SAKA003 Quantitative Methods: Multivariate Analysis
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# Lab Report 7 – Power Calculation

## *Introduction*

The dictator game is well known behavioral economics experiment consisting of two individuals, where a certain amount of money is given to only one of them who then needs to decide how much of it, she will give to the other. The second participant must accept whatever the "dictator" offers.

This game has been thoroughly utilized to understand the determinates of generosity under many different circumstances. In particular, I would explore whether people are more or less generous depending on the level money that it is at stake, being the main hypothesis that people gives proportionally less money when the stakes are higher rather than lower. Moreover, I would test this in situations when the stakes and their differences are meaningful to people.

## *Sample Size Determination*

This report contains an a-priori sample size estimation of the sample size required based on the results from previous literature on the subject. The estimation is powered to test the hypothesis with 90% power, while type I error should be lower than 5%.

The experimental design is a two-group with only post-treatment (high or low stakes) measure of "generosity". The statistical test required is the independent samples t-test, therefore I chose "Means: Difference between two independent means (two groups) in G*Power. This requires specifying the effect size (d), confidence level, power, and allocation ratio.

To determine the effect size, luckily there is a recent meta-analysis study by Larney et al. (2019), where the authors provide the results from several papers containing either "dictator" and "ultimatum" games with different stakes. This paper reports effect size (Cohen's d) and confidence intervals.

Given the objective stated above, I focused on studies that reported traditional "dictator" games with a comparatively big difference between high and low stakes (ratio of at least 5). The five studies selected (Harrison & El Mouden, 2011; Keuschnigg, Bader, & Bracher, 2016; Leibbrandt, Maitra, & Neelim, 2015; Raihani, Mace, & Lamba, 2013; Schier, Ockenfels, & Hofmann, 2016) are presented in Table 1, which includes the authors, sample size, stakes ratio, effect size (Cohen's d) and 95% confidence intervals. Also included are the effect size and confidence interval for the average of the 5 selected articles, and for all the articles included in the study (for dictator game). A positive effect size means people gave more with lower stakes (in accordance with the hypothesis).

For one article, Schier et al. (2016) I went back to the source and perform the calculations for the effect size based on the information available in the paper using the Effect Size Calculator (https://campbellcollaboration.org). I selected "t-test, unequal sample size" and entered the sample sizes (761 for low stakes, and 728 for high stakes) and the t value (4.46) and obtained d = 0.23 and 95% CI = (0.13, 0.33). The effect size obtained is the same presented in the meta-analysis, but the confidence interval is different.

Then, I proceeded to calculate sample sized for all the different effect sizes provided in Table 1 using G*power 3.1.9.6 for Mac, entering the corresponding effect size, $\alpha$=0.05, power=0.9, and allocation ratio=1. Sample sizes obtained – also shown in Table 1 – range from 30 to 5354. The average of the meta-analysis (Larney et al., 2019) seems to be a rather conservative effect size, while any effect size over 0.3 seems too optimistic. Therefore, considering the experimental design, I would select a sample size between 410 and 550, corresponding to effect sizes of 0.29 and 0.25 respectively.

This sample size was only met (end largely exceeded) by one of the studies (Schier et al., 2016), while all the other studies have sample sizes much lower to the required found here. This could be explained in terms of practical budgetary reasons: sample size of 500 with low and high stakes set at $10 and $80 USD would cost only in "prizes" $22,500; not a negligible amount of money, while also expectedly quite time consuming (also expensive).

One could try enlarging the effect size by increasing the stakes ratio. As seen in Table 1, with an effect size of d=1.1, the sample size required to achieve the power defined would be only 30. However, from the data available it is not possible to extract a clear relationship between stakes ratio and effect size. Moreover, in practice this would mean either increasing the higher stake or lowering the lower stake, leading to greater costs or loosing practical significance (as too low lower stake risks not being meaningful for the participants). This is why some of these experiments have been moved to developing countries where meaningful stakes and large differences are achievable at much lower costs (Larney et al., 2019).

Another alternative is to follow the study design of Schier et al. (2016), where subjects were selected randomly and invited to participate in an online survey that "contained several psychological tests on morality" (Schier et al., 2016, p. 110). The participants were given 10 tickets to an online raffle (with a pretty low but unknown probability of winning the prize), and they were asked how many would they be willing to give to an anonymous co-player. Roughly half of the participants were told the prize was $10, while the other half was told it was $500.

***Appendix***

Table 1. Inputs and Estimated Sample Sizes

| Source | N | Stakes ratio | Cohen's d | 95% CI | | Sample size |
|---|---|---|---|---|---|---|
| | | | | lb | ub | |
| Keuschnigg et al. 2016 | 190 | 10 | 0.17 | -0.12 | 0.45 | **1188** |
| Harrison et al. 2011 | 30 | 5 | 0.22 | -0.51 | 0.95 | **710** |
| Schier et al. 2016[1] | 1499 | 50 | 0.23 | 0.13 | 0.33 | **650** |
| Raihani et al. 2013 | 282 | 10 | 0.32 | 0.08 | 0.56 | **336** |
| Leibbrandt et al. 2015 | 45 | 100 | 1.10 | 0.47 | 1.72 | **30** |
| Average[2] | - | - | 0.41 | - | - | **206** |
| Average 2[3] | - | - | 0.23 | - | - | **650** |
| Larney et al. 2019[4] | - | - | 0.15 | 0.02 | 0.27 | **1524** |
| Minimum[5] | - | - | 0.08 | - | - | **5354** |

1. own estimation (not from Larney et al. 2019)
2. average of 5 selected studies
3. average of 5 selected studies w.o. Leibbrandt et al. 2015
4. average reported by Larney et al. 2019
5. average reported by Larney et al. 2019 minus one SD

***Links***

Papers: https://github.com/avonborries/SAKA003-VT20/tree/master/Lab%207

***References***


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Keuschnigg, M., Bader, F., & Bracher, J. (2016). Using crowdsourced online experiments to study context-dependency of behavior. *Social Science Research*, *59*, 68–82. https://doi.org/10.1016/j.ssresearch.2016.04.014

Larney, A., Rotella, A., & Barclay, P. (2019). Stake size effects in ultimatum game and dictator game offers: A meta-analysis. *Organizational Behavior and Human Decision Processes*, *151*(January), 61–72. https://doi.org/10.1016/j.obhdp.2019.01.002

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