Worksheet 5

Peyton Hall

02/14/2025

Necessary Libraries

```
library(reshape2)
# install.packages("reshape2")
# install.packages("nlme")
# install.packages("multcomp")
library(nlme)
library(multcomp)
```

```
## Loading required package: mvtnorm
```

```
## Loading required package: survival
```

```
## Loading required package: TH.data
```

```
## Loading required package: MASS
```

```
##
## Attaching package: 'TH.data'
```

```
## The following object is masked from 'package:MASS':
##
##     geyser
```

1. The attractiveness of a person's face is traditionally considered to be related to physical features, such as how symmetrical the features are, and how close a face is to the "average" face over many people. However, there is also evidence that perceived facial attractiveness can vary due to factors outside of the face. In what has become known as the "cheerleader effect", the same face is perceived to be more attractive when seen in a group, as compared to when it is seen alone. Carragher, Thomas, Gwinn, & Nicholls (2019) set out to test this hypothesis. In one part of their study (Experiment 1), they let participants rate the attractiveness of a face when presented by itself (the Alone condition), as part of a group of different faces (the Different condition), and as part of a group of similar faces (the Similar condition). Perform a hypothesis test to see whether the mean attractiveness scores are significantly different among the three conditions using the significance level of 0.05. Individual Alone Different faces in a group Similar faces in a group 1 56.3 55.9 54.3 2 49.8 49.7 51.2 3 47.1 52.5 53.2 4 38.9 41.6 42.1 5 44.7 47.0 50.5 6 45.2 43.9 46.2 7 36.8 37.3 38.8 8 53.8 52.7 53.9 9 45.1 46.2 49.1

a) Formulate the null and alternative hypotheses H_0 : $\mu_{\text{Alone}} = \mu_{\text{Different}} = \mu_{\text{Similar}}$ vs H_a : At least two means are different

b) What is the test statistic and p-value?
c) What decision can you make to H0. Explain your decision in the context
d) if there is a significant difference, which two conditions are significantly different?

```
individual1 <- 1:9
treatment <- rep(c("alone", "diff_face", "similar_face"), each = 9)
scores <- c(56.3, 49.8, 47.1, 38.9, 44.7, 45.2, 36.8, 53.8, 45.1, 55.9, 49.7, 52.5, 41.6, 47.0, 43.9, 3
            54.3, 51.2, 53.2, 42.1, 50.5, 46.2, 38.8, 53.9, 49.1)
treatment <- as.factor(treatment)
attractdf <- data.frame(individual1, treatment, scores)
#         lme(DV~IV, . . .)
model2 <- lme(scores~treatment, random = ~ 1 | individual1, data = attractdf)
anova(model2)
```

```
##             numDF denDF  F-value p-value
## (Intercept)     1    16 610.9164  <.0001
## treatment       2    16   5.6446   0.014
```

```
posthoc2 <- glht(model2, linfct = mcp(treatment = "Tukey"))
summary(posthoc2)
```

```
##
##   Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lme.formula(fixed = scores ~ treatment, data = attractdf, random = ~1 |
##     individual1)
##
## Linear Hypotheses:
##                                Estimate Std. Error z value Pr(>|z|)
## diff_face - alone == 0           1.0111     0.7172   1.410  0.33581
## similar_face - alone == 0        2.4000     0.7172   3.346  0.00227 **
## similar_face - diff_face == 0    1.3889     0.7172   1.936  0.12856
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
```

f = 5.64; p-value = 0.014 Reject H0; There is evidence to support that there is a significant difference between at least 2 conditions. The significant difference is between the face alone and among similar faces. The "Alone" and "Similar faces in a group" conditions are significantly different

2. We would like to conduct a survey to investigate excessive coffee drinking. We took a sample of 10 individuals and surveyed how many cups of coffee they drink in the morning and how many they drink in the afternoon. We also would like to know the volume of the cups (8oz, 12oz, or 16oz). The data on the worksheet is what we obtained from the 10 individuals in one day. Perform an appropriate analysis to investigate whether people drink significant different amount of coffee between morning and afternoon, whether there are significant effects from the types of cups and if there is any interaction between time and type of cups.

a) What is the F and p-value for testing the main effect of time?

b) What decision can you make for the main effect of time?
c) What is the F and p-value for testing the main effect of coffee cup size?
d) What decision can you make for the main effect of coffee cup size?
e) What can you conclude about significance of the interaction? What is the p-value

```
# Sample data based on the provided information
data <- data.frame(
  ID = 1:10,
  Morning_8oz = c(1, 1, 0, 0, 2, 0, 1, 1, 1, 1),
  Morning_12oz = c(0, 1, 0, 0, 1, 1, 1, 0, 1, 1),
  Morning_16oz = c(0, 1, 1, 0, 1, 1, 0, 1, 0, 0),
  Afternoon_8oz = c(1, 1, 0, 0, 1, 1, 0, 1, 1, 1),
  Afternoon_12oz = c(0, 1, 0, 0, 1, 0, 0, 0, 1, 1),
  Afternoon_16oz = c(0, 0, 0, 0, 0, 0, 0, 0, 1, 0)
)

# Transform data to long format suitable for ANOVA
library(tidyr)
```

```
##
## Attaching package: 'tidyr'

## The following object is masked from 'package:reshape2':
##
##     smiths
```

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following object is masked from 'package:MASS':
##
##     select

## The following object is masked from 'package:nlme':
##
##     collapse

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
data_long <- data %>%
  pivot_longer(cols = -ID, names_to = c("Time", "Size"), names_sep = "_") %>%
  mutate(Time = ifelse(grepl("Morning", Time), "Morning", "Afternoon"),
         Size = factor(gsub("\\D", "", Size), levels = c("8", "12", "16")))
```

```r
# Fit the two-way ANOVA model
model <- aov(value ~ Time * Size, data = data_long)
summary(model)
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## Time         1  0.817  0.8167   3.173 0.0805 .
## Size         2  2.033  1.0167   3.950 0.0251 *
## Time:Size    2  0.233  0.1167   0.453 0.6380
## Residuals   54 13.900  0.2574
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

f = 3.173; p-value = 0.0805 Fail to reject H0; there is no effect of time on coffee consumption. f = 3.950; p-value = 0.0251 Reject H0; there is an effect of coffee cup size on coffee consumption. The significance of the interaction is not statistically significant. p-value = 0.6380