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)) %>%

    # 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.

```
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

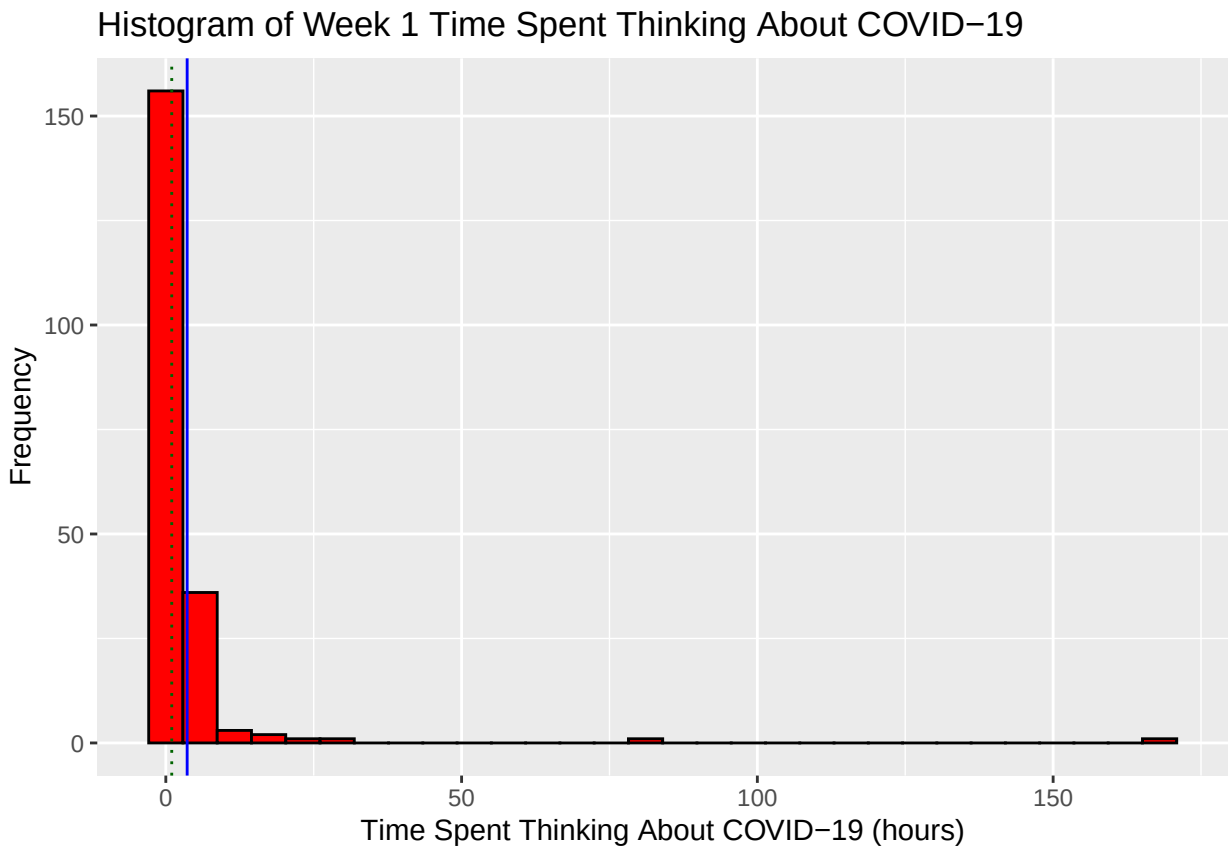
```
# TODO: See toy programs to learn how to create histograms with ggplot.
# TODO: See Demo 1 to figure out how to add histograms using grid.arrange.

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

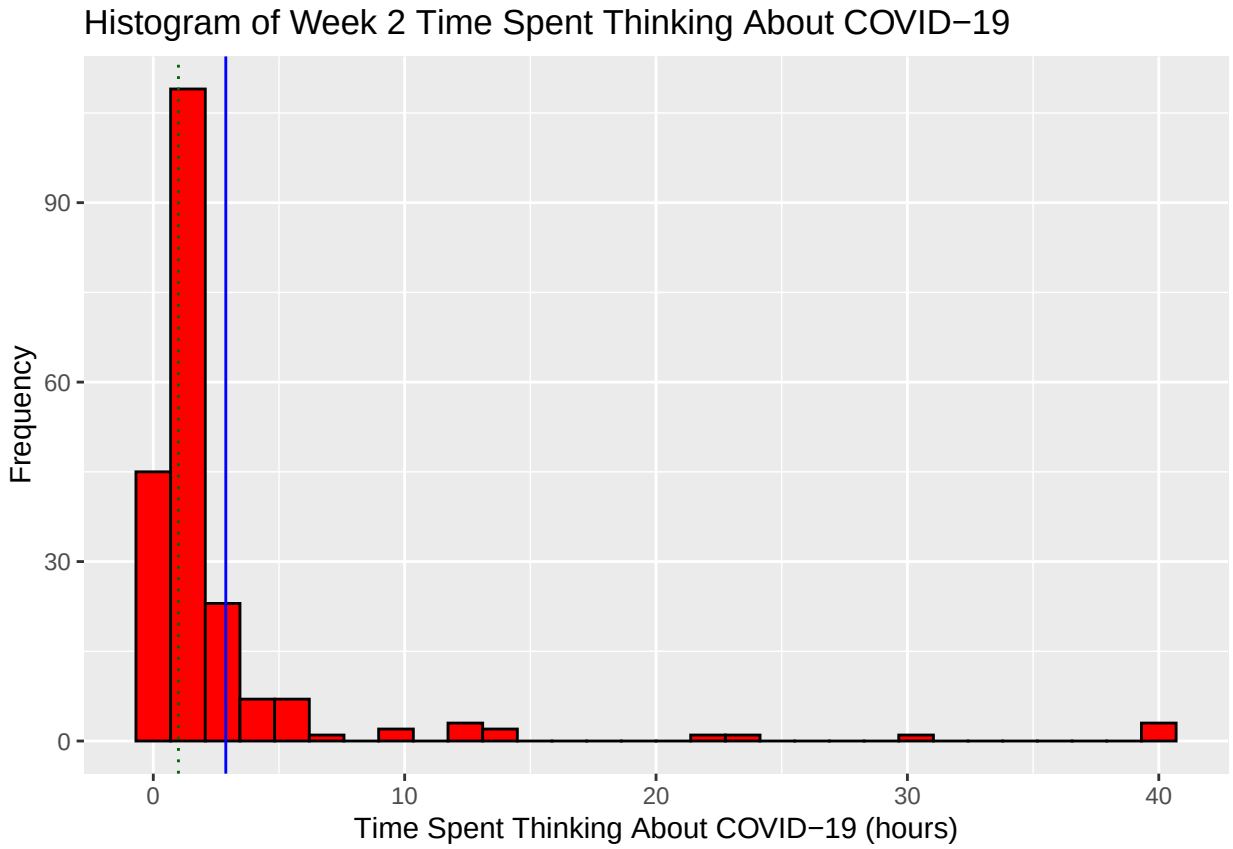
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$COVID.hours..W1.,
                  "Histogram of Week 1 Time Spent Thinking About COVID-19",
                  "Time Spent Thinking About COVID-19 (hours)")
```

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



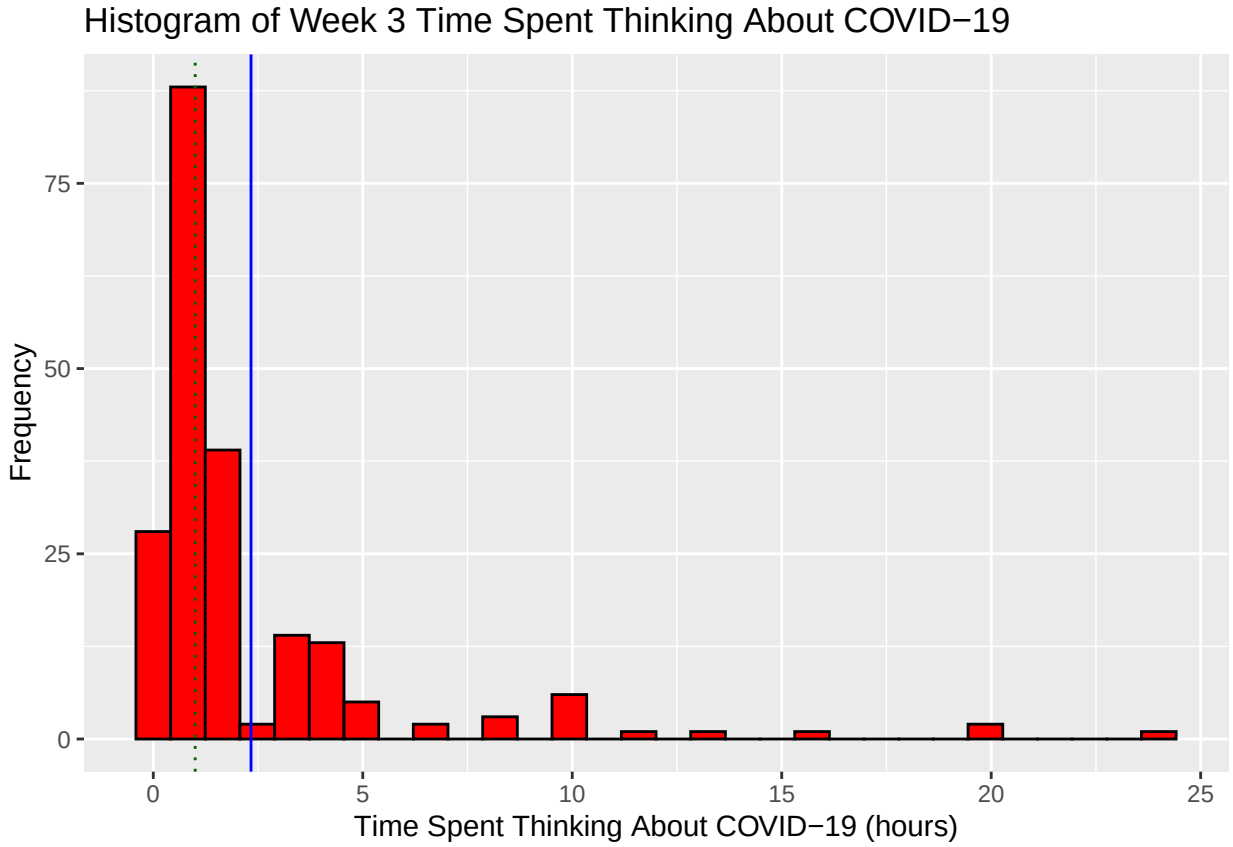
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$COVID.hours..W2.,
                  "Histogram of Week 2 Time Spent Thinking About COVID-19",
                  "Time Spent Thinking About COVID-19 (hours)")
```

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



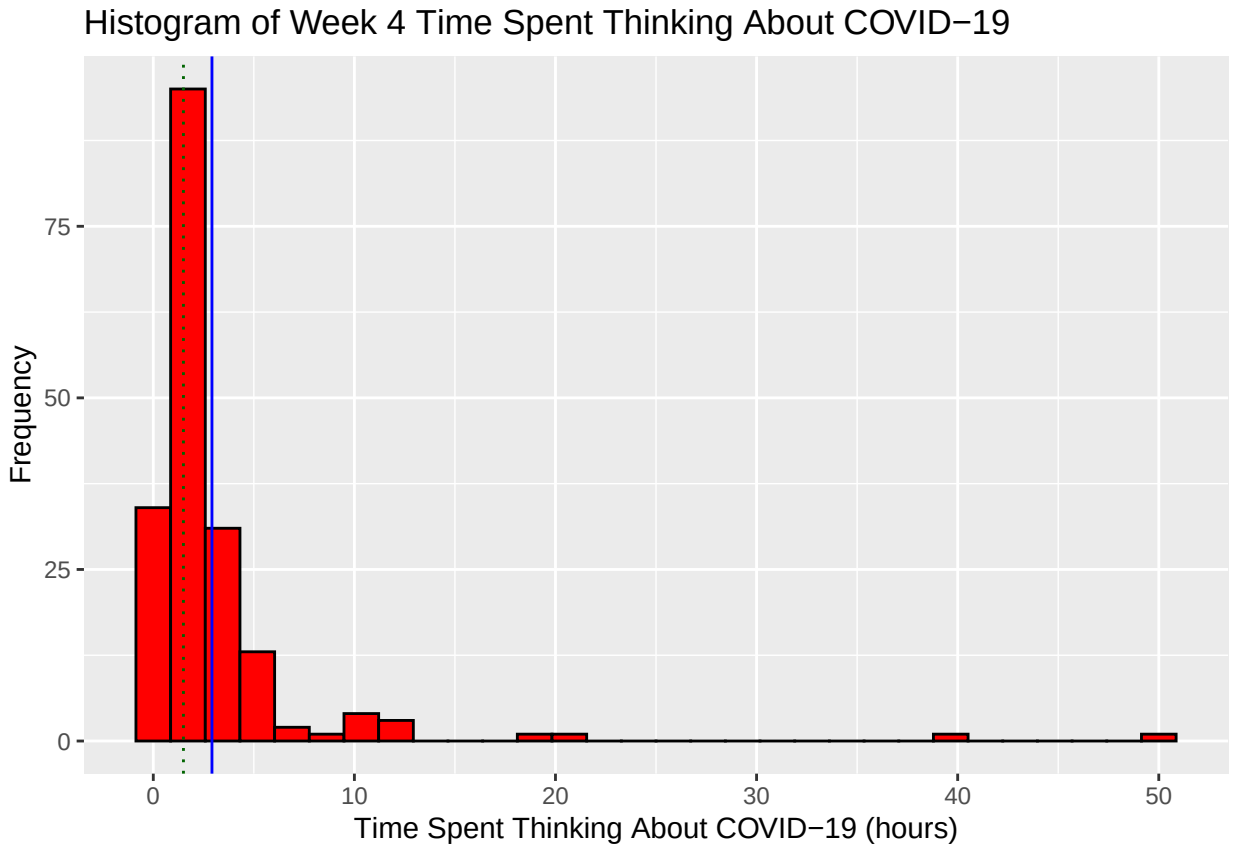
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$COVID.hours..W3.,
                  "Histogram of Week 3 Time Spent Thinking About COVID-19",
                  "Time Spent Thinking About COVID-19 (hours)")
```

```
## 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)")
```

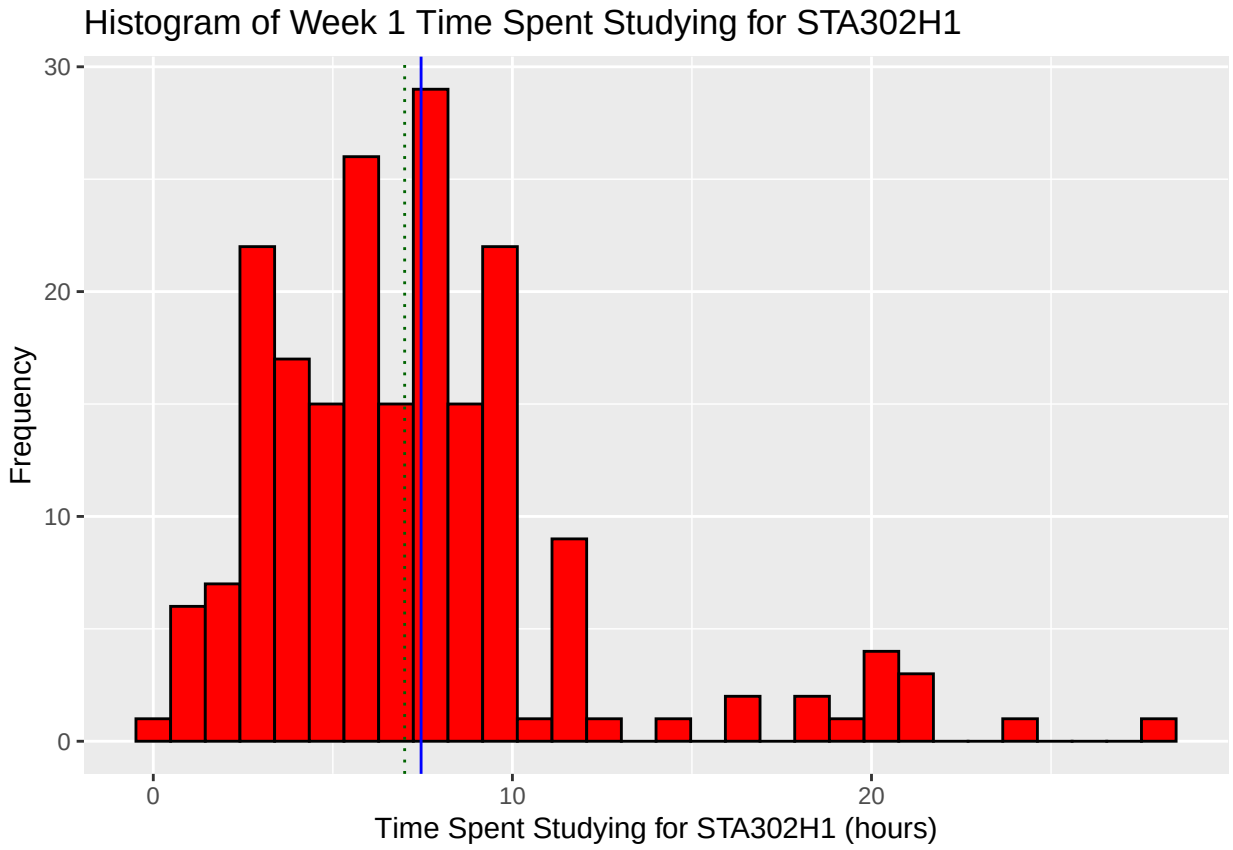
```
## Warning: Removed 40 rows containing non-finite values (stat_bin).
```



Histograms of STA302H1 Hours

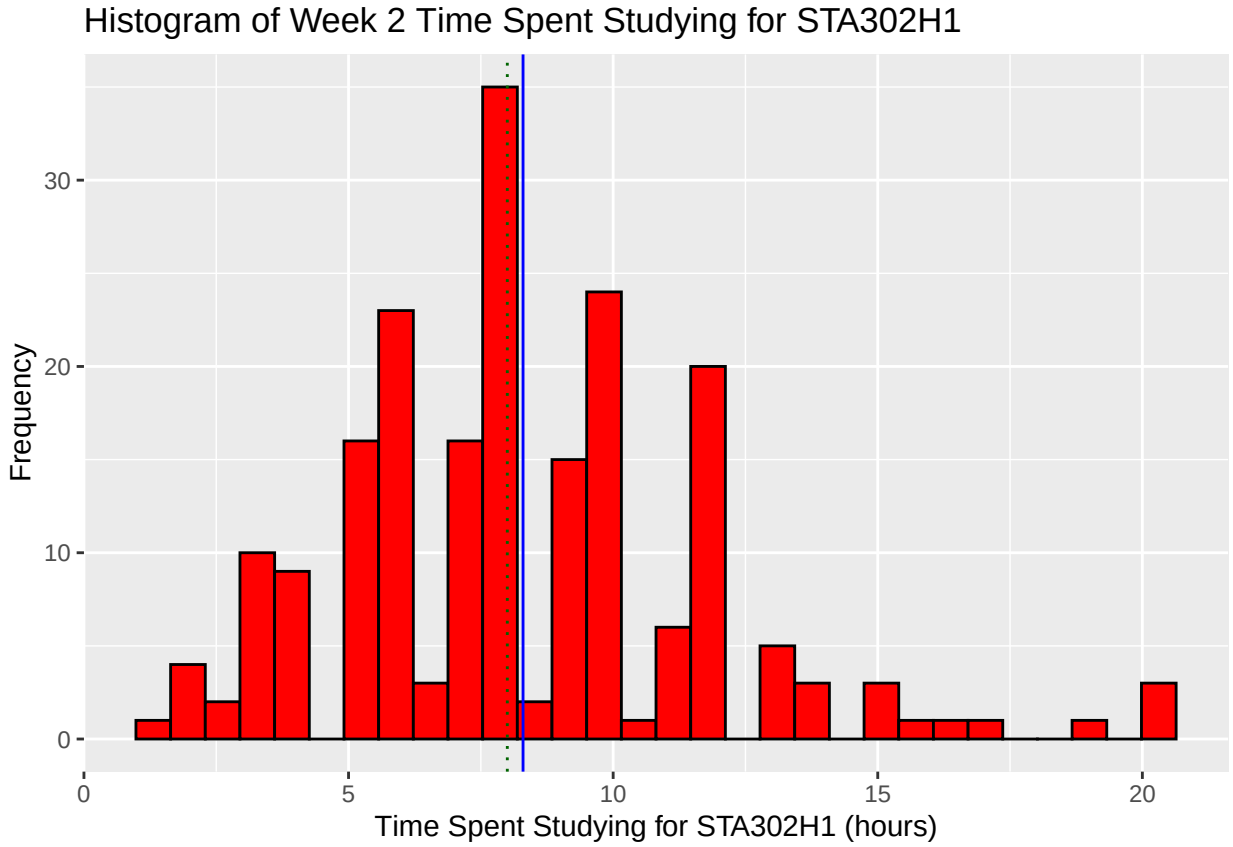
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$STA302.hours..W1.,
                  "Histogram of Week 1 Time Spent Studying for STA302H1",
                  "Time Spent Studying for STA302H1 (hours)")
```

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



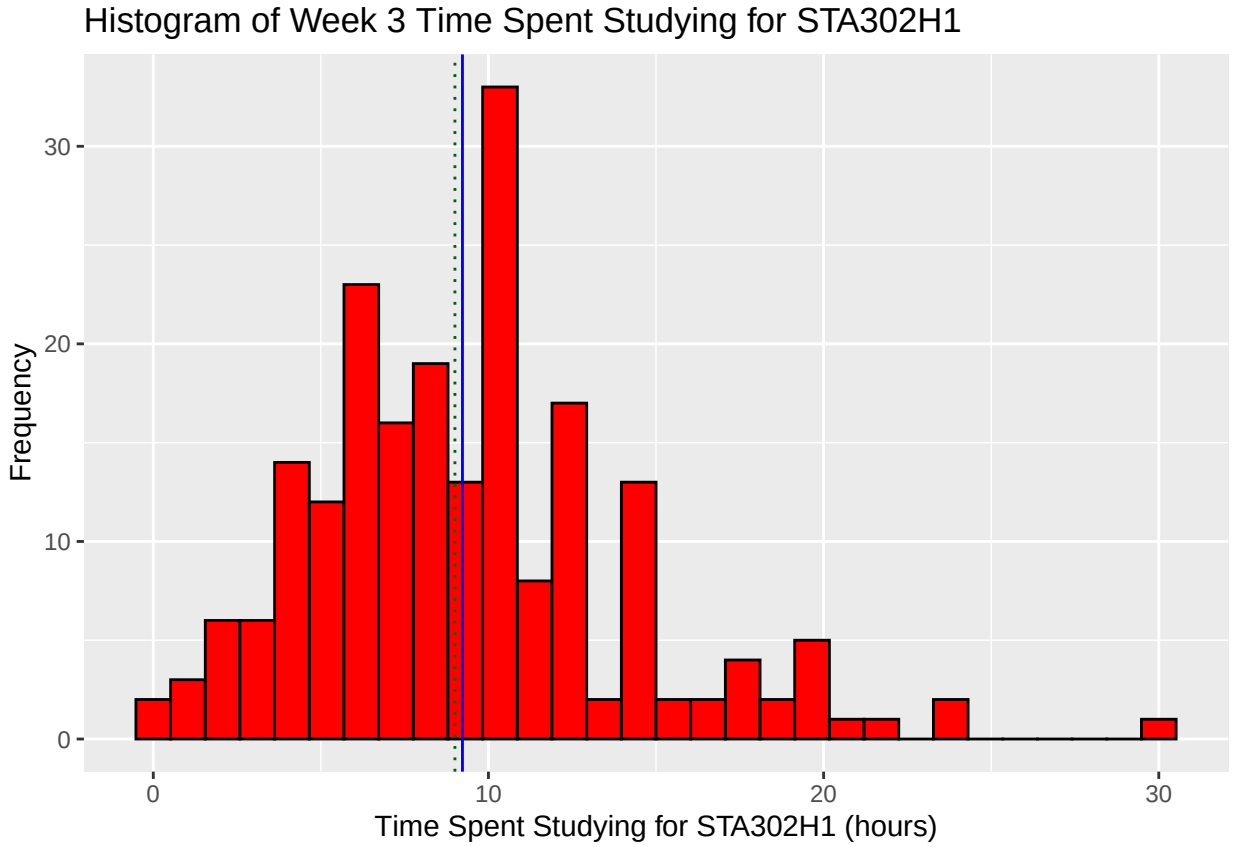
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$STA302.hours..W2.,
                  "Histogram of Week 2 Time Spent Studying for STA302H1",
                  "Time Spent Studying for STA302H1 (hours)")
```

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



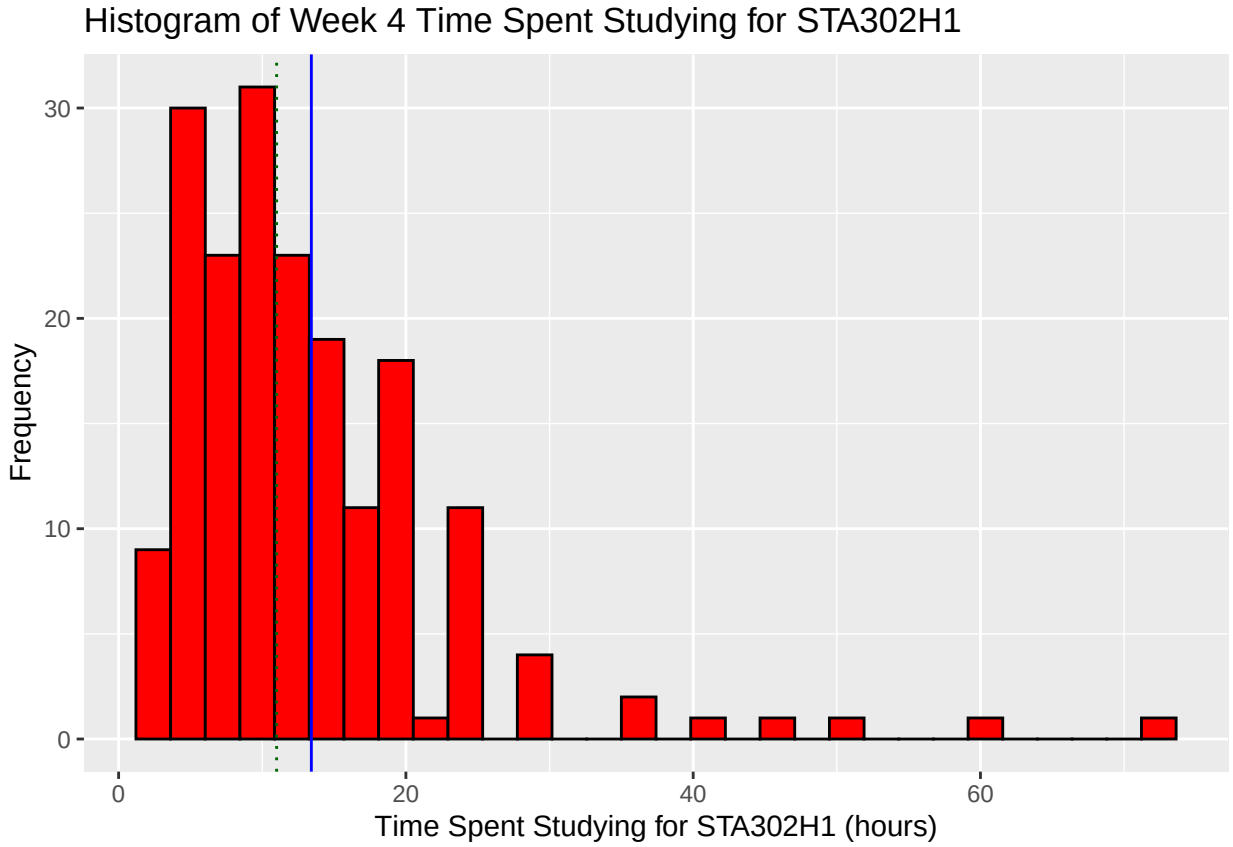
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$STA302.hours..W3.,
                  "Histogram of Week 3 Time Spent Studying for STA302H1",
                  "Time Spent Studying for STA302H1 (hours)")
```

```
## 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).
```



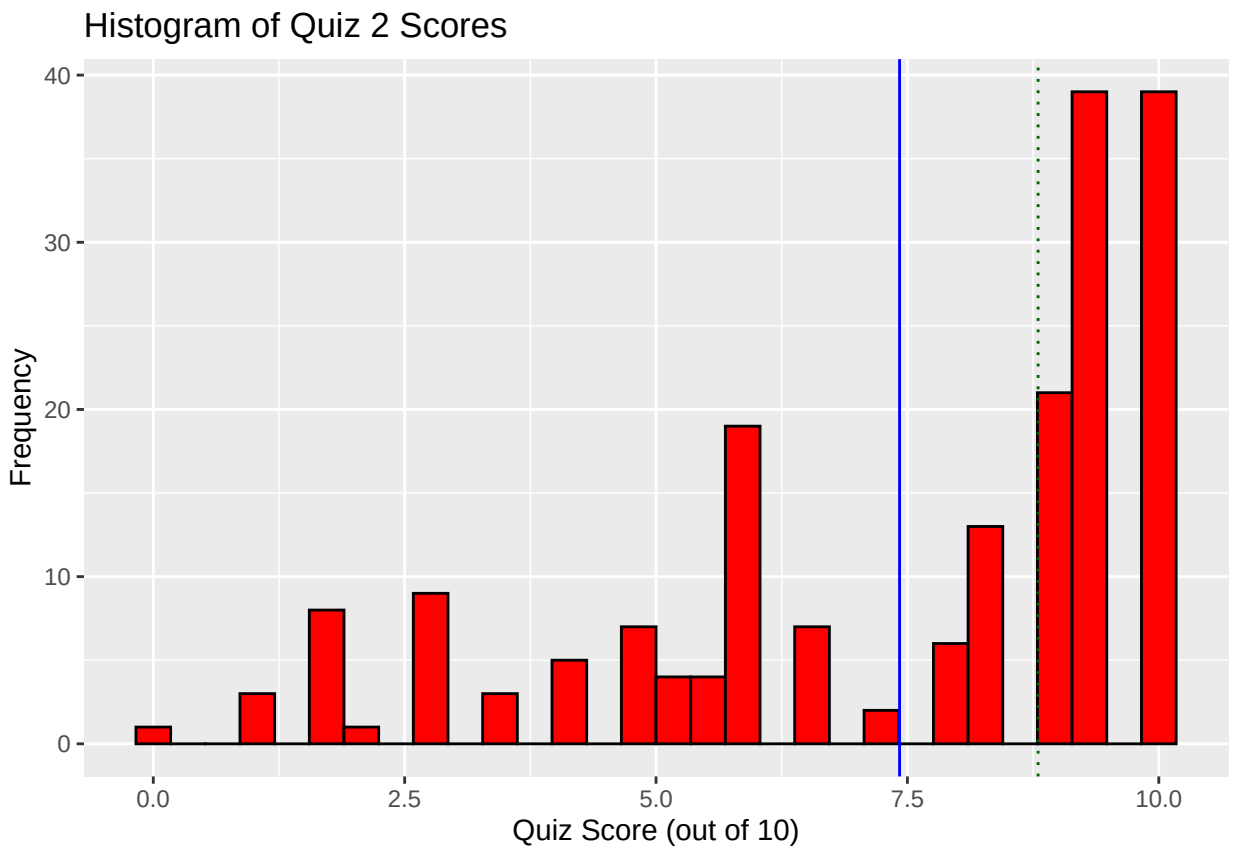
Histograms of Quiz Scores

```
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).
```

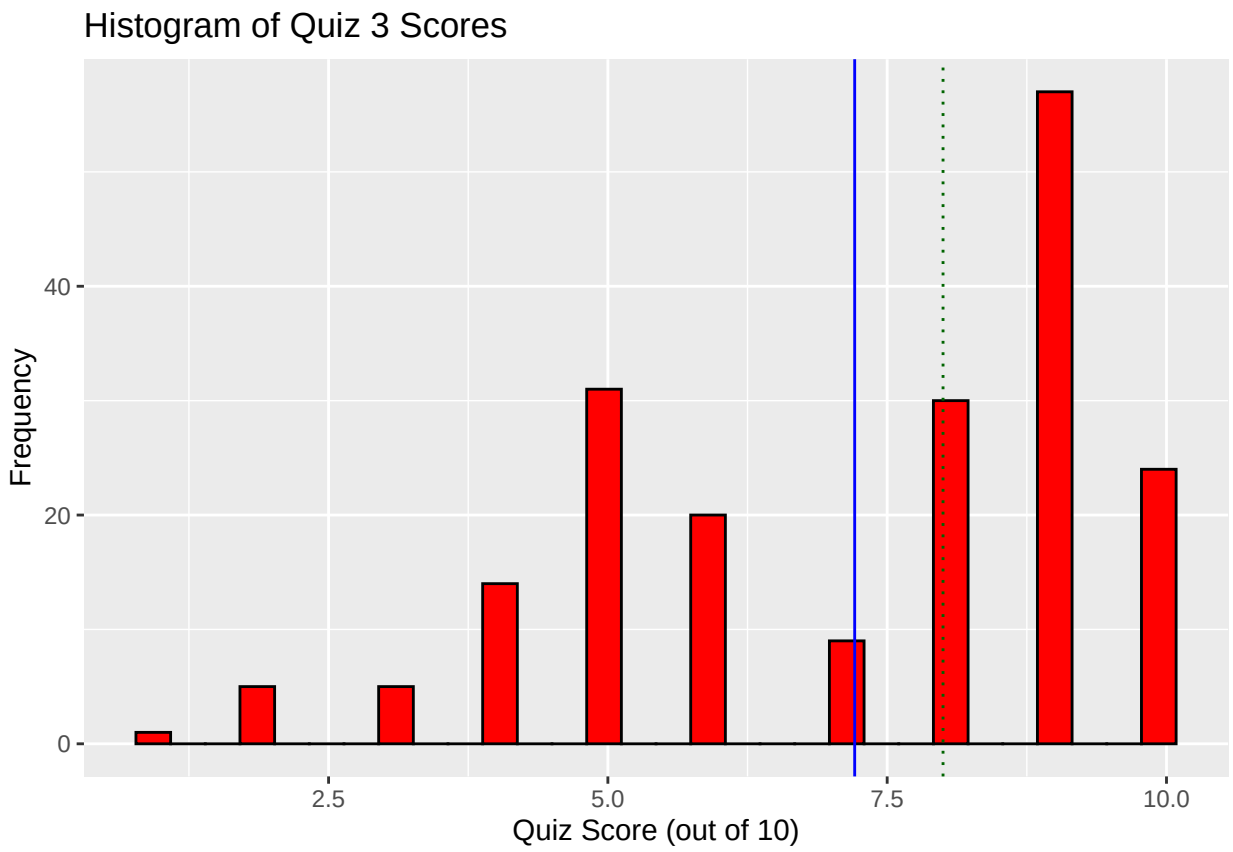
```r
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$Quiz_2_score,
                  "Histogram of Quiz 2 Scores",
                  "Quiz Score (out of 10)")
```

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



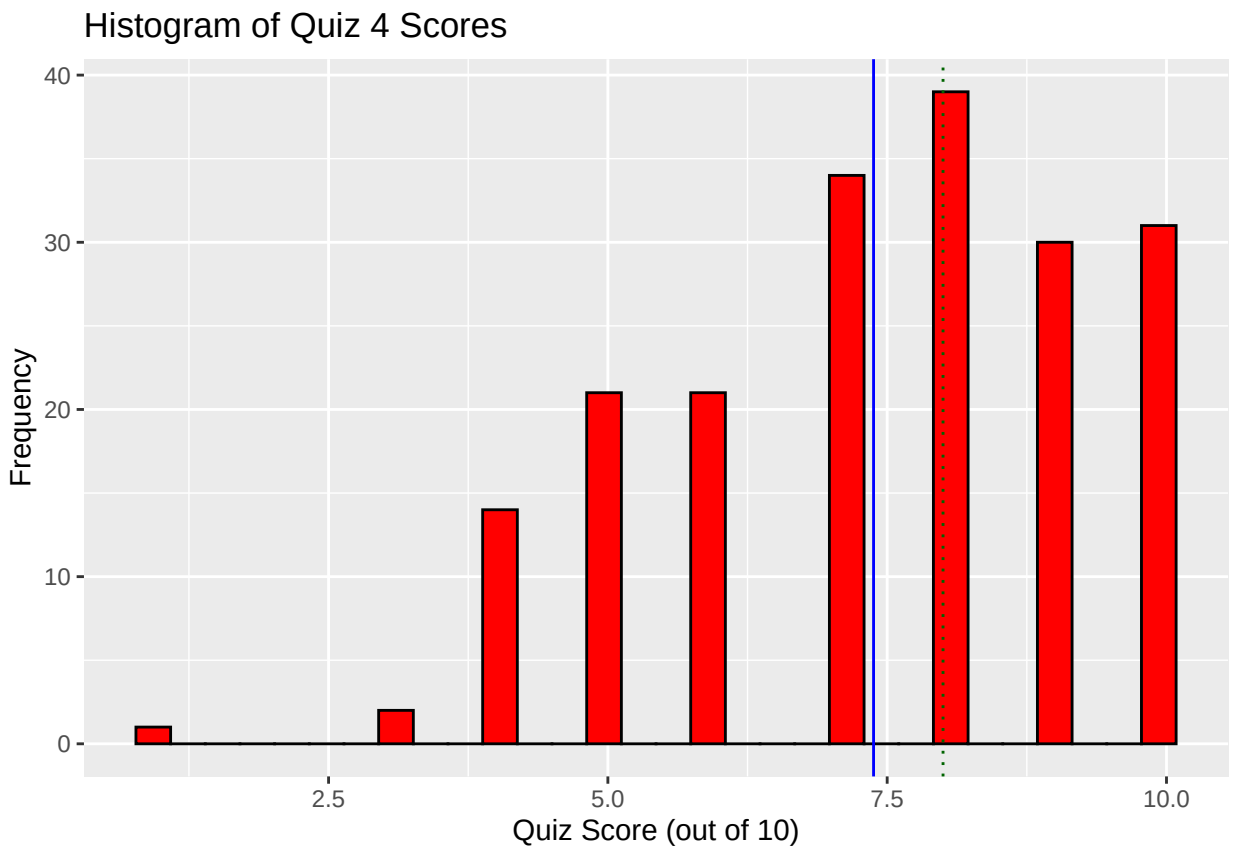
```
display_histogram(cleaned_sta302_performance_data,
                  cleaned_sta302_performance_data$Quiz_3_score,
                  "Histogram of Quiz 3 Scores",
                  "Quiz Score (out of 10)")
```

```
## 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

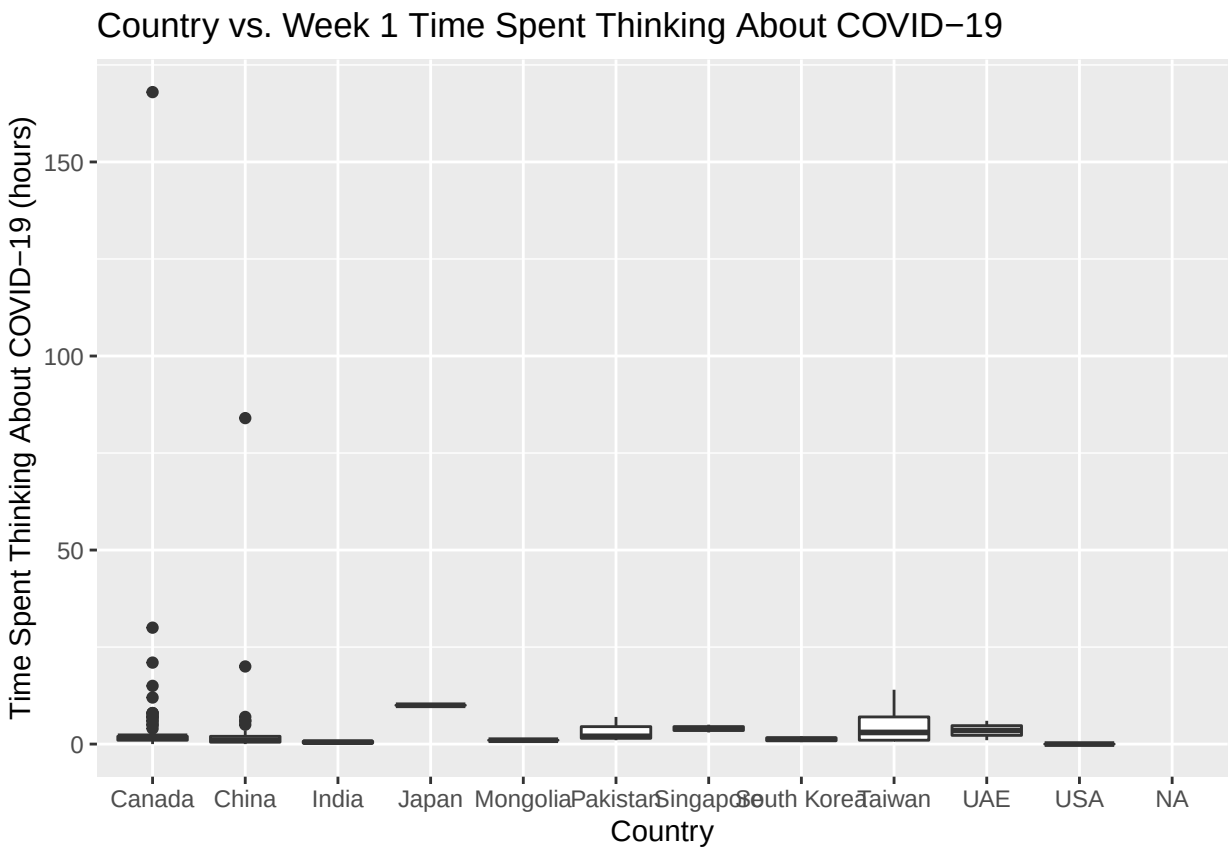
```
# TODO: See STA248H1 notes to figure out how to create boxplots. -- DONE
# TODO: See toy program of boxplots to see how to color them by factor

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

Boxplots of COVID Hours

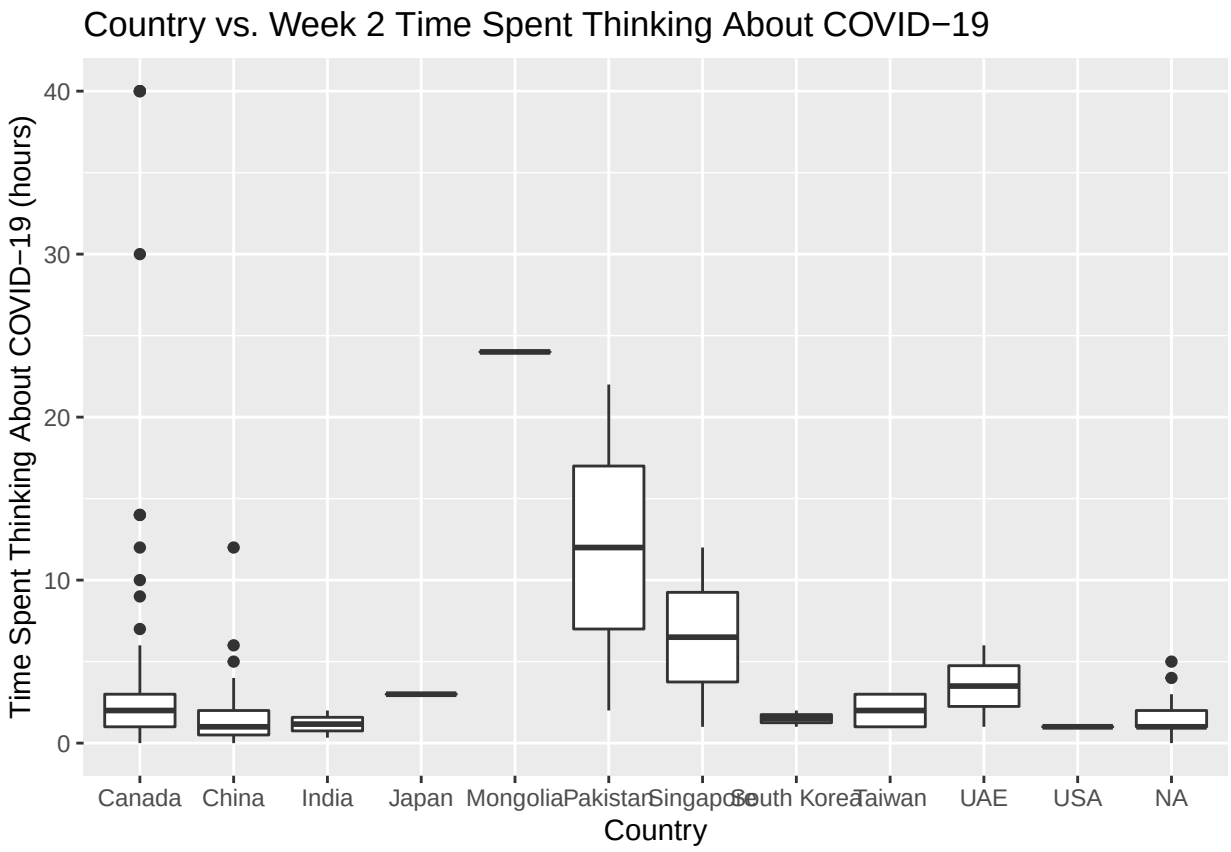
```
display_boxplot(cleaned_sta302_performance_data, COVID.hours..W1.,
                "Country vs. Week 1 Time Spent Thinking About COVID-19",
                "Time Spent Thinking About COVID-19 (hours)")
```

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



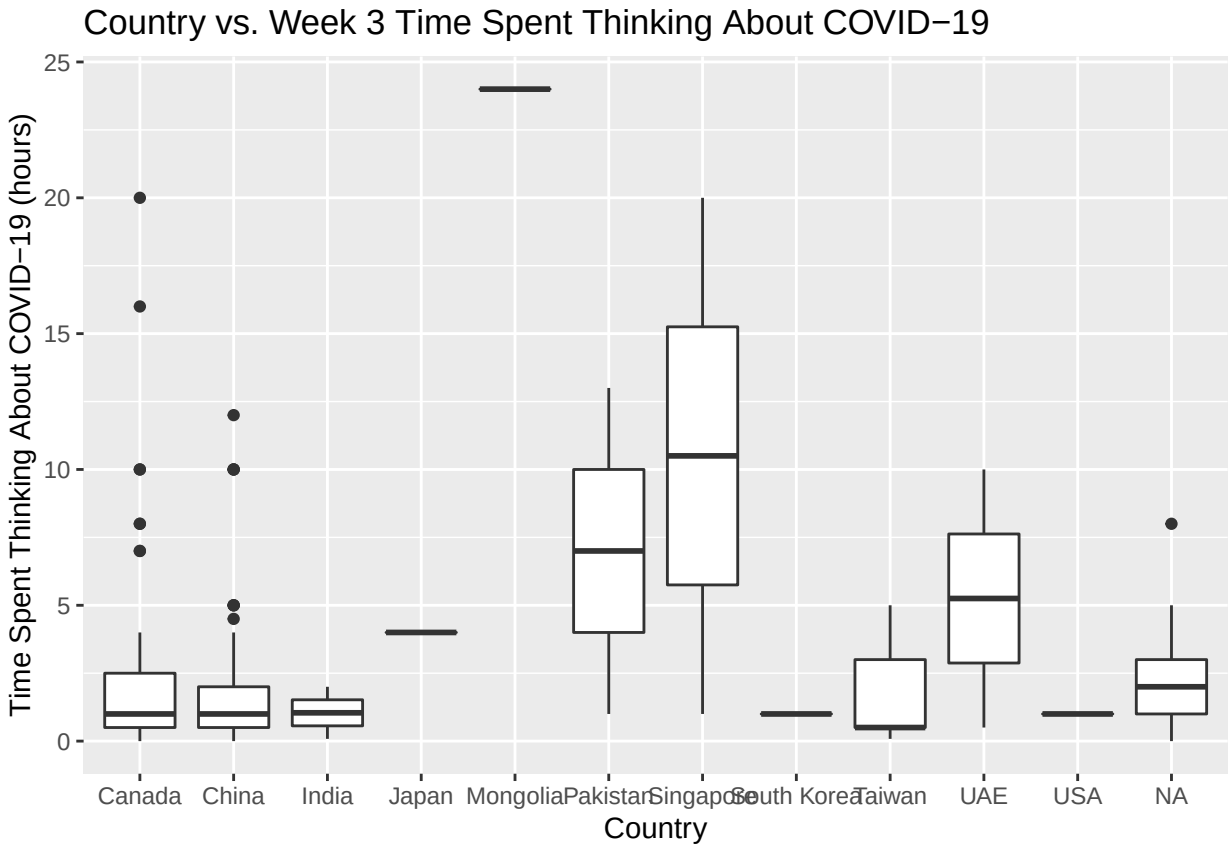
```
display_boxplot(cleaned_sta302_performance_data, COVID.hours..W2.,
                "Country vs. Week 2 Time Spent Thinking About COVID-19",
                "Time Spent Thinking About COVID-19 (hours)")
```

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



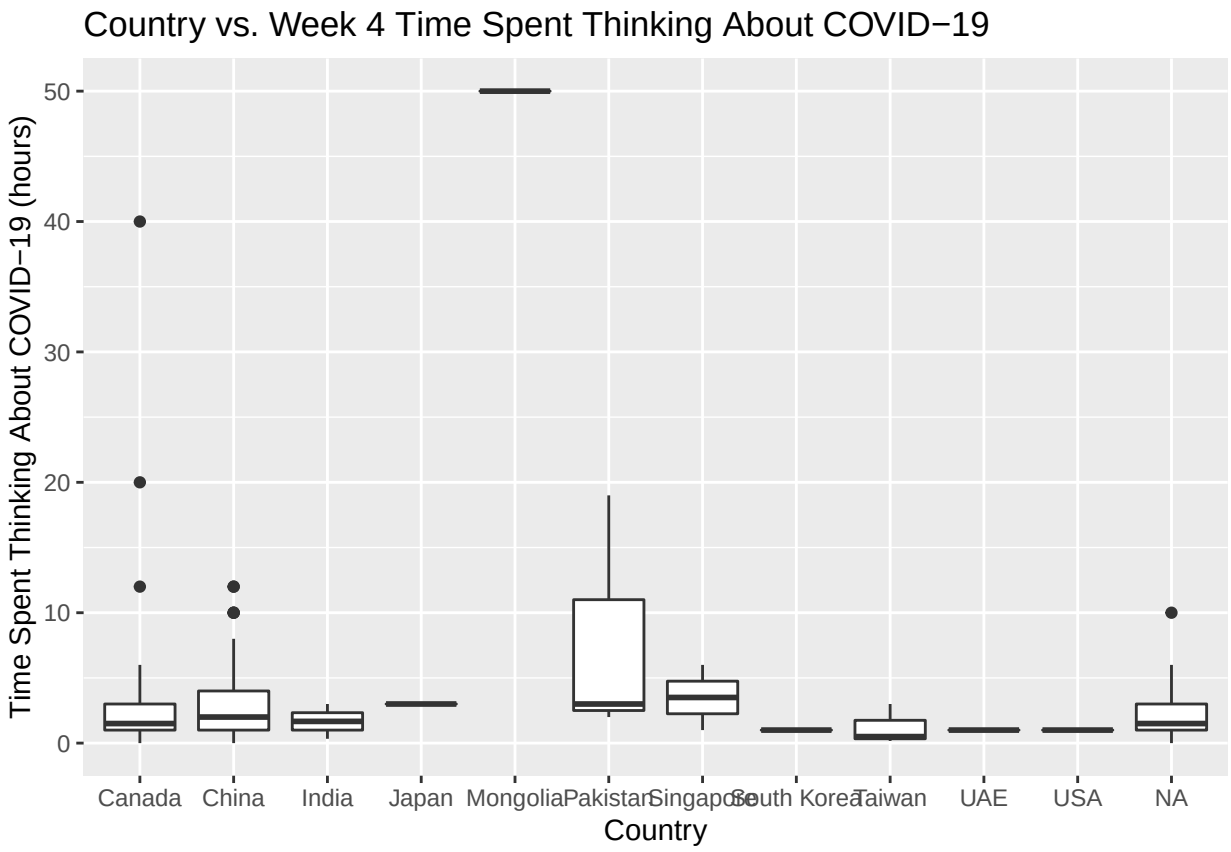
```r
display_boxplot(cleaned_sta302_performance_data, COVID.hours..W3.,
                "Country vs. Week 3 Time Spent Thinking About COVID-19",
                "Time Spent Thinking About COVID-19 (hours)")
```

```
## 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)")
```

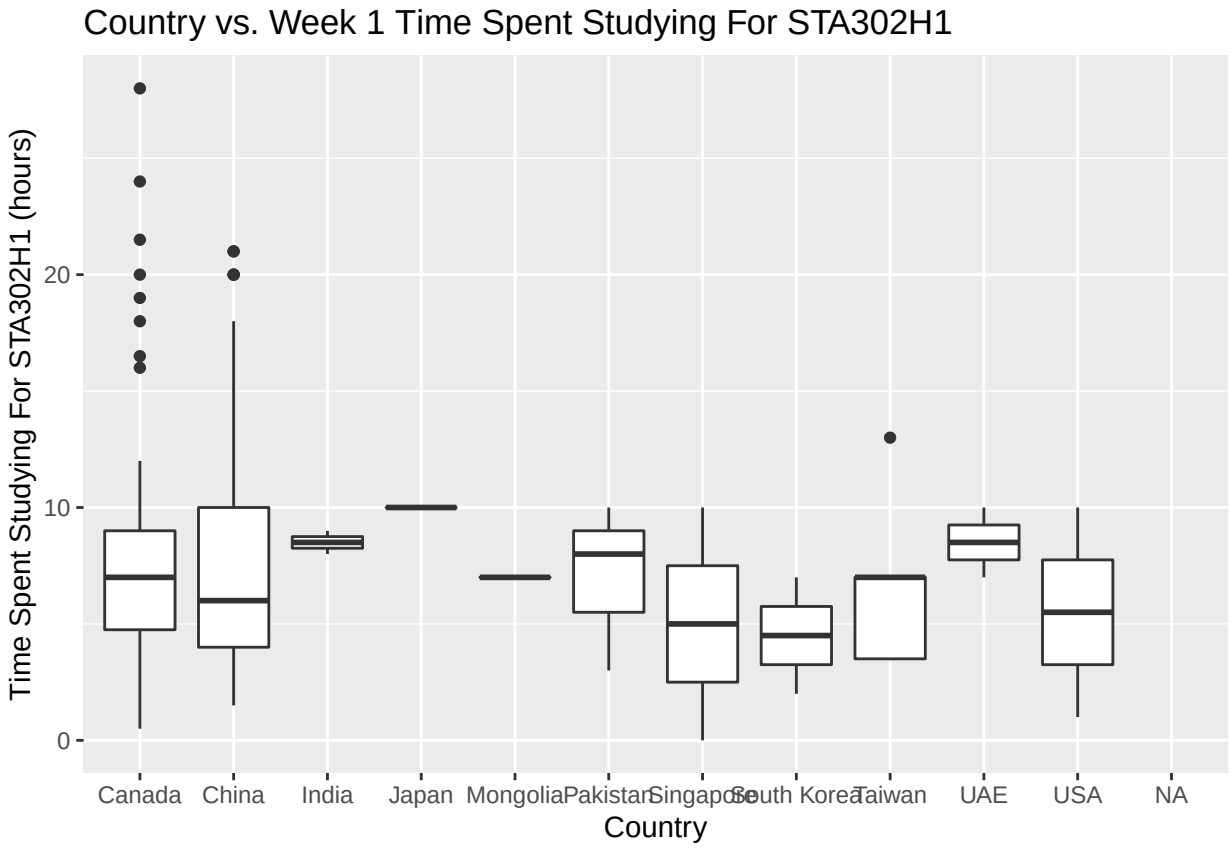
```
## Warning: Removed 40 rows containing non-finite values (stat_boxplot).
```



Boxplots of STA302H1 Hours

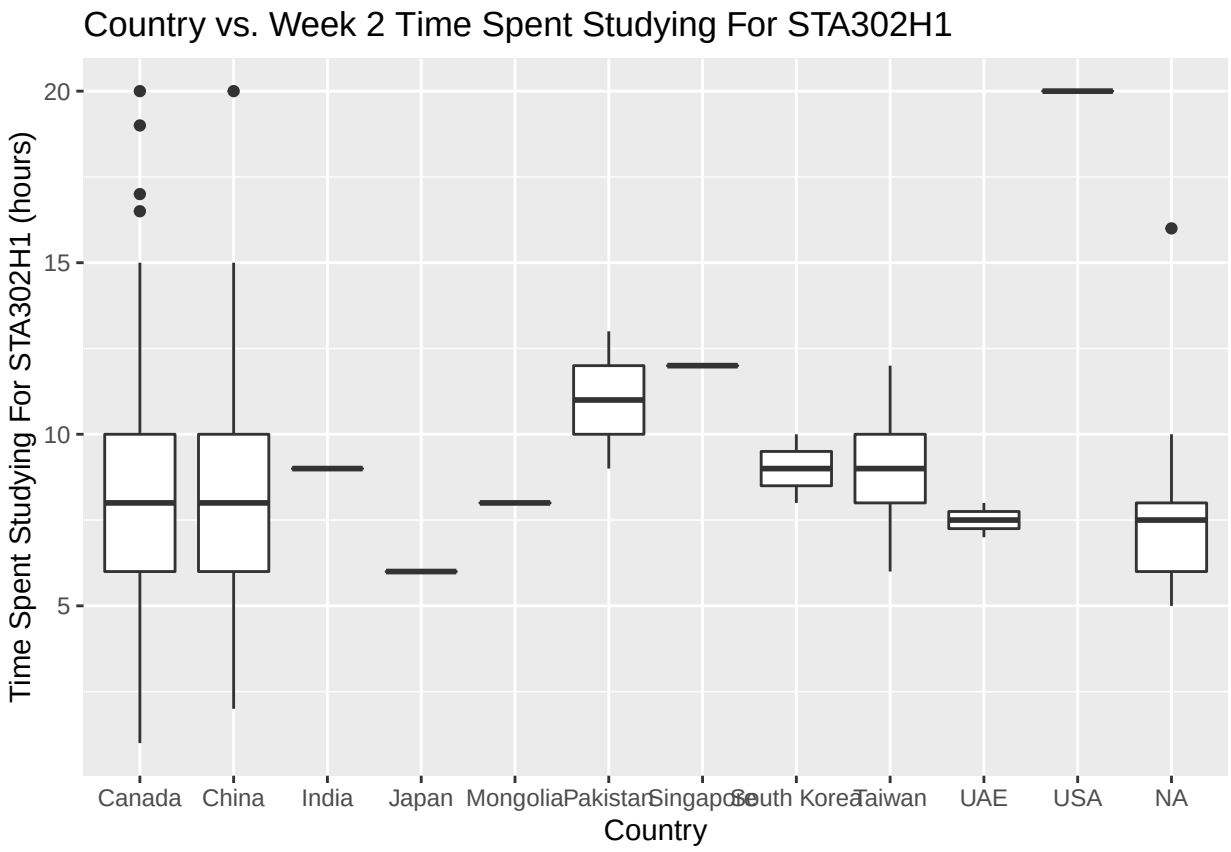
```
display_boxplot(cleaned_sta302_performance_data, STA302.hours..W1.,
                "Country vs. Week 1 Time Spent Studying For STA302H1",
                "Time Spent Studying For STA302H1 (hours)")
```

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



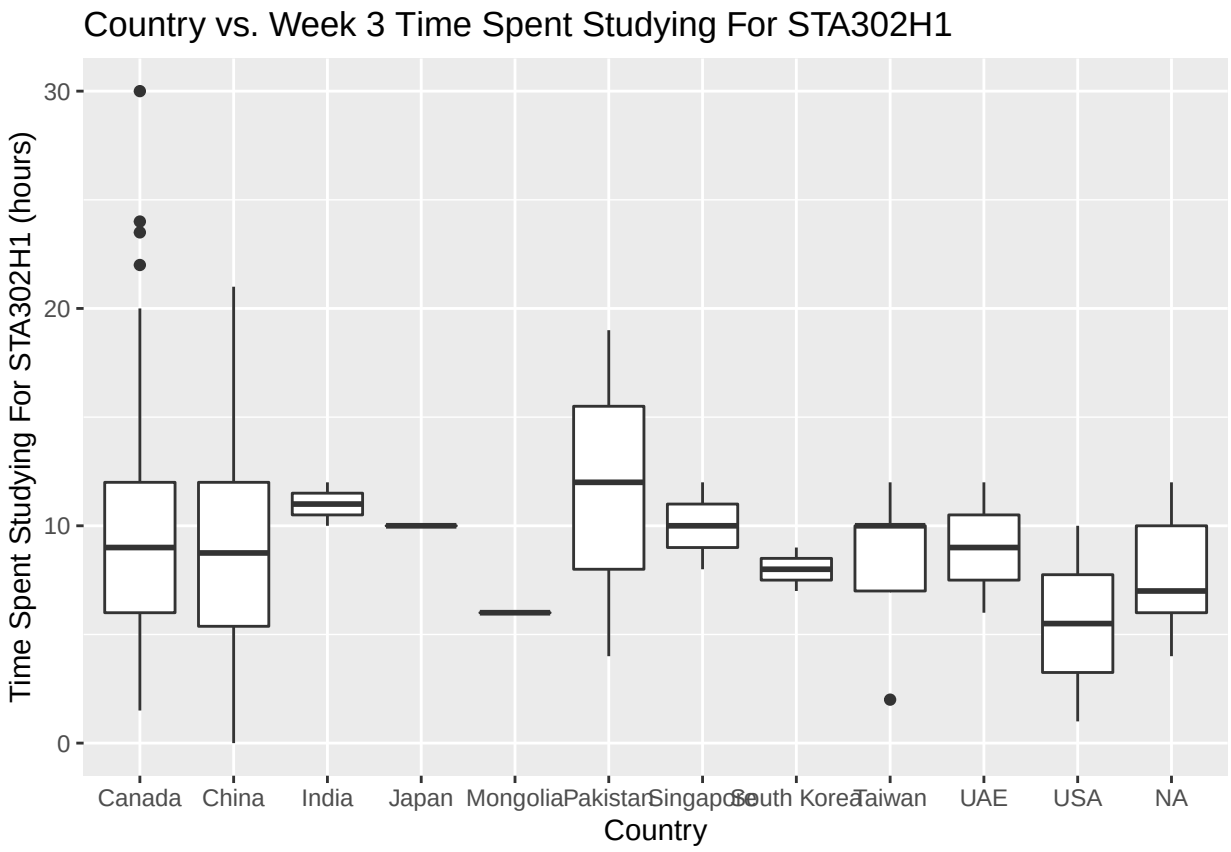
```
display_boxplot(cleaned_sta302_performance_data, STA302.hours..W2.,
                "Country vs. Week 2 Time Spent Studying For STA302H1",
                "Time Spent Studying For STA302H1 (hours)")
```

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



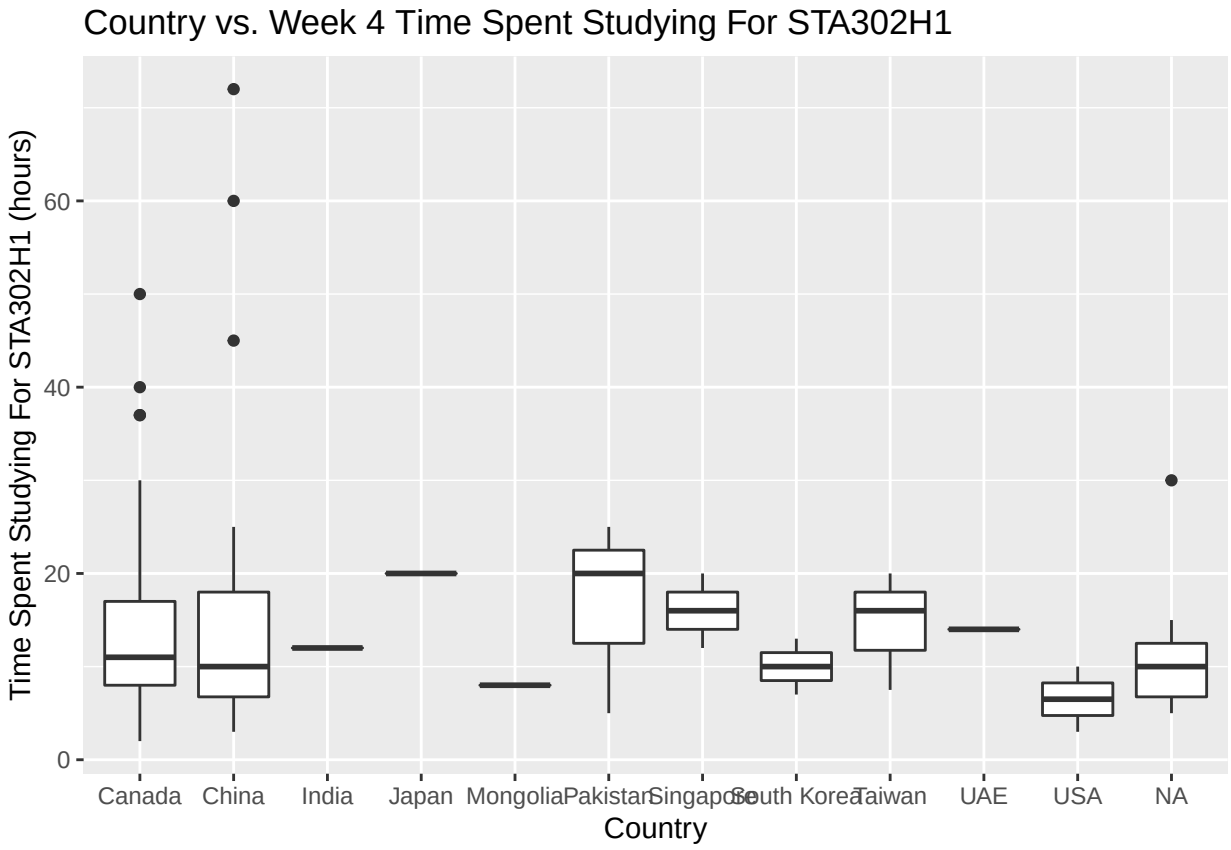
```
display_boxplot(cleaned_sta302_performance_data, STA302.hours..W3.,
                "Country vs. Week 3 Time Spent Studying For STA302H1",
                "Time Spent Studying For STA302H1 (hours)")
```

```
## 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)")
```

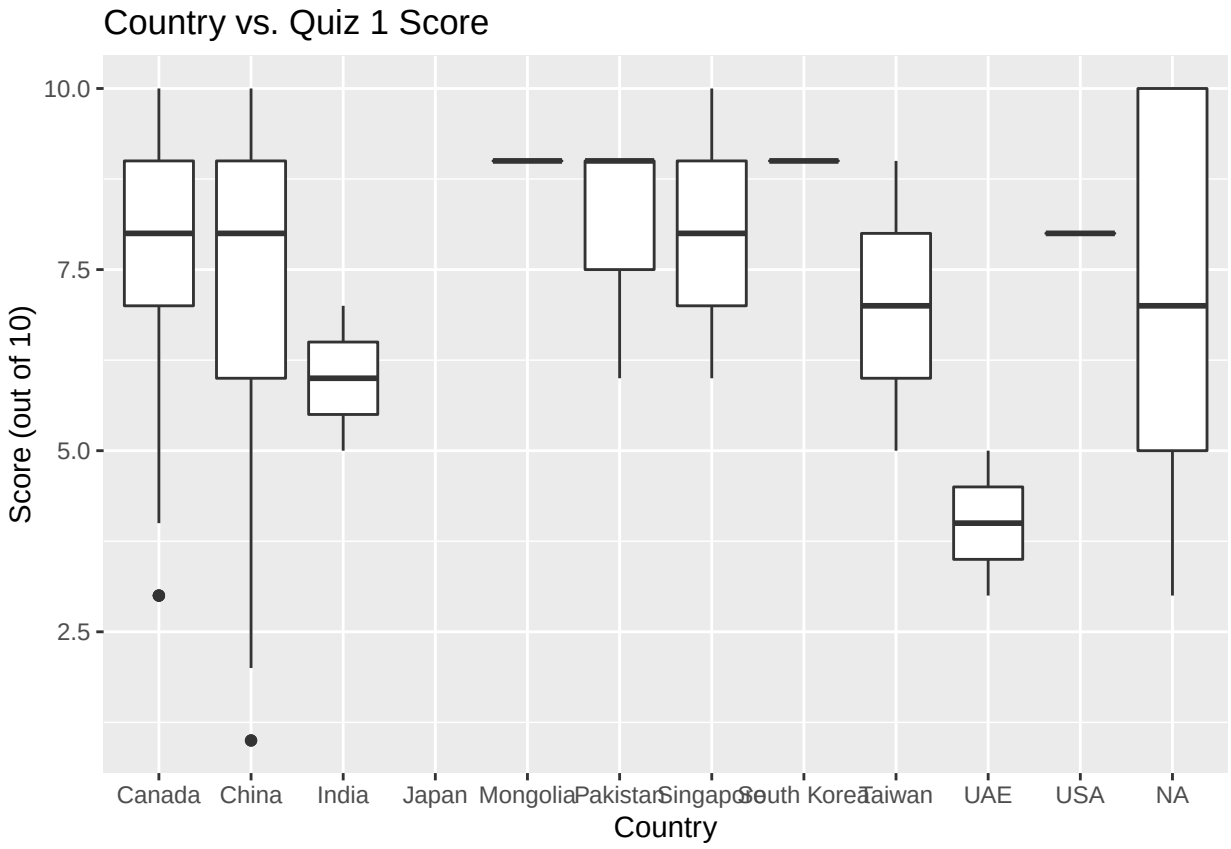
```
## Warning: Removed 40 rows containing non-finite values (stat_boxplot).
```



Boxplots of Quiz Scores

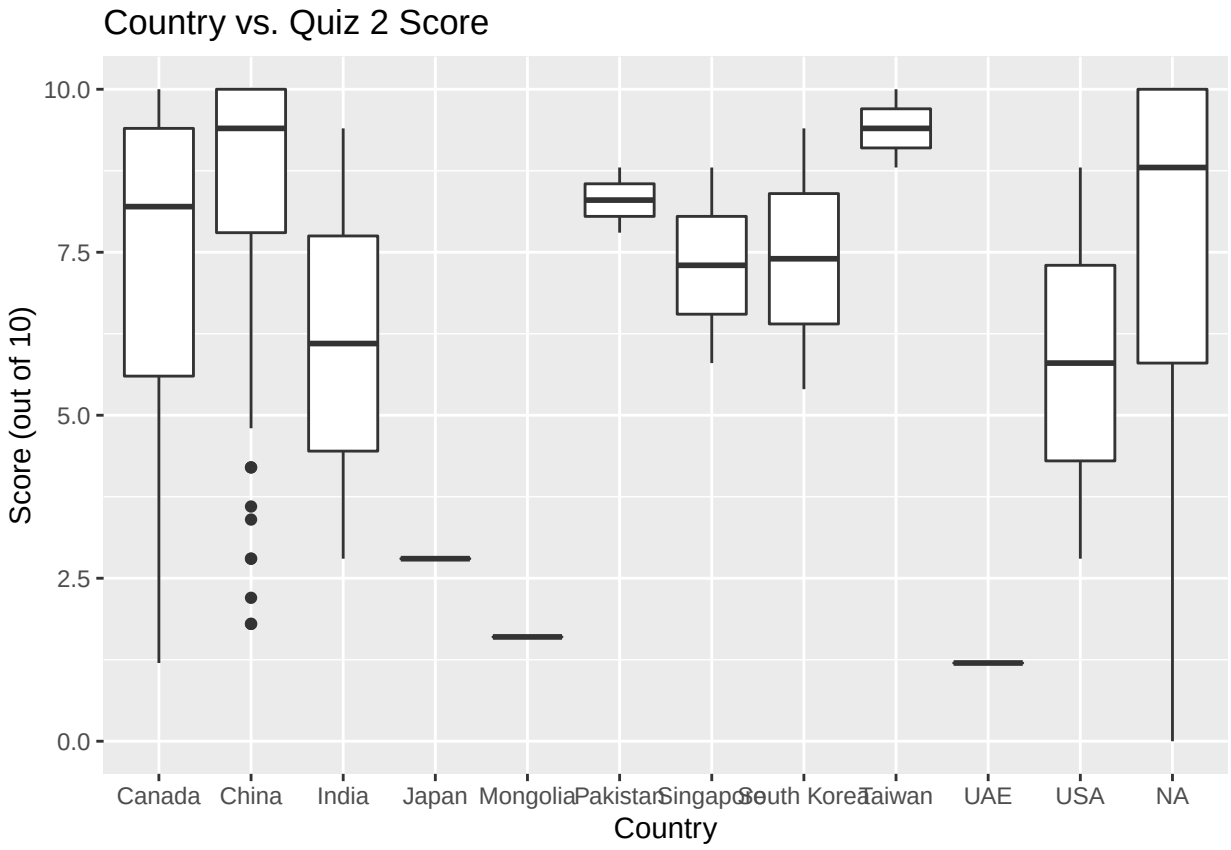
```
display_boxplot(cleaned_sta302_performance_data, Quiz_1_score,
                "Country vs. Quiz 1 Score", "Score (out of 10)")
```

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



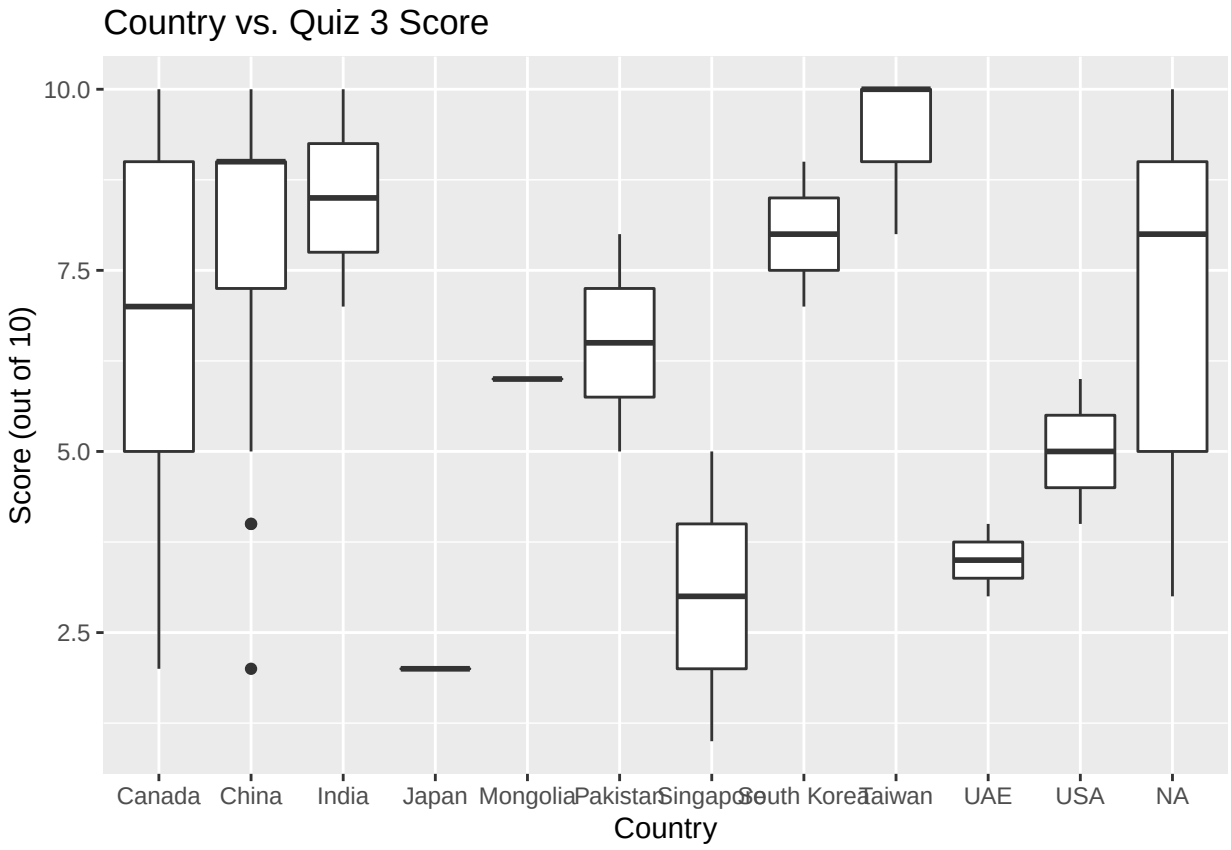
```
display_boxplot(cleaned_sta302_performance_data, Quiz_2_score,
                "Country vs. Quiz 2 Score", "Score (out of 10)")
```

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



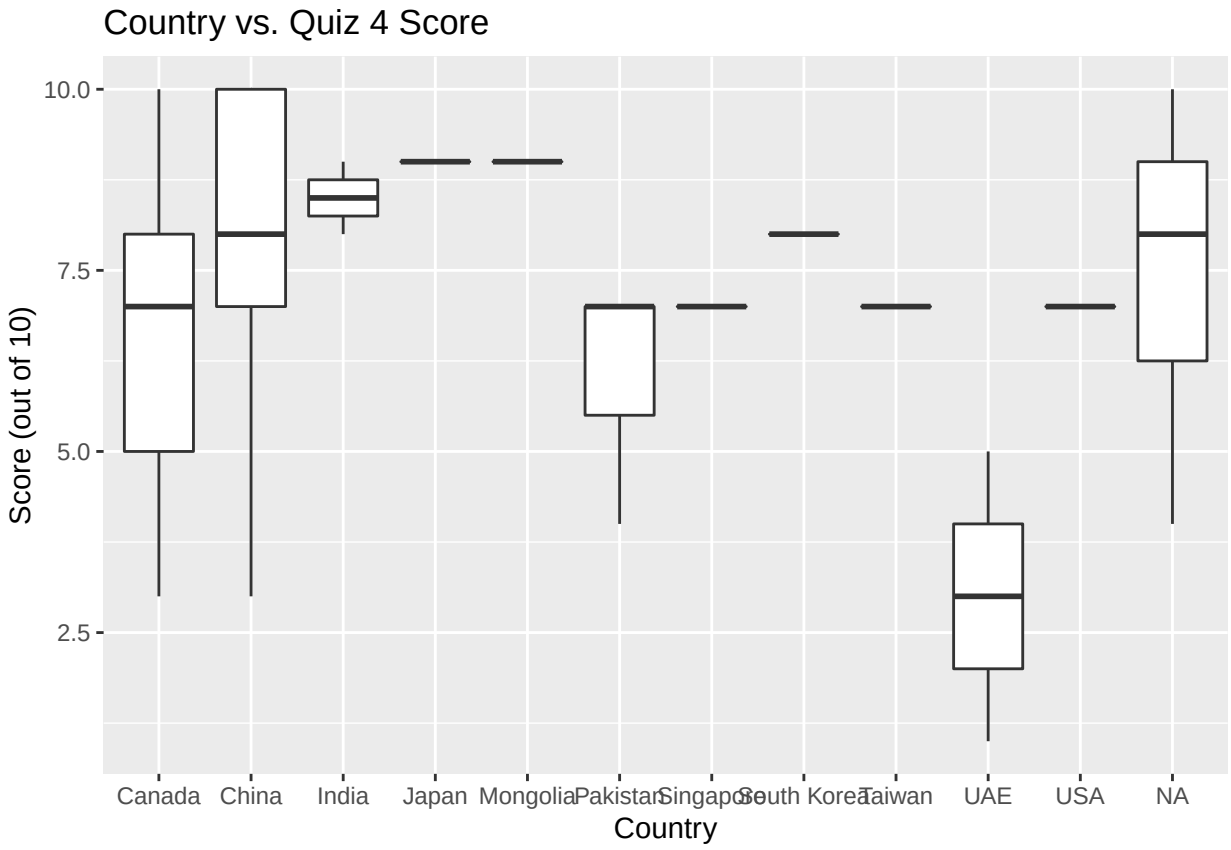
```
display_boxplot(cleaned_sta302_performance_data, Quiz_3_score,
                "Country vs. Quiz 3 Score", "Score (out of 10)")
```

```
## 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)")
```

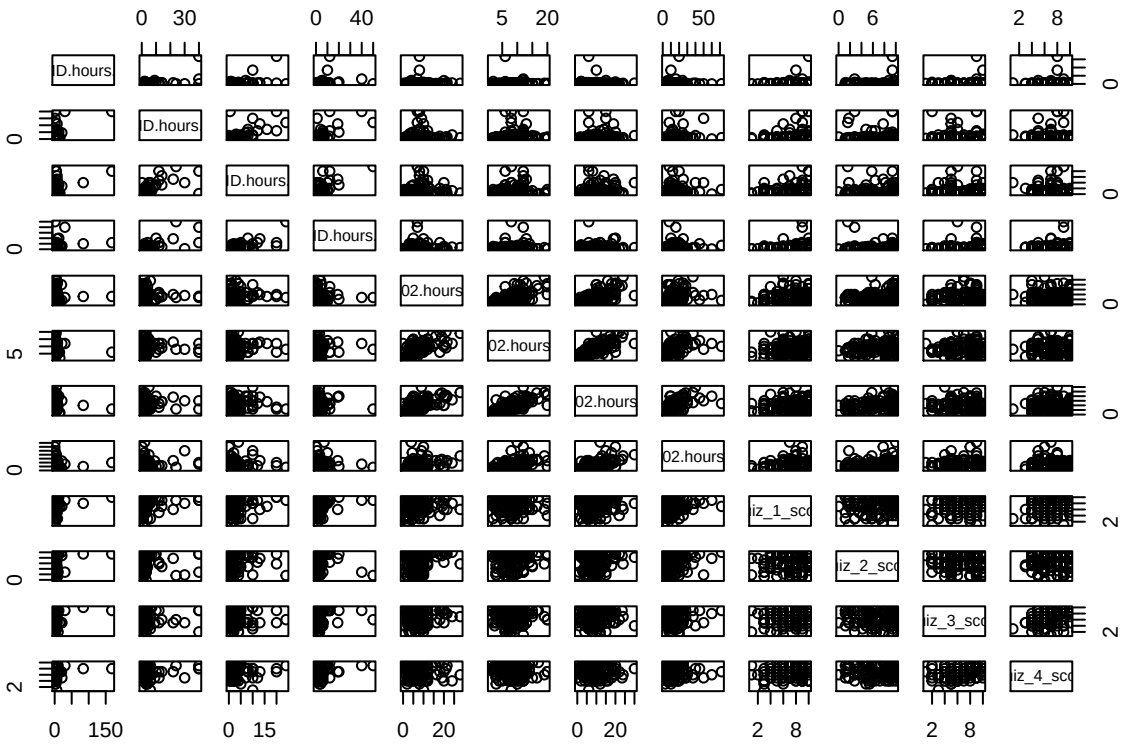
```
## Warning: Removed 34 rows containing non-finite values (stat_boxplot).
```



Scatterplots

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

# 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)
```



Correlation Matrix

All Countries

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

```
# library(GGally)
colnames(no_country) <- c("W1COV", "W2COV", "W3COV", "W4COV",
                          "W1302", "W2302", "W3302", "W4302",
                          "Q1", "Q2", "Q3", "Q4")
# ggcorr(no_country, label = TRUE, label_round = 2)
round(cor(no_country, use = "complete.obs"), 2)  # TODO: na.rm = true
```

```
##       W1COV W2COV W3COV W4COV W1302 W2302 W3302 W4302    Q1    Q2    Q3    Q4
## W1COV  1.00  0.66  0.46  0.20  0.02 -0.04 -0.02  0.06  0.10  0.07  0.05  0.01
## W2COV  0.66  1.00  0.82  0.60  0.06  0.05  0.13  0.21  0.11 -0.10 -0.08 -0.06
## W3COV  0.46  0.82  1.00  0.73  0.06  0.09  0.14  0.13  0.13 -0.10 -0.11 -0.06
## W4COV  0.20  0.60  0.73  1.00  0.02  0.04  0.09  0.07  0.10 -0.09 -0.03  0.01
## W1302  0.02  0.06  0.06  0.02  1.00  0.61  0.57  0.31  0.02  0.11  0.03 -0.07
## W2302 -0.04  0.05  0.09  0.04  0.61  1.00  0.70  0.49 -0.04  0.08 -0.09 -0.12
## W3302 -0.02  0.13  0.14  0.09  0.57  0.70  1.00  0.62 -0.07  0.08 -0.14 -0.09
## W4302  0.06  0.21  0.13  0.07  0.31  0.49  0.62  1.00 -0.07  0.02 -0.05 -0.11
## Q1     0.10  0.11  0.13  0.10  0.02 -0.04 -0.07 -0.07  1.00  0.22  0.33  0.21
## Q2     0.07 -0.10 -0.10 -0.09  0.11  0.08  0.08  0.02  0.22  1.00  0.22  0.16
## Q3     0.05 -0.08 -0.11 -0.03  0.03 -0.09 -0.14 -0.05  0.33  0.22  1.00  0.54
## Q4     0.01 -0.06 -0.06  0.01 -0.07 -0.12 -0.09 -0.11  0.21  0.16  0.54  1.00
```

By Individual Country

```
# 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
```