Learning Gap during COVID-19 Pandemic

The University of Toronto Mississauga
STA304H5 Lec 0101 Fall 2022

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Nov 26, 2022

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Introduction

The lockdown of schools across the world as a response to the recent COVID-19 undoubtedly caused an enormous impact on both societal and educational levels. Both professors and students had to rapidly adapt to a new teaching and learning environment without much prior guidelines on how to do so, hence leading to a chaotic transition from in person to online learning. The goal of this paper is to assess the learning gaps created as a result of said transition. As one can imagine, it is crucial to understanding this issue for many reasons. Perhaps the most important reason being that understanding how online learning impacted students and professors is pivotal in discovering how to recover from the damage done. In this paper, by using methods such as hypothesis testing, linear regression, and logistic regression we examine the before, during, and after relationships between several variables including average study time, average frequency of skipping lectures, average frequency of skipping lectures, and cGPA.

All data was collected from current STA304 students from the Fall 2022 semester based on a short survey designed to compare their perceptions of aspects of learning before, during, and after online learning. These surveys were all collected either manually during tutorials and lectures or filled out voluntarily through Piazza.

Description of Variables

Variable	Definition
Pandemic	The period of time during the COVID-19 Pandemic.
Pre-pandemic	The period of time before the COVID-19 Pandemic.
Comprehension Lv. of Materials of Online Lecture	Students' comprehension levels of materials when they take online lectures.
cGPA / CGPA	Average cumulative GPA of all past school years during the pandemic.
Average Study Time	Daily average total study time during the pandemic.
(Average) Frequency of Skipping Lec	Weekly average frequency of skipping online delivered lectures during the pandemic.
(Average) Frequency of Attending Office Hours	Weekly average frequency of attending office hours during the pandemic.
Comprehension Level	Student's self-recognized/assessed comprehension level of materials of online lecture during the pandemic.
Distraction Lv. of Online Lec Compared to In-Person Lec	The level of distraction students experience while receiving online instruction.

Results

Computations

As the preparation step of the study, it is necessary to find out the number of students needed to participate in the survey, also known as the sample size "n" by using the formula below:

$$n = \frac{Np(1-p)}{(N-1)\frac{B^2}{4} + p(1-p)} = \frac{200 * 1/2 * 1/2}{(200-1)0.1^2/4 + 1/2 * 1/2} = 66.88 \approx 67$$

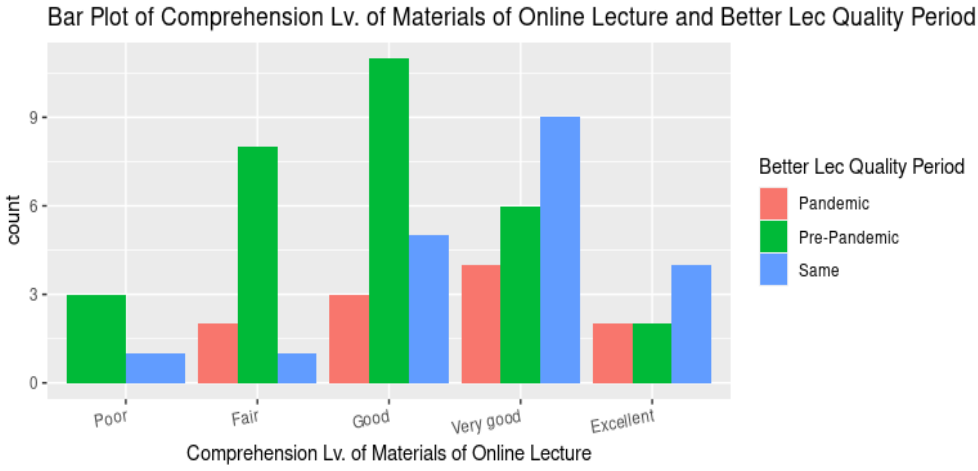
N is the total number of students who are taking STA304H5F in 2022, p is the proportion of students who are experiencing a learning gap. Since there is no way to know the proportion before the survey is distributed, assume p is 0.5 the most appropriate in a statistic's point of view. Moreover, B is called "margin of error" and represents how far the estimates will be away from the true proportion. In this case, since B is 0.1, then the estimated proportion is between 0.45 and 0.55 given sample proportion of 0.5.

However, after the data is being processed, there are only 61 valid responses left. Therefore, B is adjusted to 0.11 such that the number participant's valid responses required is reduced to 58.

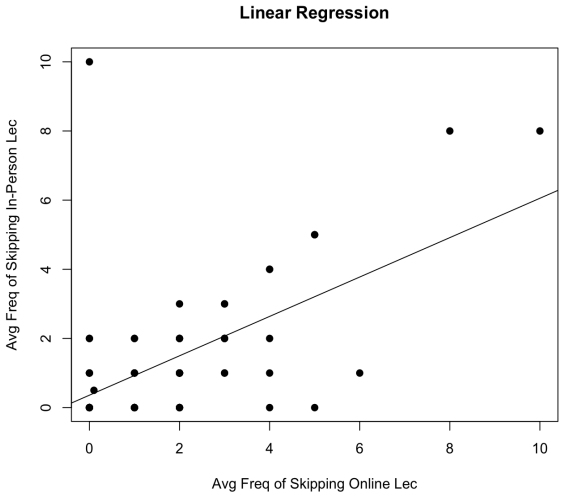
Discussion

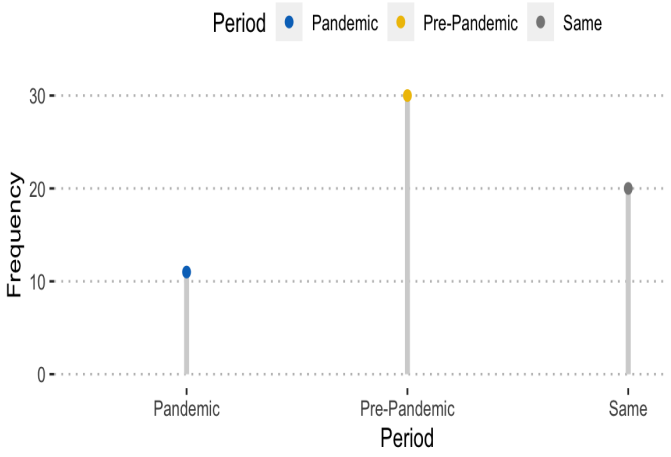
0. Before diving into some complicated statistical findings, it will be easier to look for some obvious patterns and relationships.

   For example, as students have a higher level of comprehension in the course materials, students tend to believe the lecture qualities are the same and vice versa.



1. The plot graph below contains a line which predicts the frequency of skipping in-person lectures. The slope of the line is around 0.56, which means on average, the students skip 44% less in-person lectures than online. Moreover, the bar plot shows that there are around 70% more students who believe the lecture quality is better during the pre-pandemic period, which might be one of the reasons why students skip less in-person lectures.





2. In order to have more solid evidence, the question of if one's study time, frequency of skipping online lectures and attending office hours will affect one's cGPA is important.

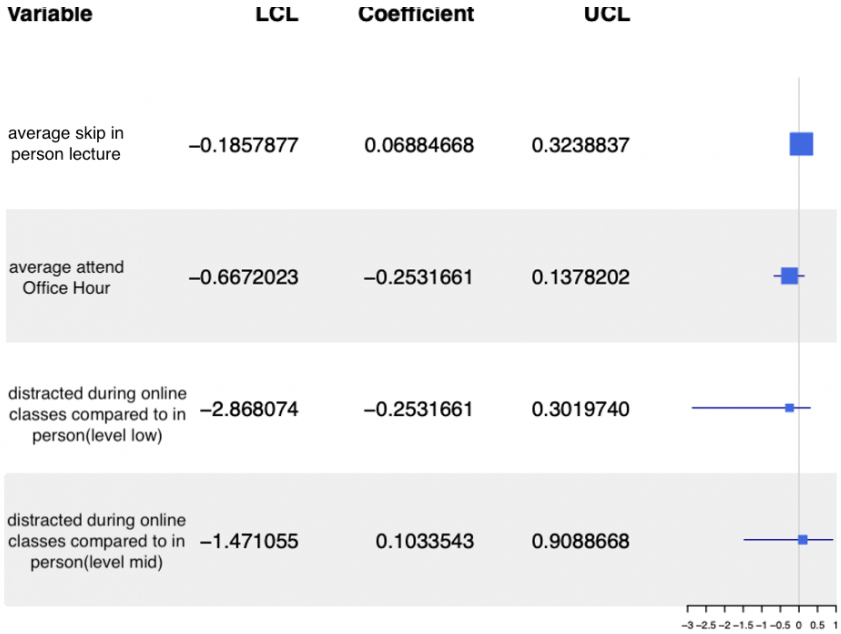
   In order to find out which variables are related to cGPA, by using a method called univariate regression analysis with confidence interval, we are 95% confident to say that there is no relationship between the frequency of skipping online lectures, attending office hours and one's cGPA.

   Therefore, the average study time is the only factor which will be analyzed with a student's cGPA. By calculating the ratio between given and not given a specific study time, we conclude that for students who study 3-4, 4-5 hours a day, the odds of being more likely to increase in cGPA more than the ones who do not is 1.46 and 2.86 times higher. While for students who study 5-6 hours, the odds are 86.75% lower.

Average Study Time	Odds Ratio
3 - 4 Hours	1.4573368
4 - 5 Hours	2.8626387
> 5 Hours	0.1325071

3. To explore whether there is an association between each parameter and cGPA, we produce a 95% confidence interval plot, which shows the intervals of the proportional changes between each variable and cGPA. LCL represents the lower bound of the ratio of variable to cGPA change, and UCL represents the upper bound of the ratio of variable to cGPA change.

   From the graph, it is obvious that 0 is between LCL and UCL for all variables, which means that there is a high probability that the change of cGPA is not related to the frequency of students skipping lectures, asking questions, or how distracted they are.



4. In particular, we used t-test to test whether the average frequency of skipping online and in-person lectures are the same. It is a statistical method to check whether the data can support a particular hypothesis. In this case, it tests if the frequency of skipping online and in-person lectures are the same. After the hypothesis test, it shows that the average frequency of skipping online and in-person lectures are highly likely to be the same, and hence they are not the reason to cause a learning gap between online lectures and in-person lectures.

5. We then compared the proportions of high cGPA during and after the pandemic, which will tell us whether the pandemic had a significant impact on academic performance.

During Pandemic \ After Pandemic	High	Low
High	29	5
Low	10	15

   The cGPAs of all students during and after the pandemic are organized into a two-by-two contingency table. From the data, for example, we can see that there are 29 students who maintained high cGPA both during and after the pandemic.

   In this case we are interested in whether there is a significant difference between the number of students who dropped from high to low cGPA and the number of students who increased their cGPA during the pandemic. After hypothesis testing, we did not find such a significant difference, and thus we conclude the pandemic has not had any significant impact on academic performance.

Conclusions & Limitations

As students and professors around the world continue to suffer from the aftermath of COVID-19, it is important to continue conducting studies like this which serves to inform us how these damages can be recovered.

Although some of the results from our study seems to suggest there being no significant impact in terms of the learning experience of students, one should not concretely say this is the case for certain. These results might be influenced by the limitations below which are built in this study.

Due to the nature of how the samples were selected, this means that there inherently exists selection bias since some students do not attend lectures/tutorials or use Piazza. Furthermore, the population of this study are students of STA304 Fall 2022 semester, meaning that the sampling units, which are students, are mostly third/fourth year Statistics students. This means many of them have taken similar courses and hence similar learning experiences.

It should also be noted that those students who understand the course material better might have a high concentration or earnest steadfast study manner. However, those explanations need more data to support this hypothesis.

Appendix

R-codes (in R-script / Rmd format):

Part 0:

```{r Relabel variables' value, echo=FALSE}
dataset$`Distraction Lv. of Online Lec Compared to In-Person Lec`<- factor(dataset$`Distraction Lv. of Online Lec Compared to In-Person Lec`, levels = c('1', '2', '3', '4', '5' ), labels = c("Poor", "Fair", "Good", "Very good", "Excellent"), ordered = TRUE)
dataset$`Comprehension Lv. of Materials of Online Lecture`<-factor(dataset$`Comprehension Lv. of Materials of Online Lecture`, levels = c('1', '2', '3', '4', '5' ), labels = c("Poor", "Fair", "Good", "Very good", "Excellent"), ordered = TRUE)
```

```{r Bar Plot of Lec Delivery Mode Preference and Study Environment Preference, include=TRUE, message=FALSE, warning=FALSE, echo=FALSE, comment="", fig.height = 3.5, fig.width=8}
ggplot(dataset, aes(x = factor(dataset$`Lec Delivery Mode Preference`),
                    fill = factor(dataset$`Study Environment Preference`))) +
  geom_bar(position = "dodge") +
  labs(fill = "Study Environment Preference") +
  xlab("Lec Delivery Mode Preference") +
  ggtitle("Bar Plot of Lec Delivery Mode Preference vs. Study Environment Preference") +
scale_x_discrete(guide = guide_axis(angle = 10))
```

```{r Bar Plot of Bar Plot of Comprehension Lv. of Materials of Online Lecture and Better Lec Quality Period, include=TRUE, message=FALSE, warning=FALSE, echo=FALSE, comment="", fig.height = 3.5, fig.width=8}
ggplot(dataset, aes(x = factor(dataset$`Comprehension Lv. of Materials of Online Lecture`),
                    fill = factor(dataset$`Better Lec Quality Period`))) +
  geom_bar(position = "dodge") +
  labs(fill = "Better Lec Quality Period") +
  xlab("Comprehension Lv. of Materials of Online Lecture") +
  ggtitle("Bar Plot of Comprehension Lv. of Materials of Online Lecture and Better Lec Quality Period") + scale_x_discrete(guide = guide_axis(angle = 10))
```

Part 1:

```
# Read ME
# Import STA304_Group2_Clean_Dataset.csv from Google Sheet
# Please follow the instructions in the terminal and give full access of your Google account
# If you failed to authorize TidyVerse API, you can reopen RStudio and run the file again and
choose 0 in the terminal to generate a new access token
library(readr)
library(googlesheets4)
library(foreign)
library(MASS)
library(Hmisc)
library(reshape2)
library(car)
library(broom)
library(VGAM)
library(forestplot)
library(dplyr)
library(ggplot2)
library(ggpubr)
theme_set(theme_pubr())

path =
"https://docs.google.com/spreadsheets/d/1mSdhVUqRZIgQaqskdE_cbvpxD29HAk2WNod3Rxx
u2PQ/edit?usp=sharing"
dataset <- read_sheet(path)

# Define Variables
avg_skip_in_person = dataset$`Avg Freq of Skipping In-Person Lec (Weekly)`
avg_skip_online = dataset$`Avg Freq of Skipping Online Lec (Weekly)`

# Build linear regression model
lr = lm(avg_skip_in_person ~ avg_skip_online)

summary(lr)
anova(lr)

# Linear Reg Plot
plot(avg_skip_in_person ~ avg_skip_online, data = dataset,
    main="Linear Regression", xlab="Avg Freq of Skipping Online Lec",
    ylab="Avg Freq of Skipping In-Person Lec", col = 1, pch = 19)
```

```
abline(lr)

table(dataset$`Better Lec Quality Period`)

# Define new variables and create data frame
Period = c("Pandemic", "Pre-Pandemic", "Same")
Frequency = c(11, 30, 20)
df <- data.frame(Period, Frequency)

# Plot frequency graphs between Period and frequency of Better Lec Quality Period
ggplot(df, aes(Period, Frequency)) +
  geom_linerange(
    aes(x = Period, ymin = 0, ymax = Frequency),
    color = "lightgray", size = 1.5
  )+
  geom_point(aes(color = Period), size = 2)+
  ggpubr::color_palette("jco")+
  theme_pubclean() + theme(aspect.ratio = 0.3)
```

Part 2:

```
# Read ME
# Import STA304_Group2_Clean_Dataset.csv from Google Sheet
# Please follow the instructions in the terminal and give full access of your Google account
# If you failed to authorize TidyVerse API, you can reopen RStudio and run the file again and
choose 0 in the terminal to generate a new access token
library(readr)
library(googlesheets4)
library(foreign)
library(ggplot2)
library(MASS)
library(Hmisc)
library(reshape2)
library(car)
library(broom)
library(VGAM)
library(forestplot)
library(dplyr)

path =
"https://docs.google.com/spreadsheets/d/1mSdhVUqRZIgQaqskdE_cbvpxD29HAk2WNod3Rxx
u2PQ/edit?usp=sharing"
dataset <- read_sheet(path)

# Response Variable
cGPA = dataset$`cGPA during the Pandemic (2019 Winter - 2021 Winter)`

# Predictor Variable
avg_study_time = dataset$`Avg Study Time (During Pandemic)`
avg_freq_skip = dataset$`Avg Freq of Skipping Online Lec (Weekly)`
avg_freq_OH = dataset$`Avg Freq of Participating OH (During Pandemic)`
comp_lv = dataset$`Comprehension Lv. of Materials of Online Lecture`

# Initialize training set
training_set <- data.frame(cGPA, avg_freq_OH, avg_freq_skip, avg_study_time, comp_lv)

# Re-label each interval
```

```
training_set$cGPA <- factor(training_set$cGPA, levels = c('3.6 - 4.0', '3.0 - 3.5', '2.6 - 2.9', '2.0 - 2.5', '1.6 - 1.9', '1.0 - 1.5', '0.6 - 0.9', '0.0 - 0.5'), labels = c("Excellent", "Good", "Adeqate", "Poor", "Poor", "Poor", "Poor", "Poor"), ordered = TRUE)
training_set$avg_study_time <- factor(training_set$avg_study_time, levels = c('< 3 Hours', '3 - 4 Hours', '4 - 5 Hours', '5 - 6 Hours', '> 6 Hours'), labels = c(': < 3 Hours', ': 3 - 4 Hours', ': 4 - 5 Hours', ': > 5 Hours', ': > 5 Hours'))

# Single Factor Analysis
study_time_fit = polr(as.factor(cGPA) ~ avg_study_time, data = training_set)
freq_skip_fit = polr(as.factor(cGPA) ~ avg_freq_skip, data = training_set)
freq_OH_fit = polr(as.factor(cGPA) ~ avg_freq_OH, data = training_set)

# Confidence Interval of Coef
confint(study_time_fit, level = 0.95)
coef(summary(study_time_fit))

confint(freq_skip_fit, level = 0.95)
coef(summary(freq_skip_fit))

confint(freq_OH_fit, level = 0.95)
coef(summary(freq_OH_fit))

# Generate LCL UCL with confidence interval graph
base_data <- tibble::tibble(mean  = c(0.3766106, 1.0517438, -2.0211190, 0.1033543, 0.2040784),
                            lower = c(-0.8527867, -0.1937557, -3.6680004, -0.1368487, -0.2317010),
                            upper = c(1.6107616, 2.3431600, -0.5102267, 0.3374198, 0.6477571),
                            coef_name = c("avg_study_time: 3 - 4 Hours", "avg_study_time: 4 - 5 Hours", "avg_study_time: > 5 Hours", "avg_freq_skip",
                                          "avg_freq_OH"),
                            coef  = c('0.3766106', '1.0517438', '-2.0211190', '0.1033543', '0.2040784'),
                            LCL = c('-0.8527867', '-0.1937557', '-3.6680004', '-0.1368487', '0.2317010'),
                            UCL = c('1.6107616', '2.3431600', '-0.5102267', '0.3374198', '0.6477571'))

base_data |>
  forestplot(labeltext = c(coef_name, LCL, coef, UCL),
             xlog = FALSE) |>
  fp_set_style(box = "royalblue",
               line = "darkblue",
               summary = "royalblue") |>
```

```
  fp_add_header(coef_name = c("", "Variable"),
                coef = c("", "Coefficient"),
                LCL = c("", "LCL"),
                UCL = c("", "UCL")) |>
  fp_set_zebra_style("#EFEFEF")

# Proportional Odds Assumption
olr <- polr(as.factor(cGPA) ~ avg_study_time, data = training_set, Hess=TRUE)
brant::brant(olr)

summary(olr)
exp(cbind(OR = coef(olr), confint(olr)))
```

Part 3:

```
# Read ME
# Import STA304_Group2_Clean_Dataset.csv from Google Sheet
# Please follow the instructions in the terminal and give full access of your Google account
# If you failed to authorize TidyVerse API, you can reopen RStudio and run the file again and
choose 0 in the terminal to generate a new access token
library(readr)
library(googlesheets4)
library(foreign)
library(ggplot2)
library(MASS)
library(Hmisc)
library(reshape2)
library(car)

path =
"https://docs.google.com/spreadsheets/d/1mSdhVUqRZIgQaqskdE_cbvpxD29HAk2WNod3Rxx
u2PQ/edit?usp=sharing"
dataset <- read_sheet(path)

# Response Variable
cGPA = dataset$`cGPA after the Pandemic (2021 Spring - 2022 Summer)`

# Predictor Variable
avg_freq_skip = dataset$`Avg Freq of Skipping In-Person Lec (Weekly)`
avg_freq_OH = dataset$`Avg Freq of Participating OH (After Pandemic)`
comp_lv = dataset$`Distraction Lv. of Online Lec Compared to In-Person Lec`

# Initialize training set and relabel the variables
training_set <- data.frame(cGPA, avg_freq_skip, avg_freq_OH, comp_lv)

training_set$cGPA[training_set$cGPA == '3.6 - 4.0'] <- "Excellent"
training_set$cGPA[training_set$cGPA == '3.0 - 3.5'] <- "Good"
training_set$cGPA[training_set$cGPA == '2.6 - 2.9'] <- "Adeqate"
training_set$cGPA[training_set$cGPA == '2.0 - 2.5'] <- "Poor"
training_set$cGPA[training_set$cGPA == '1.6 - 1.9'] <- "Poor"
training_set$cGPA[training_set$cGPA == '1.0 - 1.5'] <- "Poor"
training_set$cGPA[training_set$cGPA == '0.6 - 0.9'] <- "Poor"
training_set$cGPA[training_set$cGPA == '0.0 - 0.5'] <- "Poor"
```

```
training_set$cGPA <- factor(training_set$cGPA, levels = c("Excellent", "Good", "Adeqate",
"Poor"), ordered = TRUE)

training_set$comp_lv[training_set$comp_lv == '1'] <- "Low"
training_set$comp_lv[training_set$comp_lv == '2'] <- "Low"
training_set$comp_lv[training_set$comp_lv == '3'] <- "Mid"
training_set$comp_lv[training_set$comp_lv == '4'] <- "Hight"
training_set$comp_lv[training_set$comp_lv == '5'] <- "Hight"

# Check assumption of No Multi-collinearity
olr <- polr(as.factor(cGPA) ~ comp_lv, data = training_set, Hess=TRUE)
brant::brant(olr)
vif(olr)

# Single Factor Analysis
freq_skip_fit = polr(as.factor(cGPA) ~ avg_freq_skip, data = training_set)
freq_OH_fit = polr(as.factor(cGPA) ~ avg_freq_OH, data = training_set)
comp_lv_fit = polr(as.factor(cGPA) ~ comp_lv, data = training_set)

drop1(freq_skip_fit,test = "Chi")
drop1(freq_OH_fit,test = "Chi")
drop1(comp_lv_fit,test = "Chi")

# Check if Confidence Interval of Coefficient contain zero
confint(freq_skip_fit, level = 0.95)
coef(summary(freq_skip_fit))

confint(freq_OH_fit, level = 0.95)
coef(summary(freq_OH_fit))

confint(comp_lv_fit, level = 0.95)
coef(summary(comp_lv_fit))
coef(comp_lv_fit)

base_data <- tibble::tibble(mean  = c(0.06884668, -0.2531661, -0.2531661, 0.1033543),
                        lower = c(-0.1857877, -0.6672023, -2.868074, -1.471055),
                        upper = c(0.3238837, 0.1378202, 0.3019740, 0.9088668),
                        coef_name = c("avg_freq_skip", "avg_freq_OH",
                                "comp_lvLow", "comp_lvMid"),
                        coef  = c('0.06884668', '-0.2531661', '-0.2531661', '0.1033543'),
```

```
                    LCL = c('-0.1857877', '-0.6672023', '-2.868074', '-1.471055'),
                    UCL = c('0.3238837', '0.1378202', '0.3019740', '0.9088668'))

base_data |>
  forestplot(labeltext = c(coef_name, LCL, coef, UCL),
             xlog = FALSE) |>
  fp_set_style(box = "royalblue",
               line = "darkblue",
               summary = "royalblue") |>
  fp_add_header(coef_name = c("", "Variable"),
                coef = c("", "Coefficient"),
                LCL = c("", "LCL"),
                UCL = c("", "UCL")) |>
  fp_set_zebra_style("#EFEFEF")



# Proportional and odds Assumption
olr <- polr(as.factor(cGPA) ~ comp_lv, data = training_set, Hess=TRUE)
brant::brant(olr)
```

Part 4:

```
#Hypothesis Test
STA304_Group2_Clean_Dataset <- read.csv("~/Desktop/STA304_Group2_Clean_Dataset.csv",
header=TRUE)
online_avg=c(STA304_Group2_Clean_Dataset$Avg.Freq.of.Skipping.Online.Lec..Weekly.)
inperson_avg=c(STA304_Group2_Clean_Dataset$Avg.Freq.of.Skipping.In.Person.Lec..Weekly.)
difference=online_avg-inperson_avg

#Histogram
hist(difference_in_means, prob = TRUE, main = "Histogram with normal curve")
x = seq(min(difference_in_means), max(difference_in_means), length = 40)
f = dnorm(x, mean = mean(difference_in_means), sd = sd(difference_in_means))
lines(x, f, col = "red", lwd = 2)
```

Part 5:

```
#reading, extracting data for barplots
dataset = read.csv("STA304_Group2_Clean_Dataset.csv")
cgpa.during = dataset$cGPA.during.the.Pandemic..2019.Winter...2021.Winter.
cgpa.after = dataset$cGPA.after.the.Pandemic..2021.Spring...2022.Summer.
during <- data.frame(gpa = cgpa.during)
after <- data.frame(gpa = cgpa.after)
during <- transform(
  during,
  category =
    ifelse(
      gpa %in% c("3.0 - 3.5", "3.6 - 4.0"),
      "high",
      "low"
    )
)

after <- transform(
  after,
  category =
    ifelse(
      gpa %in% c("3.0 - 3.5", "3.6 - 4.0"),
      "high",
      "low"
    )
)
during.category <- during$category
after.category <- after$category

#barplot for during pandemic
barplot(table(during.category),
        ylim = c(0,50),
        xlab = "cGPA",
        ylab = "counts",
        col = "dodgerblue")
abline(h = 0)

#barplot for after pandemic
barplot(table(after.category),
```

```
      ylim = c(0,50),
      xlab = "cGPA",
      ylab = "counts",
      col = "dodgerblue")
abline(h = 0)

#categorizing cGPA into high and low
dataset <- dataset %>% mutate(cGPA =
case_when((cGPA.during.the.Pandemic..2019.Winter...2021.Winter. %in% c("3.0 - 3.5", "3.6 -
4.0"))
                                  & (cGPA.after.the.Pandemic..2021.Spring...2022.Summer. %in%
c("3.0 - 3.5", "3.6 - 4.0")) ~ "high to high",
                                  (cGPA.during.the.Pandemic..2019.Winter...2021.Winter. %in%
c("1.0 - 1.5", "2.0 - 2.5", "2.6 - 2.9"))
                                  & (cGPA.after.the.Pandemic..2021.Spring...2022.Summer. %in%
c("3.0 - 3.5", "3.6 - 4.0")) ~ "low to high",
                                  (cGPA.during.the.Pandemic..2019.Winter...2021.Winter. %in%
c("3.0 - 3.5", "3.6 - 4.0"))
                                  & (cGPA.after.the.Pandemic..2021.Spring...2022.Summer. %in%
c("1.0 - 1.5", "2.0 - 2.5", "2.6 - 2.9")) ~ "high to low",
                                  (cGPA.during.the.Pandemic..2019.Winter...2021.Winter. %in%
c("1.0 - 1.5", "2.0 - 2.5", "2.6 - 2.9"))
                                  & (cGPA.after.the.Pandemic..2021.Spring...2022.Summer. %in%
c("1.0 - 1.5", "2.0 - 2.5", "2.6 - 2.9")) ~ "low to low"))

#transforming data into 2x2 contingency table
frequency.table <- as.data.frame(table(dataset$cGPA))
frequencies <- frequency.table$Freq
two.by.two.table <- matrix(frequencies, nrow = 2,
                  dimnames = list("After Pandemic" = c("High", "Low"),
                              "During Pandemic" = c("High", "Low")))

#mcnemar's test using the contingency table
mcnemar.test(two.by.two.table, correct = FALSE)
```

Questionnaire:

1. Which year are you in?
    a. Year 1
    b. Year 2
    c. Year 3
    d. Year 4
2. Which of the following applies to you? Please select all that applies. (Students enrolled in 3.0 credits or more in the fall-winter section are considered full time students)
    a. I was a full time student in the 2019 school year or before
    b. I was a full time student in the 2020 school year
    c. I was a full time student in the 2021 school year
    d. I am a full time student in the 2022
    e. I had never been a full time student
3. On average, how long do you study per day **DURING** the pandemic (in hours)?
    a. Less than 3 Hours
    b. 3 - 4 Hours
    c. 4 - 5 Hours
    d. 5 - 6 Hours
    e. More than 6 Hours
4. On average, how long do you study per day **BEFORE** the pandemic (in hours)?
    a. Less than 3 Hours
    b. 3 - 4 Hours
    c. 4 - 5 Hours
    d. 5 - 6 Hours
    e. More than 6 Hours
5. On average, how often do you skip online classes per week? (numeric response)
6. On average, how often do you skip **in-person** classes per week? (numeric response)
7. Which lecture delivery mode do you prefer?
    a. Online
    b. In person
8. Which environment is more effective for your study?
    a. Home
    b. School
9. How often do you participate in Office hour **DURING** the Pandemic (Online)? (numeric response)
10. How often do you participate in Office hour **AFTER** the Pandemic (In person)? (numeric response)

11. Do you think the quality of lectures is affected by the pandemic?
    a. Better before pandemic
    b. Better after pandemic
    c. Same
12. How well do you think you understood the material taught during **online** classes? On a scale of 1 (very poor) to 5 (very good).
13. I felt more easily distracted during online classes compared to **in person** classes. On a scale of 1 (Strongly Disagree) to 5 (Strongly Agree).
14. What is your cGPA **DURING** the pandemic (2019 Winter -2021 Winter)?
    a. 0.0 - 0.5
    b. 0.6 - 0.9
    c. 1.0 - 1.5
    d. 1.6 - 1.9
    e. 2.0 - 2.5
    f. 2.6 - 2.9
    g. 3.0 - 3.5
    h. 3.6 - 4.0
15. What is your cGPA AFTER the pandemic (2021 Spring - 2022 Summer)?
    a. 0.0 - 0.5
    b. 0.6 - 0.9
    c. 1.0 - 1.5
    d. 1.6 - 1.9
    e. 2.0 - 2.5
    f. 2.6 - 2.9
    g. 3.0 - 3.5
    h. 3.6 - 4.0