RASCH ANALYSIS APPLICATION IN AGRICULTURE

Deniz GÜLKAYA[1], Özgür KOŞKAN[1], Emre ASLAN[1]

e-mail: dengulkaya@gmail.com

Abstract

Rasch model belongs to Latent Trait Theory and is preferred in survey studies due to its superior properties that convert ordinal scale to interval scale. Most of the surveys and scales used in education, health and social sciences have ordinal scale. In this case the researcher may encounters many problems. For instance; when the raw scores obtained by summing the items used and the correct answers to the survey or scale evaluation it will be plausible to encounter a problem. Thus in order to solve these problems Rash analysis is used. As mentioned, Rasch analyses is commonly used in education, psychometry and rehabilitation fields due to its superior properties. However its application in Agriculture data that are obtained by ordinal scale (*for example, milk and meat quality*) are almost nonexistent. Material of this study consists of ordinal scale data obtained from animal farms. Data generated by RUMM2030 package program are evaluated in Rasch model. As a result, purpose of this study is to show applicability of Rasch analyses which is commonly used health, education and social sciences in agriculture that may also have ordinal scale data.

Key words: Rasch analysis, ordınal scale, ıtem characteristic curves.

Rasch model which analysis created by statistician Georg Rasch. Rasch analysis is usually known for specific objectivity and separately parameters. Rasch analysis of the likelihood of an individual to select a category in item and item difficulty level and the difference between the level of people skills it accept that there is a logistic function.

Rasch analysis utilizes both items and the people situated on the only one measurement scale. Subsequently Rasch model examines between people and items interaction.

There are some theories that are used when analyzing the measurement results. When these theories are collected under two main headings; the properties of the Latent Trait Models and Classical Test Theory are specified as (Berberoğlu, 1988; Van der Linden and Hambleton, 1997; Engelhardt, 1992).

Classical test theory against the theory of the properties of implicit methods developed under the 'item response Theory' *(Item response theory)* and 'Rasch', including the development of open, today is still worked to develop two different models.

Rasch analysis of ordinal scale measurements is one of the models used in making the measurements overly intermittent. Items that are obtained by summing the raw scores given responses in case of using the correct scaling, there are some problems. These issues are:

a. Lack of the equal differences between the categories in the surveys or test

Standard analysis method accepts equally between categories difference and scores of responses collects and calculates but in fact the differences are not always equal. So that it means to accept that is equal to the difference between items use raw scores. The distances between items will create a more realistic Rasch Analysis of the actual interval by calculating.

b. All items lacks of equal difficulty situation

As measured on surveys or tests; skill, knowledge, measuring the degree of disability and concepts such as this, all of the items in the test or survey is not on the same point on the scale.

c. Unable to cope with lost data

When calculating raw scores to the item which item unanswered or category has not response, we may came across new problem. Rasch analysis conducts process only with observed values and losses in value are skipped. As a result, no need for correction.

d. Items given unexpected responses may not be determined

Unexpected answers given items generally does not take into account in the analysis. In Rasch analysis determines item difficulty levels and considering individual skill levels due to fit tests (*Infit ve Outfit*) with unexpected answers and

[1] Süleyman Demirel University, Faculty of Agriculture, Isparta, Turkey

additional analyses can be made on the cause of unexpected answers.

e. Rasch analysis is creates independent item difficulty index from the sample and independent individuals ability levels from the test

Rasch measurement model according to Classical test theory as different from are able to obtain this data and use these parameters.

Rasch measurement model is a known objective model therefore raw scores is converted to logit values by Rasch analysis which model uses to these values.(*Linacre, 1993*). In this way, the observed values obtained with the logit values based on the ranking of the results of the measurement become with these values of proportional comparison operations as well as multiplication, division, subtraction, and aggregation operations can also be performed.

MATERIAL AND METHOD

Rasch model is a model created in the framework of the implicit theory(*Latent trait theory*) of features and has its own assumptions (*Rasch, 1966*).These assumptions:

1.The group performed on the talent scale should show normal distribution.

2.In the same proficiency level, items of possibility response on the test are independent of each other and this feature is called ´local independence´.

3.All items in the test is a measure of one-dimensionality and is called `unidimensionality´.

4. In item of tests with luck the probability of finding the right answer is `zero´.

Four model still have developed by the Rasch model

1. Binary (*dual*) Model: The question in the response category 2 of the test (*if available*); For instance; I agree/ I don`t agree or Yes/No.

2. Partial credit model: Each item has its own ordinal scale structure and that give us information at an ever-increasing level of the test item has the answers. This model can predict the parameters of the individual independent is a model that allows us to obtain useful statistics.

3. Many-facet Rasch Measurement Model: Individuals with multiple skill levels + Rigidity/Generosity, the difficulty level of the questions surface, the surface expressions are important in terms of Rasch.

An impartial and effective for measurement makes the standard for combining surfaces in a common plane. Capabilities of persons to perform the task, the difficulty of the question and allows you to compare the behavior of the rigidity and generosity of individuals simultaneously.

4. Ordinal model: For item on any behavior survey or test that the means to identify the n-th step in item the (n-1)-th category to prefer 1st category are considered.

The material of our study consists of ordinal scale obtained from 223 animal farms in the provinces of Isparta and Antalya in the Mediterranean region. In this survey has 83 question and 7 ordinal category. All data was arranged in the SPSS. Then the data were subjected to Rumm2030 program for Rasch analysis.

RESULTS AND DISCUSSION

The researcher can utilize from Rasch analysis for dicoton response and politon response data. Politon data has 2 alternative model. In this study is based on politon data due to apply to Rating Scale model or Partial Credit model. Distance between thresholds can be equals. In this case the researcher can be used Rating scale model which is determined a threshold and adding the others. Providing that partial credit model is compared to rating model, credit model has superior features. Partial credit model predicts more parameters than rating scale model. Partical credit model assumptions that all distance between thresholds can´t be equal. Therefore in the partial credit model is predicted for each items category threshold. This situation can be tested by ´Likelihood Ratio Test´. As a matter of fact that likelihood ratio test result is significant, can be uses Partical Credit model. Otherwise, used to rating scale model. In this study, Likelihood Ratio Test result is significiant so that used to partial credit model.

In the table 1 shows that Likelihood ratio test probability is 0.00.

Table 1

Likelihood ratio test

Likelihood-Ratio Test		
Analysis 1	Likelihood of	-28,259.02
Analysis 2	Likelihood of	-28,929.70
Chi Square		1,341.37800
Degrees of Freedom		245.0
Probability		0.000000

Examined summary statistics, expected values of item fit residual and person fit residual should be 0 and 1 or the these values should be close each other. Means that it's good adapt to Rasch model. In this study, item residual fit and person fit residual values has almost same values. So in data of this study is well fit to model. Item location and person location indicates capacity of the instrument at hand and measured of data how approximately fit each other. It means that model fits to the items and persons. In the case of Item location result is 0 and person location result is 3, is called miss target.

Table 2

Summary Statistics

Item-Person Interactıon - Includes Extreme Persons				
	Items [N=83]		Persons [N=223]	
	Locatio n	Fit Residual	Location	Fit Residual
Mean	0.0000	0.9007	0.4518	-0.4880
SD	0.3112	2.3266	0.5838	3.3245
Skewnes	0.5161	0.1348	4.5268	-0.2298
Kurtosis	0.2301	-0.3363	36.8843	-0.5762
	Corr. [locn / Std Resid]	0.6037	Corre. [locn / Std Resid	0.2666

Item location and person location results are 1, is called well target .If Item and person mismatch one another, that means is ceiling effect. If Item and person is convergent one another, that means is floor effect. In this study shows that well target and floor effects.

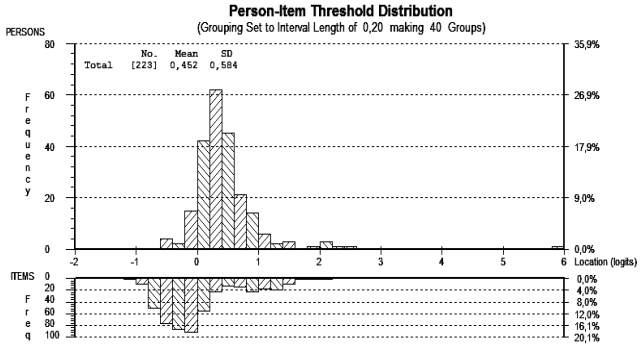

Figure 1 **Person-Item Threshold Distribution**

Summary statistics item table demonstrates power of analysis fit results. Power of analysis of fit is **Excellent** *[Based on SepnIndex of: 0.96150.* Person reliability indicates shows reliability level on the basis of the group and persons with extreme person or without extreme person.

Table 3

Summary Statistics

Total Item Chi Squ	574.8708	Person seperation index	
Total Deg of reedom	166	with extms	0.95793
Total Chi Squ Prob	0	no extms	0.9615
		Coeffalpha	0.95203
		With xtms	0.95044

Table 4

Item and Person/Item Separation Indices

	Item	Person/Item
İndex	0.77909	0.82400
Variance	0.27758	183.38560
Error	0.06132	32.27578

Cronbach alphas reliability level (*Coeffalpha*) result is 0.95203 without extreme persons. In this way determined measurement reability levels. If in the study has missing data, Rumm2030 can`t be compute cronbach's alpha result. In this situation, the researcher should be considered reliability of person seperation index. Because cronbach alpha result to corresponding of rasch is person separation index.

Each item fit can examine individual item section. This part shows that whether item fit to model or not. The researcher can select sort item by ´Chisquare probability order´**.** If item has missfit, the researcher should examines its reasons. Differential item functioning can cause to missfit. Therefore highlight probabilities below the bonferroni adjustment values is made 0.02. Then if item still shows missfit, these items removes. After highlight probabilities below the bonferroni adjustment values edited, study did not show missfit items. So this study need not remove items.

Individual person fit demonstrates that person ability level and extreme persons. Extreme person who can give response to all items maximum value or minimum value. The researcher can select sort item by location order. Analysis using to interpolation calculates standard deviation and locations (*Q*). That means these results fit or not to model. In this way enables to see extreme person`s location. In our study has only one extreme person. 130 th company shows extreme features. Also table 5 demonstrates extreme person and its raw scores. Extreme person gives to all item maximum score because total ham score is 498.

Table 5

Extreme person table

ID	130
Itms	83
totSc	498
Defaul tID	498
Max Sc	0
TotSc extm	extm
Miss Itm Extrm	5,981
Locn	1,208
Default ID	130

Residual correlation part shows the errors in the data relations with each other. The researcher can determine linkage of items each other. Highlight above can be selected and value is changed 0.3. Then examines to relation of items. If the relation of item is high (*for example; 0.6*), these items should be unify with each other. For instance; if someone walks 10km, can walk 5km. In our study is determined correlation between item 13 and item 23 is 0.47.This value isn`t high. Therefore needn`t unify to items each other.

Residual principal components indicated used the the instrument whether of the only one type measuring or not (*for example; only kg or height*). If the significance is 0.05, is called unidimensionality. In this study result is significant so unidimensionality is provided. The researcher can select Pc loadings part and then select sort Pc1. The purpose of this process, divides to 2 categories set item *(positive and negative data*). In this way the researcher can compare person's location (*Q*)

and predicts level ability of person. If the result is not close to 0.05, it means unidimensional is broken down. In this situation the researcher should be examined its reasons. Because items can be connected each other. Figure 2, Figure 3 and Figure 4 show item characteristic curves. If the item does not coincide with graphic, it means nonuniform. In this case, the item may not be fit to model. In this situation the result of anova should be checked. If the interaction is not meaningful, it can be ignored. In our study, the anova result is not meaningful so nonuniform item hasn't been mentioned. *Figure 2*, *Figure 3* and *Figure* 4 indicate examples (*for item 39 and item 47).*

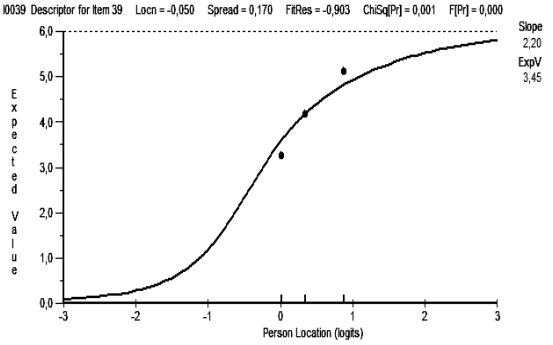

Figure 2 **Item characteristic curves(item 39)**

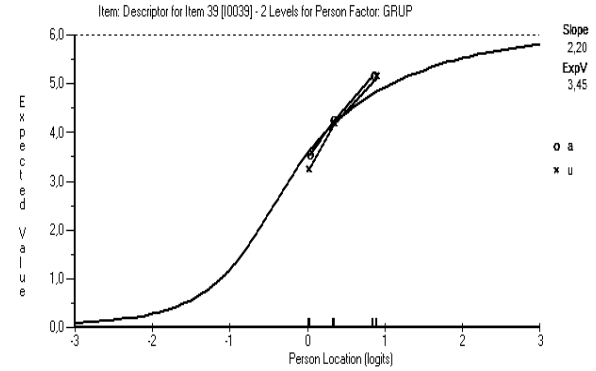

Figure 3 **Item characteristic curves(item 39 with anova)**

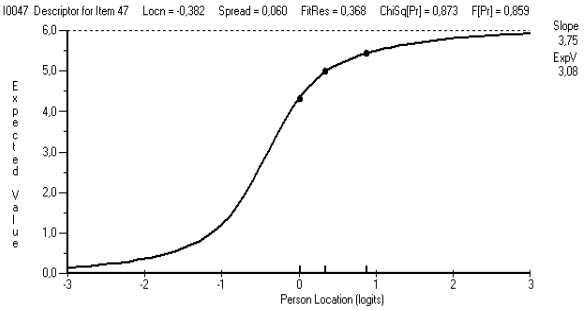

Figure 4 **Item characteristic curves(item 47)**

Thresholds item curves show threshold graph value of each item and this way orders to threshold of item. In this way possible to sort by threshold values of item. If the item does not to fit model, the thresholds should unify. That means item does not fit to model due to response category changes or unifies each other. This processing is not necessary for our study. *Figure 5* shows threshold item curves examples.

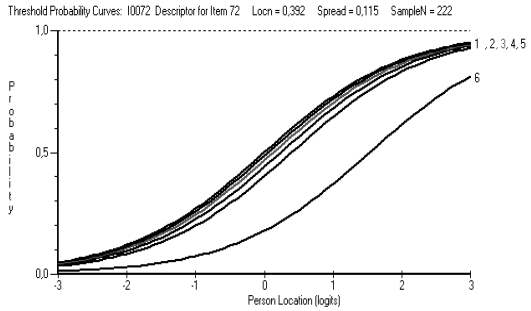

Figure 5 **Threshold item curves**

CONCLUSIONS

As a result, purpose of this study is to show applicability of Rasch analysis which is commonly used health, education and social sciences in agriculture that may also have ordinal scale data.

According to this study the researcher can utilize reliably from Rasch analysis for ordinal scale in Agriculture surveys. In this study, health, education and social sciences with ordinal scales in Rasch analysis used is intended to bring a new perspective in the field of Agriculture.

ACKNOWLEDGEMENTS

This research was supported by Asst. Prof. Özgür Koskan, Suleyman Demirel University, Phd Department of Animal Science and Beyza Doğanay Erdoğan, Ankara University, Biostatistics Department. We are thankful to Associate Professor Hayati Köknaroğlu who provided expertise that greatly assisted the research. We are also grateful to our colleague Hasan Erdogan who moderated this paper and in that line improved the manuscript significantly.

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