

W241_Simulation_Final

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Power Calculation:

Pre Experiment Implementation - Power Calculation

A simulation algorithm was implemented to estimate the group sizes required to achieve 80% power. “No Incentive” was considered the control group, and “\$5 Incentive” was considered the main treatment group. The expected response rates were estimated as follows:

- 5% response rate for “No Incentive” group (no monetary incentive provided).
- 16% response rate for “\$5 Incentive” group (\$5 Amazon Gift card for participants answering the survey).

The response rates were estimated on the lower range to reflect the following:

- Participants were given only two weeks to respond (from October 31st to November 14th).
- One of the two weeks was a break at MIDS (Nov 8th to Nov 14th).
- No reminder was sent to participants.

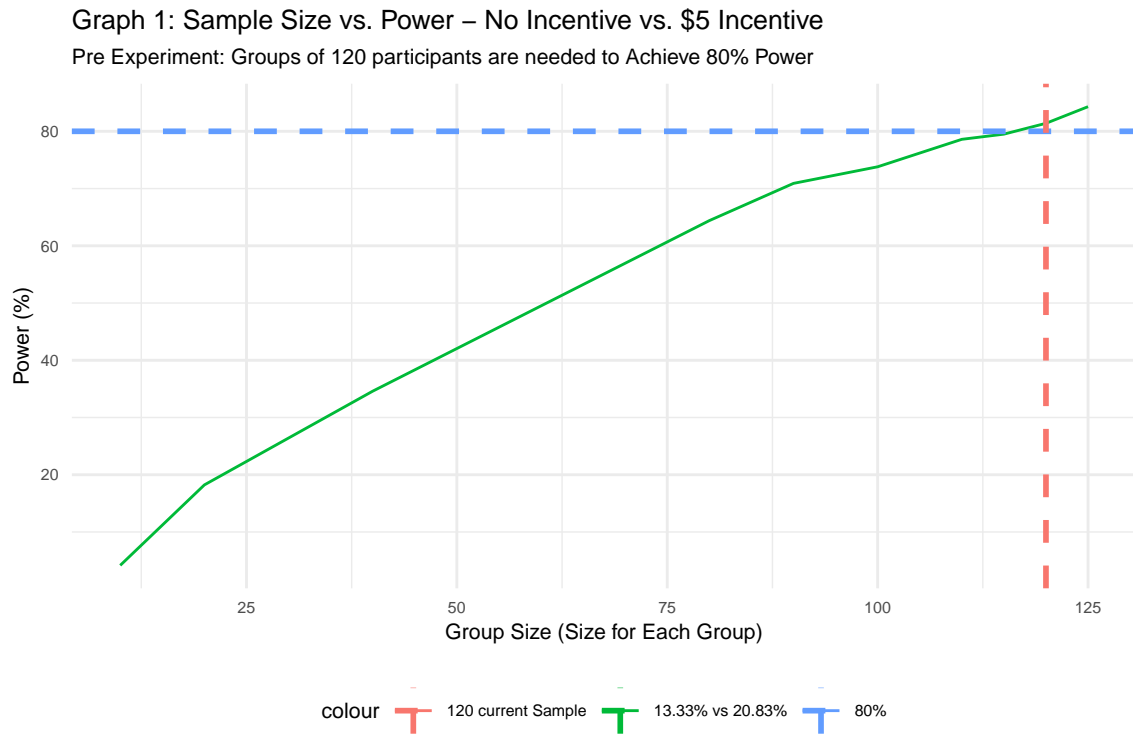
The following table summarizes the expected power versus group size, given the expected response rate. Groups of 120 participants are needed to achieve 80% power.

Table 1: Power Calculation:

Group Size	Power (%)
10	4.17
20	18.23
40	34.60
80	64.40
90	70.90
100	73.80
110	78.60
115	79.50
120	81.40
125	84.30

Note. No Incentive vs. \$5 Incentive.

The following graph presents the power calculation curve used to define group sizes to achieve 80% power. The red line indicates the power for group size of 120 participants, given the expected response rates.



Summary Response Rate by Treatment Group

Table 1 summarizes the response rate for each treatment group. Each treatment group includes 120 participants, and the response rates for “*No Incentive*” group was 13.33%, for “*\$5 Incentive*” group was 20.83%, and for “*\$100 Lottery*” group was 9.17%.

Table 2: Response Rate by Treatment.

Treatment	Group Size	Response (N)	Response (%)
No Incentive (Control)	120	16	13.33
\$5 Incentive	120	25	20.83
\$100 Lottery	120	11	9.17

Note. Summary response rate by treatment.

Statistical Power Calculation - Post Study Implementation

Given the the observed response rates (see Table 1) in the experiment, using the power simulation comparing the “No Incentive” and “\$5 Incentive” groups, **Table 2** presents a summary of the power calculation for different sample sizes. Based on this simulation, the power for this experiment (120 participants per group) is around 32.8%. To achieve a power of 80%, it requires groups of around 395.

Table 3: Power Calculation:

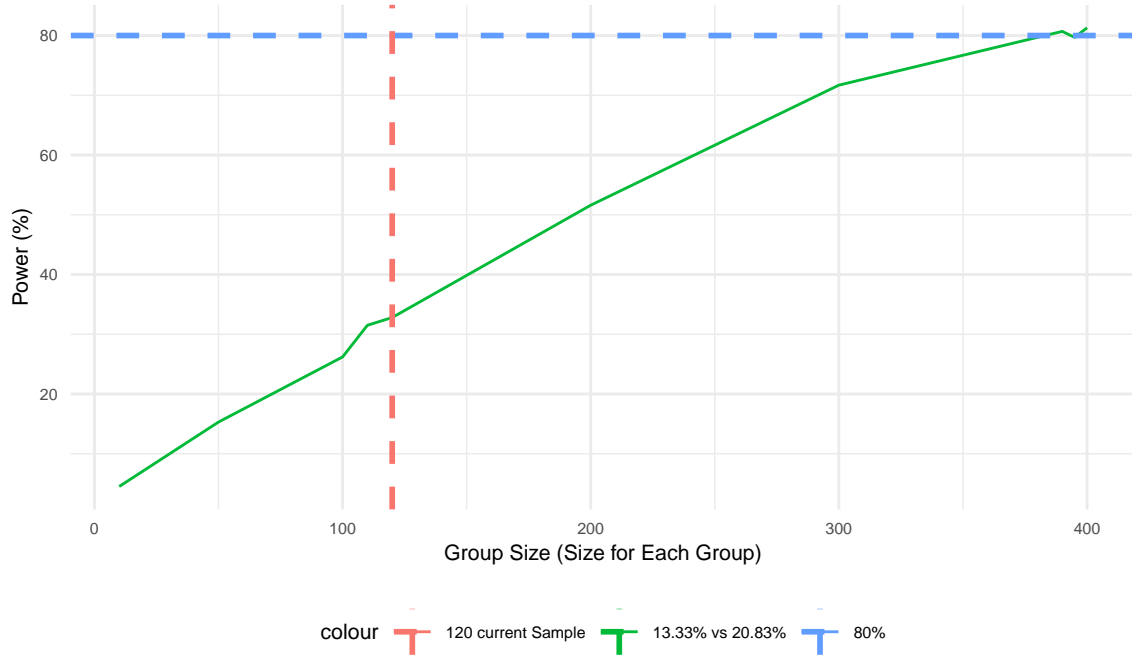
Group Size	Power (%)
10	4.52
50	15.30
100	26.20
110	31.50
120	32.80
200	51.60
300	71.70
390	80.70
395	79.70
400	81.30

Note. No Incentive vs. \$5 Incentive.

Graph 2 presents the power calculation curve for “No Incentive” versus “\$5 Incentive” groups. The red line indicates the power for the current experiment given the observed response rates with group sizes of 120 participants.

Graph 2: Sample Size vs. Power – No Incentive vs. \$5 Incentive

With a Group Size of 120, Experiment's Power is around 34%



In addition, using the power simulation comparing the “\$5 Incentive” and “\$100 Lottery” groups, given the observed response rates (see Table 1), **Table 3** presents a summary of the power calculation for different experiment sample sizes. Based on this simulation, the power for this experiment (120 participants per group) is around 73.7%. To achieve a power of 80%, it is required groups of around 145 participants (given the observed response rates).

Table 4: Power Calculation:

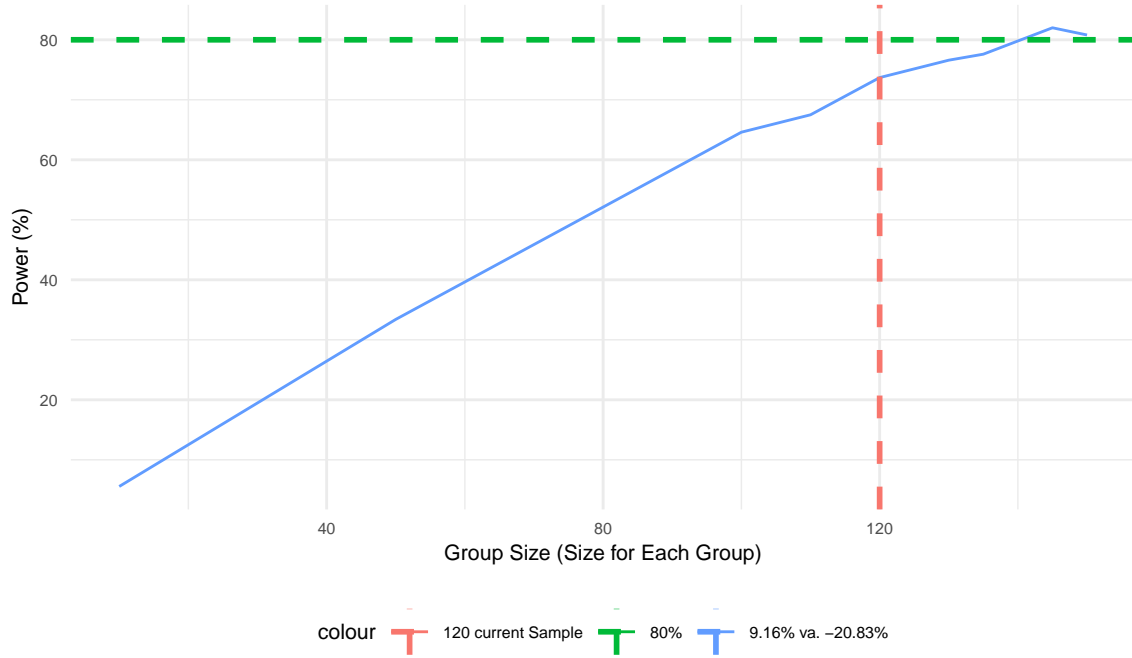
Group Size	Power (%)
10	5.56
50	33.40
100	64.60
110	67.50
120	73.70
130	76.60
135	77.60
140	79.80
145	82.00
150	80.80

Note. \$5 Incentive vs. \$100 Lottery.

Graph 3 presents the power calculation curve for “\$5 Incentive” versus “\$100 Lottery” groups. The red line indicates the power for the current experiment given the observed response rates, and group sizes of 120 participants.

Graph 3: Sample Size vs. Power. \$5 Incentive vs. \$100 Lottery.

With a Group Size of 120, Experiment's Power is around 72%



#T-Test Analysis:

T-test analysis was performed to compare the following response rates:

- (1) "\$5 Incentive" group (20.83%) vs. "No Incentive" group (13.33%).
- (2) "\$100 Lottery" group (9.17%) vs. "No Incentive" group (13.33%).
- (3) "\$100 Lottery" group (9.17%) vs. "\$5 Incentive" group (20.83%).

The table below presents a summary of t-test results. In summary:

- (1) With a p-value of 0.1237585 (> 0.05), we fail to reject the null hypothesis of the average response rate being equal. Thus, there is not enough evidence supporting that the average response rates for "\$5 Incentive" (20.83%) is statistically different from the average response rates for "No Incentive" (13.33%), at a 95% confidence.
- (2) With a p-value of 0.3090886 (> 0.05), we fail to reject the null hypothesis of the average response rate being equal. Thus, there is not enough evidence supporting that the average response rates for "\$100 Lottery" (9.17%) is statistically different from the average response rates for "No Incentive" (13.33%), at a 95% confidence.
- (3) With a p-value of 0.011323 (< 0.05), we reject the null hypothesis of the average response rate being equal. Thus, there is not enough evidence supporting that the average response rates for "\$100 Lottery" (9.17%) is statistically different from the average response rates for "\$5 Incentive" (20.83%), at a 95% confidence.

Table 5: T-Test Summary Table:

Comparison	P-Value	CI_Lower	CI_Upper	Mean Grp 1	Mean Grp 2
No Treatment vs. \$5 Incentive	0.12	-0.02	0.17	0.21	0.13
No Treatment vs. \$100 Lottery	0.31	-0.12	0.04	0.09	0.13
\$5 Incentive vs. \$100 Lottery	0.01	-0.21	-0.03	0.09	0.21

Note. Comparing \$5 Incentive versus other treatments.

Treatment - Group Analysis:

Table 6: Group Distribution and Response Rate by Cohort and Treatment Group:

Cohort	Treatment Group	Size	Response (N)	Response Rate (%)
Summer 2020	No Incentive (Control)	24	2	8.33
Summer 2020	\$5 Incentive	24	6	25.00
Summer 2020	\$100 Lottery	24	1	4.17
Fall 2020	No Incentive (Control)	24	0	0.00
Fall 2020	\$5 Incentive	24	4	16.67
Fall 2020	\$100 Lottery	24	4	16.67
Spring 2021	No Incentive (Control)	24	5	20.83
Spring 2021	\$5 Incentive	24	3	12.50
Spring 2021	\$100 Lottery	24	1	4.17
Summer 2021	No Incentive (Control)	24	4	16.67
Summer 2021	\$5 Incentive	24	4	16.67
Summer 2021	\$100 Lottery	24	0	0.00
Fall 2021	No Incentive (Control)	24	5	20.83
Fall 2021	\$5 Incentive	24	8	33.33
Fall 2021	\$100 Lottery	24	5	20.83

Note. Covariate analysis - checking for balance of cohorts across treatment groups.

The following table presents the response rate across treatment groups and In_PST. While the treatment groups seems to have similar participants from the Pacific Time (In PST = 1), the range of the response rates goes between 4.5454545% and 22.0588235%. As there is a relatively wide range of response rates, it is important to explore the impact of In_PST in the linear models as a covariate.

\begin{table}[H]

\caption{Group Distribution by Treatment and In_PST:}

Treatment Group	In PST	Size	Response (N)	Response Rate (%)
No Incentive (Control)	1	54	8	14.81
No Incentive (Control)	0	66	8	12.12
\$5 Incentive	0	68	15	22.06
\$5 Incentive	1	52	10	19.23
\$100 Lottery	1	54	8	14.81
\$100 Lottery	0	66	3	4.55

\end{table}

No Incentive (Control) and \$100 Lottery treatment share the same number of observations who are in_PST, so no covariate balance check is needed. However, No Incentive (Control)

and \$5 Incentive treatment differ in the number of observations who are in_PST, so a covariate balance check is needed.

Covariate Balance Check on PST: No Incentive vs. 5 Per Survey Incentive	
	<i>Dependent variable:</i>
	in_PST
5 Dollar Incentive	-0.017 (0.065)
Baseline	0.450*** (0.046)
Observations	240
R ²	0.0003
Adjusted R ²	-0.004
Residual Std. Error	0.499 (df = 238)
F Statistic	0.067 (df = 1; 238)
Note:	*p<0.1; **p<0.05; ***p<0.01

Randomization was successful because the covariate balance check reveals that the proportion of observations in_PST does not differ statistically significantly between control and the \$5 Incentive treatment.

Regression Tables

Between No Incentive vs. \$5 Incentive

Table 1: Linear Regression - No Incentive vs. 5 Per Survey Incentive

<i>Dependent variable:</i>				
	Response Rate			
	Simple (1)	Cohort Included (2)	PST included (3)	Cohort and PST included (4)
5 Dollar Incentive	0.075 (0.049)	0.075 (0.049)	0.075 (0.049)	0.075 (0.049)
Fall 2020		-0.083 (0.067)		-0.083 (0.068)
Fall 2021		0.104 (0.085)		0.104 (0.085)
Spring 2021		0.000 (0.078)		-0.0002 (0.078)
Summer 2021		0.000 (0.078)		-0.0003 (0.078)
In PST			-0.001 (0.049)	0.002 (0.049)
Baseline	0.133*** (0.031)	0.129** (0.055)	0.134*** (0.037)	0.129** (0.057)
Cohort fixed effects	No	Yes	No	Yes
PST fixed effects	No	No	Yes	Yes
Baseline is:	5 dollar.	5 dollar, Summer 2020.	5 dollar, Not PST.	5 dollar, Summer 2020, Not PST.
Observations	240	240	240	240
R ²	0.010	0.035	0.010	0.035
Adjusted R ²	0.006	0.014	0.002	0.010
Residual Std. Error	0.376 (df = 238)	0.374 (df = 234)	0.377 (df = 237)	0.375 (df = 233)
F Statistic	2.386 (df = 1; 238)	1.694 (df = 5; 234)	1.188 (df = 2; 237)	1.406 (df = 6; 233)
<i>Note:</i>				*p<0.1; **p<0.05; ***p<0.01

Between No Incentive vs \$100 Lottery

Table 2: Linear Regression - No Incentive vs. 100 Lottery Win

	<i>Dependent variable:</i>			
	Response Rate			
	Simple (1)	Cohort Included (2)	PST included (3)	Cohort and PST Included (4)
100 Dollar Lottery Incentive	-0.042 (0.041)	-0.042 (0.041)	-0.042 (0.041)	-0.042 (0.041)
Fall 2020		0.021 (0.055)		0.021 (0.055)
Fall 2021		0.146** (0.070)		0.147** (0.070)
Spring 2021		0.063 (0.060)		0.053 (0.059)
Summer 2021		0.021 (0.054)		0.018 (0.054)
In PST			0.065 (0.042)	0.067 (0.042)
Baseline	0.133*** (0.031)	0.083* (0.043)	0.104*** (0.036)	0.055 (0.049)
Cohort fixed effects	No	Yes	No	Yes
PST fixed effects	No	No	Yes	Yes
Baseline is:	5 dollar.	5 dollar, Summer 2020.	5 dollar, Not PST.	5 dollar, Summer 2020, Not PST.
Observations	240	240	240	240
R ²	0.004	0.031	0.015	0.042
Adjusted R ²	0.0002	0.011	0.006	0.018
Residual Std. Error	0.317 (df = 238)	0.315 (df = 234)	0.316 (df = 237)	0.314 (df = 233)
F Statistic	1.039 (df = 1; 238)	1.521 (df = 5; 234)	1.775 (df = 2; 237)	1.720 (df = 6; 233)
<i>Note:</i>				*p<0.1; **p<0.05; ***p<0.01

Between \$5 Incentive vs \$100 Lottery

Table 3: Linear Regression - 5 Per Survey Incentive vs. 100 Lottery Win

	<i>Dependent variable:</i>			
	Response Rate			
	Simple (1)	Cohort Included (2)	PST included (3)	Cohort and PST Included (4)
100 Dollar Lottery Incentive	-0.117** (0.046)	-0.117** (0.046)	-0.117** (0.046)	-0.117** (0.046)
Fall 2020		0.021 (0.075)		0.022 (0.076)
Fall 2021		0.125 (0.082)		0.122 (0.082)
Spring 2021		-0.063 (0.065)		-0.065 (0.065)
Summer 2021		-0.063 (0.064)		-0.068 (0.063)
In PST			0.037 (0.047)	0.042 (0.046)
Baseline	0.208*** (0.037)	0.204*** (0.061)	0.192*** (0.043)	0.188*** (0.066)
Cohort fixed effects	No	Yes	No	Yes
PST fixed effects	No	No	Yes	Yes
Baseline is:	5 dollar.	5 dollar, Summer 2020.	5 dollar, Not PST.	5 dollar, Summer 2020, Not PST.
Observations	240	240	240	240
R ²	0.027	0.064	0.029	0.067
Adjusted R ²	0.023	0.044	0.021	0.043
Residual Std. Error	0.354 (df = 238)	0.350 (df = 234)	0.354 (df = 237)	0.350 (df = 233)
F Statistic	6.526** (df = 1; 238)	3.200*** (df = 5; 234)	3.590** (df = 2; 237)	2.807** (df = 6; 233)
<i>Note:</i>				*p<0.1; **p<0.05; ***p<0.01

Big Regression Tables

Table 4: Linear Regression - Including All Treatments

	<i>Dependent variable:</i>			
	Response Rate			
	Simple (1)	Cohort Included (2)	PST Included (3)	Cohort and PST Included (4)
100 Dollar Lottery Incentive	-0.117** (0.046)	-0.117** (0.046)	-0.117** (0.046)	-0.117** (0.046)
No Incentive	-0.075 (0.049)	-0.075 (0.049)	-0.076 (0.049)	-0.076 (0.049)
Fall 2020		-0.014 (0.054)		-0.014 (0.054)
Fall 2021		0.125* (0.064)		0.124* (0.065)
Spring 2021		-0.000 (0.055)		-0.004 (0.055)
Summer 2021		-0.014 (0.054)		-0.019 (0.053)
In PST			0.034 (0.038)	0.037 (0.037)
Baseline	0.208*** (0.037)	0.189*** (0.053)	0.194*** (0.041)	0.175*** (0.056)
Cohort fixed effects	No	Yes	No	Yes
PST fixed effects	No	No	Yes	Yes
Baseline is:	5 dollar.	5 dollar, Summer 2020.	5 dollar, Not PST.	5 dollar, Summer 2020, Not PST.
Observations	360	360	360	360
R ²	0.019	0.042	0.021	0.044
Adjusted R ²	0.013	0.025	0.013	0.025
Residual Std. Error	0.350 (df = 357)	0.348 (df = 353)	0.350 (df = 356)	0.348 (df = 352)