# Number Series Abilities in the Mexico and Indonesia Sample

John Prindle & Jack McArdle
MPIB-Berlin & USC

## Introduction

This report identifies the properties of the Number Series score on the test sample of Mexican and Indonesian respondents. We used a Rasch scoring model, in line with WJ ability test scoring, to identify unique person ability estimates for a given set of response patterns. Once scores were obtained for each of the respondents, distributions were produced and person characteristics were regressed on the scores to account variation in scores observed. Some insights to depndencies on person characteristics are then given.

The sample characteristics were determined as follows in Table 1. The sample consisted mainly of females, and overall had a lower education level. Incomes were skewed to the lower end of the distribution, and a log transform was done to bring in extreme income values.

Table 1
*Sample Statistics for Indonesia and Mexico Samples*

| A. Indo | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| Age | 393 | 55.031 | 18.793 | 15 | 95 |
| Female | 393 | 0.504 | 0.501 | 0 | 1 |
| Education | 385 | 4.387 | 3.348 | 0 | 13 |
| **B. Mexico** | **N** | **Mean** | **St. Dev.** | **Min** | **Max** |
| Age | 381 | 70.029 | 6.308 | 60 | 88 |
| Female | 381 | 0.680 | 0.467 | 0 | 1 |
| Education | 381 | 4.814 | 4.088 | 0 | 22 |

## Rasch Model

The Rasch scoring model was used, where each item has a given difficulty (item discriminations held constant). Person scores are said to be independent of the item characteristics (and vice vera). A figure outlining the item characteristics is given in Figure 1.

This figure shows that the items generally increased in difficulty as they were presented to respondents. Most items were on the higher end of the ability spectrum, counterbalanced by items with lower difficulties compared to the highest item difficulty. It would be beneficial to include more items of lower difficulty as it seems to be the case that more participants fall within this region of the ability range. The difficulties as calculated are intended to be

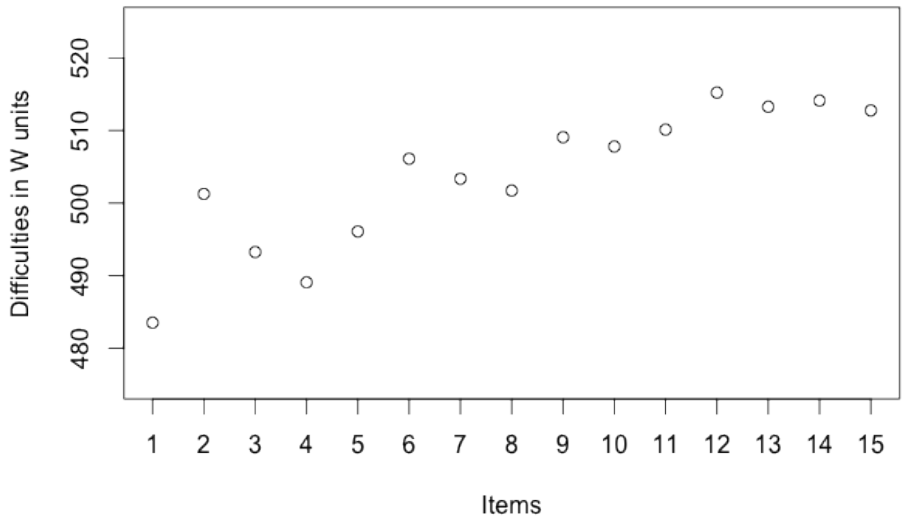



*Figure 1*. Plot of Item Difficulties for order of presentation. General increasing trend in item difficulty is observed over W-unit scaling.

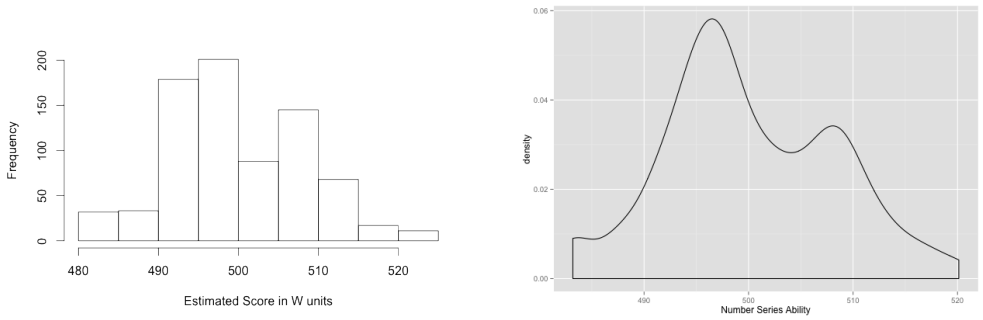
sample independent , so that the same item difficulties can be used to determine abilities on another sample and compare scores across samples.

The person scores were then graphed as shown in Figure 2. The two panels display the same data, once as binned data in a histogram (2(a)) and then as a density plot smoothing the distribution of scores (2(b). Interestingly, there seems to be a bimodal distribution within the sample. One clear mean is below the middle point of the scale, and the other in the positive region. We use the sample characteristics in the next section to examine this finding.

## Multiple Regression

In this portion of the analysis we would like to explain the variation in scores observed. Particularly, why is there a clear divide between respondents that have low scores and those that score higher. The variables used in this analysis are shown in Table **??**. This indicates a rough idea of the relationship between the two samples and predictors of Number Series ability.

The results of multiple regression analyses are presented below in Table 3. The main effects of the predictors on Number Series are the first few rows of the table. These show a negative relationship with female participants, age, and a positive relationship with education. When the interactions with sample location, the trend with increasing education in the Mexican subsample is slightly lower. THe effect of Mexican females is not significant at the $\alpha = 0.05$ level.




(a) Histogram (b) Density Plot

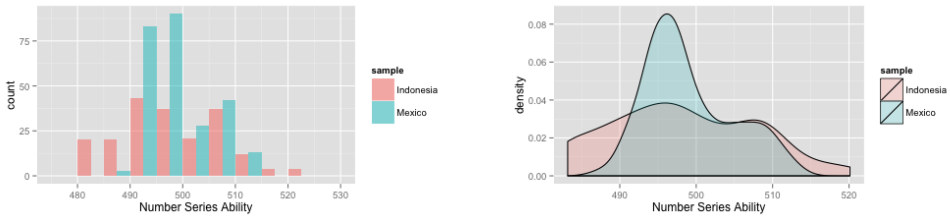
*Figure 2*. Plots of person ability scores over 15 Number Series items. Panel 2(a) shows the standard histogram of the distribution of W-scores. Panel 2(b) uses a smoother to give an idea of the continuous distribution of scores.

Table 2
*Correlations for Predictor Variables with Number Series Ability Score.*

| | A. Indo | | | | B. Mexico | | | |
|---|---|---|---|---|---|---|---|---|
| | Score | Age | Female | Edu | Score | Age | Female | Edu |
| Score | 1.00 | -0.46 | -0.24 | 0.56 | 1.00 | -0.15 | -0.11 | 0.52 |
| Age | -0.46 | 1.00 | -0.02 | -0.50 | -0.15 | 1.00 | -0.04 | -0.11 |
| Female | -0.24 | -0.02 | 1.00 | -0.23 | -0.11 | -0.04 | 1.00 | -0.03 |
| Edu | 0.56 | -0.50 | -0.23 | 1.00 | 0.52 | -0.11 | -0.03 | 1.00 |

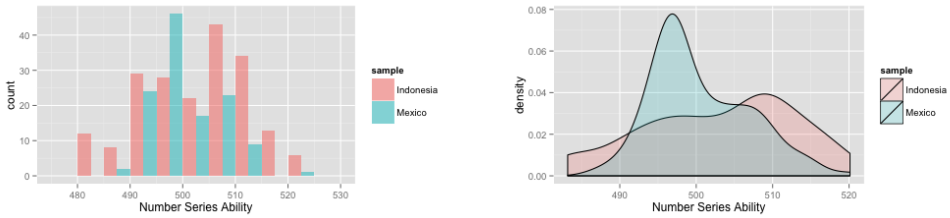
## Conclusion

Number Series in the Indo/Mexico Sample seems to provide some spread in ability that can be analyzed in structured ways. The relationship with demographic characteristics of the samples support the traditional use of the task.




(a) Histogram (b) Density Plot

*Figure 3*. Plots of person ability scores for females split by sample group. Panel 3(a) shows the standard histogram of the distribution of scores. Panel 3(b) uses a smoother to give an idea of the continuous distribution of scores for each subsample.




(a) Histogram (b) Density Plot

*Figure 4*. Plots of person ability scores for males split by sample group. Panel 4(a) shows the standard histogram of the distribution of scores. Panel 4(b) uses a smoother to give an idea of the continuous distribution of scores for each subsample.

Table 3
*GLM results for predicting Logit Scores over Indonesia and Mexico Samples*

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | est.score1 | | | |
| | (1) | (2) | (3) | (4) |
| Female | $-0.369^{***}$ | $-0.346^{***}$ | $-0.277^{***}$ | $-0.248^{***}$ |
| | (0.086) | (0.078) | (0.056) | (0.056) |
| Age | $-0.015^{***}$ | $-0.016^{***}$ | $-0.018^{***}$ | $-0.015^{***}$ |
| | (0.003) | (0.002) | (0.002) | (0.002) |
| Edu | $0.132^{***}$ | $0.126^{***}$ | $0.098^{***}$ | $0.133^{***}$ |
| | (0.016) | (0.013) | (0.008) | (0.013) |
| Mexican | $-0.059$ | $-0.037$ | $0.156^{**}$ | 0.106 |
| | (0.105) | (0.099) | (0.064) | (0.065) |
| Female:Mexican | $0.247^{*}$ | $0.201^{*}$ | | |
| | (0.132) | (0.112) | | |
| Age:Mexican | 0.006 | 0.006 | | |
| | (0.006) | (0.006) | | |
| Edu:Mexican | $-0.043^{**}$ | $-0.045^{***}$ | | $-0.052^{***}$ |
| | (0.019) | (0.016) | | (0.016) |
| Female:Age | $-0.002$ | | | |
| | (0.004) | | | |
| Female:Edu | $-0.013$ | | | |
| | (0.016) | | | |
| Age:Edu | 0.00005 | | | |
| | (0.001) | | | |
| Constant | $0.150^{***}$ | $0.144^{***}$ | $0.092^{*}$ | $0.106^{**}$ |
| | (0.058) | (0.055) | (0.049) | (0.049) |
| Observations | 766 | 766 | 766 | 766 |
| Log likelihood | $-845.113$ | $-845.561$ | $-852.961$ | $-847.461$ |
| Akaike Inf. Crit. | 1,712.226 | 1,707.122 | 1,715.922 | 1,706.923 |
| *Note:* | | | | $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01 |