# STA 518 Final Reflection

## Question 1: URL for Final Project

Github Code and Website Respository: https://github.com/Robert-Bilyk/Final-Project

Website Link: https://robert-bilyk-sta518project.netlify.app/

## Question 2: Did you Work with a Group?

I worked alone on this project.

## Question 3: Demonstration of Skills Learned

To demonstrate what I have learned, I will mainly reference 2 projects I worked on this semester. From these projects I will pull specific examples of the skills I employ to answer the questions the projects pose.

- The first project is the final project that I submitted. In that project I scraped data from the game World of Tanks for each individual tank and how well each individual tank performs. This was all done to see if there were any noticeable differences between the different playable nations, region the game is played on, tank tiers, and lastly the effect of premium tanks on the game.
- The second project was done to answer a question about dice rolling and what strategy is superior. In a game called dungeons and dragons there are two options you can choose. When you hit an enemy, you will roll a specific die to determine how much damage you deal. In the first option you can choose to simply take a flat +2 added to any damage roll. The second option, you can reroll any die that is a 2 or 1 but you have to take the second roll. To determine which of these was better I created a simulation for all of the different die combinations and simulated both options to see what choice appears to be better. I ran 1000 dice added them up and then repeated that 1000 times to get an adequtely sized dataset.

### Import, manage, and clean data:

For the World of Tanks project, the data I acquired was pulled from the Wot-News website. To do so, I wrote a function to pull the data. There were 4 different servers that I needed data from so I ran the function 4 times and then compiled them into a list. Finally, I used rbind to stack the tables on top of each other into a single data set. Note that I also imported "other_info" which included premium tank status as I had to manually pull that data as there wasn't any website that I could scrape this data from.

I also created a second data set that's grouped on the specific tanks rather than the servers using the code below. This time, I combined them horizontally using the reduce() function. The code used here was almost identical to the server data set.

```r
wotscrapewr <- function(x,y){
  tableda <- x %>%
    read_html() %>%
    html_nodes("table#stat_veh_all4")  %>%
    html_table() %>%
    .[[1]] %>%
    setNames(c('Name','Tier','Type','Nation',paste('Total Played',y, sep=" "),
    paste('Wins',y, sep=" "), paste('Win %',y, sep=" "),
    paste('Unique Players',y, sep=" "), 'Region'))
  }
```

```r
wot_tableeu <- wotscrapewr("https://wot-news.com/stat/server/eu/norm/en/", "EU")
wot_tableus <- wotscrapewr("https://wot-news.com/stat/server/us/norm/en/", "US")
wot_tableru <- wotscrapewr("https://wot-news.com/stat/server/ru/norm/en/", "RU")
wot_tablesea <- wotscrapewr("https://wot-news.com/stat/server/sea/norm/en/", "SEA")
other_info <- read_csv("~/STA 518/Final-Project/tank_stats.csv") %>%
  select("Name", "Premium")

wot_list <- list(wot_tableeu, wot_tableus, wot_tableru, wot_tablesea, other_info)

tank_statstot <- wot_list %>% reduce(inner_join, by="Name")
```

After creating these data sets, I did a lot of work to make them presentable for graphs and tables. This includes:

- Removing Unnessesary Variables and Renaming Remaining ones

```r
tank_statstot <- tank_statstot %>%
  select(-ends_with(".y"),-ends_with("x.x")) %>%
  rename("Tier"=`Tier.x`, "Nation"=`Nation.x`, "Type"=`Type.x`)
```

- Adding up all the server together and calculating the average win rate for each tank globally

```r
tank_statstot <- tank_statstot %>%
  mutate("Total Played" = `Total Played US` + `Total Played EU` +
           `Total Played SEA` + `Total Played RU`, "Total Wins" = `Wins US` +
           `Wins EU` + `Wins SEA` + `Wins RU`,
         "Total Unique Players" = `Unique Players US` + `Unique Players EU` +
           `Unique Players SEA` + `Unique Players RU`,
         "Win Rate %" = (`Total Wins`/`Total Played`)*100)
```

- Removing any duplicated variables and removing all tanks with less than 6,000 total battles

```r
tank_statstot <- tank_statstot[!duplicated(tank_statstot$Name),] %>%
  filter(`Total Played` > 6000)
```

- Changing variables to character variables and reordering them for better visuals in the future

```r
tank_statstot$`Tier` <- as.character(tank_statstot$`Tier`) %>%
  factor(levels=c("1", "2", "3", "4", "5", "6", "7", "8", "9", "10"))
tank_statstot$`Premium` <- as.character(tank_statstot$`Premium`)
```

- Renaming the responses for certain categories for better visuals

```r
tank_statstot <- tank_statstot%>%
  mutate(Type = fct_recode(Type,
                           "Medium Tank" = "Medium Tanks",
                           "Heavy Tank" = "Heavy Tanks",
                           "Light Tank" = "Light Tanks",
                           "Tank Destroyer" = "TD",
                           "Artillery" = "SPG")) %>%

  mutate(Nation = fct_recode(Nation,
                             "USA" = "Usa",
                             "USSR" = "Ussr")) %>%

  mutate(Premium = fct_recode(Premium,
                              "No" = "0",
                              "Yes" = "1"))
```

All of this created the data sets shown below that could easily be called to create tables and graphs for the different servers and the different tanks.

### Data Set for Tanks

```
## # A tibble: 971 x 30
##    Name          Tier.x Type.x    Nation.x `Total Played E~ `Wins EU` `Win % EU`
##    <chr>          <int> <chr>     <chr>               <int>     <int> <chr>
##  1 Tiger II           8 Heavy Ta~ Germany            605267    283901 46.91 %
##  2 Maus              10 Heavy Ta~ Germany            228165    112397 49.26 %
##  3 VK 36.01 (H)       6 Heavy Ta~ Germany            431108    216392 50.19 %
##  4 G.W. E 100        10 SPG       Germany            335550    165057 49.19 %
##  5 Hummel             6 SPG       Germany            327391    159269 48.65 %
##  6 G.W. Tiger         9 SPG       Germany            228558    112219 49.1 %
##  7 VK 45.02 (P)~      9 Heavy Ta~ Germany            423070    207047 48.94 %
##  8 E 50               9 Medium T~ Germany            466249    236179 50.66 %
##  9 E 100             10 Heavy Ta~ Germany            561181    269958 48.11 %
## 10 Panther II         8 Medium T~ Germany            243038    108550 44.66 %
## # ... with 961 more rows, and 23 more variables: Unique Players EU <int>,
## #   Tier.y <int>, Type.y <chr>, Nation.y <chr>, Total Played US <int>,
## #   Wins US <int>, Win % US <chr>, Unique Players US <int>, Tier.x.x <int>,
## #   Type.x.x <chr>, Nation.x.x <chr>, Total Played RU <int>, Wins RU <int>,
## #   Win % RU <chr>, Unique Players RU <int>, Tier.y.y <int>, Type.y.y <chr>,
## #   Nation.y.y <chr>, Total Played SEA <int>, Wins SEA <int>, Win % SEA <chr>,
## #   Unique Players SEA <int>, Premium <dbl>
```

### Data Set for Servers

```
## # A tibble: 2,811 x 10
##    Name       Tier  Type    Nation `Total played`    Win `Vehicles amoun~ Server
##    <chr>      <fct> <chr>   <chr>           <int>  <int>            <int> <chr>
##  1 Tiger II   8     Heavy ~ Germa~         605267 283901             3061 EU
##  2 Maus       10    Heavy ~ Germa~         228165 112397             1292 EU
##  3 VK 36.01 ~ 6     Heavy ~ Germa~         431108 216392             4430 EU
##  4 G.W. E 100 10    SPG     Germa~         335550 165057              803 EU
##  5 Hummel     6     SPG     Germa~         327391 159269             3044 EU
##  6 G.W. Tiger 9     SPG     Germa~         228558 112219             1025 EU
##  7 VK 45.02 ~ 9     Heavy ~ Germa~         423070 207047             6455 EU
##  8 E 50       9     Medium~ Germa~         466249 236179             1995 EU
##  9 E 100      10    Heavy ~ Germa~         561181 269958             2405 EU
## 10 Panther II 8     Medium~ Germa~         243038 108550             2091 EU
## # ... with 2,801 more rows, and 2 more variables: Winrate <dbl>, Premium <fct>
```

Lastly, using the dice project functions I created (will be shown later in this reflection), I needed up with this data set which wasn't very good for visuals so I pivoted it.

```
##   Normal_d6 With_GWF_d6 Normal_d8 With_GWF_d8 Normal_d10 With_GWF_d10
## 1      3625        4231      4481        5239       5489         6333
## 2      3433        4164      4491        5184       5466         6225
## 3      3547        4144      4510        5190       5407         6213
## 4      3557        4126      4433        5284       5426         6215
## 5      3468        4200      4468        5368       5655         6306
## 6      3486        4114      4479        5342       5408         6071
## 7      3532       4223     4579       5196      5503        6240
## 8      3486       4139     4520       5210      5362        6390
## 9      3414       4173     4547       5221      5497        6213
## 10     3467       4157     4479       5232      5667        6398
```

```
final <- dataframe %>%
  pivot_longer(
    cols = c(Normal_d6, With_GWF_d6, Normal_d8, With_GWF_d8, Normal_d10,
             With_GWF_d10, Normal_2d6, With_GWF_2d6),
    names_to = "Roll_Type",
    values_to = "Sum_of_Rolls"
  )
```

This changed the data set to the following so visuals could be easily created.

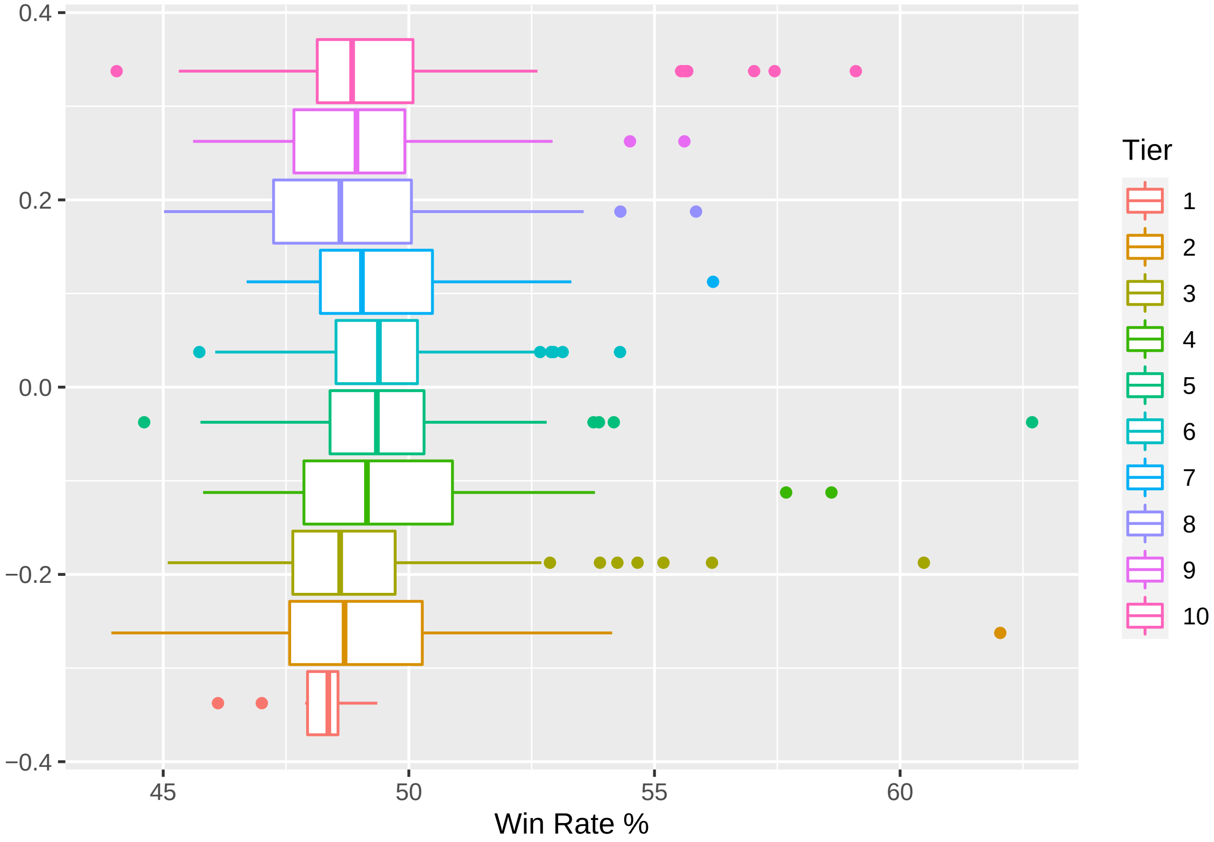
```
## # A tibble: 10 x 2
##    Roll_Type    Sum_of_Rolls
##    <fct>               <int>
##  1 Normal_d6            3625
##  2 With_GWF_d6          4231
##  3 Normal_d8            4481
##  4 With_GWF_d8          5239
##  5 Normal_d10           5489
##  6 With_GWF_d10         6333
##  7 Normal_2d6           6932
##  8 With_GWF_2d6         8311
##  9 Normal_d6            3433
## 10 With_GWF_d6          4164
```

### Creating Visuals and Numerical Summaries

I created numerous summaries and visuals for the final project. Here are a few examples.

### Comparative Boxplots

```
tank_statstot %>%
  ggplot(mapping=aes(x=`Win Rate %`, group=Tier, color=Tier)) +
  geom_boxplot()
```



### Numerical Summaries of Means

```
tank_statstot %>%
  group_by(Tier) %>%
  summarise("Mean Percent by Tank Type" = mean(`Win Rate %`),
            "Total Number of Tier" = length(`Win Rate %`))
```

```
## # A tibble: 10 x 3
##    Tier  `Mean Percent by Tank Type` `Total Number of Tier`
##    <fct>                       <dbl>                  <int>
##  1 1                            48.1                     12
##  2 2                            49.1                     51
##  3 3                            49.3                     56
##  4 4                            49.6                     53
##  5 5                            49.7                     67
##  6 6                            49.5                     79
##  7 7                            49.5                     74
##  8 8                            48.7                    156
##  9 9                            49.0                     69
## 10 10                           49.4                     79
```

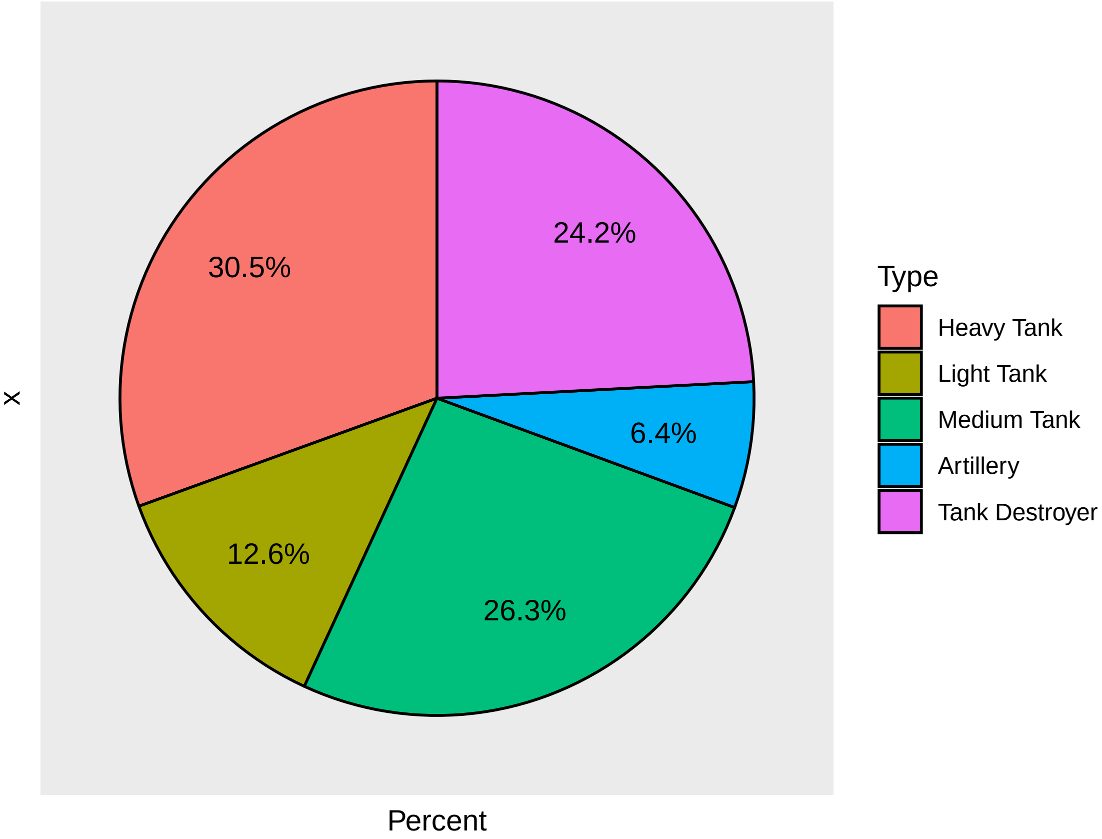
### ANOVA Tests

```
aov(`Win Rate %` ~ Tier, data = tank_statstot) %>%
  summary()
```

```
##              Df Sum Sq Mean Sq F value Pr(>F)
## Tier          9     95  10.541   2.107 0.0269 *
## Residuals   686   3432   5.002
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

### Pie Charts

```
tank_statstot %>%
  group_by(Type) %>%
  summarise(`Type Played` = sum(`Total Played`)) %>%
  mutate(Percent = `Type Played` / sum(`Type Played`)) %>%
  mutate(labels = scales::percent(Percent)) %>%
  group_by(Type)%>%
  ggplot(aes(x = "", y = Percent, fill = Type)) +
  geom_col(color="black") +
  geom_text(aes(x=1.2, label = labels),
            position = position_stack(vjust = 0.5)) +
  coord_polar(theta = "y") +
  theme(axis.text = element_blank(),
        axis.ticks = element_blank(),
        panel.grid  = element_blank())
```



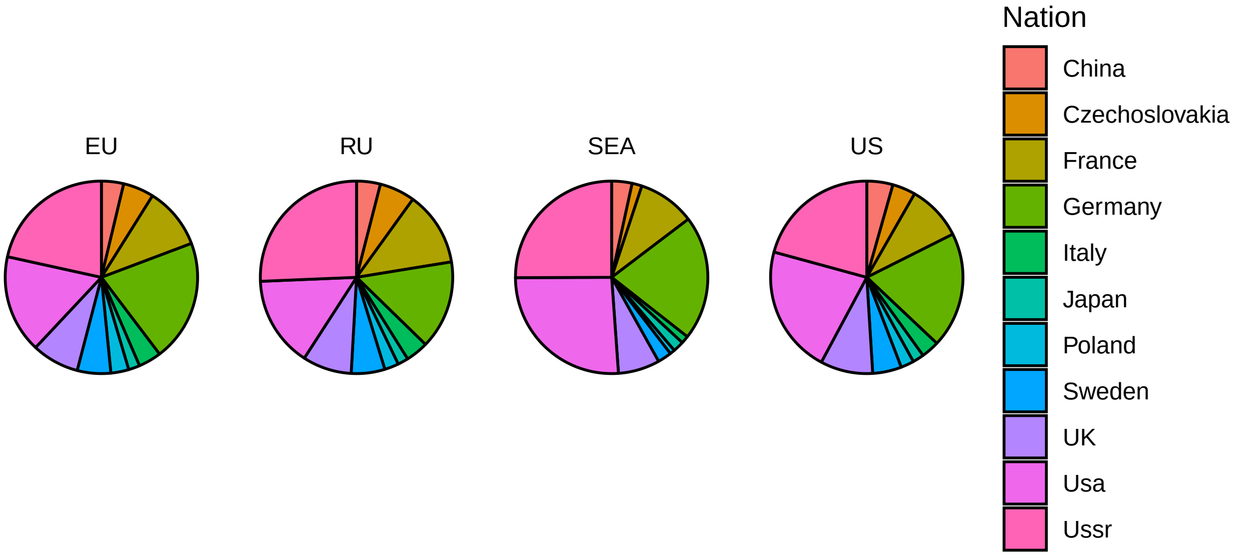
### Comparative Pie Charts

```
Server_pct <- function(x, y){
  tank_statsreg %>%
    filter(Server == x) %>%
    group_by({{y}}) %>%
    summarise(hold = sum(`Total played`), Server = {{x}}) %>%
    mutate(Percent = hold / sum(hold)) %>%
    mutate(labels = scales::percent(Percent))
}

NSEA <- Server_pct("SEA", Nation)
NRU <- Server_pct("RU", Nation)
NUS <- Server_pct("US", Nation)
NEU <- Server_pct("EU", Nation)

regnat <- list(NSEA, NRU, NUS, NEU)
regpnat <- do.call(rbind, regnat)

regpnat %>%
  ggplot(aes(x = "", y = Percent, fill = Nation, group = Server)) +
  geom_col(color="black") +
  coord_polar(theta = "y") +
  facet_grid(.~ Server) + theme_void() +
  theme(axis.text = element_blank(),
        axis.ticks = element_blank(),
        panel.grid  = element_blank())
```



### Write R Programs for Similations w/ Randomization Based Expiriments

Moving back to the dice project, I used the following code to create a function that first simply rolled a certain number of dice that had a certain number of sides. This is because in D&D many different sided die are used.

```
normal <- function(x,y){
  Normal_2d <- 1:1000; Normal_2d
  for(l in 1:1000){
    sumofall2d <- 1:1000; sumofall2d
    for(i in 1:1000){
      sum2d <- 0
      roll2d <- sample(1:x, y, replace=TRUE)
      sum2d <- sum(roll2d)
      sumofall2d[i] <- sum2d
    }
    Normal_2d[l] <- sum(sumofall2d)
  }
  return(Normal_2d)
}
```

Then I wrote a code to reroll any 1's and 2's and take the new roll. I wrote seperate functions for one and two die.

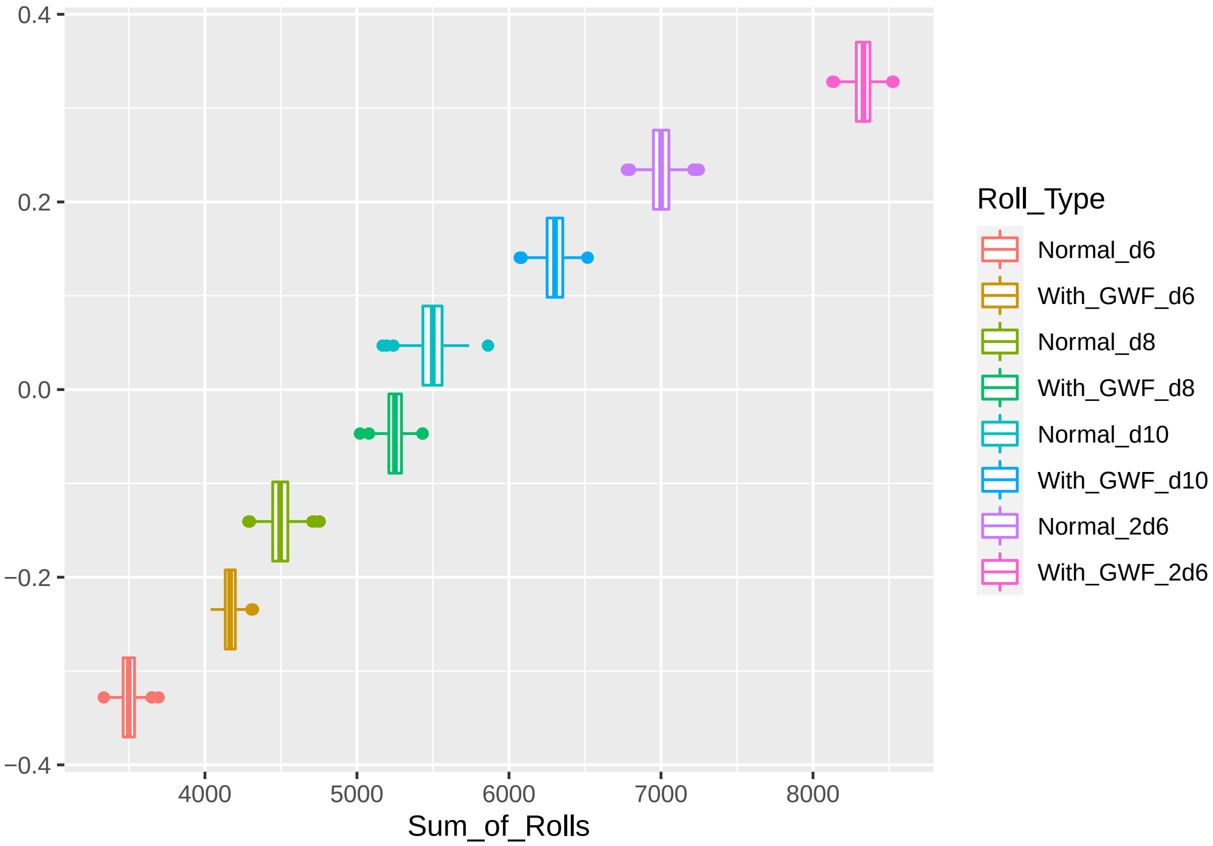
### 1 Dice _

```
gwf_rolls  <- function(x){
With_GWF <- 1:1000; With_GWF
for(l in 1:1000){
  sum <- 0
  roll <- sample(1:x, 1000, replace=TRUE)
  for(i in 1:1000){
    if(roll[i]<3){
      roll[i] <- sample(1:x, 1, replace=TRUE)
    }
  }
  sum <- sum(roll)
  With_GWF[l] <- sum
}
return(With_GWF)
}
```

### 2 Die _

```
gwf_2dice <- function(x){
totalroll <- 1:1000; totalroll
With_GWF_2d <- 1:1000; With_GWF_2d
for(l in 1:1000){
  for(i in 1:1000){
    roll2d <-sample(1:x, 2, replace=TRUE)
    if(roll2d[1]<3){
      roll2d[1] <-sample(1:x, 1, replace=TRUE)
    }
    if(roll2d[2]<3){
        roll2d[2] <-sample(1:x, 1, replace=TRUE)
    }
    sumroll <- sum(roll2d)
    totalroll[i] <- sumroll
  }
    finalroll <- sum(totalroll)
    With_GWF_2d[l] <- finalroll
}
return(With_GWF_2d)
}
```

With these functions written I ran them for all of the different dice combinations that would be encountered. Putting these all into a dataframe and pivoting it as shown earlier, I was able to create the following box plot and table describing the average damage improvement from taking option 2.



#### Table of Improvement from Picking Option 2

```
## # A tibble: 1 x 4
##   d6dmgincrease d8dmgincrease d10dmgincrease d2d6dmgincrease
##           <dbl>         <dbl>          <dbl>           <dbl>
## 1         0.961          1.15           1.28            1.92
```

This all appears to indicate that picking option 1 for the flat +2 damage increase is better than taking the second option as all common dice combinations result in a dmage increase of less than 2.

#### Using Source Documentation to Troubleshoot and Extend R Programs

I had to use numerous sources both in R and using outside sources to accomplish tasks.

Stack Overflow was easily the most helpful for general advice on issues and simple syntax errors: https://stackoverflow.com/

For web scraping, I found a fantastic youtube series which really helped me learn to web scrape: https://www.youtube.com/watch?v=v8Yh_4oE-Fs&list=PLr5uaPu5L7xLEclrT0-2TWAz5FTkfdUiW

Finally, another helpful source for setting up my website was this web article: https://lisalendway.netlify.app/posts/2020-12-09-buildingdistill/

All of this, allowed me to improve my skills in web scraping and web design which really allowed me to enhance my project and any future projects I will do in R.

## Question 4: Grade I Think I Deserve

I would overall give myself an A. I am very confident in all of the topics we covered and I know that I can adequately accomplish any tasks related to modifying data and displaying it. My biggest issue is forgetting the necessary syntax with different R commands. However, using the ? in R and using online resources mostly covers any major issues I have on that front.

## Question 5: Thoughts or Reflections

My personal preference is to have more structure to classes and actually having grades but this class was certainly effective in teaching me the necessary skills needed to code in R. I don't have any major criticisms with how the class is run.