STA302H1 – Final Project Descriptive Statistics

Danny Chen

August 10, 2021

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)) %>%

    # Remove the "X" column: it's simply the row number, which isn't very useful.
    # Remove the "Country" column: column "country" already exists
    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)

    # Identify rows with no quiz 4.
    # These indicate students who have dropped STA302H1, and who
    # should be excluded from the final data.
```

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.

```
at_least_one_NA = function(data) {
  return (rowSums(is.na(cleaned_sta302_performance_data)) >= 1)
}
```

```
rows_with_some_NAs = cleaned_sta302_performance_data[
  at_least_one_NA(cleaned_sta302_performance_data),
]
```

Rows with Mistyped Columns

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

```
rows_with_mistyped_columms = cleaned_sta302_performance_data[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_data %>%
  select(-country)
```

Find Significance Predictor Variables, Select Predictor Variables Based on Criterion

```
# use week 5b slides -- choose model selection criterion to pick predictor variables.


# use lm() on a bunch of predictor variables to determine significant
# predictor variables.
```

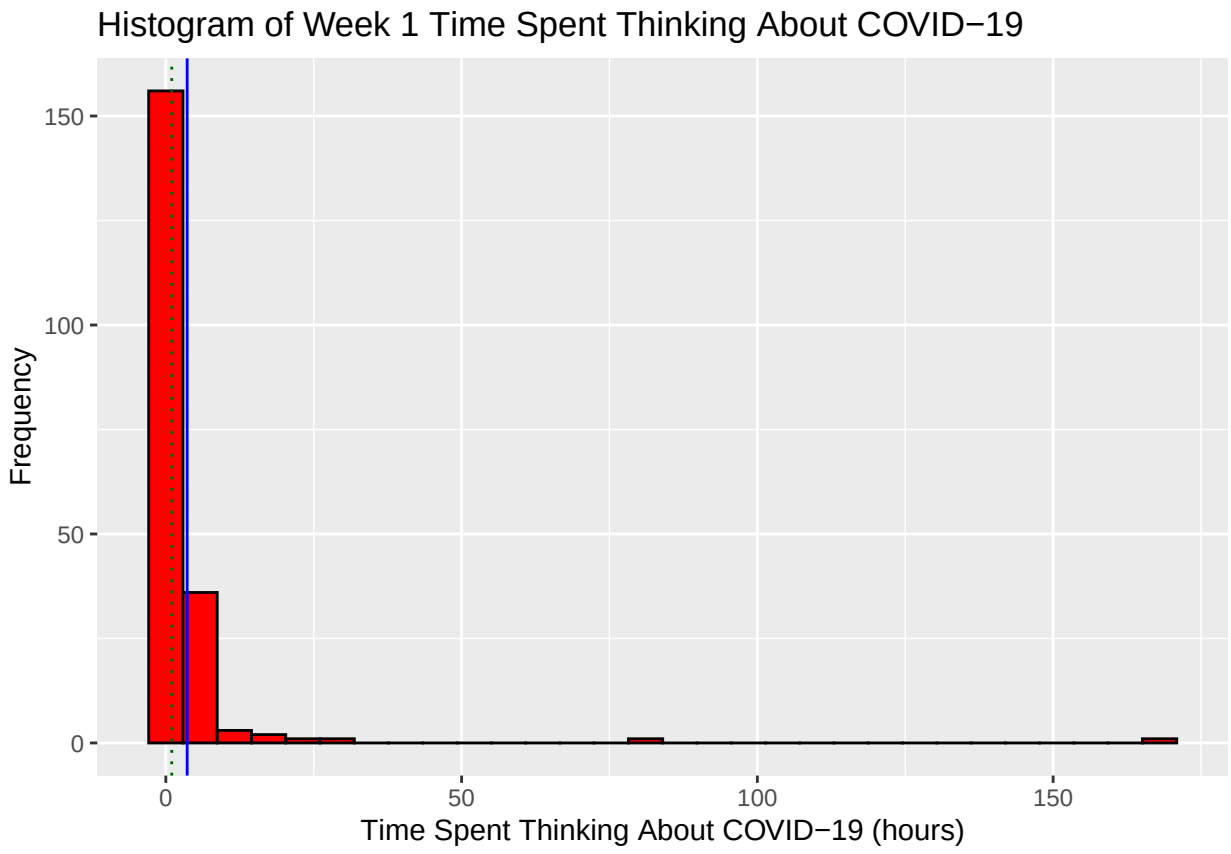
Histograms

```
# TODO: See toy programs to learn how to create histograms with ggplot. -- DONE
# TODO: See Demo 1 to figure out how to add histograms using grid.arrange. -- IGNORE

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")
}
```

Histograms of COVID Hours

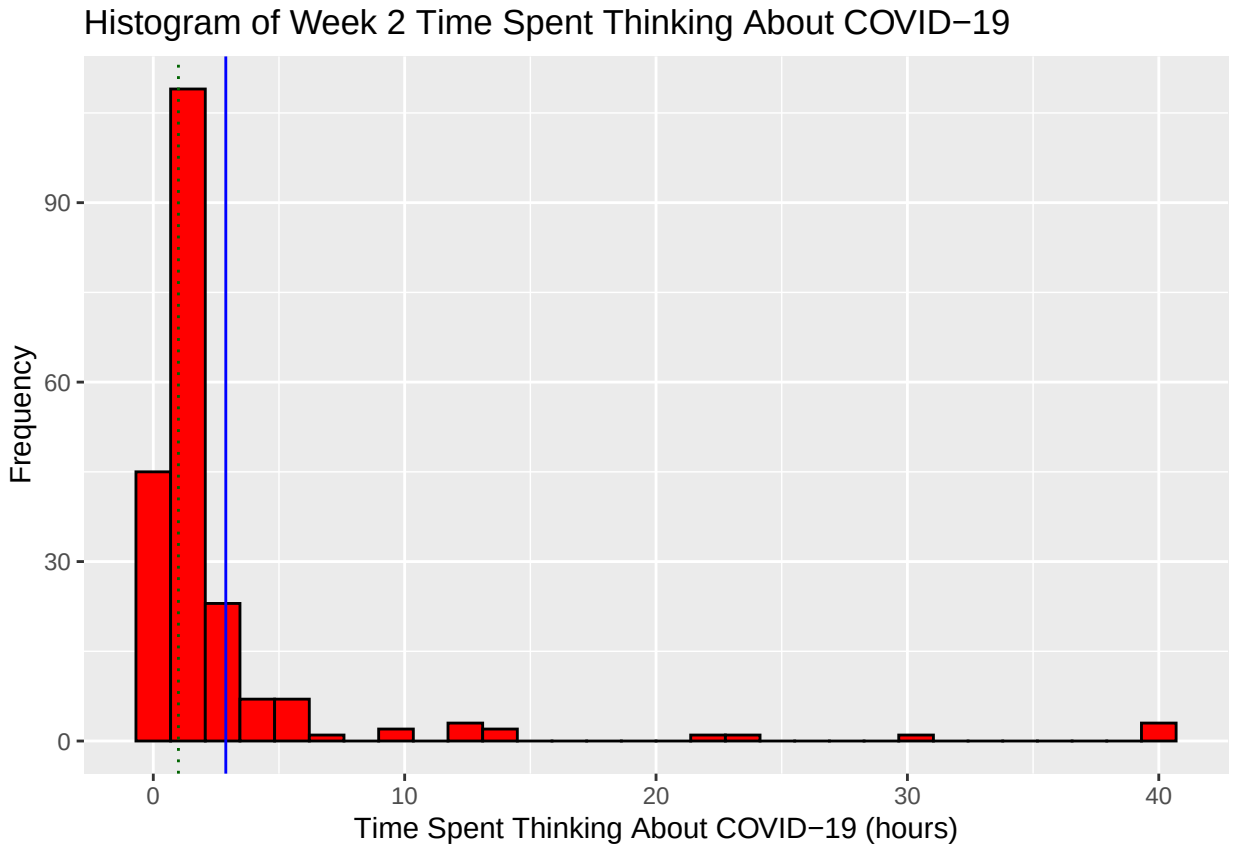
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$COVID.hours..W1.,
                  "Histogram of Week 1 Time Spent Thinking About COVID-19",
                  "Time Spent Thinking About COVID-19 (hours)")
```

```
## Warning: Removed 26 rows containing non-finite values (stat_bin).
```



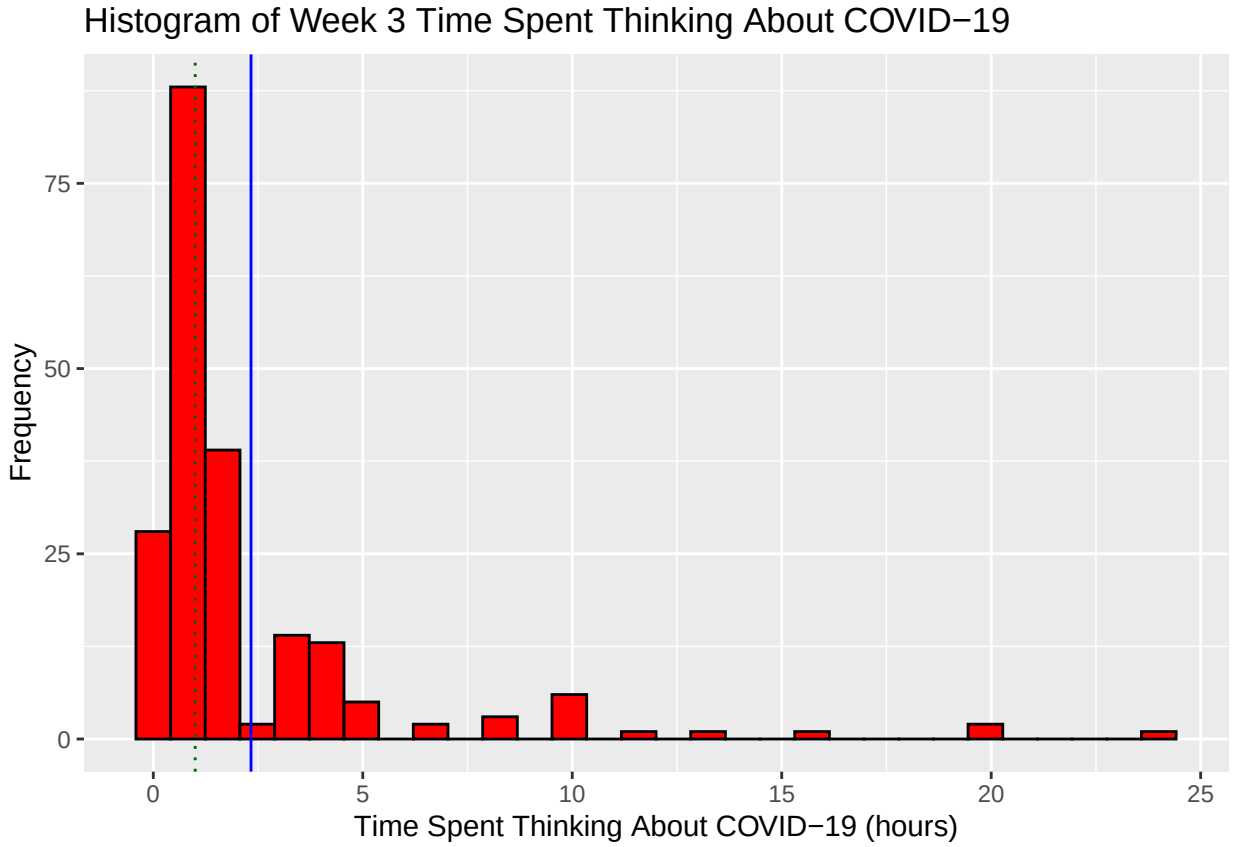
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$COVID.hours..W2.,
                  "Histogram of Week 2 Time Spent Thinking About COVID-19",
                  "Time Spent Thinking About COVID-19 (hours)")
```

```
## Warning: Removed 22 rows containing non-finite values (stat_bin).
```



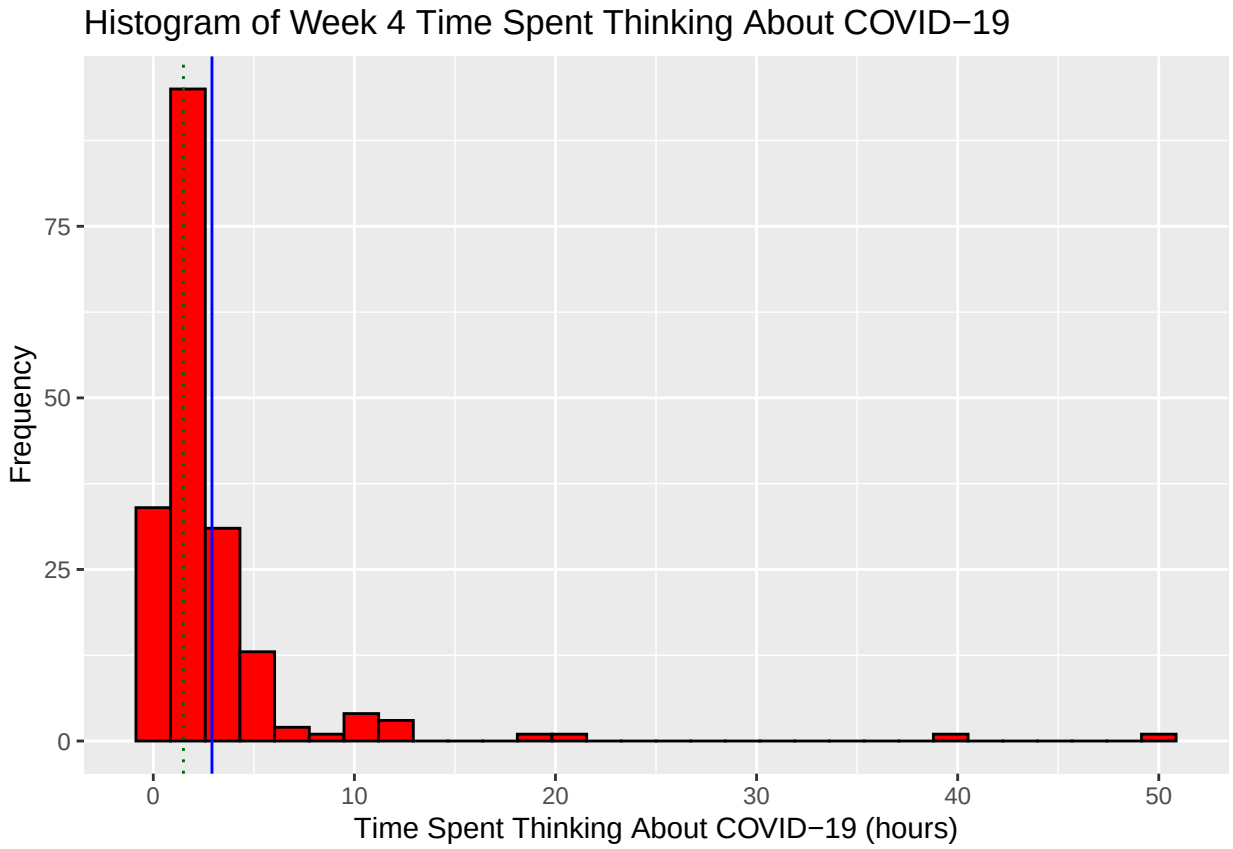
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$COVID.hours..W3.,
                  "Histogram of Week 3 Time Spent Thinking About COVID-19",
                  "Time Spent Thinking About COVID-19 (hours)")
```

```
## Warning: Removed 21 rows containing non-finite values (stat_bin).
```



```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$COVID.hours..W4.,
                  "Histogram of Week 4 Time Spent Thinking About COVID-19",
                  "Time Spent Thinking About COVID-19 (hours)")
```

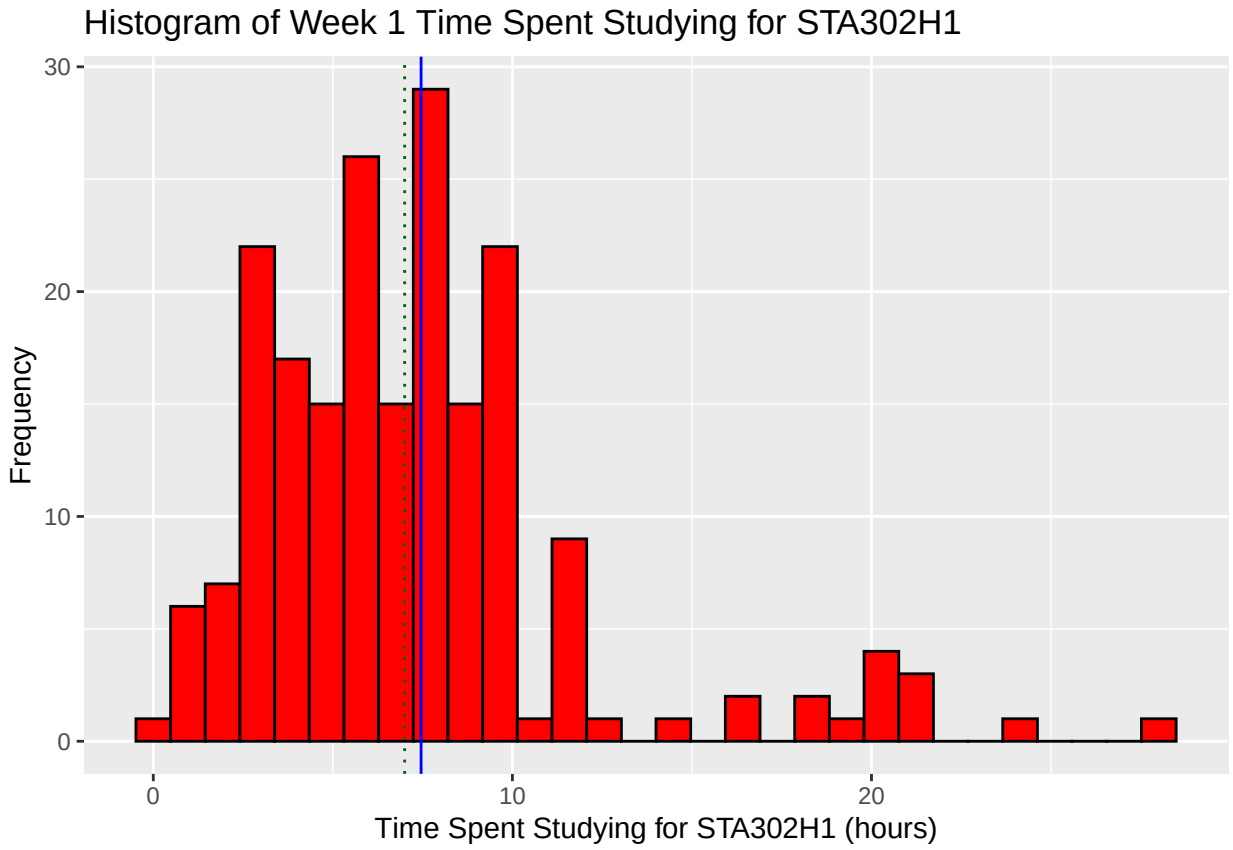
```
## Warning: Removed 40 rows containing non-finite values (stat_bin).
```



Histograms of STA302H1 Hours

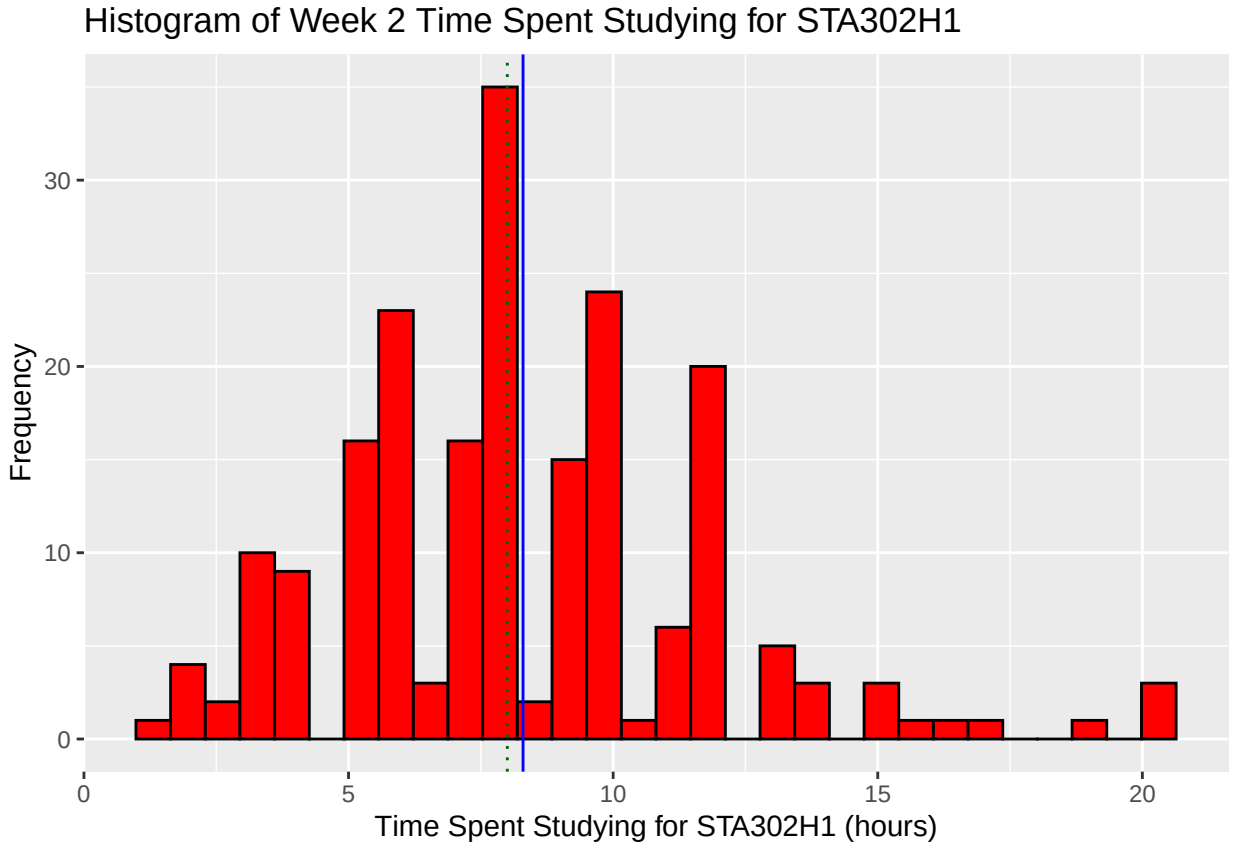
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$STA302.hours..W1.,
                  "Histogram of Week 1 Time Spent Studying for STA302H1",
                  "Time Spent Studying for STA302H1 (hours)")
```

```
## Warning: Removed 26 rows containing non-finite values (stat_bin).
```



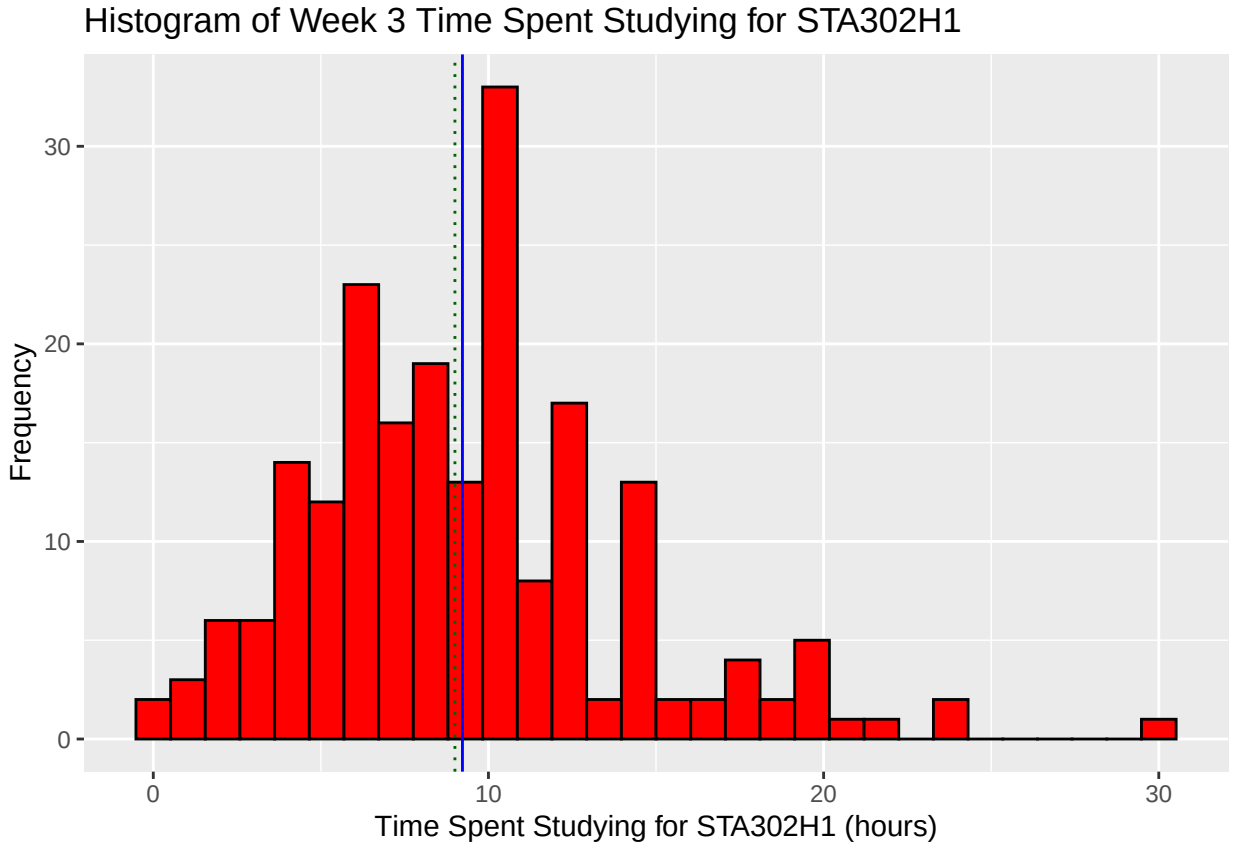
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$STA302.hours..W2.,
                  "Histogram of Week 2 Time Spent Studying for STA302H1",
                  "Time Spent Studying for STA302H1 (hours)")
```

```
## Warning: Removed 22 rows containing non-finite values (stat_bin).
```



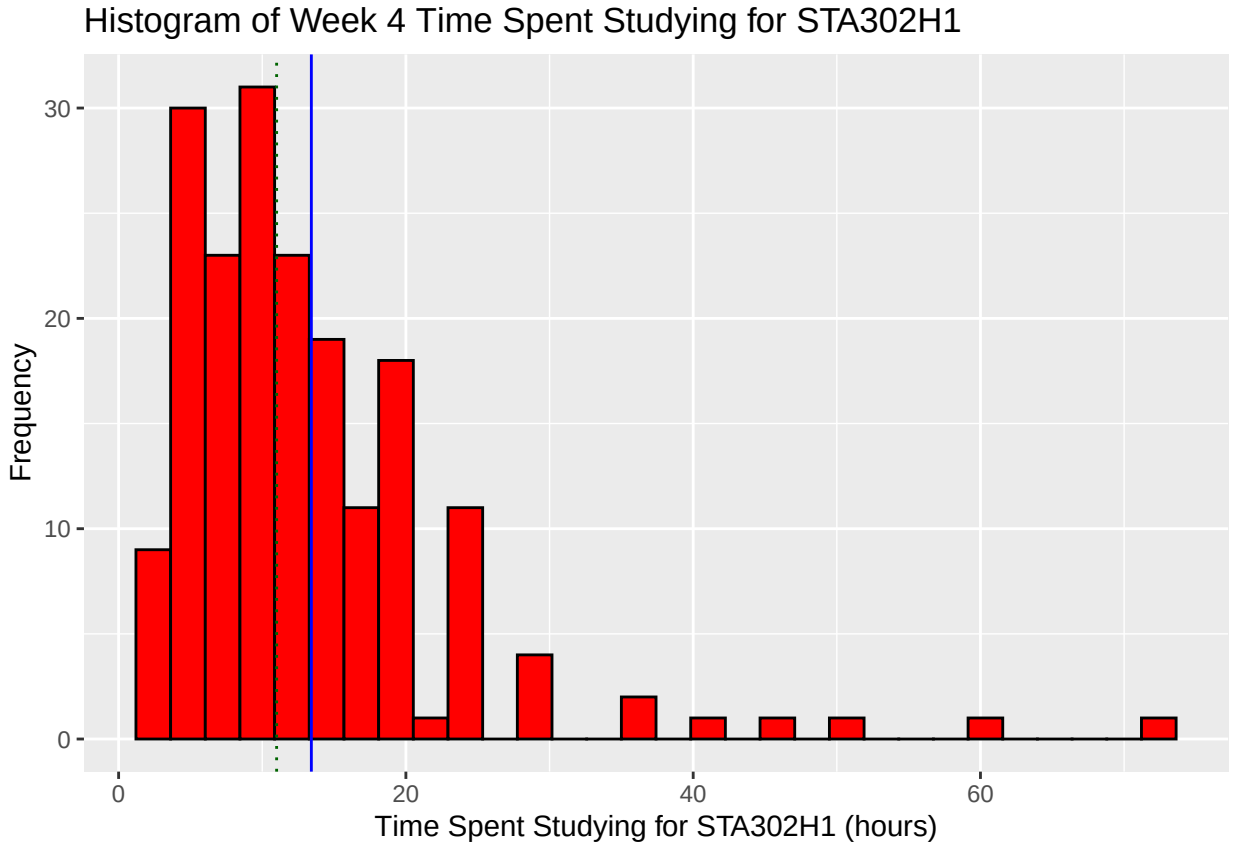
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$STA302.hours..W3.,
                  "Histogram of Week 3 Time Spent Studying for STA302H1",
                  "Time Spent Studying for STA302H1 (hours)")
```

```
## Warning: Removed 20 rows containing non-finite values (stat_bin).
```



```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$STA302.hours..W4.,
                  "Histogram of Week 4 Time Spent Studying for STA302H1",
                  "Time Spent Studying for STA302H1 (hours)")
```

```
## Warning: Removed 40 rows containing non-finite values (stat_bin).
```



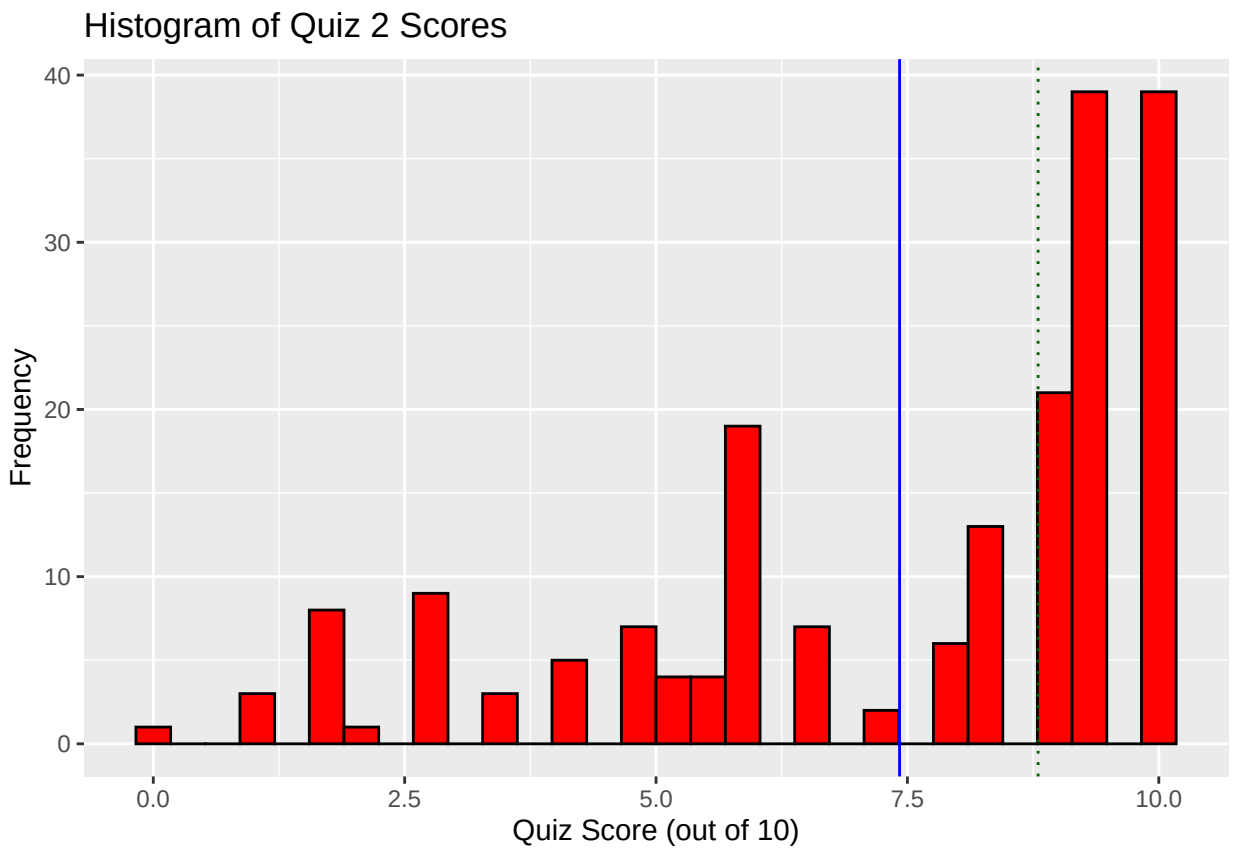
Histograms of Quiz Scores

```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$Quiz_1_score,
                  "Histogram of Quiz 1 Scores",
                  "Quiz Score (out of 10)")
```

```
## Warning: Removed 13 rows containing non-finite values (stat_bin).
```

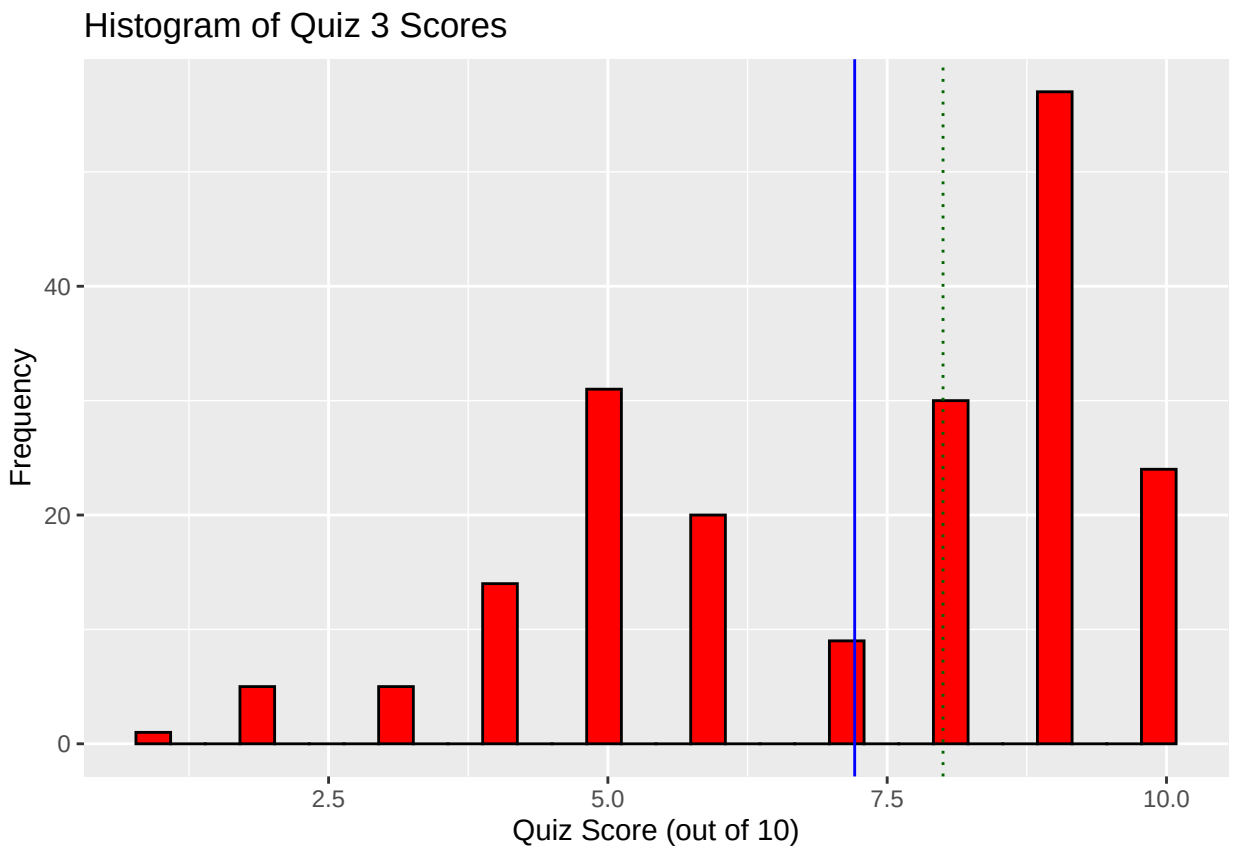
```r
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$Quiz_2_score,
                  "Histogram of Quiz 2 Scores",
                  "Quiz Score (out of 10)")
```

```
## Warning: Removed 36 rows containing non-finite values (stat_bin).
```



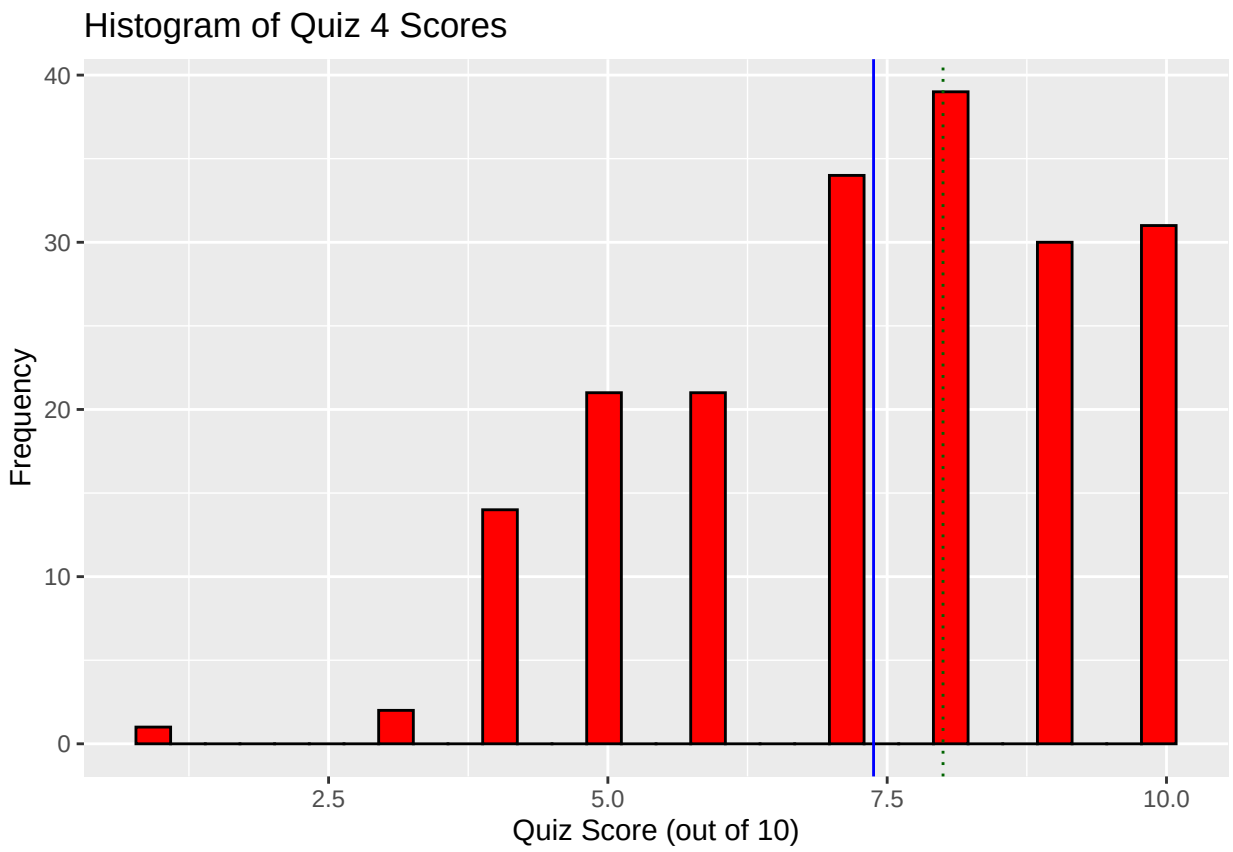
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$Quiz_3_score,
                  "Histogram of Quiz 3 Scores",
                  "Quiz Score (out of 10)")
```

```
## Warning: Removed 31 rows containing non-finite values (stat_bin).
```



```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$Quiz_4_score,
                  "Histogram of Quiz 4 Scores",
                  "Quiz Score (out of 10)")
```

```
## Warning: Removed 34 rows containing non-finite values (stat_bin).
```



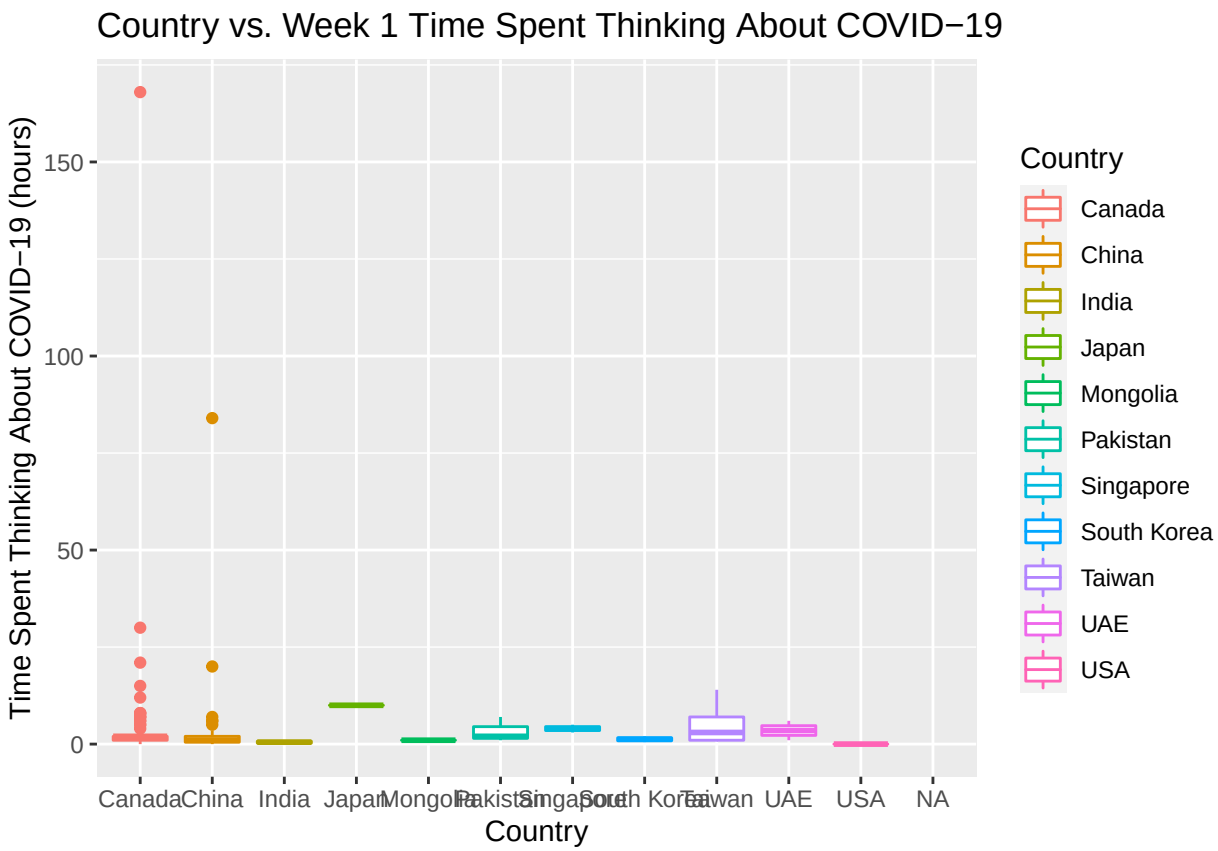
Boxplots

```
# TODO: See STA248H1 notes to figure out how to create boxplots. -- DONE
# TODO: See toy program of boxplots to see how to color them by factor -- DONE

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)
}
```

Boxplots of COVID Hours

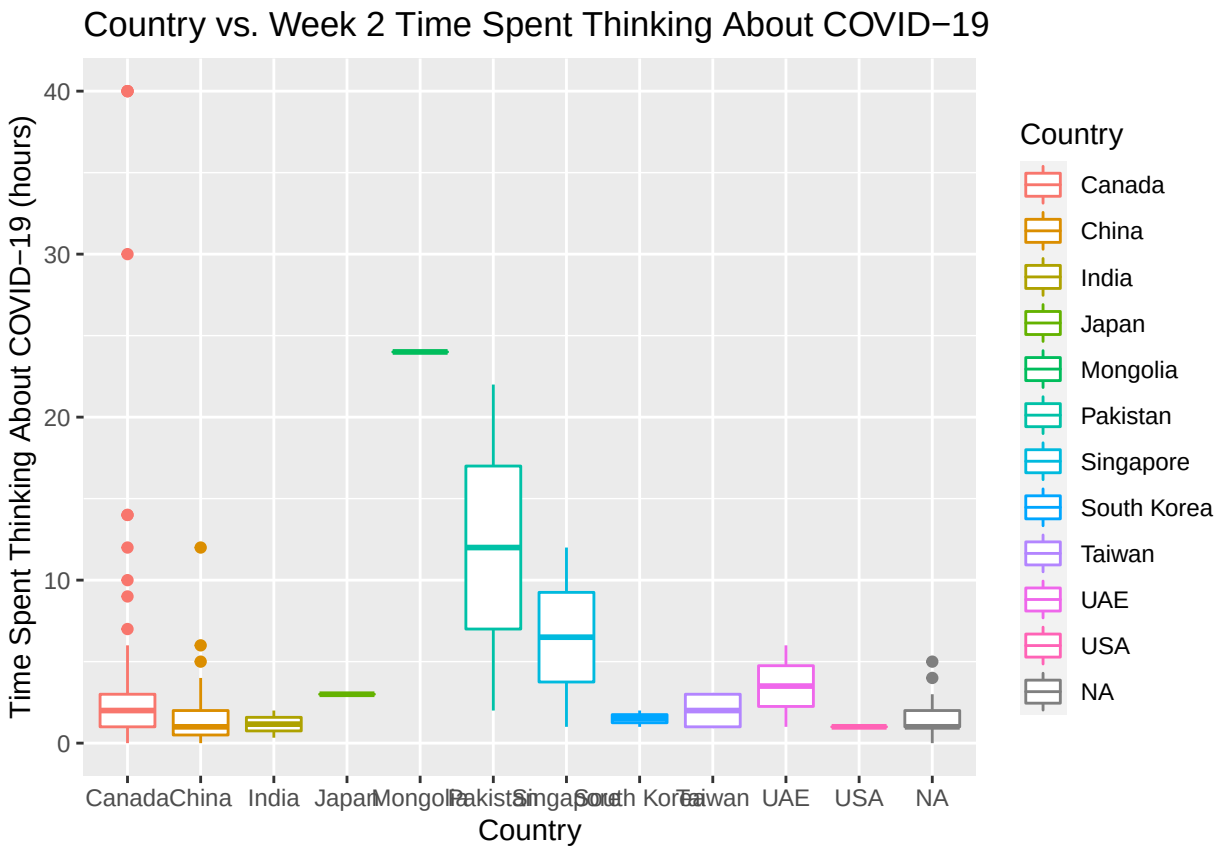
```
display_boxplot(cleaned_sta302_performance_data, COVID.hours..W1.,
                "Country vs. Week 1 Time Spent Thinking About COVID-19",
                "Time Spent Thinking About COVID-19 (hours)")
```

```
## Warning: Removed 26 rows containing non-finite values (stat_boxplot).
```



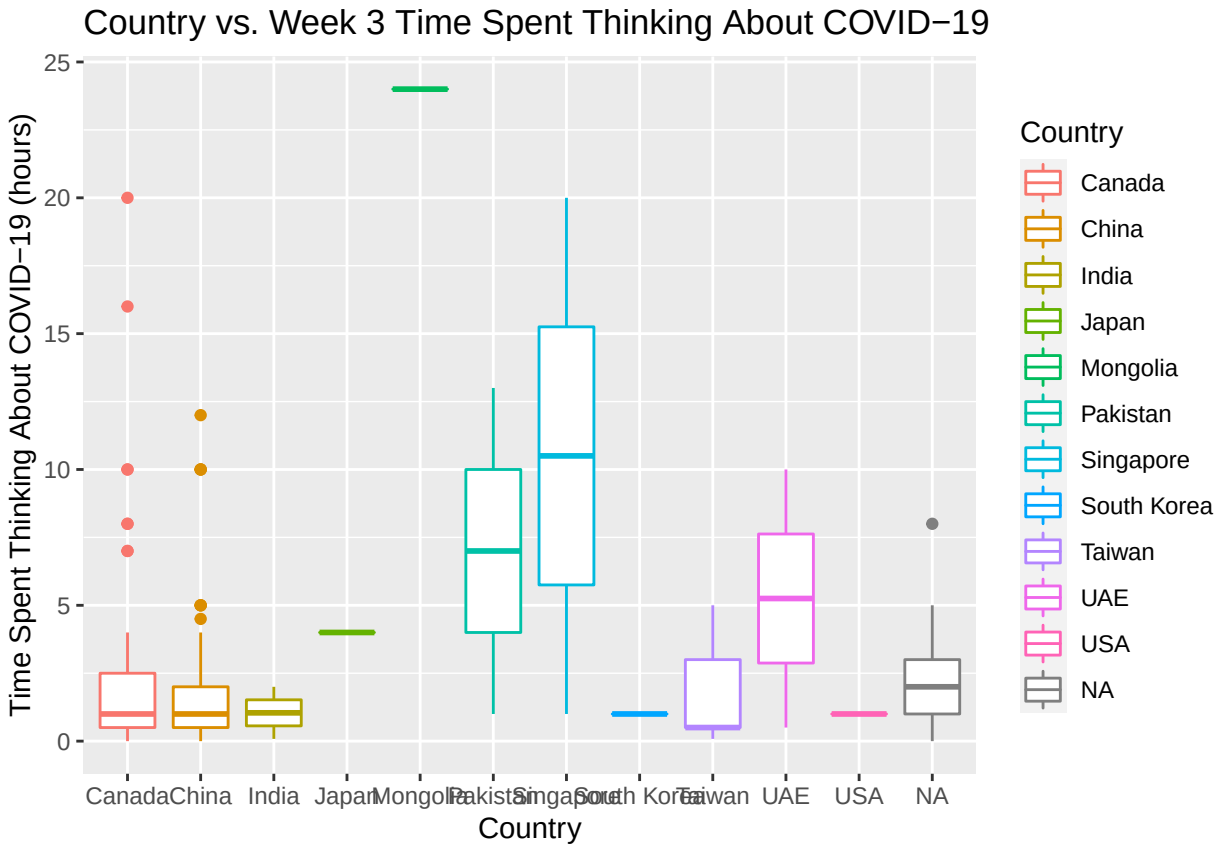
```
display_boxplot(cleaned_sta302_performance_data, COVID.hours..W2.,
                "Country vs. Week 2 Time Spent Thinking About COVID-19",
                "Time Spent Thinking About COVID-19 (hours)")
```

```
## Warning: Removed 22 rows containing non-finite values (stat_boxplot).
```



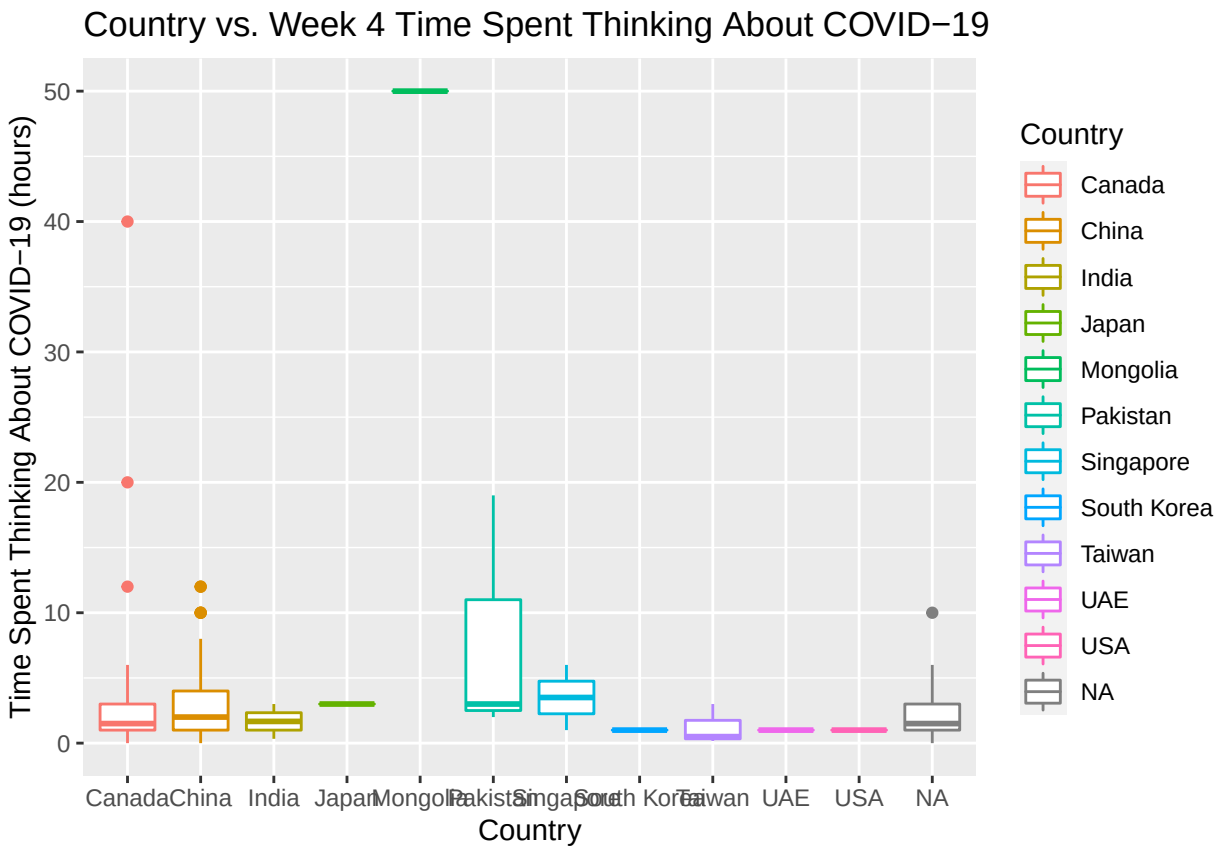
```
display_boxplot(cleaned_sta302_performance_data, COVID.hours..W3.,
                "Country vs. Week 3 Time Spent Thinking About COVID-19",
                "Time Spent Thinking About COVID-19 (hours)")
```

```
## Warning: Removed 21 rows containing non-finite values (stat_boxplot).
```



```
display_boxplot(cleaned_sta302_performance_data, COVID.hours..W4.,
                "Country vs. Week 4 Time Spent Thinking About COVID-19",
                "Time Spent Thinking About COVID-19 (hours)")
```

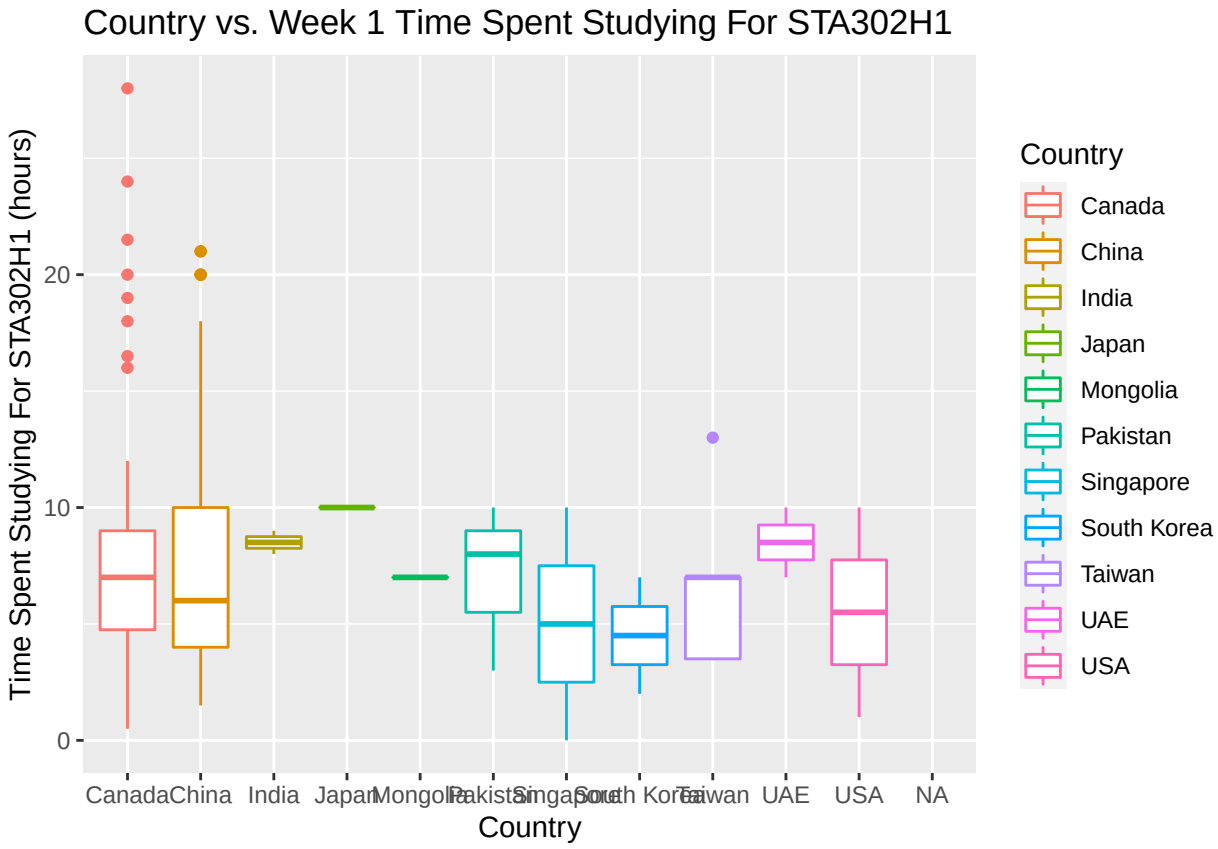
```
## Warning: Removed 40 rows containing non-finite values (stat_boxplot).
```



Boxplots of STA302H1 Hours

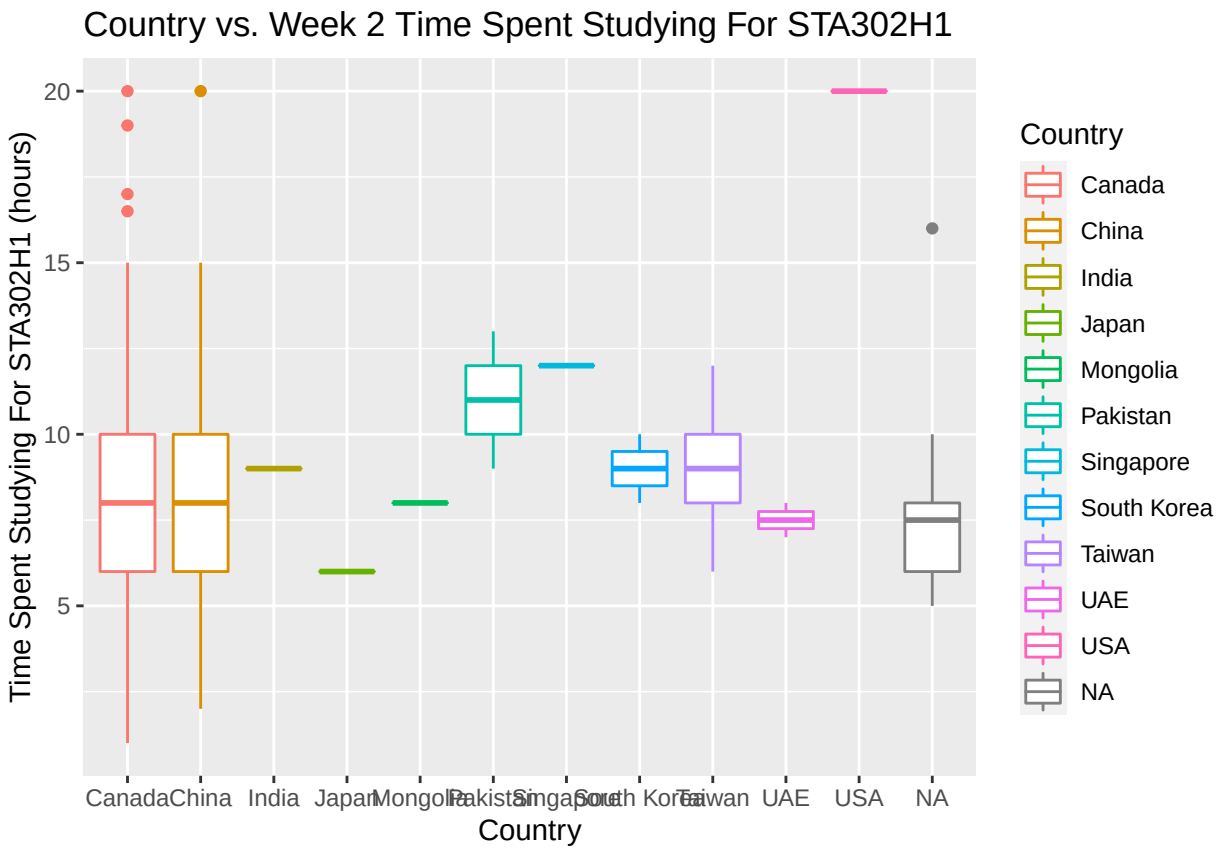
```
display_boxplot(cleaned_sta302_performance_data, STA302.hours..W1.,
                "Country vs. Week 1 Time Spent Studying For STA302H1",
                "Time Spent Studying For STA302H1 (hours)")
```

```
## Warning: Removed 26 rows containing non-finite values (stat_boxplot).
```



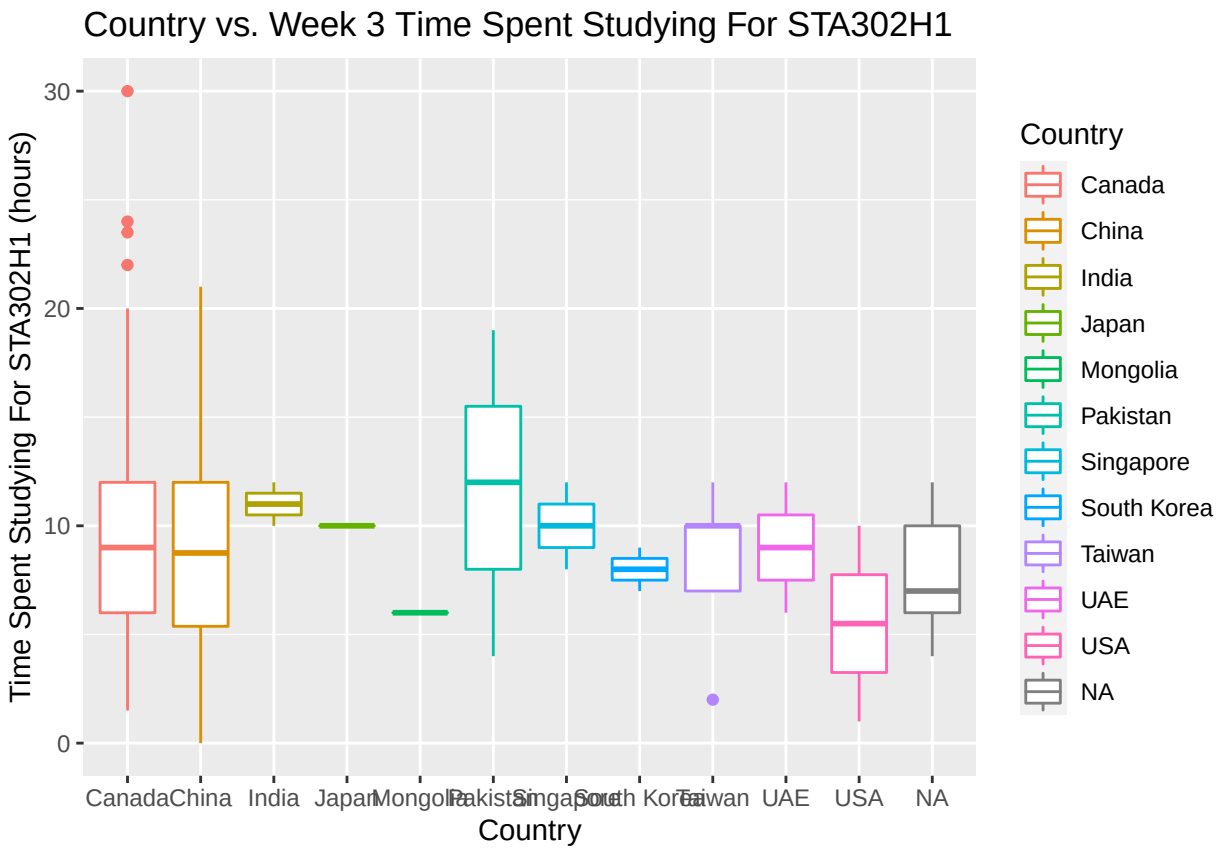
```
display_boxplot(cleaned_sta302_performance_data, STA302.hours..W2.,
                "Country vs. Week 2 Time Spent Studying For STA302H1",
                "Time Spent Studying For STA302H1 (hours)")
```

```
## Warning: Removed 22 rows containing non-finite values (stat_boxplot).
```



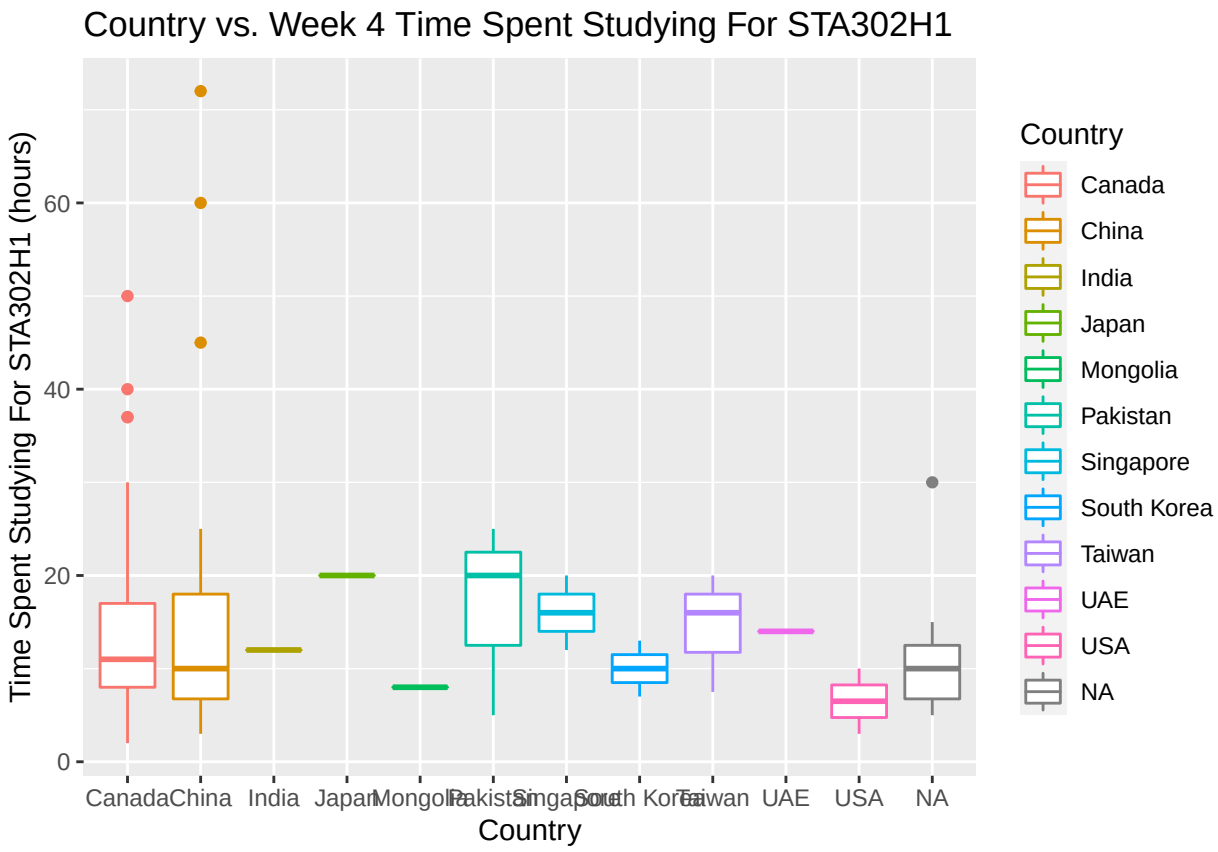
```
display_boxplot(cleaned_sta302_performance_data, STA302.hours..W3.,
                "Country vs. Week 3 Time Spent Studying For STA302H1",
                "Time Spent Studying For STA302H1 (hours)")
```

```
## Warning: Removed 20 rows containing non-finite values (stat_boxplot).
```



```
display_boxplot(cleaned_sta302_performance_data, STA302.hours..W4.,
                "Country vs. Week 4 Time Spent Studying For STA302H1",
                "Time Spent Studying For STA302H1 (hours)")
```

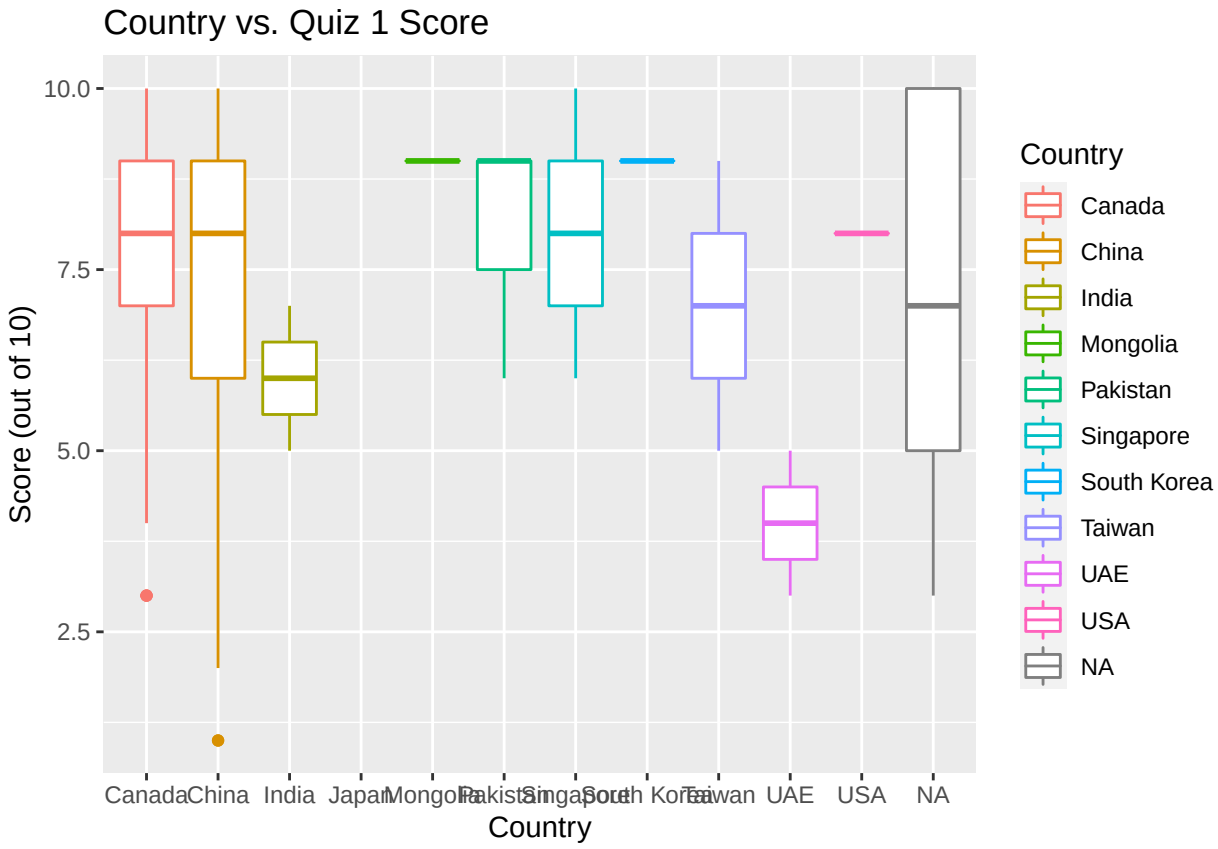
```
## Warning: Removed 40 rows containing non-finite values (stat_boxplot).
```



Boxplots of Quiz Scores

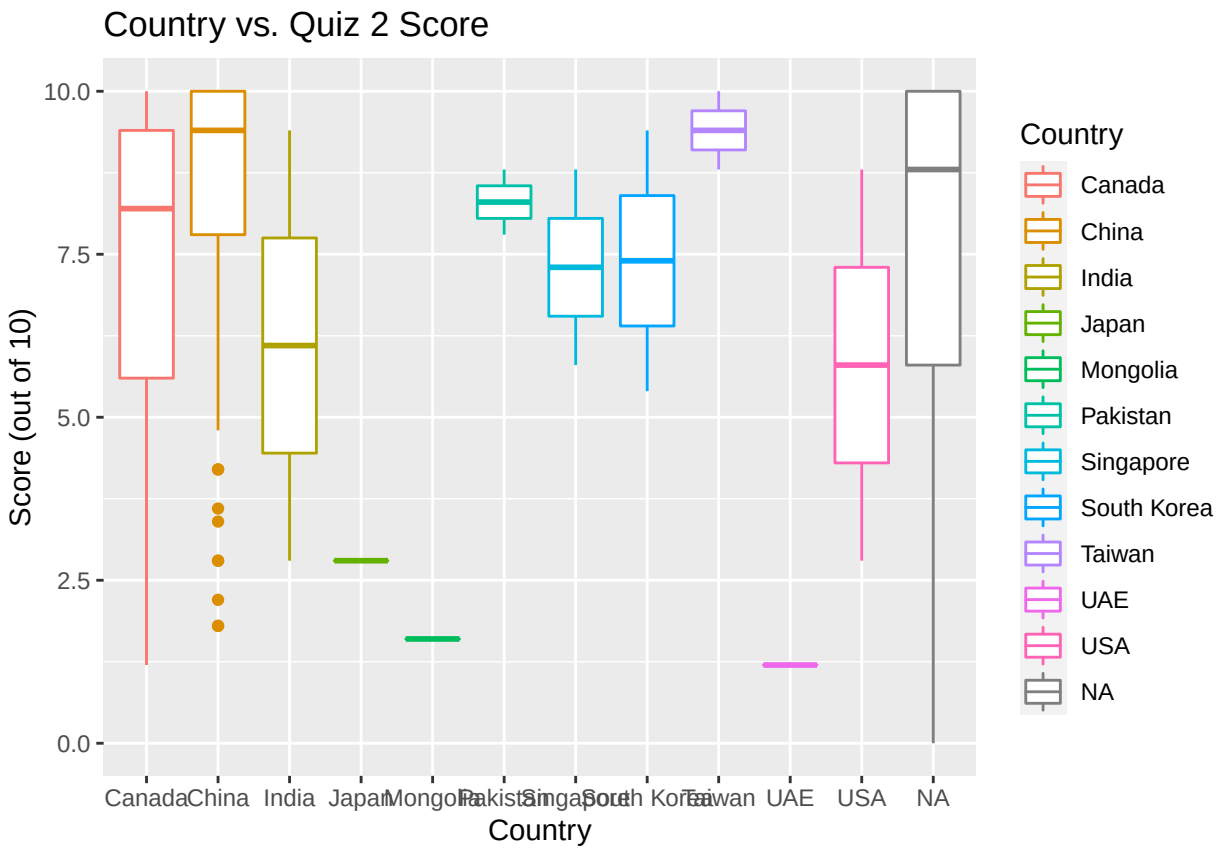
```
display_boxplot(cleaned_sta302_performance_data, Quiz_1_score,
                "Country vs. Quiz 1 Score", "Score (out of 10)")
```

```
## Warning: Removed 13 rows containing non-finite values (stat_boxplot).
```



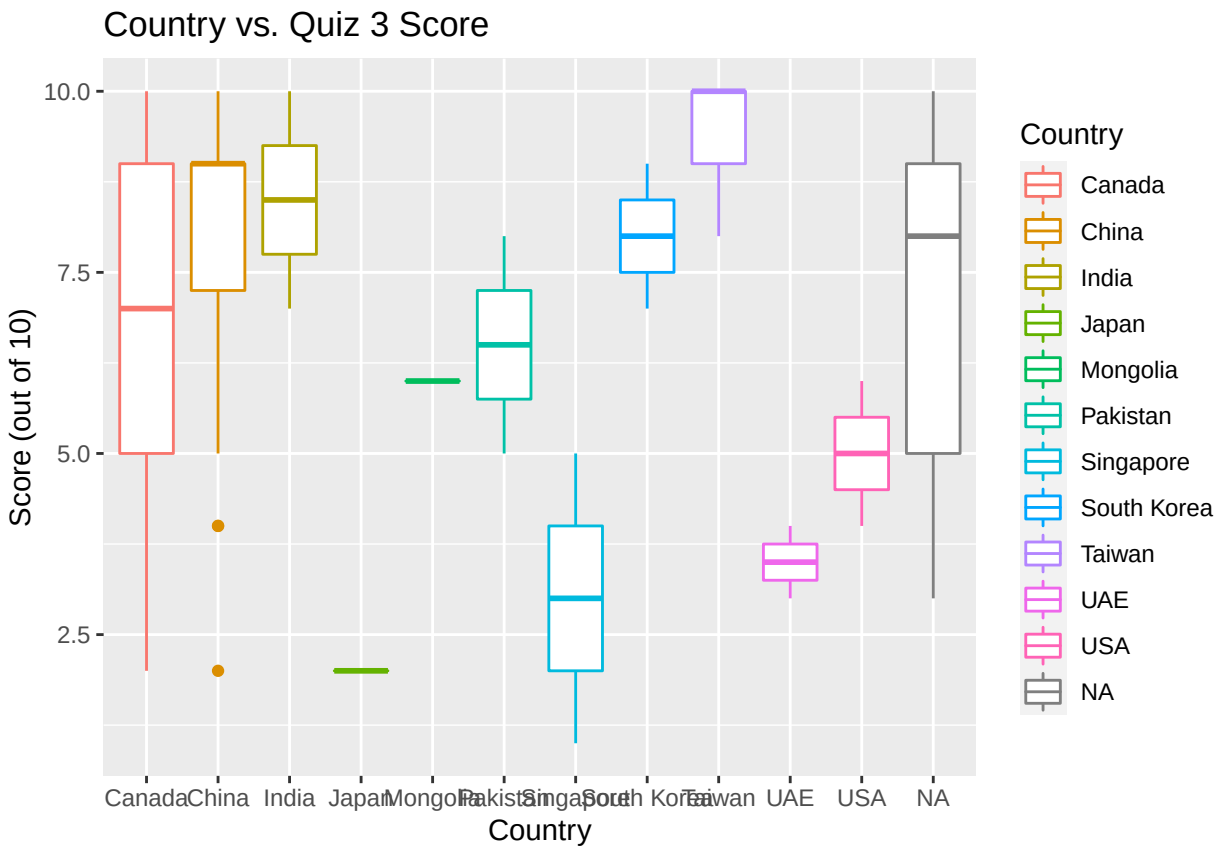
```
display_boxplot(cleaned_sta302_performance_data, Quiz_2_score,
                "Country vs. Quiz 2 Score", "Score (out of 10)")
```

```
## Warning: Removed 36 rows containing non-finite values (stat_boxplot).
```



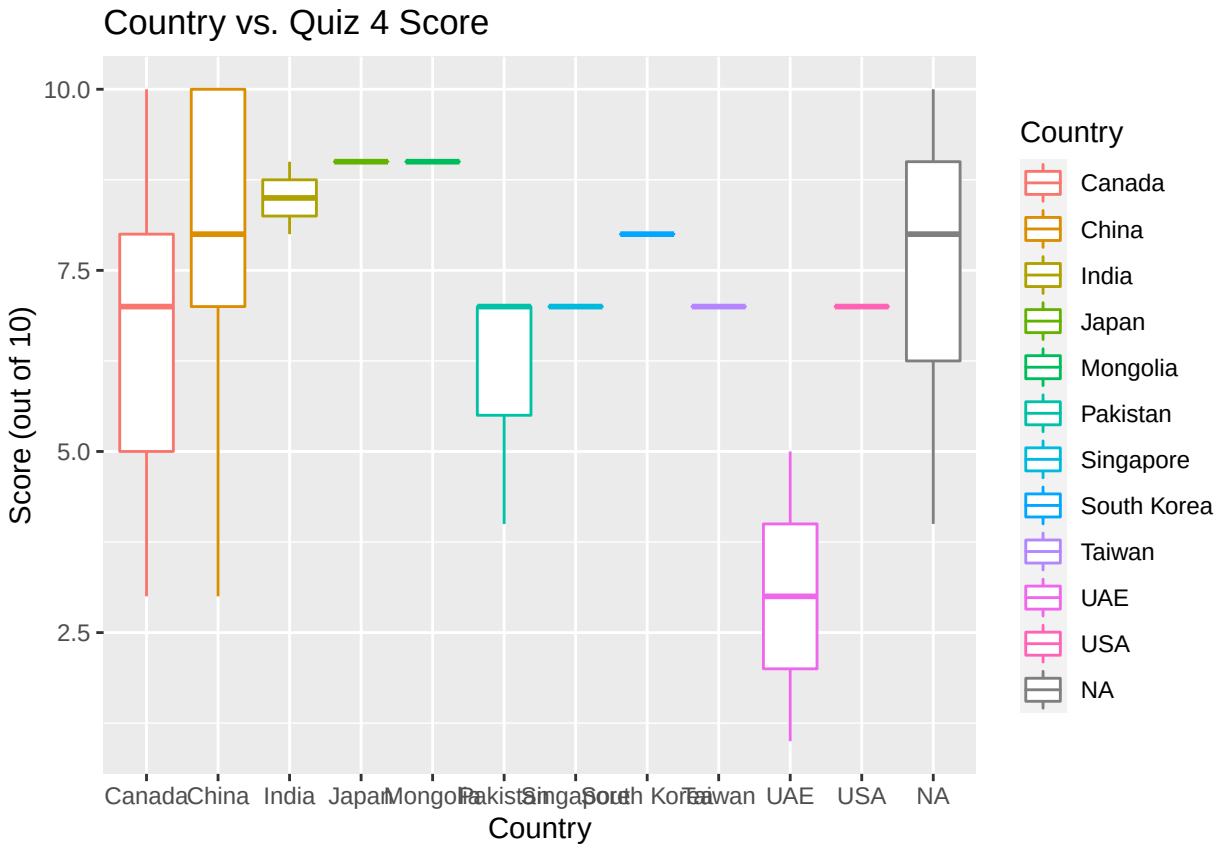
```
display_boxplot(cleaned_sta302_performance_data, Quiz_3_score,
                "Country vs. Quiz 3 Score", "Score (out of 10)")
```

```
## Warning: Removed 31 rows containing non-finite values (stat_boxplot).
```



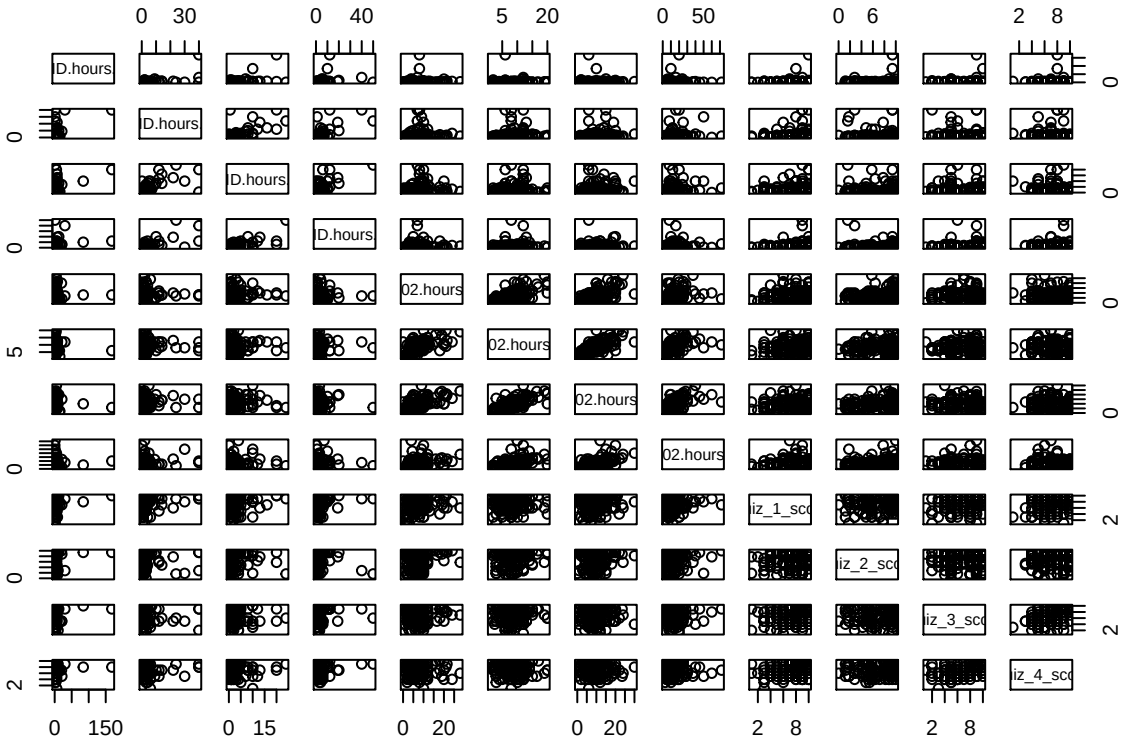
```
display_boxplot(cleaned_sta302_performance_data, Quiz_4_score,
                "Country vs. Quiz 4 Score", "Score (out of 10)")
```

```
## Warning: Removed 34 rows containing non-finite values (stat_boxplot).
```



Scatterplots

```
# TODO: How do I know which scatterplots are most important to focus on?

# work in groups of 2?

# three different pairs function

# quiz4 ~ quiz 1, 2, 3
# covid4 ~ covid 1, 2, 3
# sta302h14 ~ sta302h1 1, 2, 3

# or pick out 4 - 5 scatterplots that have interesting relationships

# back up with correlation
# scatterplot more informative as a first step

# comprehensive pairwise scatterplot
pairs(~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,
      data = cleaned_sta302_performance_data)
```



```
## GGally
# ggpairs -- removes bottom half of pairs plot
```

Correlation Matrix

All Countries

We can find correlation matrix to determine candidate significant predictor values.

preliminary data analysis shows these two vars are significant... so we did this

put correlation matrix in appendix for further details

exploratory data analysis – descriptive statistics.

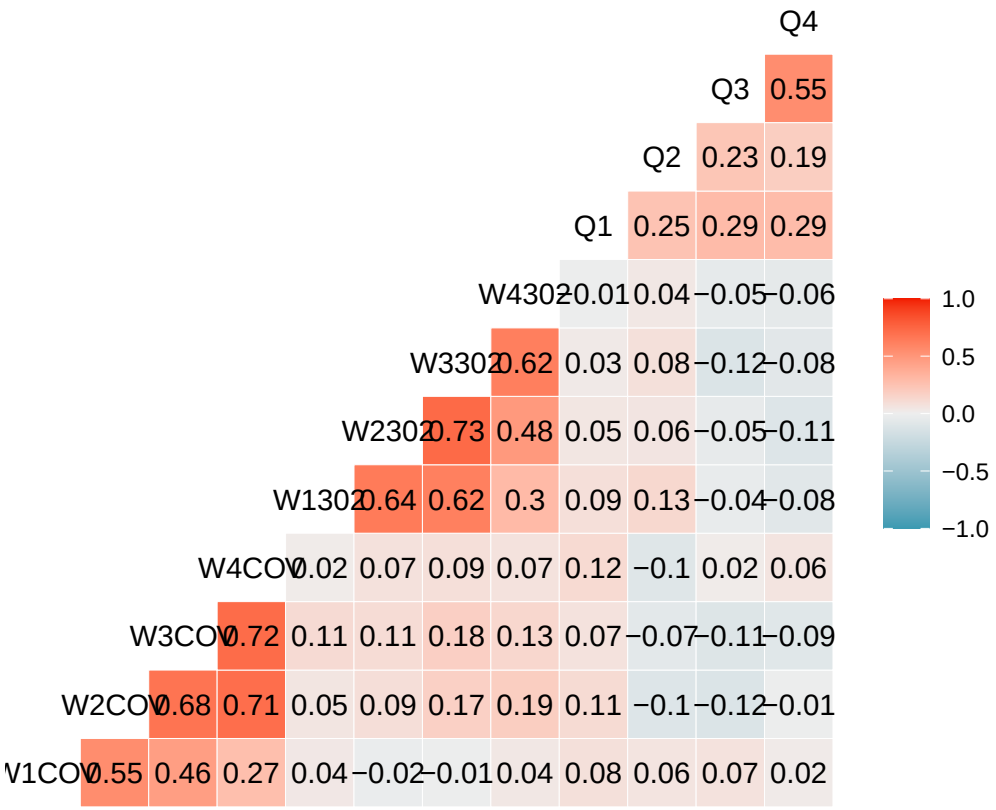
show residual plots in final report – justifying model

ggsummary – demo 3 or 4 – for nicely formatted tables.

```
library(GGally)
```

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

```
colnames(rows_with_no_country) <- c("W1COV", "W2COV", "W3COV", "W4COV",
                           "W1302", "W2302", "W3302", "W4302",
                           "Q1", "Q2", "Q3", "Q4")
ggcorr(rows_with_no_country, label = TRUE, label_round = 2)
```




```r
round(cor(rows_with_no_country, use = "pairwise.complete.obs", method = "pearson"), 2)  # TODO: na.rm =
```

```
##       W1COV W2COV W3COV W4COV W1302 W2302 W3302 W4302    Q1    Q2    Q3    Q4
## W1COV  1.00  0.55  0.46  0.27  0.04 -0.02 -0.01  0.04  0.08  0.06  0.07  0.02
## W2COV  0.55  1.00  0.68  0.71  0.05  0.09  0.17  0.19  0.11 -0.10 -0.12 -0.01
## W3COV  0.46  0.68  1.00  0.72  0.11  0.11  0.18  0.13  0.07 -0.07 -0.11 -0.09
## W4COV  0.27  0.71  0.72  1.00  0.02  0.07  0.09  0.07  0.12 -0.10  0.02  0.06
## W1302  0.04  0.05  0.11  0.02  1.00  0.64  0.62  0.30  0.09  0.13 -0.04 -0.08
## W2302 -0.02  0.09  0.11  0.07  0.64  1.00  0.73  0.48  0.05  0.06 -0.05 -0.11
## W3302 -0.01  0.17  0.18  0.09  0.62  0.73  1.00  0.62  0.03  0.08 -0.12 -0.08
## W4302  0.04  0.19  0.13  0.07  0.30  0.48  0.62  1.00 -0.01  0.04 -0.05 -0.06
## Q1     0.08  0.11  0.07  0.12  0.09  0.05  0.03 -0.01  1.00  0.25  0.29  0.29
## Q2     0.06 -0.10 -0.07 -0.10  0.13  0.06  0.08  0.04  0.25  1.00  0.23  0.19
## Q3     0.07 -0.12 -0.11  0.02 -0.04 -0.05 -0.12 -0.05  0.29  0.23  1.00  0.55
## Q4     0.02 -0.01 -0.09  0.06 -0.08 -0.11 -0.08 -0.06  0.29  0.19  0.55  1.00
```

By Individual Country

```r
# TODO: You could also create separate correlation matrices for each country.
```

5-Number Summary Statistics

STA302H1 Hours 5-Number Summary

```
summary(sta302_performance_data$STA302.hours..W1.)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   4.000   7.000   7.458   9.000  28.000      26
```

```
summary(sta302_performance_data$STA302.hours..W2.)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   1.000   6.000   8.000   8.298  10.000  20.000      22
```

```
summary(sta302_performance_data$STA302.hours..W3.)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   6.000   9.000   9.225  11.500  30.000      20
```

```
summary(sta302_performance_data$STA302.hours..W4.)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    2.00    7.00   11.00   13.42   16.00   72.00      40
```

COVID Hours 5-Number Summary

```
summary(sta302_performance_data$COVID.hours..W1.)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   1.000   1.000   3.607   2.000 168.000      26
```

```
summary(sta302_performance_data$COVID.hours..W2.)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   1.000   1.000   2.884   2.000  40.000      22
```

```
summary(sta302_performance_data$COVID.hours..W3.)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   0.500   1.000   2.333   2.000  24.000      21
```

```
summary(sta302_performance_data$COVID.hours..W4.)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   1.000   1.500   2.918   3.000  50.000      40
```

Quiz Scores 5-Number Summary

```
summary(sta302_performance_data$Quiz_1_score)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   1.000   6.000   8.000   7.617   9.000  10.000      13
```

```
summary(sta302_performance_data$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      36
```

```
summary(sta302_performance_data$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      31
```

```
summary(sta302_performance_data$Quiz_4_score)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   1.000   6.000   8.000   7.378   9.000  10.000      34
```