**Rasch analysis 2 – Saudi data usual ratings individual facet analysis**

**Description:** Separate Rasch analysis for each facet individually, beginning with the largest groups.

|  |  |  |
| --- | --- | --- |
| Number of facets | Number of person factors | Number of items |
| 10 | 7 | 6 |

|  |  |
| --- | --- |
| **Facet key** | **Item key** |
| |  | | --- | | 1 Ariel Automatic LS Powder (green atomium) (171) | | 2 Ariel HS/ regular powder (blue atomium) (70) | | 3 Bonux HS/ regular powder (34) | | 4 Omo Active Auto LS Powder (59) | | 5 Omo HS/ regular powder (for semi auto washing machine) (75) | | 6 Persil HS/ regular powder (blue artwork) (25) | | 7 Persil LS Powder (green artwork) (99) | | 8 Tide Automatic LS Powder (276) | | 9 Tide HS/ regular powder (for semi auto washing machine) (172) | | 10 Xtra HS/ regular powder (18) | | 1 Overall Rating For Usual Laundry Detergent  2 Relative Category Rating For Usual Laundry Detergent  3 Purchase Intent For Usual Laundry Detergent  4 Performance vs. Expectations For Usual Laundry Detergent  5 Distinctiveness Vs Other Products For Usual Laundry Detergent  6 Value For Price/ Money For Usual Laundry Detergent |

1. Remove extreme persons (i.e. those who answered all high or all low)
2. Principal components analysis (PCA)
3. Correct disordered thresholds
4. Remove extreme persons
5. Remove extreme items
6. Check independent items
7. Check dimensionality again (PCA)

**Facet 8 (276 participants) - Initial analysis**

**Notes:** There is a high person location mean of 2.586 (persons are generally answering more positively than the model would predict)

1. **Remove extreme persons**

There are 63 extreme persons initially. After removal the person mean location lowers to 1.847.

1. **Test for unidimensionality (PCA)**

Identify 2 most divergent subset of items (if there is a difference between estimated person abilities, it is most likely to be found between the 2 most divergent subset of items): {3,1,2} (positive) and {5,4.6} (negative).

Generate person ability estimates from these 2 subset of items. Compare the 2 sets of items with an independent t-test to check for multidimensionality: 6.1% of tests fall outside of the acceptable significance range (> 5% expected for random unidimensional data). 13 persons are significant at the 5% level, and 6 at the 1% level – 11, 26, 31, 34, 51, 54, 64, 167, 177, 196, 222, 238, 249.

1. **Correct disordered thresholds (and those with 0 quantities)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 1 | 1 | 2 | 3 | 1.368 | 0.055 |
| 2 | 0 | 0 | 1 | 2 | 3 | -0.598 | 0.441 |
| 3 | 0 | 1 | 1 | 2 | 3 | 0.582 | 0.219 |
| 5 | 0 | 0 | 1 | 2 | 3 | -0.689 | 0.209 |
| 6 | 0 | 0 | 1 | 2 | 3 | 1.485 | 0.346 |

1. **Remove extreme persons/items**

There are no extreme persons or items. There are some persons with a high negative fit residual (115, 162, 77, 269, 209, 121), indicating there is little variation in their responses. Person with ID 177 has a high positive fit residual, highlighting unexpected response patterns.

1. **Check for local dependency**

Items 2 and 3 have local dependency (their residual correlation is significantly greater than the average of all residual correlations).

1. **Test for unidimensionality**

2 most divergent subsets: {1,2,3} (positive) and {4,5,6} (negative). 6.57 % of tests fall outside of the acceptable significance range (14 persons with significant t-tests).

**Facet 9 (172 participants) - Initial analysis**

1. **Remove extreme persons**

There are 42 extreme persons initially.

1. **Test for unidimensionality (PCA)**

2 most divergent subset of items: {6,1,5} (positive), {3,4,2} (negative). 4.62 % of tests fall outside of the acceptable significance range (6 persons with significant t-tests at a 5% level, 1 person at a 1% level).

1. **Correct disordered thresholds (and those with 0 quantities)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 0 | 1 | 2 | 3 | 1.554 | 0.132 |
| 2 | 0 | 0 | 0 | 1 | 2 | 0.031 | 0.402 |
| 3 | 0 | 0 | 1 | 2 | 3 | -0.733 | 0.263 |
| 6 | 0 | 0 | 1 | 2 | 3 | 1.469 | 0.437 |

1. **Remove extreme persons/items**

There are no extreme persons. Persons 87, 82, 92 have high negative fit residuals. Item 4 doesn’t fit the model at the 1 % significance level (will be removed)

1. **Check for local dependency**

There are no locally dependent items.

1. **Test for unidimensionality**

6 persons with significant t-tests still (but none at 1 %)

**Facet 1 (171 participants) - Initial analysis**

**Notes:** There is a high person location mean of 3.73 (persons are generally answering more positively than the model would predict)

1. **Remove extreme persons**

There are 55 extreme persons initially. After removal the person mean location lowers to 2.769.

1. **Test for unidimensionality (PCA)**

2 most divergent subset of items: {4,5,6} (positive), {1,2,3} (negative). 5.17 % of tests fall outside of the acceptable significance range (6 persons with significant t-tests at a 5% level, 1 person at a 1% level: 5, 46, 79, 82, 85, 159).

1. **Correct disordered thresholds**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 0 | 1 | 2 | 3 | 1.854 | 0.392 |
| 2 | 0 | 0 | 0 | 1 | 2 | -0.888 | 0.03 |
| 3 | 0 | 0 | 1 | 2 | 3 | -1.166 | 0.259 |
| 5 | 0 | 0 | 1 | 2 | 3 | 0.132 | 0.281 |

1. **Remove extreme persons/items**

There are no extreme persons. Person 66 has a high negative fit residual. Item 2 doesn’t fit the model at the 5% significance level (according to the chi^2 probability). Remove item 2. Subsequently there is 1 extreme person (144). After removing item 2, item 4 doesn’t fit the model at the 1% significance level.

1. **Check for local dependency**

Items {1,3} have local dependency.

1. **Test for unidimensionality**

2 most divergent subset of items: {6,5} (positive), {3,1} (negative). 2.61% of tests fall outside of the acceptable significance range (3 persons at 5%, 1 at 1%).

**Facet 7 (99 participants) - Initial analysis**

1. **Remove extreme persons**

There are 14 extreme persons initially.

1. **Test for unidimensionality (PCA)**

2 most divergent subset of items: {2,3,1} (positive), {6,5,4} (negative). 5.88 % of tests fall outside of the acceptable significance range (5 persons with significant t-tests at a 5% level, 2 person at a 1% level).

1. **Correct disordered thresholds**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 0 | 0 | 1 | 2 |  |  |
| 2 | 0 | 0 | 1 | 2 | 3 |  |  |
| 3 | 0 | 0 | 1 | 2 | 3 |  |  |
| 5 | 0 | 1 | 1 | 2 | 3 | -0.919 | 0.162 |
| 6 | 0 | 0 | 1 | 2 | 3 | 0.789 | 0.783 |

1. **Remove extreme persons/items**

There are no extreme persons or items.

1. **Check for local dependency**

Items {2,3}, {1,2} and {4,5} have local dependency. Items 4 and 5 have the highest residual correlation.

1. **Test for unidimensionality**

2 most divergent subset of items: {4,5,6} (positive), {1,3,2} (negative). 4.71% of tests fall outside of the acceptable significance range (4 persons at 5% level, 2 at a 1% level).

**Facet 5 (75 participants) - Initial analysis**

1. **Remove extreme persons**

There are 6 extreme persons initially – 37, 62, 5, 35, 53, 70

1. **Test for unidimensionality (PCA)**

2 most divergent subset of items: {5,1,2} (positive), {4,3,6} (negative). 5.8 % of tests fall outside of the acceptable significance range (4 persons with significant t-tests at a 5% level, 1 person at a 1% level).

1. **Correct disordered thresholds**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 0 | 1 | 2 | 3 | 0.622 | 0.756 |
| 2 | 0 | 0 | 1 | 2 | 3 | -0.422 | 0.530 |
| 3 | 0 | 0 | 1 | 2 | 3 | 0.25 | 0.520 |
| 5 | 0 | 1 | 1 | 2 | 3 | -0.522 | 0.300 |
| 6 | 0 | 0 | 0 | 1 | 2 | 0.133 | 0.606 |

1. **Remove extreme persons/items**

There are no extreme persons or items. Persons 27, 74 and 3 have high negative fit residuals.

1. **Check for local dependency**

Items {1,5}, {2,5} and {3,6} have local dependency. Items 1 and 5 have the highest residual correlation.

1. **Test for unidimensionality**

2 most divergent subset of items: {6,3,4} (positive), {2,1,5} (negative). There are 4 persons with significant t-tests at a 5% level (5.8% of tests fall outside of the acceptable significance range).

**Facet 2 (70 participants) - Initial analysis**

**Notes: significant initial chi^2 value (0.004531), and PSI (0.57819 w/o extremes)**

1. **Remove extreme persons**

There are 16 extreme persons initially – 8, 7, 4, 52, 65, 14, 15, 24, 21, 53, 27, 56, 33, 37, 38, 61

1. **Test for unidimensionality (PCA)**

2 most divergent subset of items: {6,4,1} (most positive), {5,2,3} (most negative). 1.85 % of tests fall outside of the acceptable significance range (1 person with significant t-test at a 1% level).

1. **Correct disordered thresholds**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 0 | 0 | 1 | 2 | 0.775 | 0.368 |
| 2 | 0 | 0 | 0 | 1 | 2 | -0.248 | 0.378 |
| 3 | 0 | 0 | 0 | 1 | 2 | -0.790 | 0.394 |
| 4 | 0 | 0 | 1 | 2 |  | -0.814 | 0.362 |
| 5 | 0 | 0 | 1 | 2 | 3 | -0.608 | 0.081 |
| 6 | 0 | 0 | 1 | 2 | 3 | 2.693 | 0.000386 |

1. **Remove extreme persons/items**

There are no extreme persons. Item 6 has a high positive fit residual, and doesn’t fit the model at the 1% significance level. After removal of item 6, There are subsequently 7 additional extreme persons – 19, 23, 44, 28, 42, 39, 54. (sample size is now 47)

1. **Check for local dependency**

Items {2,3} and {4,5} have local dependency. Items 2 and 3 have the highest residual correlation.

1. **Test for unidimensionality**

2 most divergent subset of items: {4,5} (positive), {1,3,2} (negative). There are now 3 persons with significant t-tests at a 5% level – 6.38% of tests fall outside of the acceptable significance range.

**Facet 4 (59 participants) - Initial analysis**

1. **Remove extreme persons**

There are 9 extreme persons initially – 55, 51, 4, 30, 9, 18, 37, 1, 38

1. **Test for unidimensionality (PCA)**

2 most divergent subset of items: {6,4,1} (most positive), {5,2,3} (most negative). 4 % of tests fall outside of the acceptable significance range (2 people with significant t-test at a 5% level).

1. **Correct disordered thresholds**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 0 | 1 | 2 | 3 | 1.337 | 0.334 |
| 2 | 0 | 0 | 1 | 2 | 3 | 0.089 | 0.543 |
| 3 | 0 | 0 | 0 | 1 | 2 | -0.554 | 0.311 |
| 4 | 0 | 1 | 1 | 2 |  | -0.725 | 0.231 |
| 5 | 0 | 0 | 1 | 2 | 3 | -0.069 | 0.812 |
| 6 | 0 | 0 | 1 | 2 | 3 | 1.19 | 0.769 |

1. **Remove extreme persons/items**

There are no extreme persons or items. Person 14 has a high negative fit residual.

1. **Check for local dependency**

Items {2,3} have local dependency.

1. **Test for unidimensionality**

t-test results remain unchanged

**Facet 3 (34 participants) - Initial analysis**

1. **Remove extreme persons**

There are 12 extreme persons initially – 2, 32, 31, 7, 18, 9, 11, 13, 26, 24, 19, 8

1. **Test for unidimensionality (PCA)**

2 most divergent subset of items: {6,3,4} (most positive), {5,1,2} (most negative). 4.55 % of tests fall outside of the acceptable significance range (1 person with significant t-test at a 5% level).

1. **Correct disordered thresholds**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 0 | 1 | 2 | 3 | -0.598 | 0.255 |
| 2 | 0 | 0 | 0 | 1 | 2 | -0.215 | 0.986 |
| 3 | 0 | 0 | 0 | 1 | 2 | 0.457 | 0.765 |
| 5 | 0 | 0 | 0 | 1 | 2 | -0.330 | 0.910 |
| 6 | 0 | 0 | 1 | 2 | 3 | 0.227 | 0.908 |

1. **Remove extreme persons/items**

There are no extreme persons or items.

1. **Check for local dependency**

Items {1,2}, {1,5} and {2,5} have local dependency.

1. **Test for unidimensionality**

2 most divergent subset of items: {1,2,5} (positive), {4,3,6} (negative). No tests fall outside of the acceptable significance range.

**Facet 6 (25 participants) - Initial analysis**

1. **Remove extreme persons**

There are 5 extreme persons initially – 8,7,6,18,24

1. **Test for unidimensionality (PCA)**

2 most divergent subset of items: {1,6,2} (most positive), {4,5,3} (most negative). No tests fall outside of the acceptable significance range.

1. **Correct disordered thresholds**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 0 | 1 | 1 | 2 | 1.297 | 0.522 |
| 2 | 0 | 0 | 0 | 1 | 2 | 1.285 | 0.424 |
| 3 | 0 | 0 | 0 | 1 | 2 | -0.073 | 0.403 |
| 4 | 0 | 0 | 1 | 2 |  | -0.986 | 0.294 |
| 5 | 0 | 0 | 1 | 2 | 3 | -0.518 | 0.477 |
| 6 | 0 | 0 | 1 | 1 | 2 | -0.11 | 0.211 |

1. **Remove extreme persons/items**

There are no extreme persons or items. Person 23 has a high negative fit residual.

1. **Check for local dependency**

Items {1,6} and {3,5} have local dependency.

1. **Test for unidimensionality**

2 most divergent subset of items: {1,2,4} (most positive), {5,3,2} (negative). No tests fall outside of the acceptable significance range.

**Facet 10 (18 participants) - Initial analysis**

1. **Remove extreme persons**

There is 1 extreme person initially – 7

1. **Test for unidimensionality (PCA)**

2 most divergent subset of items: {6,3,1} (most positive), {4,2,5} (most negative). 5.88% of tests fall outside of the acceptable significance range (1 person at the 5% level).

1. **Correct disordered thresholds**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Item** | **0** | **1** | **2** | **3** | **4** | **Fit. Resid.** | **Chi^2** |
| 1 | 0 | 0 | 1 | 1 | 2 | 0.299 | 0.097 |
| 2 | 0 | 0 | 1 | 2 | 3 | -0.17 | 0.465 |
| 3 | 0 | 0 | 0 | 1 | 2 | 0.7 | 0.477 |
| 4 | 0 | 0 | 1 | 1 |  | -0.145 | 0.811 |
| 5 | 0 | 0 | 1 | 2 | 3 | -0.763 | 0.325 |
| 6 | 0 | 0 | 0 | 1 | 2 | 1.716 | 0.003 |

Note: chi squared probability reduces to below the 5% significance level after the item rescoring.

1. **Remove extreme persons/items**

There are no extreme persons. Item 6 doesn’t fit the model at the 1% significance level according to the chi^2 probability. After removal, persons 5 and 6 are now extreme. After removal of these extreme persons there are 15 people remaining. Subsequently change number of class intervals from 3 to 2.

1. **Check for local dependency**

Items {2,5} and {4,5} have local dependency.

1. **Test for unidimensionality**

2 most divergent subset of items: {3,1} (most positive), {2,4,5} (negative). 13.33% of tests fall outside of the acceptable significance range (2 out of 15 people at the 5% level).

**Final item locations for each facet**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Facet 8 | Facet 9 | Facet 1 | Facet 7 | Facet 5 | Facet 2 | Facet 4 | Facet 3 | Facet 6 | Facet 10 |
| 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 2 |
| 1 | 1 | 1 | 2 | 1 | 5 | 4 | 4 | 6 | 1 |
| 2 | 5 | 6 | 6 | 5 | 1 | 1 | 6 | 1 | 3 |
| 4 | 6 | 5 | 5 | 2 | 2 | 3 | 2 | 2 | 4 |
| 6 | 2 |  | 4 | 4 | 4 | 5 | 3 | 5 | 5 |
| 5 |  |  | 1 | 6 |  | 6 | 5 | 4 |  |

**Comments**

* Items 2 and 3 are frequently dependent
* Item 3 is consistently the least likely to endorse (amongst the facets with a sufficient number of respondents)
* Item 3 often needs to be rescored as 0 0 0 1 2 – suggesting customers responses are more like ‘likely to buy again’ vs ‘not likely to buy again’.
* All analyses have a high mean person location – the majority of people lie on the upper end of the scale (suggesting that the statements are too “easy” to endorse)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Facet 8** | **Facet 9** | **Facet 1** | **Facet 7** |  |  |
| **Age** |  |  | **Performance vs expectation (uniform)** |  |  |  |
| **Region** |  |  | **Performance vs expectation (uniform)**  **Distinctiveness (uniform)** | **Purchase intent (non-uniform)**  **Performance vs expectation (non-uniform)** |  |  |
| **Education** | **Value for price (uniform)** | **Purchase intent (uniform)**  **Distinctiveness (uniform)** | **Distinctiveness (non-uniform)** |  |  |  |
| **Monthly Income** |  | **Overall rating (non-uniform)** |  |  |  |  |
| **Employment** | **Purchase intent (uniform)**  **Performance vs expectation (non-uniform)**  **Distinctiveness (non-uniform)** | **Overall rating (uniform and non-uniform)** | **Overall rating (non-uniform)** |  |  |  |
| **Nationality** | **Distinctiveness (uniform)** | **Value for price (uniform)** |  |  |  |  |
| **Size of household** | **Overall rating (uniform)**  **Relative category (uniform)**  **Distinctiveness (uniform)**  **Value for price (non-uniform)** | **Value for price (non-uniform)** | **Value for price (uniform)** |  |  |  |