Sampling Design and Survey Practice — Lab 4

November 24th, 2021

1 Cronbach's alpha

- Cronbach's alpha coefficient is a quality indicator of test scores.

$$\begin{aligned} \alpha &= \frac{k}{k-1}\left[1-\frac{\sum_{i=1}^{k}\sigma_i^2}{\sigma_t^2}\right], \\ \text{where } \sigma_i^2 &= \mathrm{Var}(X_i), \\ \sigma_t^2 &= \mathrm{Var}(X_1+\cdots+X_k) \end{aligned}$$

- It is estimated using the sample variance:

$$\begin{aligned} \hat{\alpha} &= \frac{k}{k-1}\left[1-\frac{\sum_{i=1}^{k}S_i^2}{S_t^2}\right], \\ \text{where } S_i^2 &= \widehat{\mathrm{Var}}(X_i), \\ S_t^2 &= \widehat{\mathrm{Var}}(X_1+\cdots+X_k) \end{aligned}$$

- We use the package **psych** and the function `alpha`.

```
library(psych)
# three survey questions on ten people
Q <- data.frame(Q1 = c(5, 5, 4, 4, 4, 2, 1, 3, 1, 2),
                Q2 = c(4, 5, 1, 3, 4, 1, 4, 1, 1, 3),
                Q3 = c(5, 4, 2, 4, 3, 2, 1, 1, 3, 2))
alpha(Q)
```

```
##
## Reliability analysis
## Call: alpha(x = Q)
##
##   raw_alpha std.alpha G6(smc) average_r S/N  ase mean  sd median_r
##       0.76      0.77    0.71      0.53 3.4 0.13  2.8 1.2     0.48
##
##  lower alpha upper     95% confidence boundaries
## 0.51 0.76 1.02
##
##  Reliability if an item is dropped:
##    raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## Q1      0.65      0.65    0.48      0.48 1.9     0.22    NA  0.48
## Q2      0.80      0.80    0.67      0.67 4.1     0.13    NA  0.67
## Q3      0.60      0.60    0.43      0.43 1.5     0.25    NA  0.43
##
```

```
##  Item statistics
##     n raw.r std.r r.cor r.drop mean  sd
## Q1 10  0.85  0.85  0.75   0.63  3.1 1.5
## Q2 10  0.78  0.77  0.56   0.50  2.7 1.6
## Q3 10  0.85  0.87  0.79   0.68  2.7 1.3
##
## Non missing response frequency for each item
##      1   2   3   4   5 miss
## Q1 0.2 0.2 0.1 0.3 0.2    0
## Q2 0.4 0.0 0.2 0.3 0.1    0
## Q3 0.2 0.3 0.2 0.2 0.1    0
```

- Inspect `raw_alpha` values. We see that Q2 is irrelevant.

2 Review of Final Projects

- We review two projects from 2018 sampling design class.
  - 학업/연애/동아리 만족도가 학교생활만족도에 미치는 영향
  - 설문조사 방법에 따른 피설문자의 응답 의향