Worksheet 3

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```r
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.5.1     v tibble    3.2.1
## v lubridate 1.9.4     v tidyr     1.3.1
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```r
library(readxl)
```

```r
drugtype <- rep(c("drug1", "drug2", "drug3"), c(5, 7, 7))
relieftime <- c(7.3, 8.2, 10.1, 6, 9.5, 7.1, 10.6, 11.2, 9, 8.5, 10.9, 7.8, 5.8,
                6.5, 8.8, 4.9, 7.9, 8.5, 5.2)
myrelief <- data.frame(drugtype, relieftime)
myrelief
```

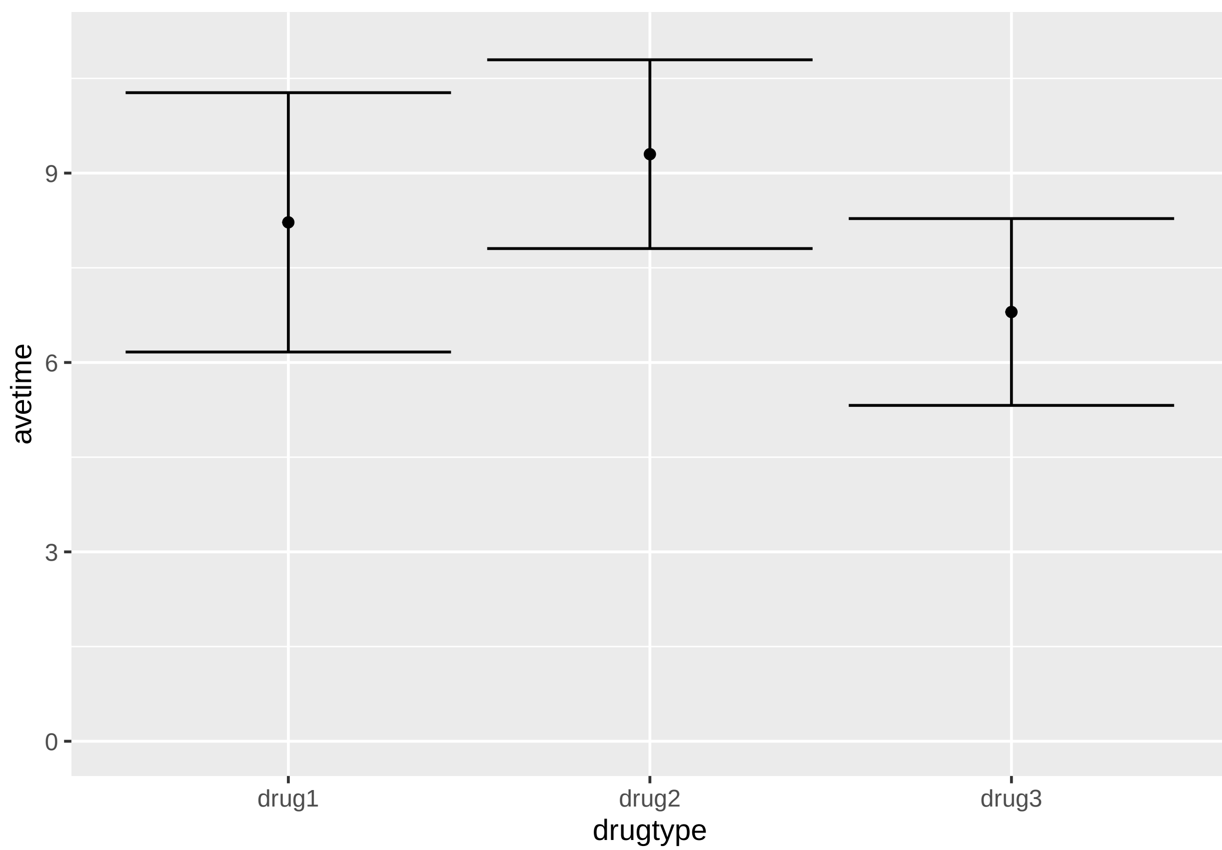
```
##    drugtype relieftime
## 1     drug1        7.3
## 2     drug1        8.2
## 3     drug1       10.1
## 4     drug1        6.0
## 5     drug1        9.5
## 6     drug2        7.1
## 7     drug2       10.6
## 8     drug2       11.2
## 9     drug2        9.0
## 10    drug2        8.5
## 11    drug2       10.9
## 12    drug2        7.8
## 13    drug3        5.8
## 14    drug3        6.5
## 15    drug3        8.8
## 16    drug3        4.9
## 17    drug3        7.9
## 18    drug3        8.5
## 19    drug3        5.2
```

```r
model1 <- aov(relieftime~drugtype, data = myrelief)
summary(model1)
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)  
## drugtype     2  21.98  10.991   4.188 0.0345 *
## Residuals   16  41.99   2.624                 
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

f = 4.188; p-value = 0.0345 Reject H0; there is no evidence to support that the average relief time for the three drugs are indentical.

```r
myrelief %>%
  group_by(drugtype) %>%
  summarize(avetime = mean(relieftime), setime = sd(relieftime)/
              sqrt(length(relieftime)),
            tstar=qt(1-0.05/2, length(relieftime) - 1))%>%
  ggplot(aes(x=drugtype, y=avetime)) + geom_point()+
  geom_errorbar(aes(ymin=avetime -setime*tstar, ymax = avetime+setime*tstar))+
  ylim(c(0,11))
```



There is various flickering light in our environment. For instance, light from computer screens and fluorescent bulb. If the frequency of the flicker is below a certain threshold, the flicker can be detected by the eye. Different people have different flicker "threshold" frequencies (known as the critical flicker frequency, or CFF). Knowing the critical threshold frequency below which flicker is detected can be important for product manufacturing as well as tests for ocular disease. Do people with different eye color have different threshold flicker sensitivity? A 1973 study ("The Effect of Iris Color on Critical Flicker Frequency", Journal of General Psychology (1973)) obtained the following data (see worksheet) from a random sample of 19 subjects. Do these data suggest that people with different eye color have different threshold sensitivity to flickering light? Worksheet 3 Number 1

```r
eyecolor <- rep(c("Brown", "Green", "Blue"), c(8,5,6))
CFF <- c(26.8, 27.9, 23, 25, 26, 24.8, 25.7, 24.5, 26.4, 24.2, 28, 26.9, 29.1,
         25.7, 27.2, 29.9, 28.5, 29.4, 29.4)
flickerdf <- data.frame(eyecolor, CFF)

model2 <- aov(CFF~eyecolor, data=flickerdf)
summary(model2)
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## eyecolor     2  28.76  14.382   5.442 0.0157 *
## Residuals   16  42.28   2.643
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
TukeyHSD(model2) # pairwise comparison test
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = CFF ~ eyecolor, data = flickerdf)
##
## $eyecolor
##                diff        lwr        upr     p adj
## Brown-Blue  -2.8875 -5.1528498 -0.6221502 0.0121491
## Green-Blue  -1.4300 -3.9699642  1.1099642 0.3389182
## Green-Brown  1.4575 -0.9337972  3.8487972 0.2855020
```

```r
# Step 1: formulate the null and alternative hypotheses using symbols
# H_0:  _Brown =  _Green =  _Blue
# H_a: at least 2 means are different

# Step 2: choose one-way ANOVA test.

# Step 3: Find the statistic and the p-value for testing the means from R output

# Step 4: Make a decision based on significance level of 0.05; and explain your
# decision in the context.

# Step 5: If there is any significant differences among the means, perform a
# pairwise comparison to determine where the differences lie.
```

f = 5.442; p-value = 0.0157 Reject H0; there is evidence to support that people with diff eye color have diff threshold sensitivity to flickering lights.

2. Referring to the data "James Intrusive Memory Activity", perform the following one-way ANOVA tests by answering the questions below. The authors compared the frequency of intrusive memories under four conditions: No task(1); Reactivation plus Tetris (2); Reactivation only (3); and Tetris only (4). The independent variable is the first column of the data ' "Condition"

```r
James_Intrusive_Memories_Activity <- read_excel("~/Desktop/STAT 301/Week 3/James Intrusive Memories Acti
# a) Test to see if the mean frequency of intrusive memories are significantly
# different between the four conditions at day 0, using the variable
# Day_Zero_Number_of_Intrusions with the 0.05 significance level.
model4 <- aov(Day_Zero_Number_of_Intrusions~Condition,
              data=James_Intrusive_Memories_Activity)
summary(model4)
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## Condition    3    2.5   0.829   0.163  0.921
## Residuals   68  345.2   5.076
```

```r
# b) Test to see if the mean frequency of intrusive memories are significantly
# different between the four conditions for the seven days following the
# experiment, using the variable Days_One_to_Seven_Number_of_Intrusions, with
# the significance level of 0.05.
model4 <- aov(Days_One_to_Seven_Number_of_Intrusions~Condition,
              data=James_Intrusive_Memories_Activity)
summary(model4)
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## Condition    3  114.8   38.27   3.795 0.0141 *
## Residuals   68  685.8   10.09
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
# C) continue with b), if you observe any significant difference, perform a
# multiple comparison to determine where the significant differences lie.
TukeyHSD(model4) # pairwise comparison test
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Days_One_to_Seven_Number_of_Intrusions ~ Condition, data = James_Intrusive_Memori
##
## $Condition
##                  diff       lwr        upr     p adj
## one-four    0.2777778 -2.510286  3.0658416 0.9936134
## three-four -0.9444444 -3.732508  1.8436194 0.8089270
## two-four   -2.9444444 -5.732508 -0.1563806 0.0344808
## three-one  -1.2222222 -4.010286  1.5658416 0.6572614
## two-one    -3.2222222 -6.010286 -0.4341584 0.0170843
## two-three  -2.0000000 -4.788064  0.7880638 0.2422598
```

a) f = 0.163; p-value = 0.921 Fail to reject H0; there is not enough evidence to support that the mean frequency of intrusive memories are significantly different between the four conditions at day O

b) f = 3.795; p-value = 0.0141 Reject H0; there is evidence to support that the mean frequency of intrusive memories are significantly different between the four conditions for the seven days following the experiment