0   | .14              | .24  | 50.0             | 42.3 | P41                           |  |
| 29                                                                  | 46          | 12    | -.56    | .34        | .53        | -1.3 | .56         | -1.2 | .44              | .24  | 50.0             | 42.5 | P29                           |  |
| 27                                                                  | 48          | 12    | -.80    | .35        | .81        | -.4  | .81         | -.4  | .52              | .23  | 33.3             | 43.0 | P27                           |  |
| 4                                                                   | 13          | 3     | -1.40   | .81        | .39        | -.7  | .46         | -.5  | .29              | .27  | 33.3             | 46.9 | P4                            |  |
| MEAN                                                                | 35.7        | 10.8  | .00     | .35        | 1.07       | .0   | 1.09        | .0   |                  |      | 37.0             | 40.8 |                               |  |
| S.D.                                                                | 9.7         | 2.7   | .56     | .11        | .69        | 1.2  | .70         | 1.2  |                  |      | 16.3             | 2.1  |                               |  |

## 4 Conclusions

The Rasch measurement analysis indicates that the person distribution only fairly matches the item distribution but is within the range that the items can measure. However, the moderate item reliability can be attributed to the homogenous and small sample size, whereas the low person reliability is caused by the lack of items within the first standard deviation above the mean. PIDM shows that most of the students have similar perceptions when the person map shows that the persons are located close to one another. The PIDM also reveals items that are extremely difficult for all the students to endorse. The items are “sometimes shy, inhibited”, followed by “ingenious, a deep thinker” and “inventive”. The items easily agreed to by all of the students are “reliable worker”, “tends to be quiet”, “can be moody”, “can be cold and aloof”, and “depressed, blue”. For further improvement, one of the items identified as “misfit” item can be considered for elimination. The misfit item was “does a thorough job”.

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