**Qing Shu - BUS-Z 798 - Assignment 4**

**Part 1 - Multilevel Data**

1. **How did you go about simulating the data to ensure that the data had the characteristics described above?**

First, for any of the three constructs, I saw it as a linear combination of two ‘true scores’, i.e. Person Score, Time Score. For each score, I must ensure a) that they are perfectly correlated with, respectively, respondents’ individual ID and time ID, and b) that they have the same variance with each other at first (in this way I can then inflate or deflate their effect on the constructs according to specific need).

Second, I operationalized above requirements by a) generating individual ID as 0-19, and time ID 0-4, b) constructing two score variables through standardizing these two ID variables.

Third, I constructed an initial version of three constructs by setting:

Construct1= Time Score + **3**\*Person Score

Construct2= **3\***Time Score + Person Score

Construct3= total random numbers by each line

At last, I scaled the constructs to [1,7], and rounded them all to whole numbers. I pushed the python code (*main.py*) in the new folder *PyforDataSimulation* in the submission.

1. **Calculate and interpret the necessary aggregation statistics. Explain why these are necessary, and what they are telling you.**

**Table 1** ICC(1) of three constructs

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | ICC – Intra Time Classes | ICC - Intra Person Classes | Rwg(j) |
| Construct1 | .06 | .84 | .90 |
| Construct2 | .84 | .00 | .25 |
| Construct3 | .00 | .00 | .59 |

I rerun the data using the code introduced by you. Now all ICCs are larger than 0 before I rounded them.

First, by browsing all ICCs, 84% of Construct1 variance can be explained by Person group effect, which means it has high with-group agreement, thus implies that the with-group effect explains only very little variance of the total. On the other hand, almost no variance of Construct2 and Construct3 can be explained by group difference. Their variances can only be explained by other factors. As for Construct2, ICC for the intra Time class explained 84% of the total variance, implying there is little agreement with-person (i.e., for any data of one person across different times). As for Construct3, since its data are created randomly, no agreement is shown when we try to group the data by Time or Person, which means almost all the variance can only be explained by some factor else. Not matter what the factor is, it is not Time or Person.

Second, the Rwgs for which Time is taken as the ID of judges, indicate the across-judge (Time) agreement, i.e. within-person agreement. With a value of .90, the Rwg of Construct1 implies a high within-person agreement, which there is little variance within people. On the contrary, the Rwg of Construct2 (.25) shows that with-person agreement is very low, implying there is a large variance with people (i.e. the across-time values are not stable). However, the Rwg of Construct3 is not too high or too low **while it should be expected to be low**. I guess this issue is because of the way I used to randomly generate the data of Construct3. Even though I generated the data randomly, I asked the python to ensure a normal distribution by command np.random.normal(0, 1, 100). I think when Stata runs the ira code, it must automatically choose some other distribution, maybe uniform distribution.

1. **Calculate a** **null model for each construct. Identify the** **variance components and compute what** **percentage of the variance is at each level. See Examples 1 and 4 in this Stata documentation.**

I consider level-1 as the level of every single line of the data, i.e. every time of the survey for an individual, and level-2 as the level of Person. To construct the null model, below codes are run for each construct:

mixed ConstructX || Person:

estat icc

Below are the percentage of the variance in each level:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Constructs | Var(\_cons) | Var(Rsidual) | percentage of the variance at level 1 | percentage of the variance at level 2 |
| Construct1 | 2 | .4 | 16.67% | 83.33% |
| Construct2 | 0 | 2.74 | 100.00% | 00.00% |
| Construct3 | 0 | 1.30 | 100.00% | 00.00% |

1. **If these were real data and the variance you found was reflective of the construct's theorizing, what would this mean for the constructs you are studying with** **respect to level of measurement/aggregation?**

For Construct1, it can be implied that cross-level effect is important for their further model construction. Meanwhile, their LR test results (Prob >= chibar2 = 0.00) also reveal that their standard deviations of between-group intercept can hardly be zero, thus, in a formal model, their intercepts are likely to vary across groups. Therefore, a random intercept model or intercept-as-outcomes model should be considered.

For Construct2 and Construct3, results reveal that the high-level effect of person is not very important. Its LR test result (Prob >= chibar2 = 1.0000) shows the null hypothesis that intercept doesn’t vary across groups, can’t be rejected. However, this result doesn’t exclude the possibility that there is no other high-level effect! As I simulated this data by myself, I know that construct2 is also influenced by high-level effect of survey times (because I set construct value to consist of the value of survey time), even though it is not often a high-level effect in real practice.

**Part 2 - Multilevel Analysis**

whether conscientiousness (an individual-level personality trait) relates positively to job engagement (an individual-level motivational state)

whether transformational leadership (a group-level leadership variable) moderates the relationship between conscientiousness and engagement.

The individuals are nested within supervisors as noted by their individual and team IDs.

1. **Report and provide an interpretation of the results of your aggregation statistics. Explain why these are necessary, and why you computed them on the variable(s) you chose to compute them on.**

|  |  |
| --- | --- |
|  | Transformational leadership |
| ICC1 | .31 |
| ICC2 | .69 |
| F test of ICC | F(99.0, 400.0) = 3.28, Prob > F = 0.000 |
| Mean of Rwg, Uniform | .74 |
| Mean of Rwg, Skewed | .65 |

Transformational leadership should be included in computation, because later models requires this construct to be aggregated at higher level. Therefore, we have to justify such aggregation by showing its data has high agreement within groups. As transformational leadership is evaluated by team members, ICC2 is more suggested than ICC1. Its ICC2 results shows that the statistic is well performed (ICC2 = .69, *p* = 0.00). Meanwhile, Rwgs also indicate a moderate (.65) or strong (.74) agreement within groups.

1. **Report the results of your two series of models (ordered simple to complex). Be sure to report the key parameter estimates associated with each model.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | |
| consci |  | 1.772\*\*\* | 1.755\*\*\* | 0.896\*\*\* |  |  |  |  | |
|  |  | (0.0613) | (0.0528) | (0.219) |  |  |  |  | |
| trans |  |  | 1.632\*\*\* | 0.772\*\*\* |  | 1.642\*\*\* | 1.642\*\*\* | 1.635\*\*\* | |
|  |  |  | (0.110) | (0.188) |  | (0.115) | (0.115) | (0.109) | |
| consci#trans |  |  |  | 0.284\*\*\* |  |  |  |  | |
|  |  |  |  | (0.0699) |  |  |  |  | |
| consci\_gmc |  |  |  |  | 1.780\*\*\* | 1.764\*\*\* | 0.958\*\*\* | 0.942\*\*\* | |
|  |  |  |  |  | (0.0618) | (0.0533) | (0.222) | (0.221) | |
| consci\_gmc#trans |  |  |  |  |  |  | 0.270\*\*\* | 0.273\*\*\* | |
|  |  |  |  |  |  |  | (0.0708) | (0.0705) | |
| consci\_gm |  |  |  |  |  |  |  | 1.298\*\*\* | |
|  |  |  |  |  |  |  |  | (0.344) | |
| \_cons | 6.298\*\*\* | 1.009\*\*\* | -3.926\*\*\* | -1.318\* | 6.298\*\*\* | 1.285\*\*\* | 1.285\*\*\* | -2.569\* | |
|  | (0.165) | (0.163) | (0.382) | (0.588) | (0.165) | (0.363) | (0.363) | (1.078) | |
| var(Constant) |  |  |  |  |  |  |  |  | |
| \_cons | 2.528\*\*\* | 0.122\*\*\* | 0.770 | 0.0682\*\*\* | 0.121\*\*\* | 0.844 | 0.0650\*\*\* | 0.0647\*\*\* | |
|  | (0.193) | (0.0294) | (0.0584) | (0.0140) | (0.0295) | (0.0636) | (0.0244) | (0.0144) | |
| var(Residual) |  |  |  |  |  |  |  |  | |
| \_cons | 1.027 | 0.247\*\*\* | 0.274\*\*\* | 0.246\*\*\* | 0.246\*\*\* | 0.274\*\*\* | 0.247\*\*\* | 0.247\*\*\* | |
|  | (0.0363) | (0.00992) | (0.00971) | (0.00871) | (0.00986) | (0.00970) | (0.00993) | (0.00878) | |
| lns1\_1\_2 |  |  |  |  |  |  |  |  | |
| \_cons |  | 0.376 |  | 0.00787 | 2.684\*\*\* |  | 0.849 | 0.763 | |
|  |  | (0.189) |  | (0.0135) | (0.193) |  | (0.0636) | (0.0574) | |
| atr1\_1\_1\_2 |  |  |  |  |  |  |  |  | |
| \_cons |  | 1.220 |  | 8.425 | 1.655 |  | 1.709 | 6.343 | |
|  |  | (3.651) |  | (9404.4) | (1.160) |  | (2.410) | (327.5) | |
| *N* | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | |
| *AIC* | 1697.0 | 1130.5 | 1053.5 | 1014.8 | 1138.8 | 1062.0 | 1030.2 | 1018.9 | |
| *BIC* | 1709.7 | 1155.8 | 1074.6 | 1048.5 | 1164.1 | 1083.1 | 1064.0 | 1056.8 | |
| icc | 0.711 | 0.603 | 0.737 | 0.0310 | 0.916 | 0.755 | 0.775 | 0.755 | |
| ll | -845.5 | -559.3 | -521.8 | -499.4 | -563.4 | -526.0 | -507.1 | -500.4 | |
| df\_m | 0 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | |
| Standard errors in parentheses \* *p* < 0.05, \*\* *p* < 0.01, \*\*\* *p* < 0.001 | | | | | | | | |

Above table includes all key results. Model 1 is the null model. Model 2-4 are fitted with uncentered data and Model 5-7 are fitted with centered data. I also run model 8 with the group mean of conscientiousness added into the model, according to the requirement of Hoffman & Gavin (1998).

1. **Write a short description of the results, telling me what the analyses revealed about the data. This should look like a (very short) version of a journal article's results section, half a page or so.**

The results from the null model (Model 1) suggest that the team exerts a significant random effect on the intercepts (*var* = 2.528, *p* < .001). The variance explained by group level is about 71.1%. Therefore, the group effect emerges as a focal point of this model. Consistent with previous literatures (Model 2), the conscientiousness is positively related with job engagement with significance (*b*=1.772, *p*<.001). Further, we incorporated the group-level variable, transformational leadership, into our analysis. The findings from Model 3 reveal a positive relationship between transformational leadership and job engagement (*b*=1.632, *p*<.001), with the inclusion of this variable offering a marginal enhancement in model fit (AIC = 1053.5, BIC = 1074.6). When examining transformational leadership as a moderator (Model 4), the results align with our hypothesis: in the presence of high conscientiousness and transformational leadership, an augmented effect on job engagement is observed. At last, the robustness of these empirical findings is demonstrated in Models 5-8, which show that the results are not influenced by whether the independent variables are group mean centered.