

STA302H1 – Final Project Descriptive Statistics

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Import STA302H1 Study Time and COVID Contemplation Time vs. Quiz Performance Dataset

Data Cleaning

First, I'll clean my data.

```
cleaned_sta302_performance_data <- sta302_performance_data %>%  
  # Create a new "country" column, which is just "Country" but whose entries are factors.  
  mutate(country = as.factor(Country)) %>%  
  
  # TODO: Replace quiz grades, covid hours, and sta302h1 study hours with their  
  # TODO: median counterparts.  
  
  # Remove the "X" column: it's simply the row number, which isn't very useful.  
  # Remove the "Country" column: column "country" already exists  
  dplyr::select(-X, -Country) %>%  
  
  # Rearrange similar columns side-by-side.  
  relocate(country,  
            COVID.hours..W1., COVID.hours..W2., COVID.hours..W3., COVID.hours..W4.,  
            STA302.hours..W1., STA302.hours..W2., STA302.hours..W3., STA302.hours..W4.,  
            Quiz_1_score, Quiz_2_score, Quiz_3_score, Quiz_4_score)
```

Helper Functions

```
num_column_NAs = function(predictor_variable) {  
  sum(is.na(predictor_variable))  
}
```

```
row_nums_of_NA_columns = function(data, predictor_variable) {  
  which(is.na(predictor_variable))  
}
```

```
rows_with_num_NAs = function(data, num_NAs) {  
  return (rowSums(is.na(data)) == num_NAs)  
}
```

```
row_nums_of_NA_rows = function(data, num_NAs) {  
  return (which(rows_with_num_NAs(data, num_NAs)))  
}
```

```
display_histogram <- function(data, predictor_variable, histogram_title, x_axis_label) {  
  ggplot(data = tibble(data), mapping = aes(x = predictor_variable)) +  
    geom_histogram(col = "black", fill = "red", bins = 30) +  
    labs(title = histogram_title, y = "Frequency", x = x_axis_label) +  
    geom_vline(mapping = aes(xintercept = mean(predictor_variable, na.rm = TRUE)),  
              color = "blue", linetype = "solid") +  
    geom_vline(mapping = aes(xintercept = median(predictor_variable, na.rm = TRUE)),  
              color = "dark green", linetype = "dotted")  
}
```

```
display_boxplot <- function(data, predictor_variable, boxplot_title, y_axis_label) {  
  ggplot(mapping = aes(x = Country, y = predictor_variable, color = Country)) +  
    geom_boxplot(mapping = aes(x = Country, y = predictor_variable)) +  
    labs(title = boxplot_title, x = "Country", y = y_axis_label)  
}
```

```
get_row_nums_to_exclude <- function(data) {  
  row_nums_with_3_NAs = which(rows_with_num_NAs(data, 3))  
  row_nums_with_4_NAs = which(rows_with_num_NAs(data, 4))  
  row_nums_to_exclude <- union(row_nums_with_3_NAs,  
                               row_nums_with_4_NAs)  
  return (row_nums_to_exclude)  
}
```

```
display_correlation_by_country <- function(country_data) {  
  colnames(country_data) <- c("W1COV", "W2COV", "W3COV", "W4COV",  
                             "W1302", "W2302", "W3302", "W4302",  
                             "Q1", "Q2", "Q3", "Q4")  
  round(cor(country_data, use = "pairwise.complete.obs", method = "pearson"), 2)  
}
```

Special Tables

Rows With At Least One NA

Rows with at least one NA deserve closer examination.

Some of the rows might only have 1 - 2 NAs and are therefore salvageable, which is OK.

Other rows may contain 3 or more NAs, and might indicate students who have dropped STA302H1. We'd like to exclude them from our analysis.

Here are the number of rows with 0 - 4 NAs.

```
##   nrows_0_NAs nrows_1_NAs nrows_2_NAs nrows_3_NAs nrows_4_NAs
## 1           143           9           16           19           1
```

Columns with NAs

```
##   week1_covid week2_covid week3_covid week4_covid
## 1           26           22           21           40
```

```
##   week1_sta302 week2_sta302 week3_sta302 week4_sta302
## 1           26           22           20           40
```

```
##   quiz1_score quiz2_score quiz3_score quiz4_score
## 1           13           36           31           34
```

Number of Missed Quizzes

```
##   miss_0_quizzes miss_1_quizzes miss_2_quizzes miss_3_quizzes miss_4_quizzes
## 1           176           20           3           24           4
```

Who to Exclude from the Dataset?

Identify rows with at least 3 missing quiz marks. These indicate students who have dropped STA302H1, and who should be excluded from the final data.

Notice that we didn't check the number of NAs for country of origin, COVID hours, and STA302H1 hours, since some students either forgot or abstained. So there's no reason to exclude these students from our final dataset.

```
row_nums_to_exclude <- get_row_nums_to_exclude(quiz_grades)
cleaned_sta302_performance_data2 =
  cleaned_sta302_performance_data[-row_nums_to_exclude,]
```

Rows with Mistyped Columns

Rows whose columns are mis-typed may need to be corrected via imputation.

```
rows_with_mistyped_columns = cleaned_sta302_performance_data2[c(38, 83, 84, 117),]
# row 83: Country -> "canada" -- DONE
# row 84: Country -> "canada" -- DONE

# row 117: COVID.hours..W4. -> 0.5 hours -- DONE

# row 38: STA302.hours..W3. -> 5.5<U+00A0> -- DONE
# row 117: STA302.hours..W4. -> 7.5 hours -- DONE
```

```
# library(janitor)
# use it to clean up data.
```

Rows Without Country Entry

Taking out the country column can come in handy for functions like `cor()` where factors aren't allowed.

```
rows_with_no_country = cleaned_sta302_performance_data2 %>%
  dplyr::select(-country)
```

Rows Filtered by Country

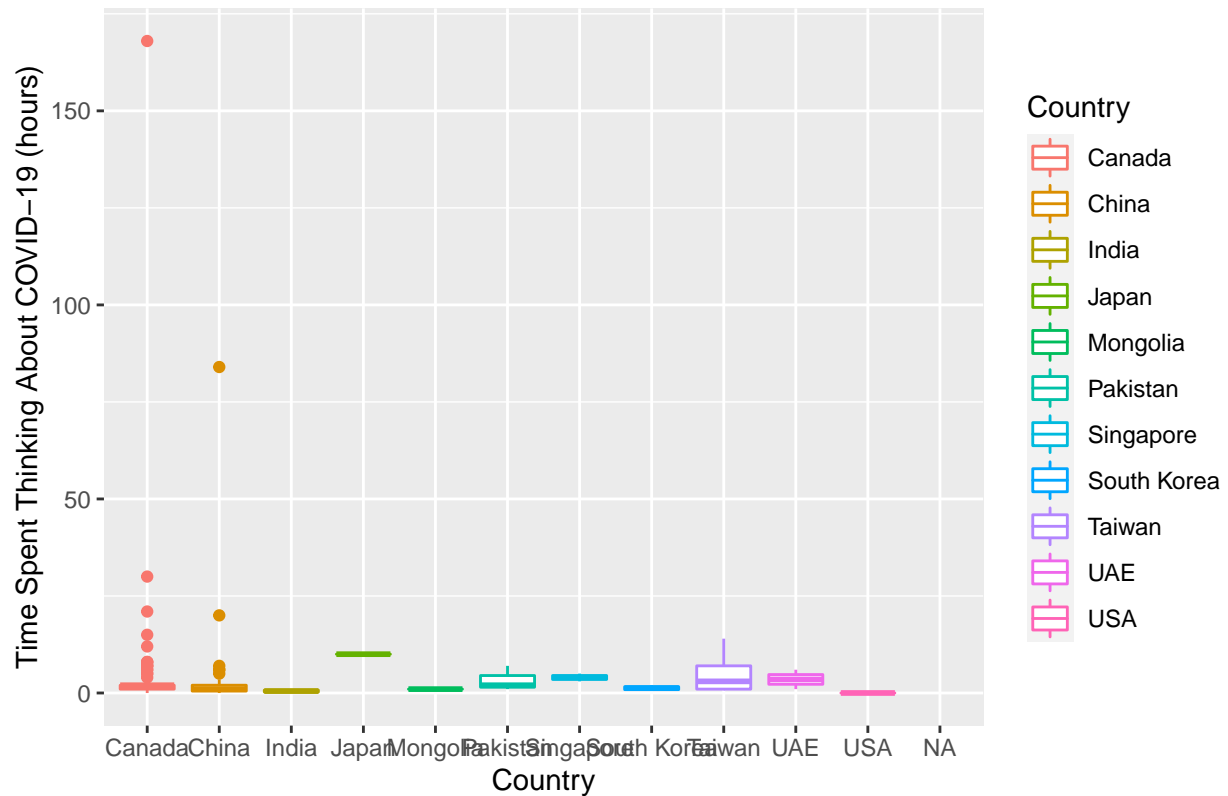
This is useful if we want data for individual countries.
Only the first and last code snippets are shown.

```
canada <- cleaned_sta302_performance_data2 %>%
  filter(as.character(country) == "Canada") %>%
  dplyr::select(-country)

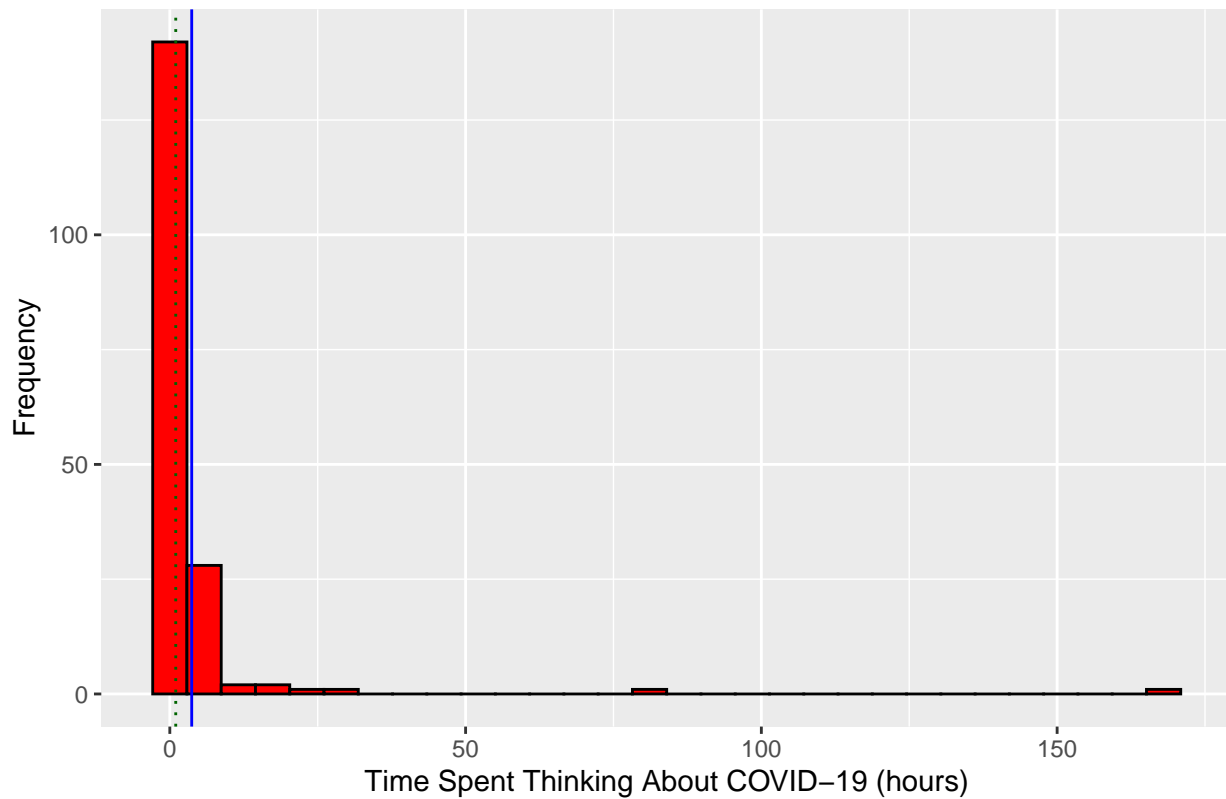
unknown <- cleaned_sta302_performance_data2 %>%
  filter(is.na(as.character(country))) %>%
  dplyr::select(-country)
```

##	Country
## Canada	97
## China	63
## India	2
## Japan	1
## Mongolia	1
## Pakistan	3
## Singapore	2
## South_Korea	2
## Taiwan	3
## UAE	2
## USA	2
## Unknown	21

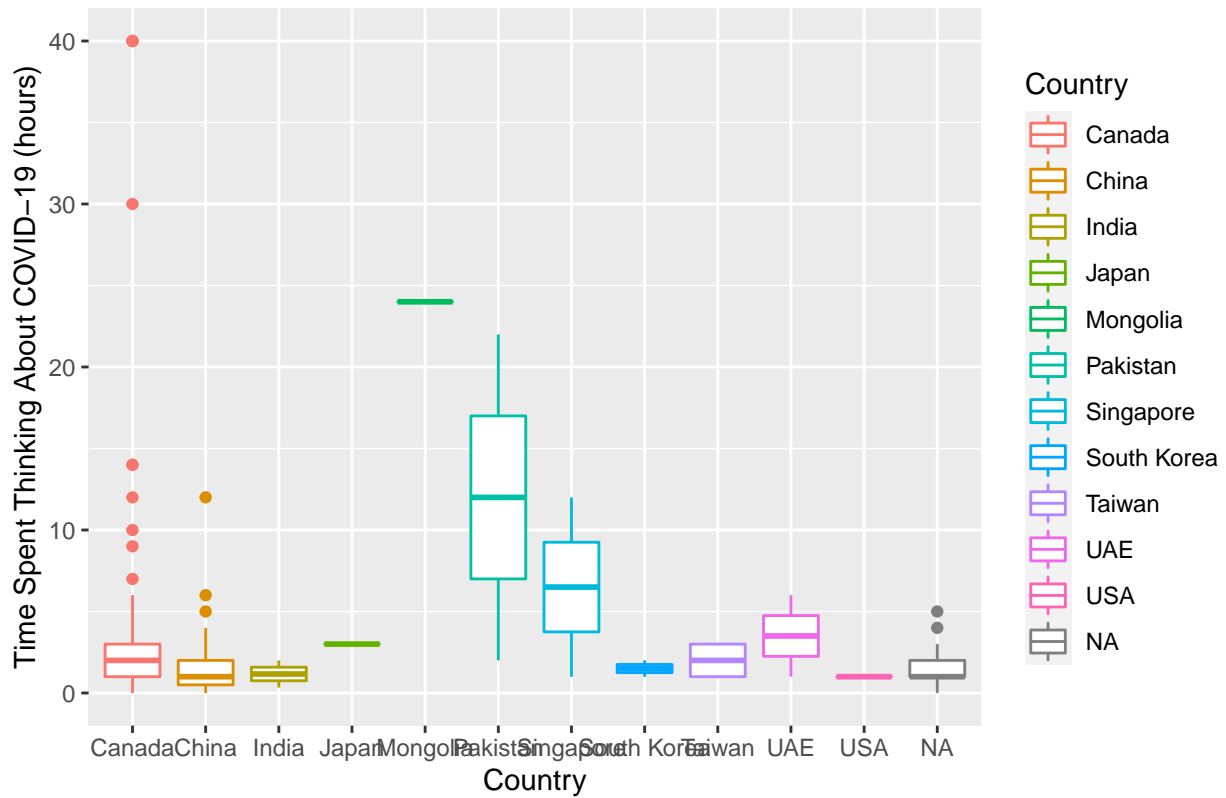
Country vs. Week 1 Time Spent Thinking About COVID-19



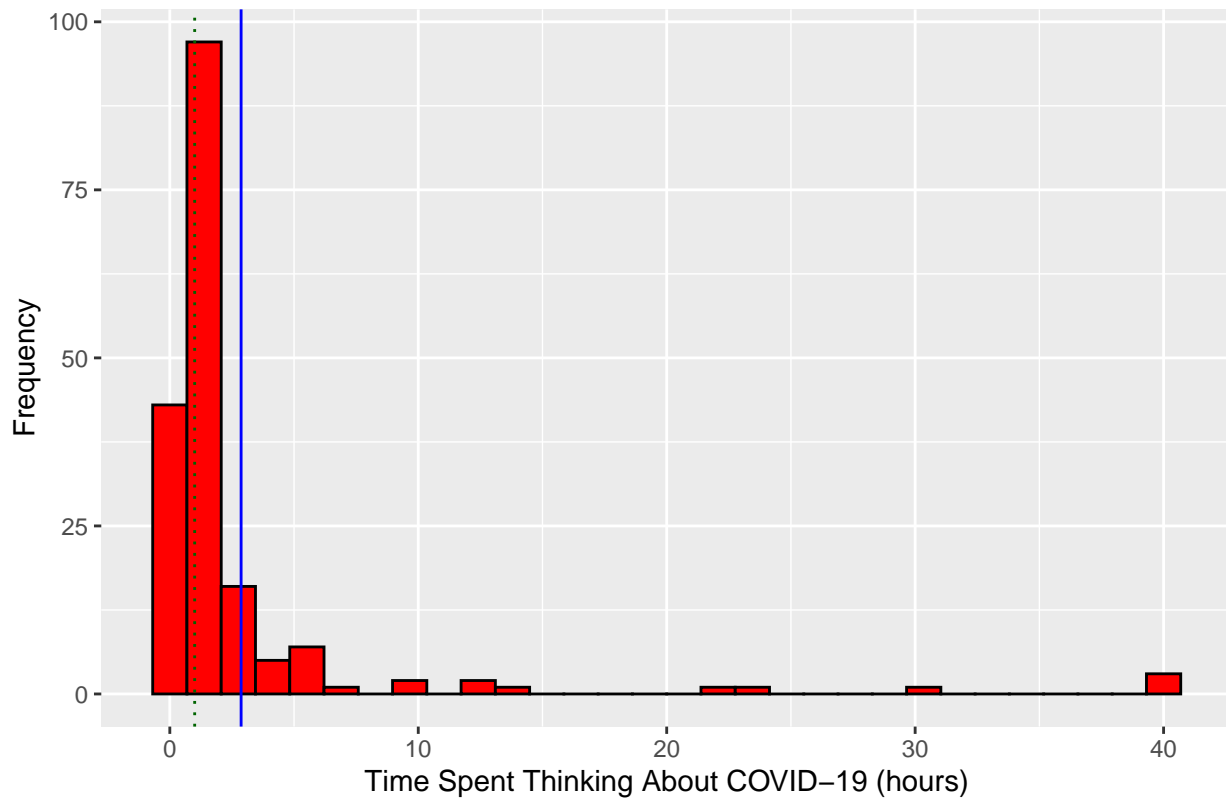
Histogram of Week 1 Time Spent Thinking About COVID-19



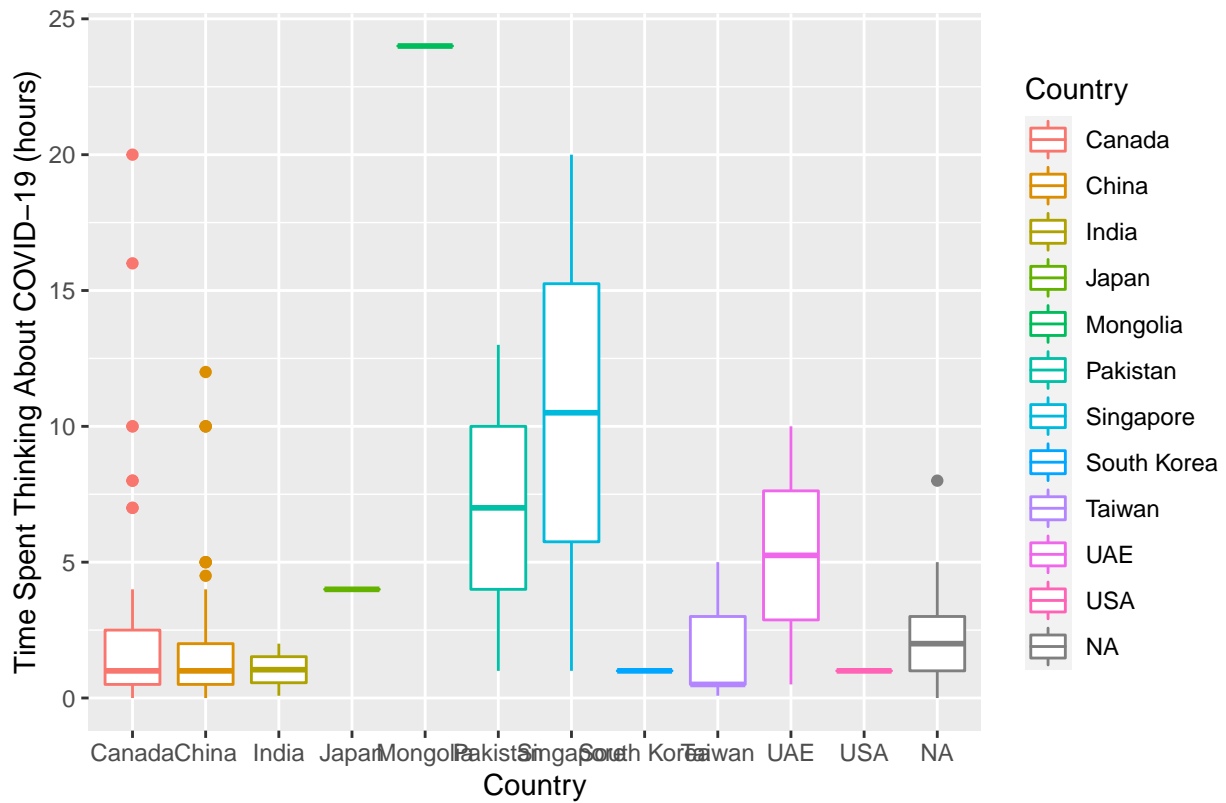
Country vs. Week 2 Time Spent Thinking About COVID-19



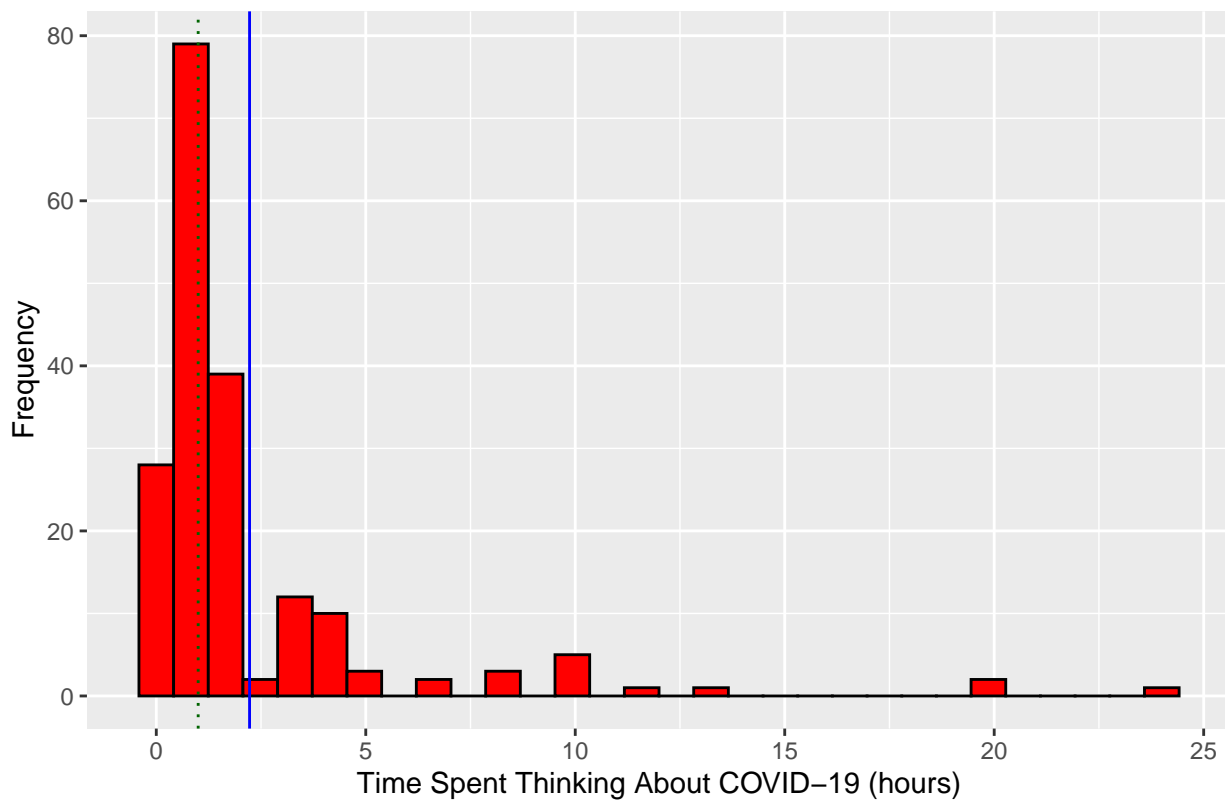
Histogram of Week 2 Time Spent Thinking About COVID-19



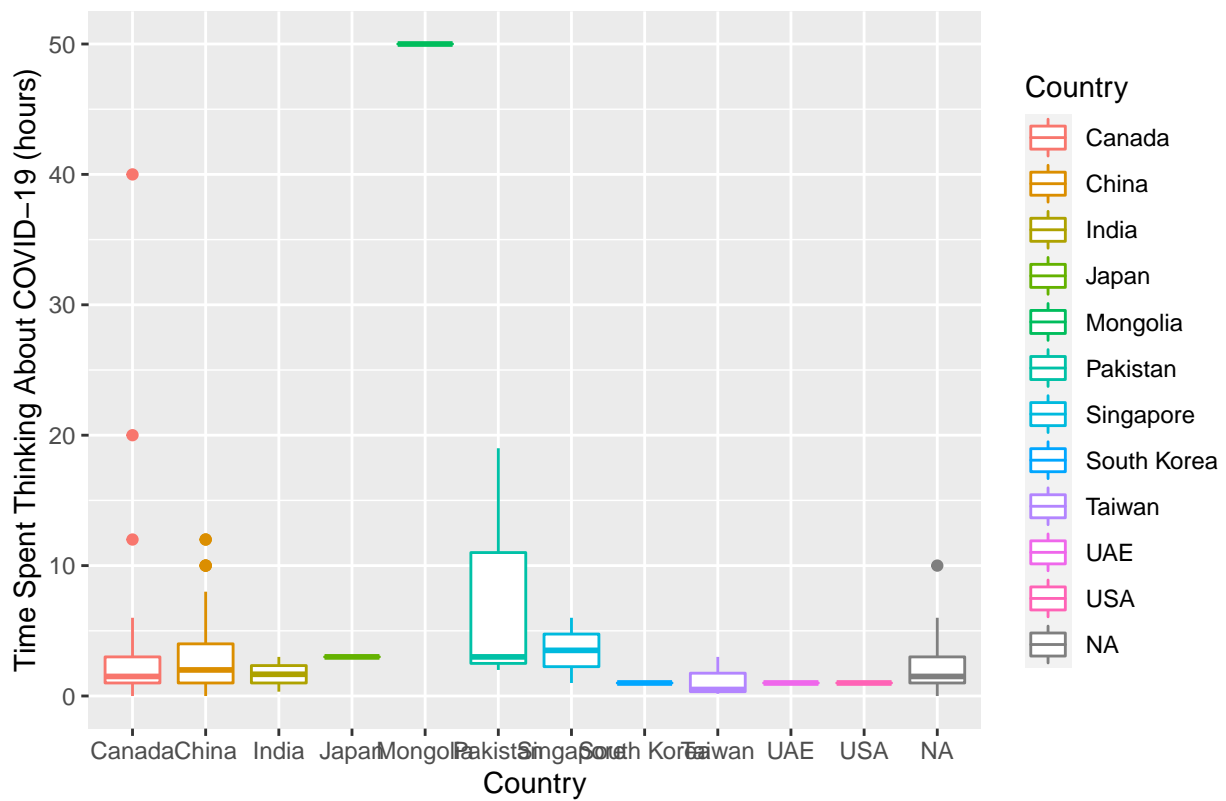
Country vs. Week 3 Time Spent Thinking About COVID-19



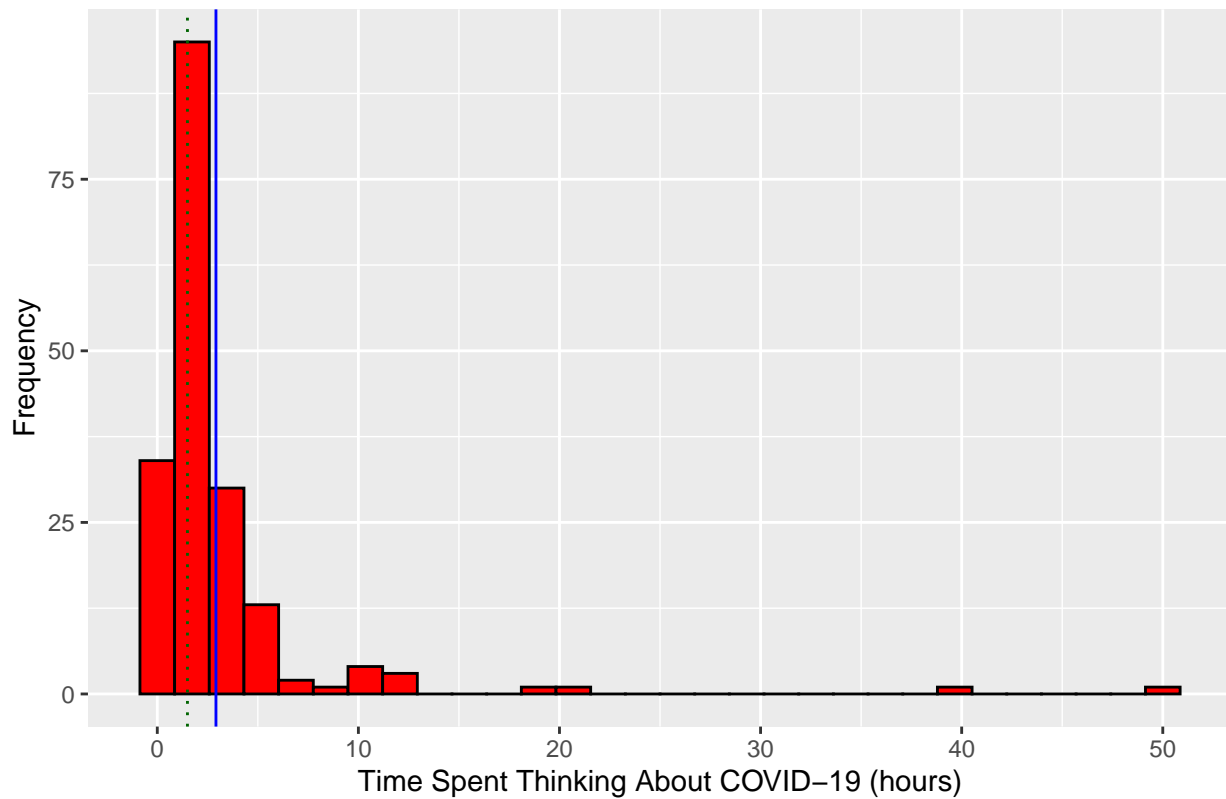
Histogram of Week 3 Time Spent Thinking About COVID-19



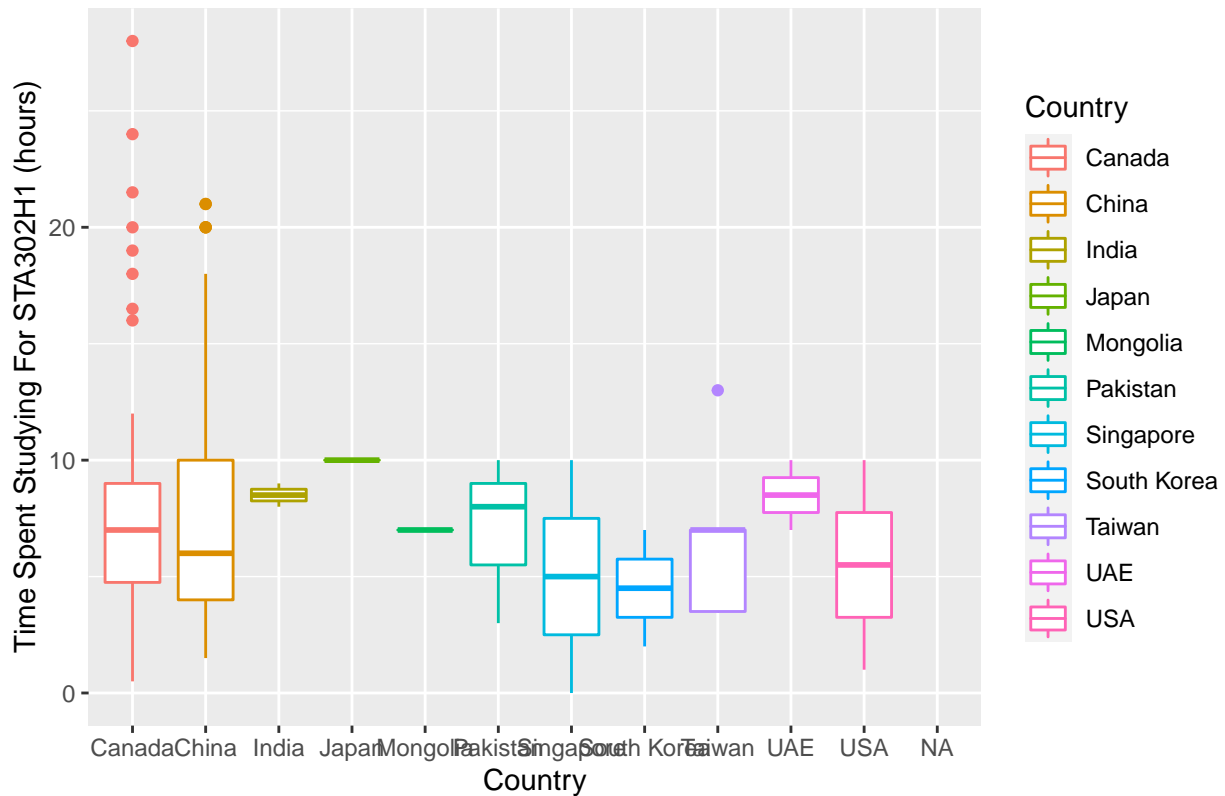
Country vs. Week 4 Time Spent Thinking About COVID-19



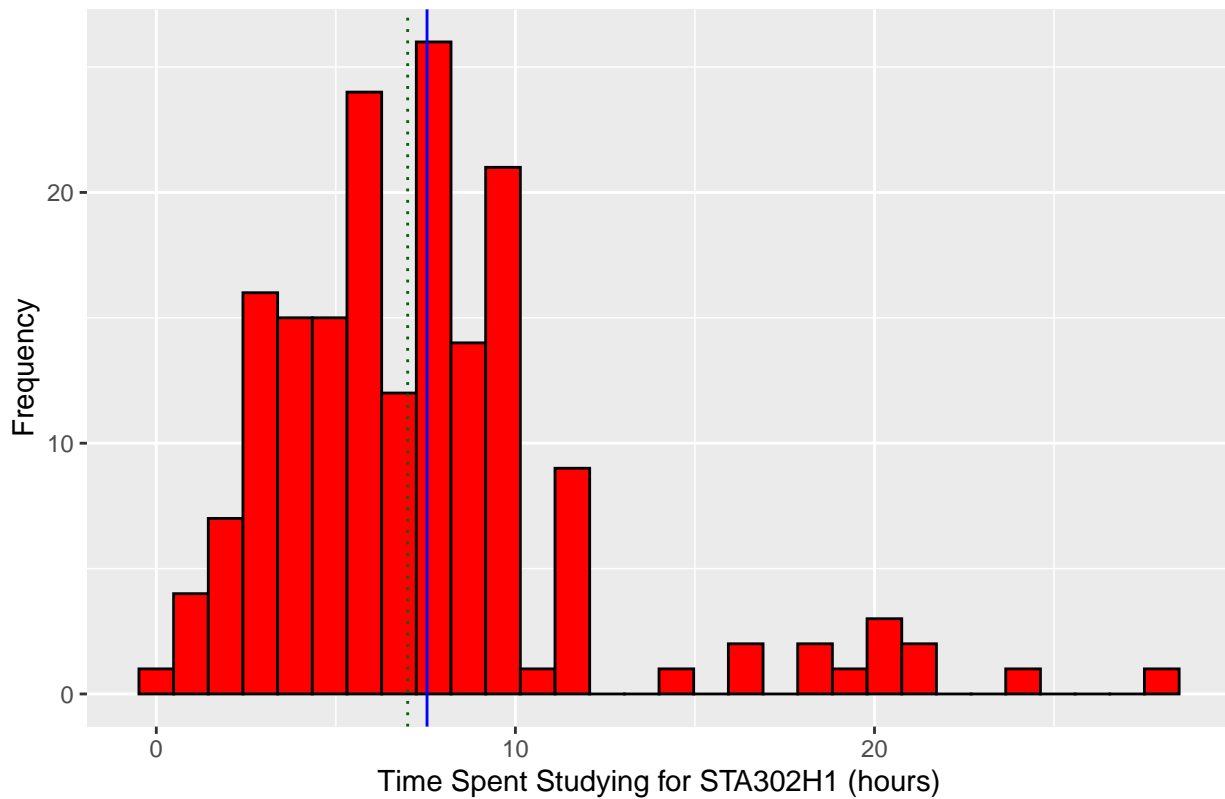
Histogram of Week 4 Time Spent Thinking About COVID-19

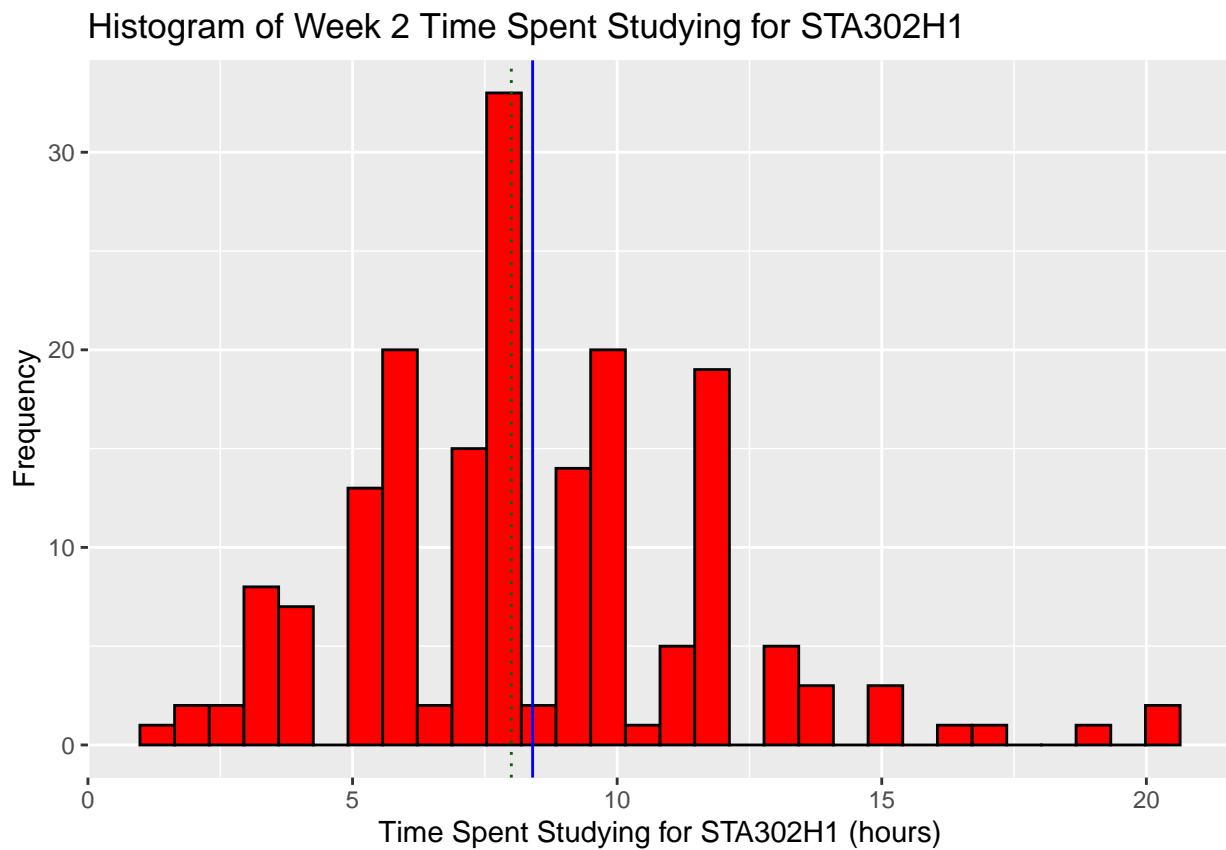
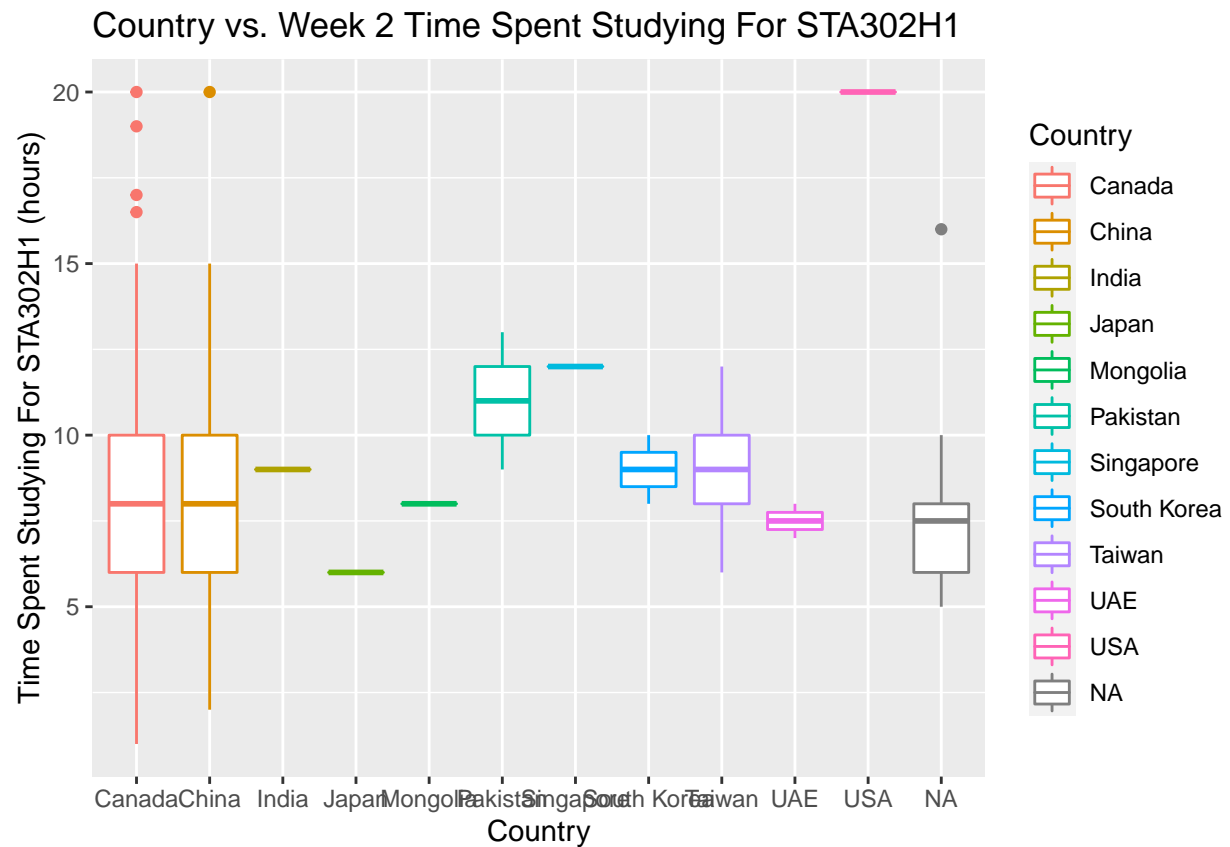


Country vs. Week 1 Time Spent Studying For STA302H1

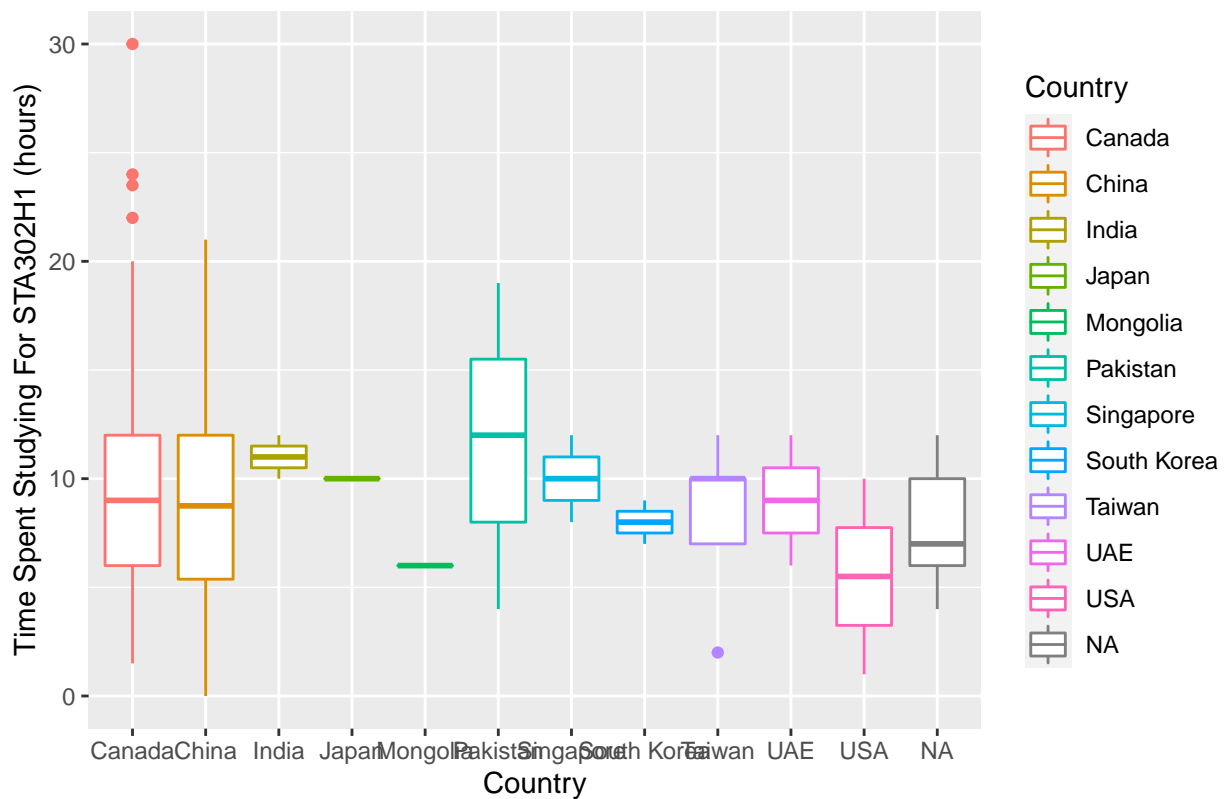


Histogram of Week 1 Time Spent Studying for STA302H1

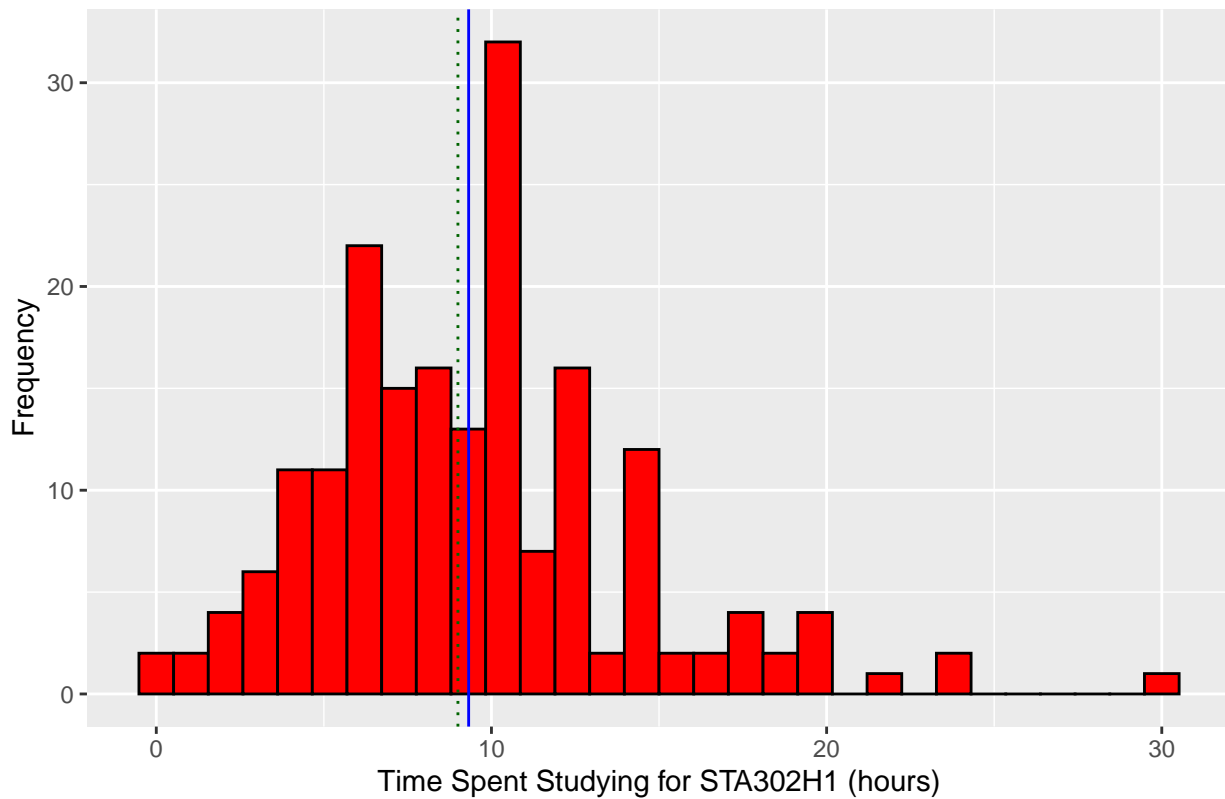




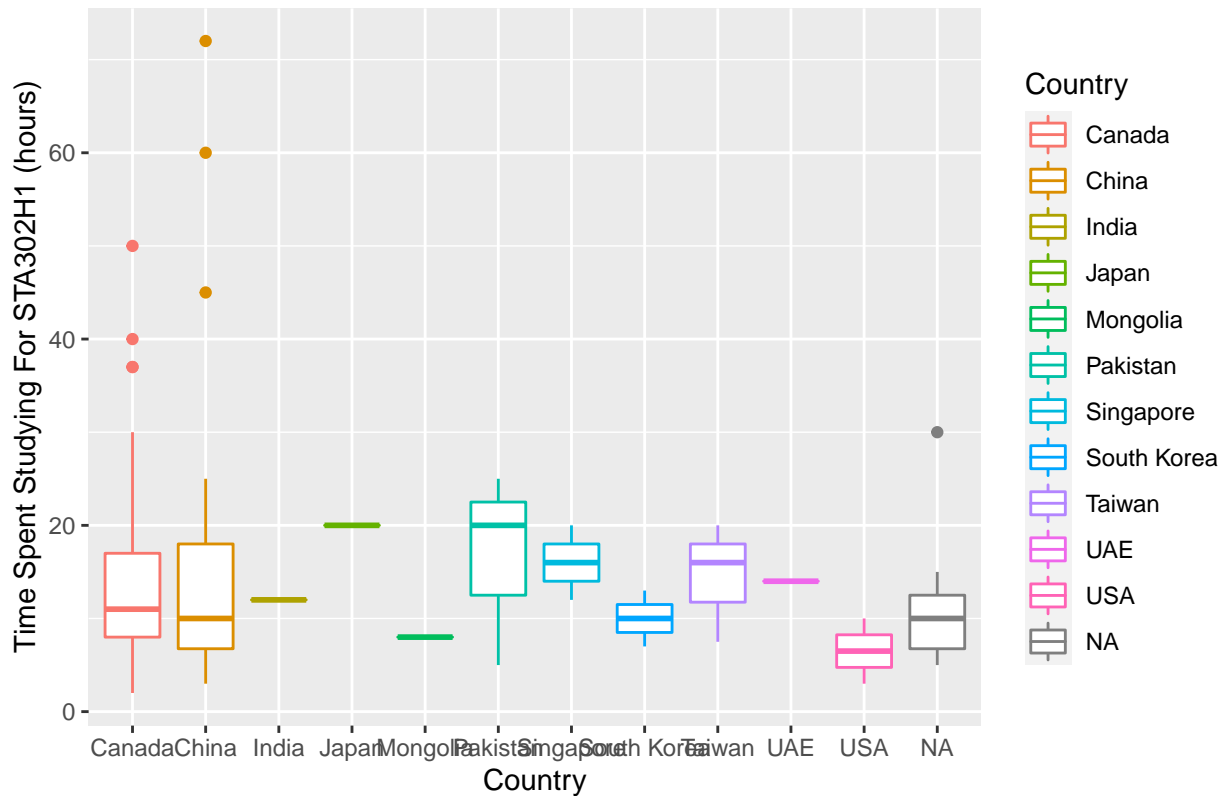
Country vs. Week 3 Time Spent Studying For STA302H1



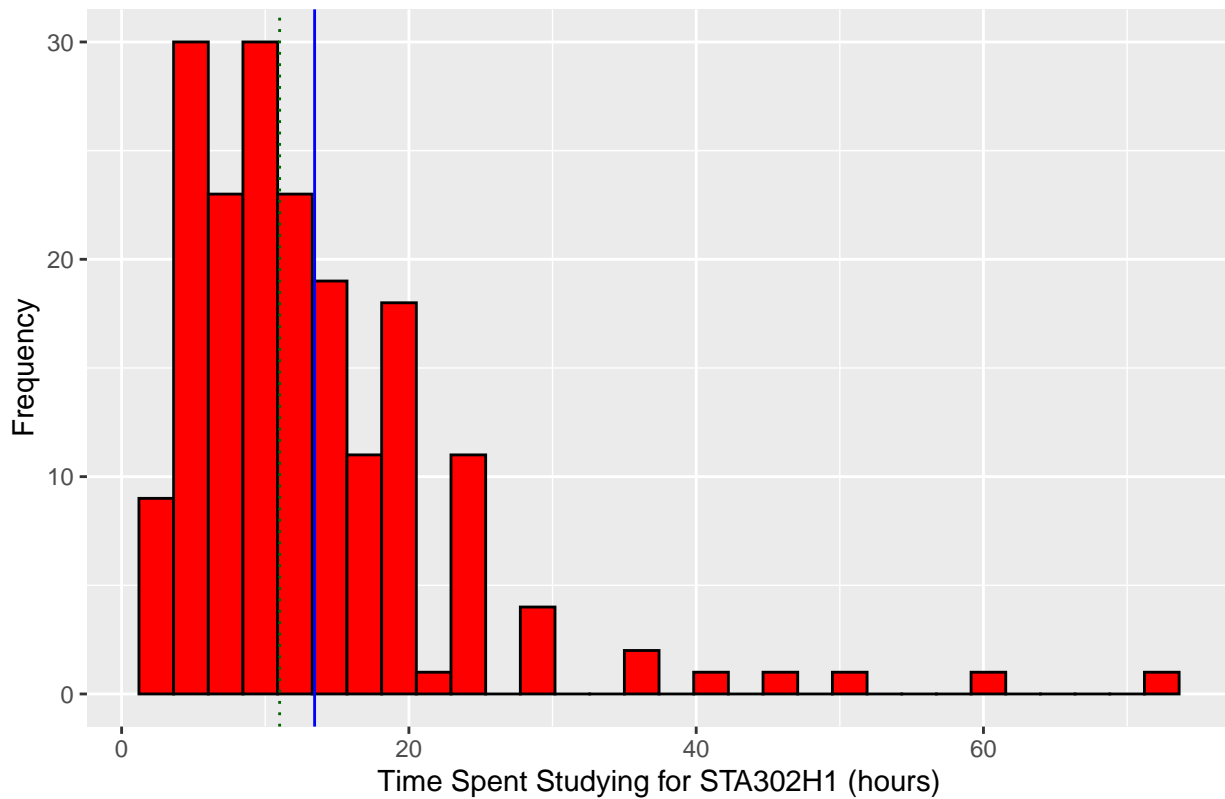
Histogram of Week 3 Time Spent Studying for STA302H1

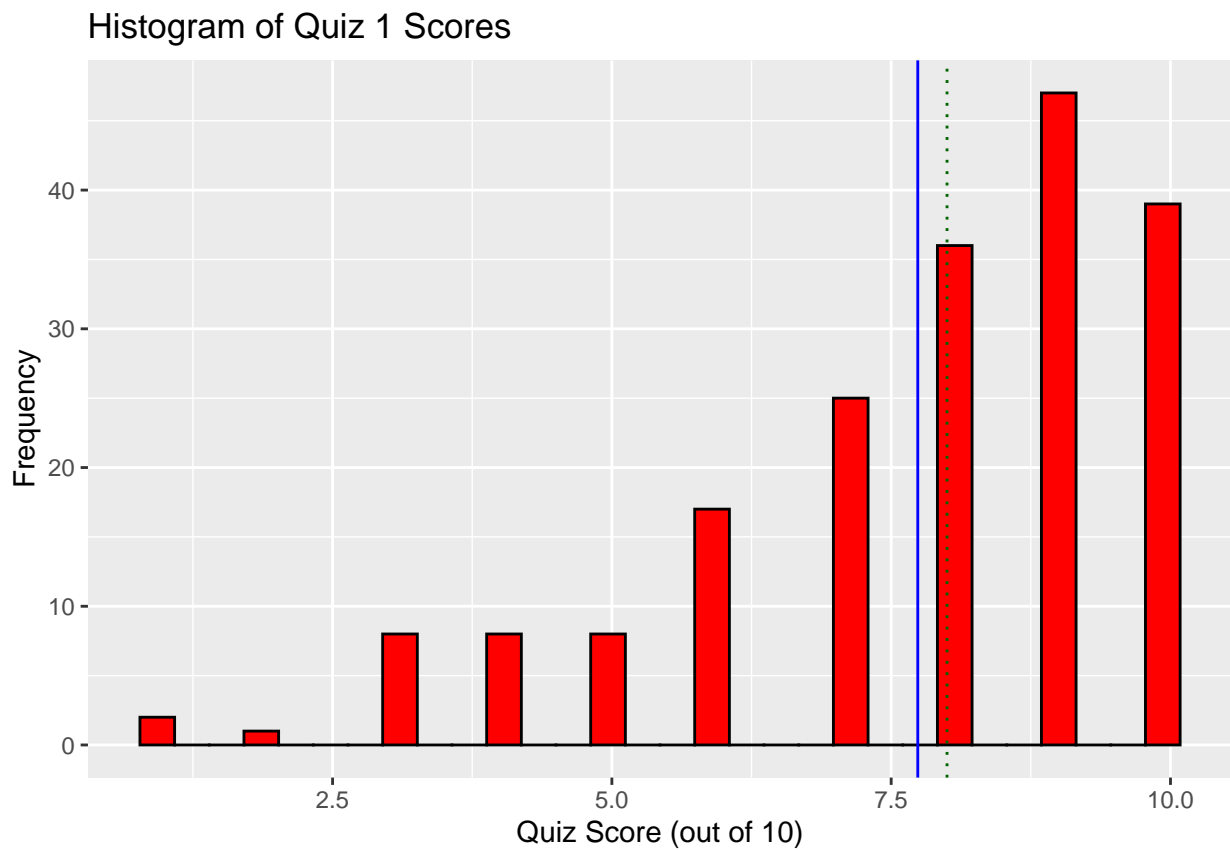
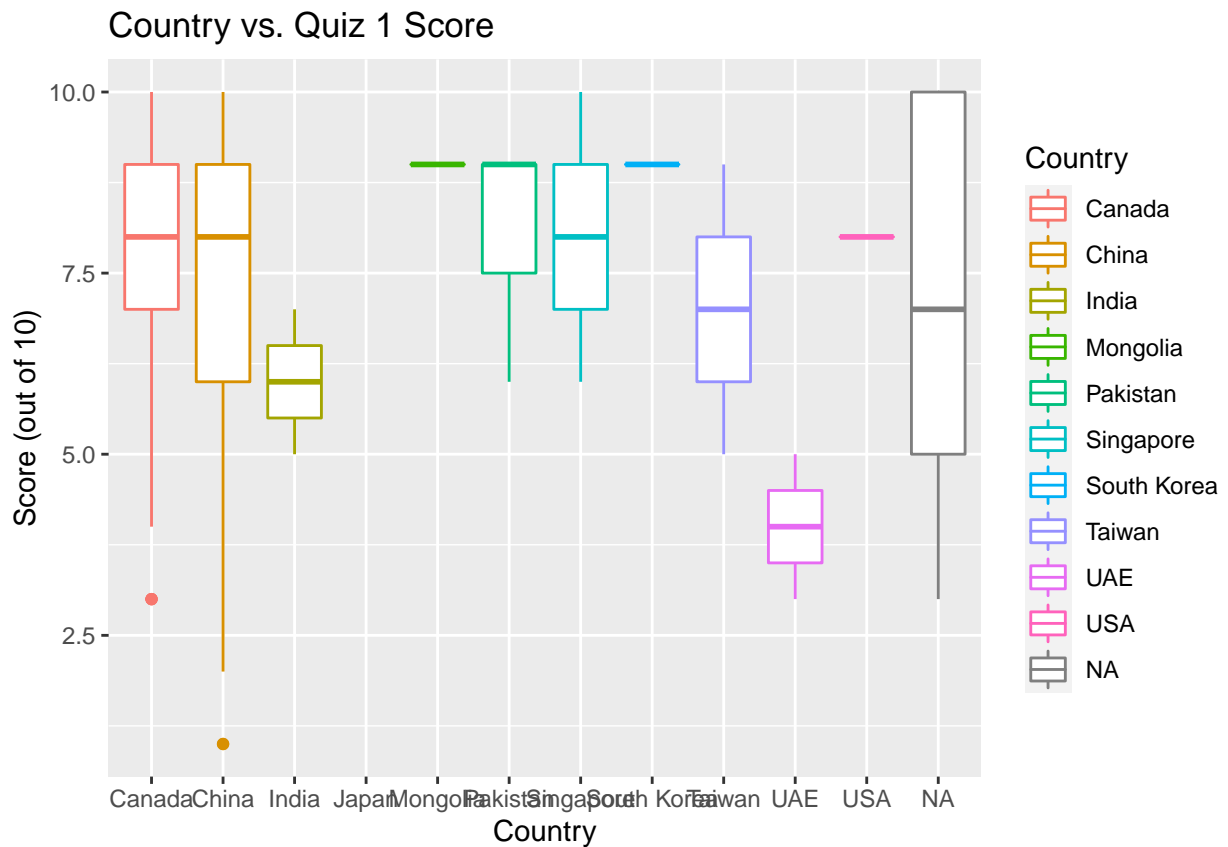


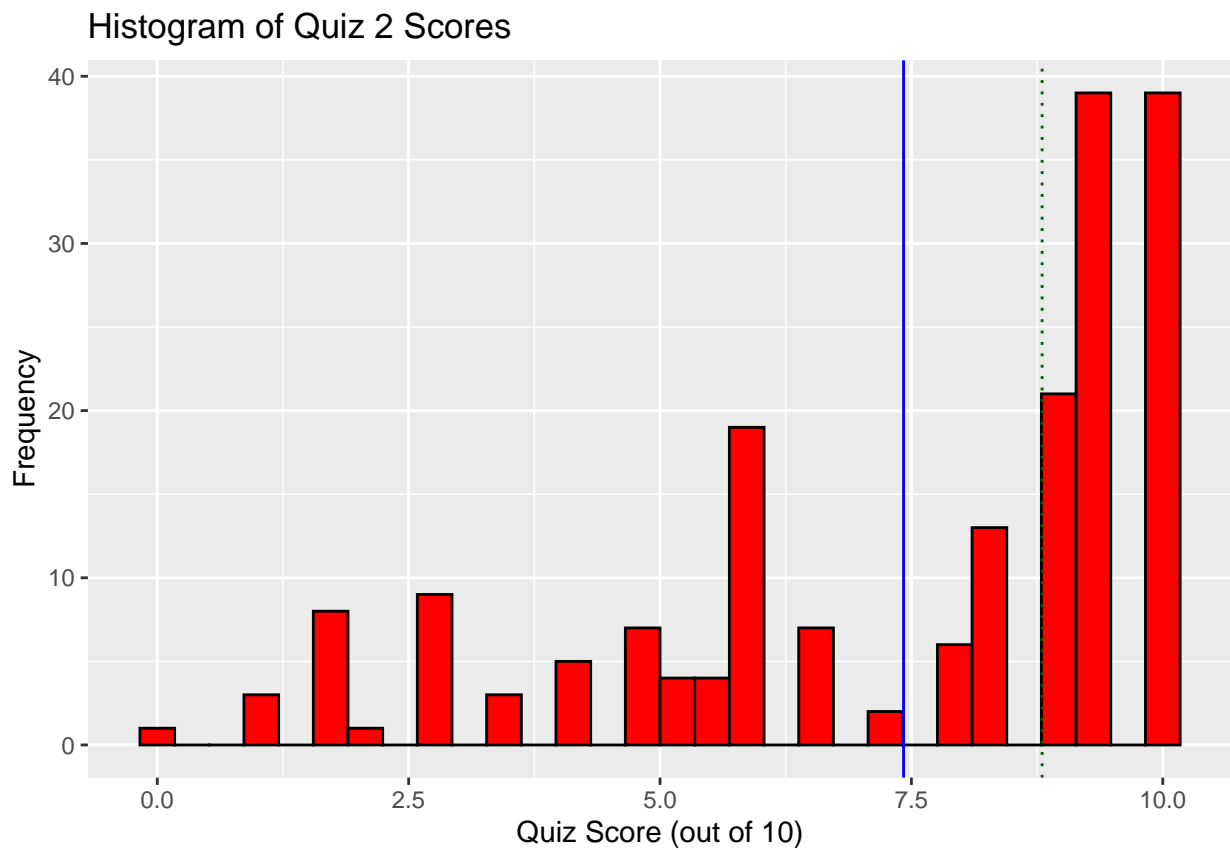
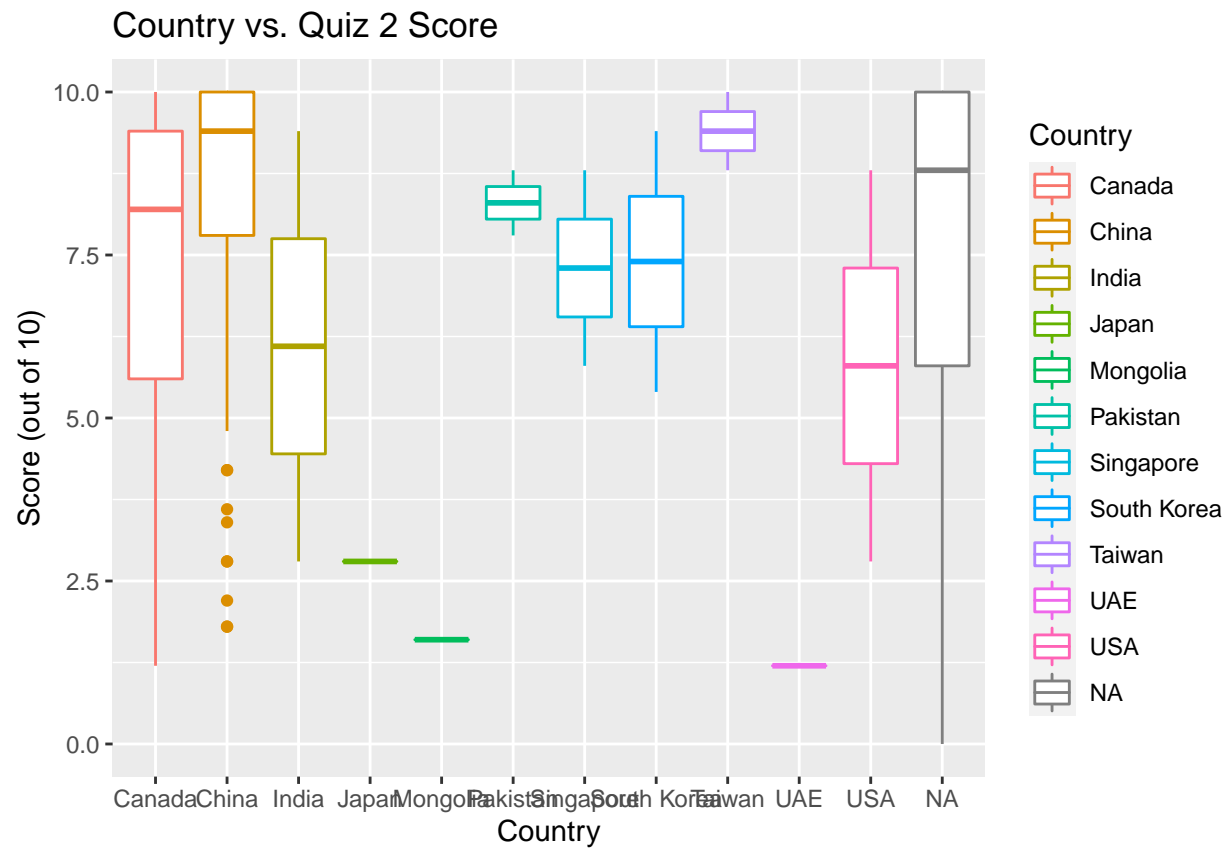
Country vs. Week 4 Time Spent Studying For STA302H1

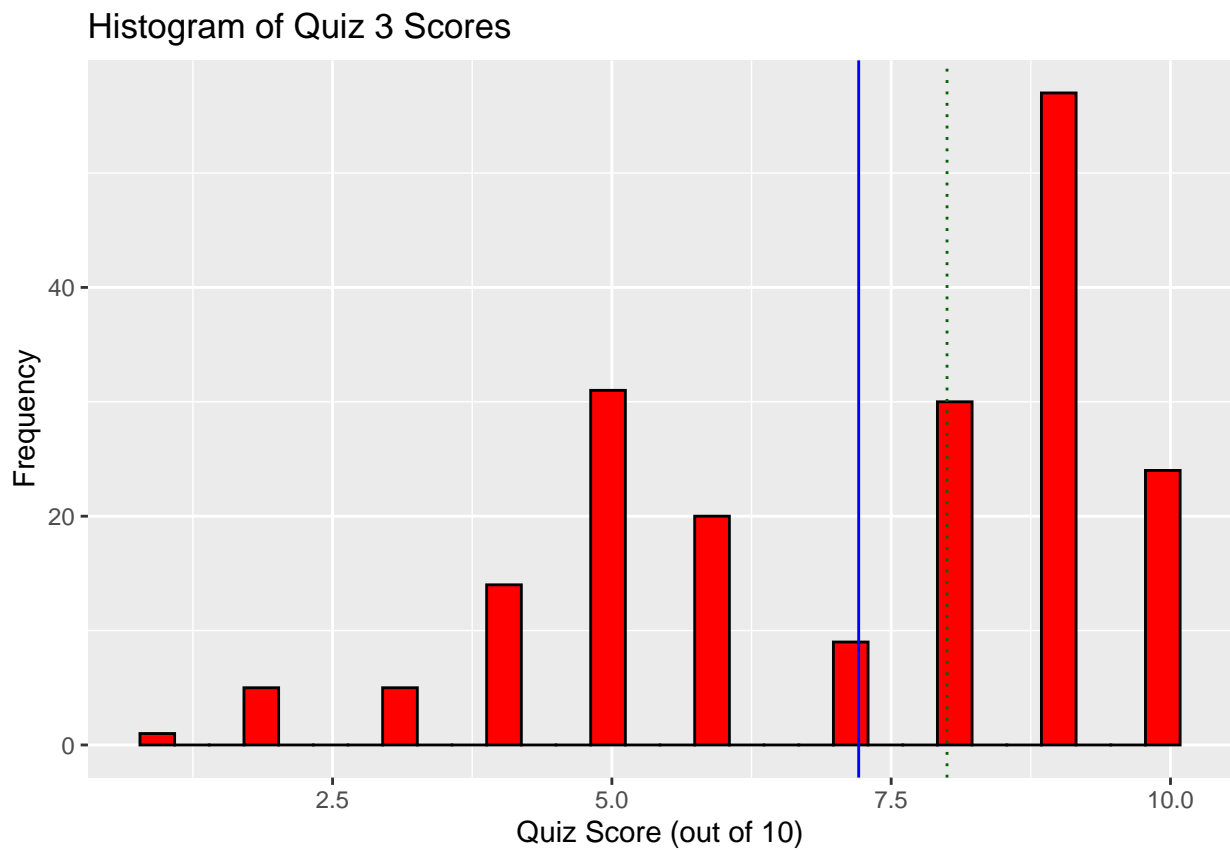
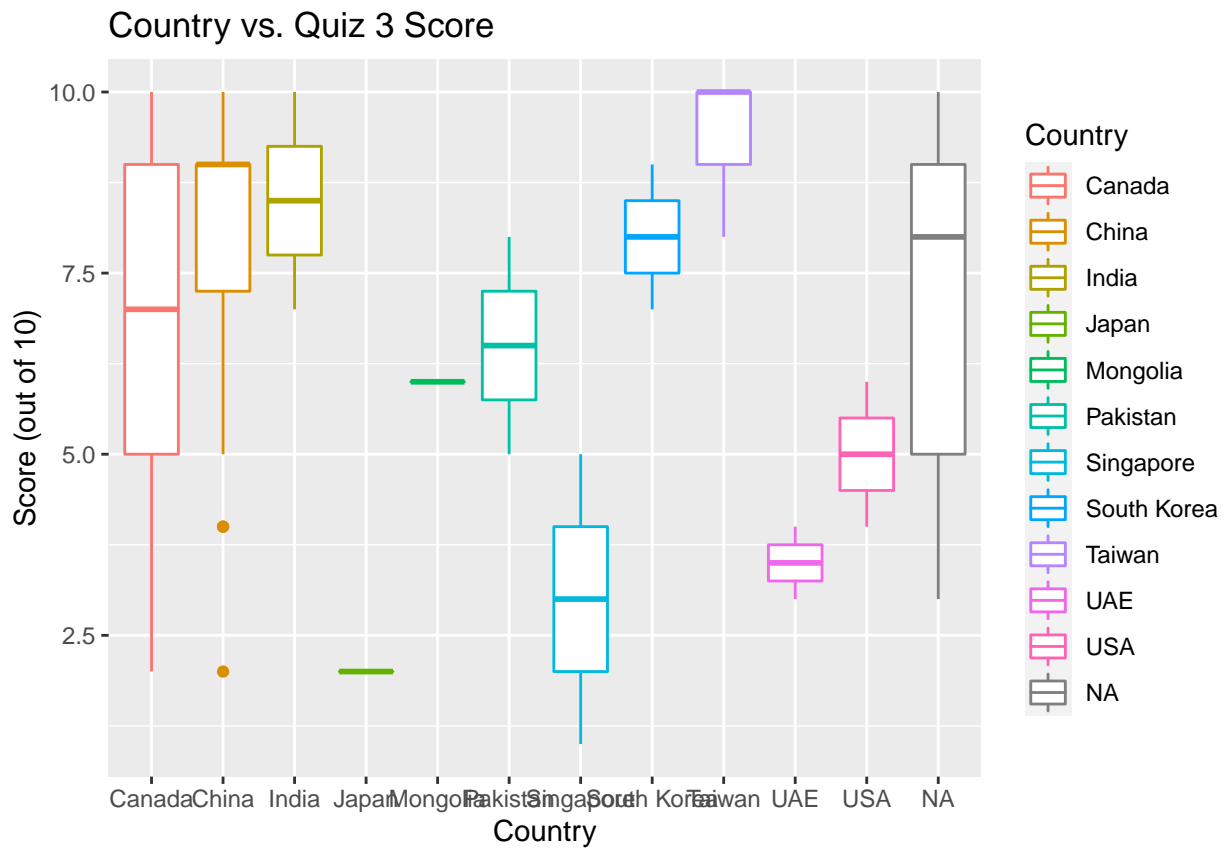


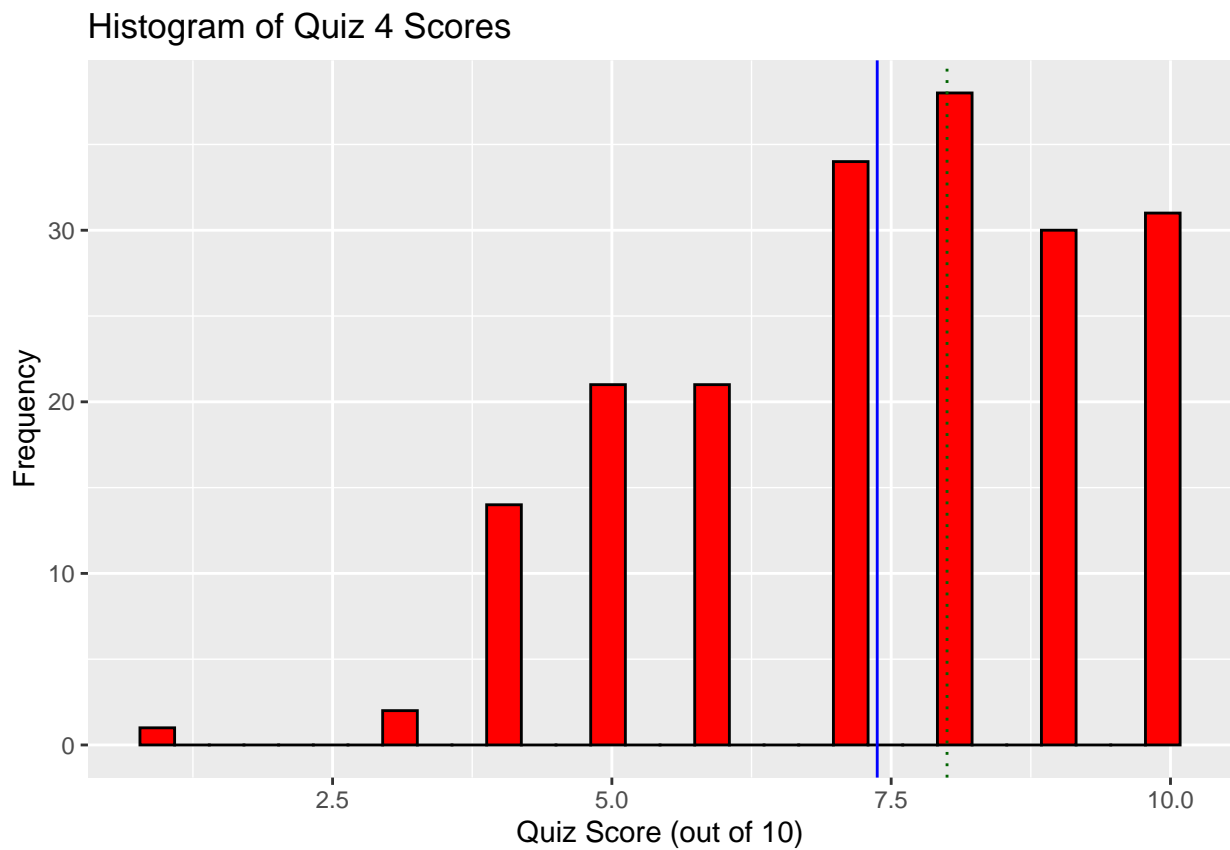
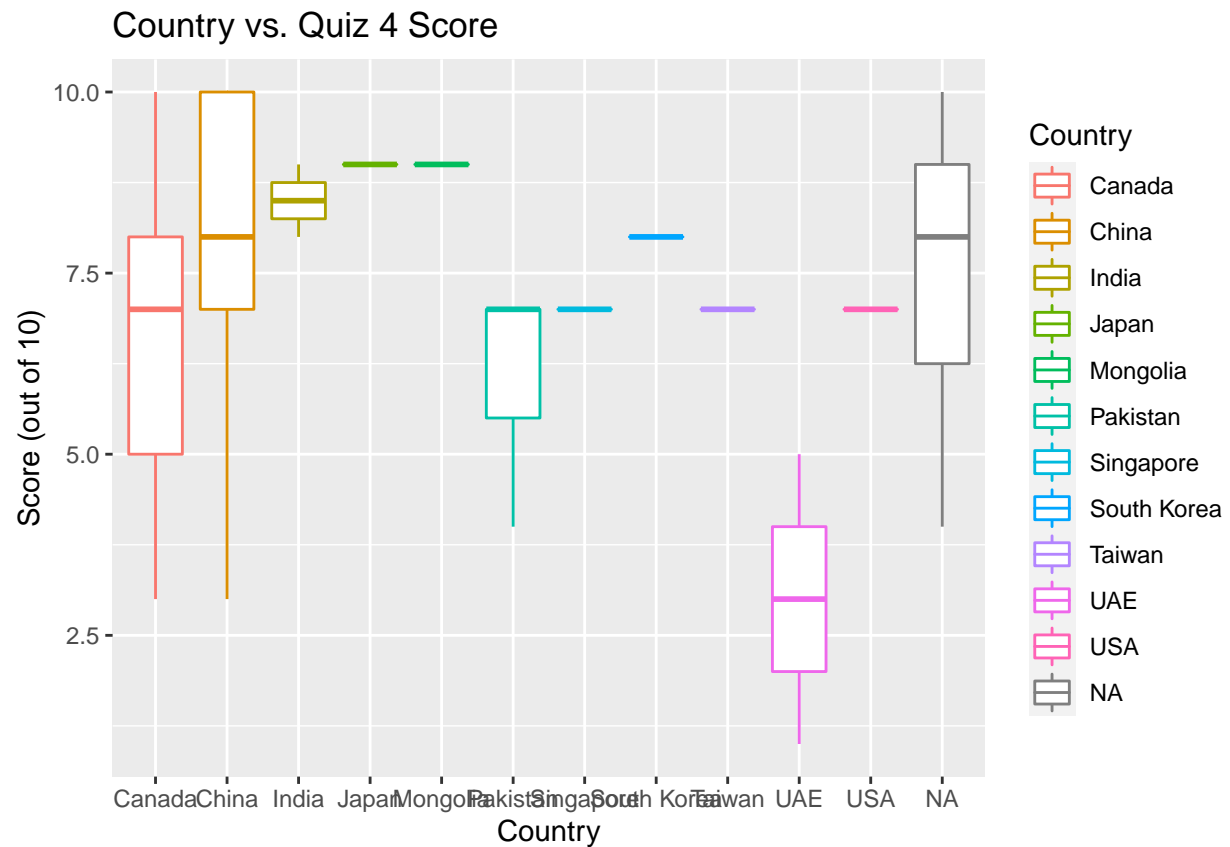
Histogram of Week 4 Time Spent Studying for STA302H1











5-Number Summary Statistics

```
summary(cleaned_sta302_performance_data2$COVID.hours..W1.)
```

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
##	0.0	1.0	1.0	3.7	2.0	168.0	21

```
summary(cleaned_sta302_performance_data2$COVID.hours..W2.)
```

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
##	0.000	1.000	1.000	2.869	2.000	40.000	19

```
summary(cleaned_sta302_performance_data2$COVID.hours..W3.)
```

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
##	0.000	0.500	1.000	2.227	2.000	24.000	11

```
summary(cleaned_sta302_performance_data2$COVID.hours..W4.)
```

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
##	0.000	1.000	1.500	2.917	3.000	50.000	13

```
summary(cleaned_sta302_performance_data2$STA302.hours..W1.)
```

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
##	0.000	5.000	7.000	7.539	9.000	28.000	21

```
summary(cleaned_sta302_performance_data2$STA302.hours..W2.)
```

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
##	1.000	6.000	8.000	8.403	10.000	20.000	19

```
summary(cleaned_sta302_performance_data2$STA302.hours..W3.)
```

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
##	0.00	6.00	9.00	9.32	12.00	30.00	10

```
summary(cleaned_sta302_performance_data2$STA302.hours..W4.)
```

##	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
##	2.00	7.00	11.00	13.44	16.00	72.00	13

```
summary(cleaned_sta302_performance_data2$Quiz_1_score)
```

```
##      Min. 1st Qu.  Median      Mean 3rd Qu.      Max.      NA's  
##      1.000   7.000   8.000   7.738   9.000  10.000         8
```

```
summary(cleaned_sta302_performance_data2$Quiz_2_score)
```

```
##      Min. 1st Qu.  Median      Mean 3rd Qu.      Max.      NA's  
##      0.000   5.800   8.800   7.422   9.400  10.000         8
```

```
summary(cleaned_sta302_performance_data2$Quiz_3_score)
```

```
##      Min. 1st Qu.  Median      Mean 3rd Qu.      Max.      NA's  
##      1.000   5.000   8.000   7.209   9.000  10.000         3
```

```
summary(cleaned_sta302_performance_data2$Quiz_4_score)
```

```
##      Min. 1st Qu.  Median      Mean 3rd Qu.      Max.      NA's  
##      1.000   6.000   8.000   7.375   9.000  10.000         7
```

```

quiz1 = canadians$Quiz_1_score
quiz2 = canadians$Quiz_2_score
quiz3 = canadians$Quiz_3_score
quiz4 = canadians$Quiz_4_score

covid1 = canadians$COVID.hours..W1.
covid2 = canadians$COVID.hours..W2.
covid3 = canadians$COVID.hours..W3.
covid4 = canadians$COVID.hours..W4.

study1 = canadians$STA302.hours..W1.
study2 = canadians$STA302.hours..W2.
study3 = canadians$STA302.hours..W3.
study4 = canadians$STA302.hours..W4.

additive_model = lm(
  quiz4 ~
    # quiz1 + quiz2
  + quiz3
  # + covid1 + covid2 + covid3 + covid4
  # + study1 + study2 + study3 + study4
  + I(covid1 * study1) + I(covid2 * study2) + I(covid3 * study3) + I(covid4 * study4)
)
summary(additive_model)

```

```

##
## Call:
## lm(formula = quiz4 ~ +quiz3 + I(covid1 * study1) + I(covid2 *
##   study2) + I(covid3 * study3) + I(covid4 * study4))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -3.6252 -0.8843  0.0141  0.8890  3.7941
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    4.309527   0.595306   7.239  2.6e-10 ***
## quiz3          0.432806   0.080449   5.380  7.4e-07 ***
## I(covid1 * study1) 0.003991   0.001784   2.237  0.02813 *
## I(covid2 * study2) -0.010429   0.006972  -1.496  0.13870
## I(covid3 * study3) 0.016116   0.005960   2.704  0.00839 **
## I(covid4 * study4) -0.020362   0.007279  -2.797  0.00647 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.549 on 79 degrees of freedom
## (12 observations deleted due to missingness)
## Multiple R-squared:  0.3271, Adjusted R-squared:  0.2845
## F-statistic: 7.679 on 5 and 79 DF,  p-value: 6.329e-06

```

```

quiz1 = non_canadians$Quiz_1_score
quiz2 = non_canadians$Quiz_2_score
quiz3 = non_canadians$Quiz_3_score
quiz4 = non_canadians$Quiz_4_score

covid1 = non_canadians$COVID.hours..W1.
covid2 = non_canadians$COVID.hours..W2.
covid3 = non_canadians$COVID.hours..W3.
covid4 = non_canadians$COVID.hours..W4.

study1 = non_canadians$STA302.hours..W1.
study2 = non_canadians$STA302.hours..W2.
study3 = non_canadians$STA302.hours..W3.
study4 = non_canadians$STA302.hours..W4.

additive_model2 = lm(
  quiz4 ~
    # quiz1 + quiz2
  + quiz3
  # + covid1 + covid2 + covid3 + covid4
  # + study1 + study2 + study3 + study4
  + I(covid1 * study1) + I(covid2 * study2) + I(covid3 * study3) + I(covid4 * study4)
)
summary(additive_model2)

```

```

##
## Call:
## lm(formula = quiz4 ~ +quiz3 + I(covid1 * study1) + I(covid2 *
##   study2) + I(covid3 * study3) + I(covid4 * study4))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -3.6294 -0.9600  0.1752  1.0628  3.0574
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   4.5445815   0.8252308   5.507 9.49e-07 ***
## quiz3         0.4234620   0.0976217   4.338 6.07e-05 ***
## I(covid1 * study1) 0.0196100   0.0118517   1.655  0.1036
## I(covid2 * study2) 0.0159508   0.0103272   1.545  0.1281
## I(covid3 * study3) -0.0246415   0.0124028  -1.987  0.0518 .
## I(covid4 * study4) 0.0007863   0.0024039   0.327  0.7448
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.563 on 56 degrees of freedom
## (40 observations deleted due to missingness)
## Multiple R-squared:  0.2972, Adjusted R-squared:  0.2344
## F-statistic: 4.735 on 5 and 56 DF,  p-value: 0.001119

```

```

quiz1 = cleaned_sta302_performance_data2$Quiz_1_score
quiz2 = cleaned_sta302_performance_data2$Quiz_2_score
quiz3 = cleaned_sta302_performance_data2$Quiz_3_score
quiz4 = cleaned_sta302_performance_data2$Quiz_4_score

covid1 = cleaned_sta302_performance_data2$COVID.hours..W1.
covid2 = cleaned_sta302_performance_data2$COVID.hours..W2.
covid3 = cleaned_sta302_performance_data2$COVID.hours..W3.
covid4 = cleaned_sta302_performance_data2$COVID.hours..W4.

study1 = cleaned_sta302_performance_data2$STA302.hours..W1.
study2 = cleaned_sta302_performance_data2$STA302.hours..W2.
study3 = cleaned_sta302_performance_data2$STA302.hours..W3.
study4 = cleaned_sta302_performance_data2$STA302.hours..W4.

additive_model3 = lm(
  quiz4 ~
    # quiz1 + quiz2
  quiz3
  # + covid1 + covid2 + covid3 + covid4
  # + study1 + study2 + study3 + study4
  + I(covid1 * study1) + I(covid2 * study2) + I(covid3 * study3) + I(covid4 * study4)
)
summary(additive_model3)

```

```

##
## Call:
## lm(formula = quiz4 ~ quiz3 + I(covid1 * study1) + I(covid2 *
##   study2) + I(covid3 * study3) + I(covid4 * study4))
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -3.6953 -1.0538  0.1813  1.0495  3.8693
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    4.1699017   0.4911384   8.490 2.59e-14 ***
## quiz3          0.4414666   0.0631209   6.994 9.87e-11 ***
## I(covid1 * study1) 0.0003017   0.0013982   0.216  0.829
## I(covid2 * study2) -0.0036989   0.0055367  -0.668  0.505
## I(covid3 * study3) 0.0034740   0.0049446   0.703  0.483
## I(covid4 * study4) -0.0004111   0.0021873  -0.188  0.851
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.629 on 141 degrees of freedom
## (52 observations deleted due to missingness)
## Multiple R-squared:  0.268, Adjusted R-squared:  0.242
## F-statistic: 10.32 on 5 and 141 DF, p-value: 1.889e-08

```