Impact of Different Incentives on Response Rate for an Academic Survey

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4/29/2021

Introduction:

Nowadays, checking emails all the time has become one of the major "stresses" for graduate students. As most students are inundated with a great amount of information, there are increasing possibilities of unwillingness to open and read every message. This could be harmful for academic organizations who are conducting research by sending surveys to student email addresses. To provide several solutions that can help these institutions to conduct more successful research, we start an experiment to discover what motivates students to open their emails and complete the survey.

Previous research has discussed the effect of several methods on survey response rates. Ryu, E. (2006) discovered a significant difference between response rate with monetary incentives and non-monetaries. Furse, D. H., & Stewart, D. W. (1982) indicates that charity will not improve response rates while research in Robertson, D. H., & Bellenger, D. N. (1978) shows significant improvement. Petrovčič, A. et al., (2016) points out that sense of community does not significantly change the response rates. Building on top of these discoveries, we will send one type of survey with a raffle (monetary), another by mentioning donation to charity, and the other with emotional words that may evoke the sense of community.

Method

Experimental Design

We utilize Qualtrics to design a survey about how COVID impacts academic performance and behavior and draft and use Mailchimp to deliver four different emails including the survey, one belongs to control and the other three belongs to the treatment. Since our research focuses on whether students will read the email and click on the survey, we mainly keep track of the open rate of the email and the click rate of the survey link. We await the survey results for two days and send another reminder. The survey was closed two days after the reminder was released.

Participants

Our participants contain all students from the MSMFT program of class 2021 and 2022 at Questrom School. We Exclude MSBA students to prevent interference of participants since MSBA students are aware of this experiment and can probably be notified to fill out the survey from other resources, such as learning this information from their classmates.

Treatment and Control Group

To find out what types of email are the most appealing to students, we create four groups to proceed our analysis: control, treatment_arm_1, treatment_arm_2, and treatmet_arm_3. We design customized emails including our academic survey for each group and send it to assigned participants in each category. The control group receives an normal informational email asking them to participate in the academic survey. For treatment_arm_1, we offer a chance to win a monetary incentive raffle of $5 for those who complete

the survey. For treatment_arm_2, we mention that we will donate an amount of money to charity if the recipients fill out the survey. For treatment_arm_3, we add an appealing text that urges the goodwill of others. To ensure excludability, titles of all emails are starting from "BU Academic survey" and specific information for treatment groups are added on top of original message of control group.

Hypothesis

- Null Hypothesis (H0) = Treatment will not result in change in the Response Rate (ATE == 0)
- Alternative Hypothesis (H1) = Treatment Response Rate is not equal to Control Response Rate (ATE != 0)

R Markdown

```
library(ggplot2)
library(fixest)
library(broom)
library(pwr)
library(data.table)
set.seed(830)
```

Statiscal Power Analysis

To construct the power analysis we see that d=.3 allows us have a number of observations we can collect feasibly.

```
#number of observations

pwr.t.test(n=NULL, d = 0.3, power = 0.8, sig = 0.05)
```

```
##
##      Two-sample t test power calculation
##
##               n = 175.3847
##               d = 0.3
##       sig.level = 0.05
##           power = 0.8
##     alternative = two.sided
##
## NOTE: n is number in *each* group
```

Seeing the MSMFT class of 2022 data.

```
contacts<- fread('ContactPool.csv')
head(contacts)
```

```
##    Program Year              Name           Email
## 1:   MSMFT 2022  Jung Cheng Chang junchang@bu.edu
## 2:   MSMFT 2022        Anran Chen   archen@bu.edu
## 3:   MSMFT 2022         Chen Chen cchen489@bu.edu
## 4:   MSMFT 2022         Fuyu Chen   fychen@bu.edu
## 5:   MSMFT 2022 Jonathan Chisholm    jchis@bu.edu
## 6:   MSMFT 2022      Junfeng Ding junfding@bu.edu
```

```
nrow_co <- nrow(contacts)
ncol_co <- ncol(contacts)
message('The sample size of MSMFT Class 2022 this dataset is ', nrow_co, ' rows and ', ncol_co, ' colum
```

```
## The sample size of MSMFT Class 2022 this dataset is 143 rows and 4 columns
```

Code above that cut off in the PDF we are attaching it below:

message('The sample size of MSMFT Class 2022 this dataset is', nrow_co, ' rows and ', ncol_co,' columns')

Randomization

We utilize a blocking method and randomize the data with rand() function, which shuffle the students from 2021 and 2022 classes. We are unable to proceed with a balance check as demographic information regarding MSMFT students is not accessible.

```
contact_2021 <- contacts[Year==2021, ]
contact_2022 <- contacts[Year==2022, ]

contact_2021 <- contact_2021[sample(1:nrow(contact_2021)), ]
contact_2022 <- contact_2022[sample(1:nrow(contact_2022)), ]
```

Assigning people to control and treatment arms, whether they receive the treatment, 1 = received treatment, 0 = did not receive treatment.

```
contact_2021[, any_treatment:=0]
contact_2021[c(21:77), any_treatment:=1]

#treatment arms
contact_2021[, treatment_arm:=0]
contact_2021[c(21:39), treatment_arm:=1]
contact_2021[c(40:58), treatment_arm:=2]
contact_2021[c(59:77), treatment_arm:=3]
```

First, we assign whether a student is either treatment or control (1=treatment, 0=control). Next within the treatment group, we assign people to 1 of 3 treatment arms.

```
contact_2022[, any_treatment:=0]
contact_2022[c(17:66), any_treatment:=1]
#treatment arms
contact_2022[, treatment_arm:=0]
contact_2022[c(17:33), treatment_arm:=1]
contact_2022[c(34:49), treatment_arm:=2]
contact_2022[c(50:66), treatment_arm:=3]
```

Collection of data

After receiving the response from MSMFT students, we download the data from MailChimp and merge data from all groups into a csv file. We also create three variables: one separates the treatment and control, another labels the treatment arm, and the other indicates the type of gender. These new features are helpful for our further data analysis process. We manipulated the results obtained in mailchimp through a series of merges in python.

```
control <- fread('control.csv')
treatment1 <- fread('treatment1.csv')
treatment2 <- fread('treatment2.csv')
treatment3 <- fread('treatment3.csv')
```

Dimensions of data above.

```
nrow_c <- nrow(control)
ncol_c <- ncol(control)
message('The sample size of this dataset is ', nrow_c, ' rows and ', ncol_c, ' columns')
```

```
## The sample size of this dataset is 40 rows and 4 columns
```

```
nrow_t1 <- nrow(treatment1)
ncol_t1 <- ncol(treatment1)
message('The sample size of this dataset is ', nrow_t1, ' rows and ', ncol_t1, ' columns')
```

```
## The sample size of this dataset is 42 rows and 4 columns
```

```
nrow_t2 <- nrow(treatment2)
ncol_t2 <- ncol(treatment2)
message('The sample size of this dataset is ', nrow_t2, ' rows and ', ncol_t2, ' columns')
```

```
## The sample size of this dataset is 35 rows and 4 columns
```

```
nrow_t3 <- nrow(treatment3)
ncol_t3 <- ncol(treatment3)
message('The sample size of this dataset is ', nrow_t3, ' rows and ', ncol_t3, ' columns')
```

```
## The sample size of this dataset is 36 rows and 4 columns
```

Adding an additional column with the treatment arms and assigning it to the correct treatment, or 0 in the case that it is a control.

```
#Create treatment arms: control = 0, treatment1 = 1, treatment2 = 2, treatment3 = 3
control[, treatment_arms := 0]
treatment1[, treatment_arms := 1]
treatment2[, treatment_arms := 2]
treatment3[, treatment_arms := 3]
#create treatment column, which control = 0, and other treatments = 1
control[, treatment := 0]
treatment1[, treatment := 1]
treatment2[, treatment := 1]
treatment3[, treatment := 1]
```

Merging the above data together, and deleting our emails (we used a test when sending emails).

```
full_data <- rbind(control,treatment1, treatment2,treatment3)
full_data <- full_data[full_data$`Email Address` !=  'selmasen@bu.edu', ]
full_data <- full_data[full_data$`Email Address` !=  'chhou@bu.edu', ]
full_data <- full_data[full_data$`Email Address` !=  'wzhang97@bu.edu', ]
full_data <- full_data[full_data$`Email Address` !=  'shamika@bu.edu', ]
full_data <- full_data[full_data$`Email Address` !=  'marodh@bu.edu', ]
full_data <- full_data[full_data$`Email Address` !=  'jnagesh@bu.edu', ]
```

Final dataset that would be used for further analysis.

```
full_data <- fread("FullDataResp.csv")
head(full_data)
```

```
##      Email Address Clicks Opens treatment_arms treatment response gender
## 1:  kent159@bu.edu      0     3              0         0        0      1
## 2:     qich@bu.edu      0     0              0         0        0      0
## 3: xiangyiz@bu.edu      0     1              0         0        0      0
## 4: langxiao@bu.edu      0     0              0         0        0      1
## 5: xinyasun@bu.edu      0     0              0         0        0      0
## 6: jing0047@bu.edu      0     0              0         0        0      0
```

```
nrow_full_data <- nrow(full_data)
ncol_full_data <- ncol(full_data)
message('The sample size of this dataset is ', nrow_full_data, ' rows and ', ncol_full_data, ' columns')
```

```
## The sample size of this dataset is 143 rows and 7 columns
```

Randomization Check/Balance Check

```
library(broom)
gender_t_test <- t.test(full_data[treatment == 1, gender], full_data[treatment == 0, gender])

gender_t_test
```

```
##
##  Welch Two Sample t-test
##
## data:  full_data[treatment == 1, gender] and full_data[treatment == 0, gender]
## t = -0.076749, df = 57.348, p-value = 0.9391
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.2006500  0.1858352
## sample estimates:
## mean of x mean of y
## 0.5925926 0.6000000
```

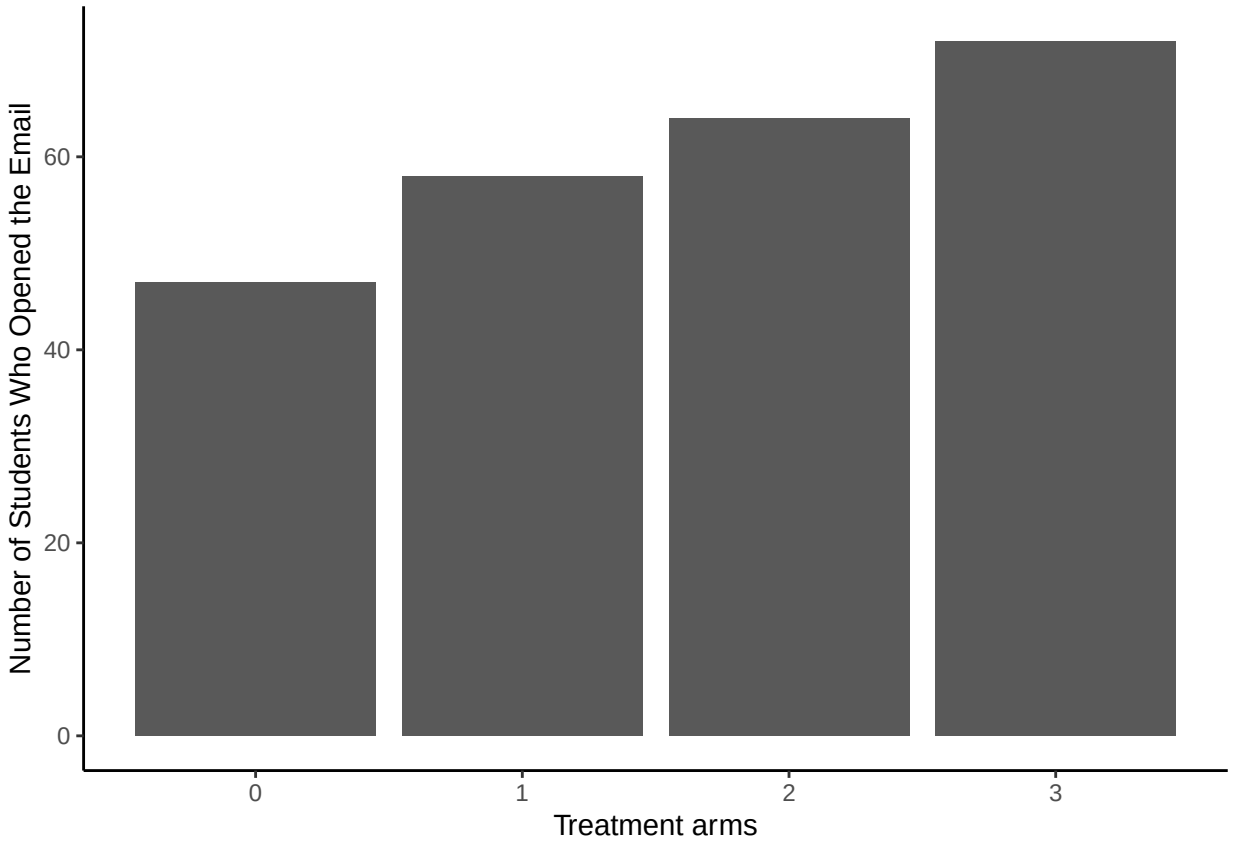
As we can see from the t-test above, the mean of x(treatment = 0.5926) and the mean of y(control = 0.6) have not much difference. We can't do more further balance check for each individual treatment arms due to data collection restrictions.

Exploratory Data Analysis

In order to do further analysis we added the response column to our dataset to check how the response rate was.For each group we have three variables to analyze. The 'Opens' that indicates whether they have opened the email or not. The 'Clicks' to check if participants have clicked on the survey link. And the 'response' which shows which participants who have completed the survey. With the data we have, we visualized the rate for each one in the control group and the three treatment arms. The plots below display the number of students that responded. Although the students who opened the email is the most in treatment arm3, we observe that a few of them have clicked on the link and none of them have completed the survey.The highest number of students who have completed the survey are in the treatment arm1. As the plots indicate in treatment arm1 among the students who clicked on the survey link only one person didn't complete the survey, which indicates that monetary incentive seems to be a good motivation to complete the survey. Also we can see that after treatment arm1 the highest rate among students who opened the email and clicked on the link is in the control group. Among the 3 people who clicked on the link 2 of them completed the survey. Next we run a number regressions to analyze the performance of the students in different ways in order to analyze the effect of being in a treatment (being offered different incentives) on the response rate of an academic survey.

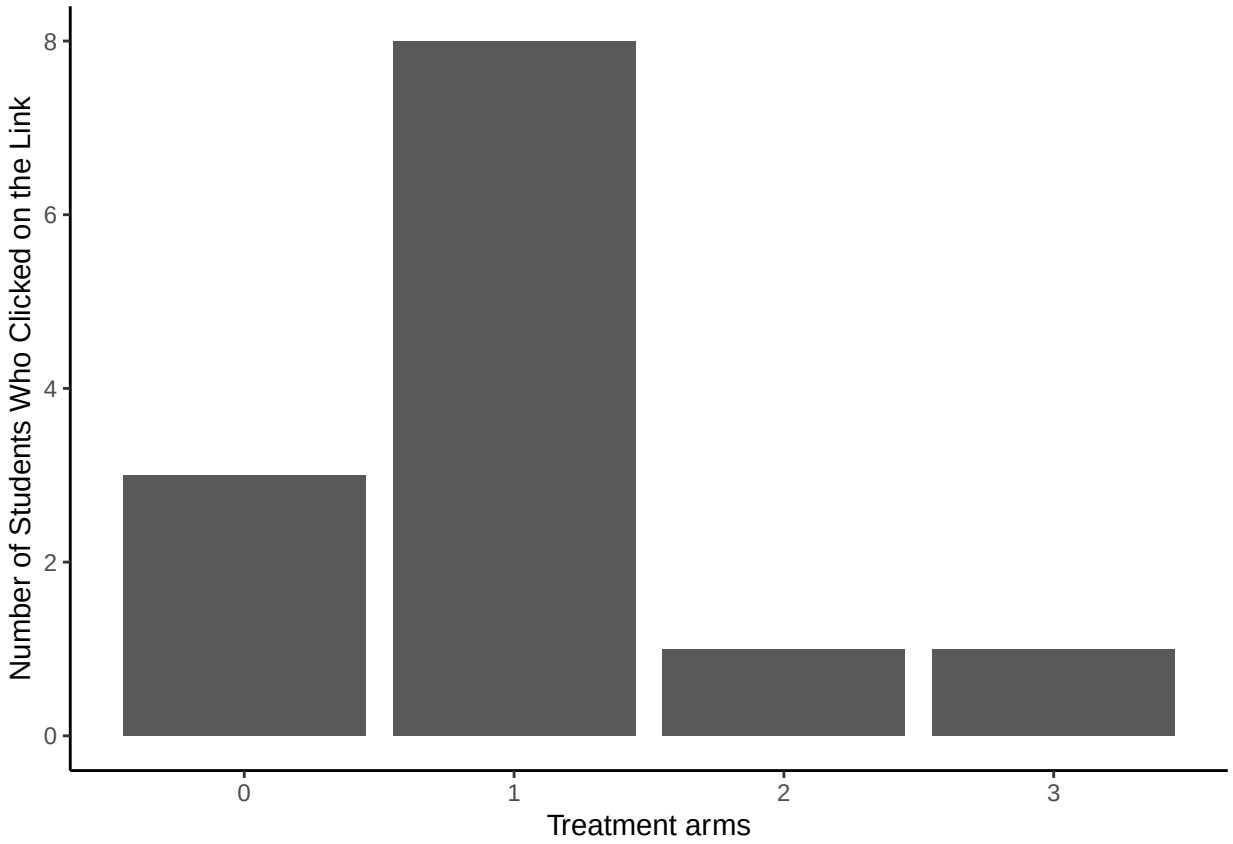
```
agg_data <- full_data[, list(num_opens = sum(Opens)), list(treatment_arms)]

ggplot(agg_data, aes(x = treatment_arms, y = num_opens)) + geom_bar(stat = 'identity', position = 'dodg
ylab("Number of Students Who Opened the Email") + theme_classic() +
theme(legend.title=element_blank())
```



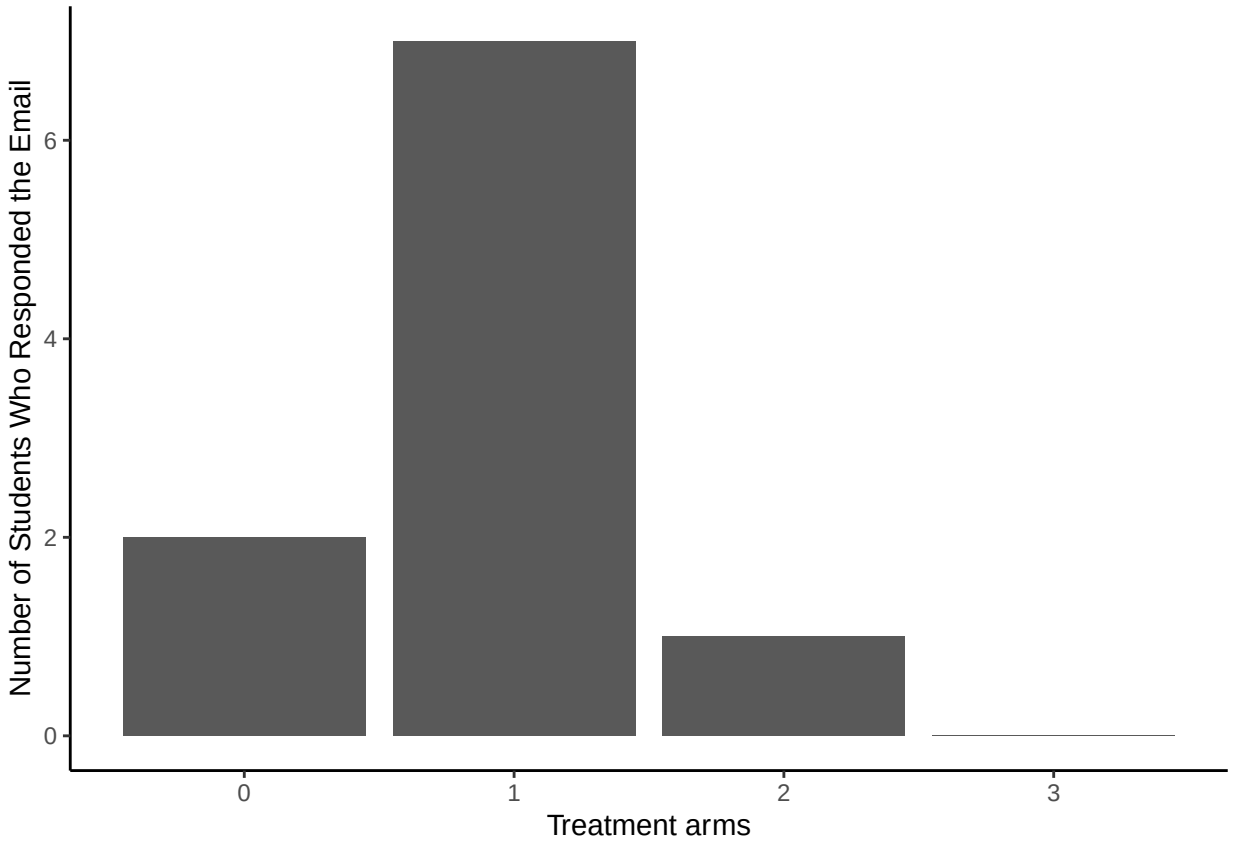

```
agg_data <- full_data[, list(num_clicks = sum(Clicks)), list(treatment_arms)]

ggplot(agg_data, aes(x = treatment_arms, y = num_clicks)) + geom_bar(stat = 'identity', position = 'dod
ylab("Number of Students Who Clicked on the Link") + theme_classic() +
theme(legend.title=element_blank())
```




```
agg_data <- full_data[, list(num_response = sum(response)), list(treatment_arms)]

ggplot(agg_data, aes(x = treatment_arms, y = num_response)) + geom_bar(stat = 'identity', position = 'd
ylab("Number of Students Who Responded the Email") + theme_classic() +
theme(legend.title=element_blank())
```



Average Treatment Effect(ATE)

Calculating our ATE manually.

```
ate <- full_data[treatment == 1, mean(response)] - full_data[treatment == 0, mean(response)]
ate
```

```
## [1] 0.01693122
```

Calculating ATE with linear regression, we will use feols since the precision is better.

```
this_reg <- feols(response ~ treatment, data = full_data, se='white')
etable(this_reg)
```

```
##                         this_reg
## Dependent Var.:         response
##
## (Intercept)      0.0571 (0.0395)
## treatment        0.0169 (0.0470)
## ---------------- ---------------
## S.E. type        Heteroske.-rob.
## Observations                 143
## R2                       0.00081
## Adj. R2                 -0.00627
```

Interpretation of ATE: there is some effect of the treatment (.016), however is it not statistically significant (as shown by the p-value). Hence, we cannot reject the null that the treatment made a difference. If we increase the sample size, thus we can have higher statistical power, we may have detected a statistically significant effect of the treatment.

Conditional Average Treatment Effect(CATE)

Number of Clicks on the Survey link

```
conditional_clicked_ate<- full_data[Clicks>=1,]
conditonal_clicked_reg <- feols(response ~ treatment, data = conditional_clicked_ate, se='white')
etable(conditonal_clicked_reg)
```

```
##                 conditonal_clicke..
## Dependent Var.:            response
##
## (Intercept)     1.000*** (1.38e-15)
## treatment          -0.2000 (0.1386)
## _______________ ___________________
## S.E. type       Heteroskedast.-rob.
## Observations                    12
## R2                         0.04000
## Adj. R2                   -0.05600
```

Conditional ATE: conditional on whether they click

Interpretation: Given that a student has clicked on the survey, the response rate is negative (-.2) and statistically insignificant. A potential reason the estimate of the treatment is negative is because students could have clicked the survey, seen the length, and then left without completing or opened the survey link and forgot to fill it out.

Number of Opens on the Email

```
#conditional ate, conditional on who opened it
conditional_opened_ate <-full_data[Opens>=1, ]
conditonal_opens_reg <- feols(response ~ treatment, data = conditional_opened_ate , se='white')
etable(conditonal_opens_reg)
```

```
##                 conditonal_op..
## Dependent Var.:        response
##
## (Intercept)     0.0952 (0.0648)
## treatment       0.0174 (0.0751)
## _______________ _______________
## S.E. type       Heteroske.-rob.
## Observations                 92
## R2                      0.00055
## Adj. R2                -0.01055
```

Conditional ATE: conditional on whether students opened the email.

Interpretation: Given that a student has opened the email, the response rate is .017438 and is not statistically significant. This estimate is positive as unless someone opens the email, they cannot fill out this survey.

Regression of Different Treatment Arms on Response

```
reg_treatment1 <- feols(response ~ treatment, data=full_data[(treatment_arms==1 | treatment==0)])
reg_treatment2 <- feols(response ~ treatment, data=full_data[treatment_arms==2 | treatment==0])
reg_treatment3 <- feols(response ~ treatment, data=full_data[treatment_arms==3 | treatment==0])
etable(reg_treatment1, reg_treatment2, reg_treatment3)
```

```
##                   reg_treatment1   reg_treatment2   reg_treatment3
```

```
## Dependent Var.:         response         response         response
##
## (Intercept)      0.0571 (0.0556)  0.0571 (0.0347) 0.0571* (0.0279)
## treatment       0.1320. (0.0775) -0.0286 (0.0490) -0.0571 (0.0392)
## _______________ ________________ ________________ ________________
## S.E. type                Standard         Standard         Standard
## Observations                   72               70               71
## R2                        0.03982          0.00498          0.02981
## Adj. R2                   0.02611         -0.00966          0.01575
```

Interpretation of above regressions: For treatment arm 1 , the effect is positive (.013) probably due to the monetary incentive. Regarding treatment arm 2, the effect is negative (-.028) - this was the charity incentive. A potential reason for this negative value could be that people were not as responsive to charity donations. Treatment arm 3 which was the pathos appeal is also negative (-.0571) and more negative than treatment arm 2. A possible reason could be that the email was too lengthy and potentially people could not take the time to read it. It is important to note that none of the effect sizes are statistically significant.

Heterogenous Treatment Effect of Gender

Gender: 1 = Male, 0 = Female.

```
heterogenuous_reg <- feols(response ~ treatment * gender, data = full_data, se = 'white')
etable(heterogenuous_reg)
```

```
##                    heterogenuous_..
## Dependent Var.:            response
##
## (Intercept)          0.0714 (0.0698)
## treatment           -0.0260 (0.0767)
## gender              -0.0238 (0.0842)
## treatment x gender   0.0721 (0.0973)
## ___________________ ________________
## S.E. type           Heterosked.-rob.
## Observations                    143
## R2                          0.00787
## Adj. R2                    -0.01355
```

Interpretation to heterogeneous treatment effect: We have computed a heterogeneous treatment effect of being treated or not by their gender. We have set the gender equal to 1 as Male, and gender equal to 0 as female. Moreover, we didn't set any condition for the data, and all of effect is shown as ITT, which means this regression is the heterogeneous treatment effect of being assigned to the treatment group.

As the regression above shown, the coefficient of treatment x gender shows that the male students have 0.0721 higher treatment effect on response than that of female students. Moreover, we can compute the CATE for Female students(gender == 0) and in the treatment group = (-0.0238 + 0.0714) - 0.0714 = -0.0238. On the other hand, the CATE for Male studnets(gender == 1) and in the treatment group = (-0.026 + 0.0721) = 0.0461. The results of CATE for gender show that the Male students who are in treatment group are more likely to response the survey than the Female students. However, our p-value for all the coefficient are shown that we can't statically significant reject the null hypothesis basing on our data.

Complier Average Causal Effect of number of Opens on the Response

```
cace_reg <- feols(response ~ 1 | 0 | Opens ~ treatment, data = full_data, se='white')
etable(cace_reg)
```

```
##                        cace_reg
## Dependent Var.:        response
```

```
##
## (Intercept)     0.0070 (0.1559)
## Opens           0.0373 (0.0941)
## --------------- ---------------
## S.E. type       Heteroske.-rob.
## Observations                143
## R2                      0.07716
## Adj. R2                 0.07061
```

Interpretation to CACE: We want to observe the CACE(Complier average causal effect) for students response basing on people who open the survey and the treatment. We set 'Opens' column as complier rate, which means the students who opened the email but didn't response on the survey. As the regression shown above, the CACE = 0.0373 and with high standard error = 0.0941. There is a positive CACE (0.0373) for the response with group people who open and in the treatment group. However, as the p-value shown and the small size of response that we collect, we can't statically significant reject the null hypothesis.

Conclusion

- Both open rate of email and the click rate of survey is the same as the frequency of control group
- Offering Amazon gift cards of $5 is the optimal way to increase the survey response rate
- Charity does not improves the return rate
- Emotional text which reminds sense of community may not make a difference on return rate

Although clicks to the email were low, and survey responses were even lesser, we see that the Incentive which offered the Amazon Gift Certificate got the highest response rate. However, we cannot be certain about our estimates as they lack statistical significance due to the low sample size. However, it is interesting to note that there were more survey responses for the control than for the treatment. We speculate that perhaps the treatment_3 arm (pathos) was too lengthy and students may have not had a chance to read it fully.

Limitations

- Randomization check: The randomization check is limited only for gender column. We can't do randomization check/balance check for each individual treatment arms due to data collection restrictions.
- Non-representative sample: We only test samples from students in the MSMFT program, whose age lasts probably between 21 to 25. Thus, our results, including opening, clicking, and completing the survey, does not apply to other groups of people.
- Sample: Sample size was small (hence lacked precision).
- Covariates were limited to only one (gender), also due to lack of data.
- Fixed-effect: We are unable to conduct fixed-effect since related data, such as the time of taking the survey, are not available.

Appendix

Emails for the groups:

Control Group (No Incentive)

Subject: BU Academic Survey - request to complete

Email: Hi All,

We are students of the MSBA'21 batch and are doing research on COVID's Impact on Academic Behavior among the BU community for one of our courses. If you could complete the following survey to help our

research we would be grateful. The survey will only take under 5 minutes and all the responses will be confidential.

These responses will only be used for the purpose of our research project and will not be published anywhere. Demographics collected are purely for research purposes.

Survey link: https://qfreeaccountssjc1.az1.qualtrics.com/jfe/form/SV_cIT2pbeg3Jiw0fA

Deadline: 21st Apr (Wed) by 12:30 pm EST

Should you have any questions, please feel free to reach out.

Thank you and have a great weekend!

Thanks & Regards, MSBA-2021

Treatment 1 (Direct Monetary Incentive: Amazon Gift Certificate Raffle)

Subject: BU Academic Survey - win an amazon gift certificate

Email: Hi All,

We are students of the MSBA'21 batch and are doing research on COVID's Impact on Academic Behavior among the BU community for one of our courses. If you could complete the following survey to help our research we would be grateful. About 20% of the respondents will be randomly selected and rewarded with an Amazon gift card.

The survey will only take under 5 minutes and all the responses will be confidential. These responses will only be used for the purpose of our research project and will not be published anywhere. Demographics collected are purely for research purposes.

Survey link: https://qfreeaccountssjc1.az1.qualtrics.com/jfe/form/SV_1Ii9MpVZmOFhsV0

Deadline: 21st Apr (Wed) by 12:30 pm EST

Should you have any questions, please feel free to reach out.

Thanks & Regards, MSBA-2021

Treatment 2 (Indirect Monetary Incentive: Donation to Charity)

Subject: BU Academic Survey - you complete and we donate to charity

Email: Hi All,

We are students of the MSBA'21 batch and are doing research on COVID's Impact on Academic Behavior among the BU community for one of our courses. If you could complete the following survey to help our research we would be grateful. For each survey response that we get, we will donate $2 to Red Cross.

The survey will only take under 5 minutes and all the responses will be confidential. These responses will only be used for the purpose of our research project and will not be published anywhere. Demographics collected are purely for research purposes.

Survey link: https://qfreeaccountssjc1.az1.qualtrics.com/jfe/form/SV_6Pw3i4TAplF9asK

Deadline: 21st Apr (Wed) by 12:30 pm EST

Should you have any questions, please feel free to reach out.

Thanks & Regards, MSBA-2021

Treatment 3 (Non-Monetary Incentive - Appealing to pathos of the respondents)

Subject: BU Academic Survey - helping your Terrier community

Email: Hi All,

We are students of the MSBA'21 batch and are doing research on COVID's Impact on Academic Behavior among the BU community for one of our courses. Answering these questions not only enhances the research we are conducting but will allow us to make an impact on students at BU. We will be able to better understand academic challenges faced by students and to develop programs to combat these challenges where possible. We appreciate the time and effort you put into this survey, and we will make good use of all responses.

The survey will only take under 5 minutes and all the responses will be confidential. These responses will only be used for the purpose of our research project and will not be published anywhere. Demographics collected are purely for research purposes.

Survey link: https://qfreeaccountssjc1.az1.qualtrics.com/jfe/form/SV_79UrIZjvAEpkHsy

Deadline: 21st Apr (Wed) by 12:30 pm EST

Should you have any questions, please feel free to reach out.

Thanks & Regards, MSBA-2021

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