```r
# Loading necessary libraries
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(ggplot2)
```

```r
vaccine_data <- read.csv("~/Desktop/appld stats/vaccine-1.csv") head(vaccine_data)
```

```
##   X Vaccine_Type Age_Group Antibody_Titer
## 1 1    Vaccine_A     Young       71.59287
## 2 2    Vaccine_A   Elderly       76.54734
## 3 3    Vaccine_A     Young      103.38062
## 4 4    Vaccine_A   Elderly       81.05763
## 5 5    Vaccine_A     Young       81.93932
## 6 6    Vaccine_A   Elderly      105.72597
```

```r
str(vaccine_data)
```

```
## 'data.frame':    40 obs. of 4 variables:
## $ X             : int 1 2 3 4 5 6 7 8 9 10 ...
## $ Vaccine_Type : chr "Vaccine_A" "Vaccine_A" "Vaccine_A" "Vaccine_A" ...
## $ Age_Group     : chr "Young" "Elderly" "Young" "Elderly" ...
## $ Antibody_Titer: num 71.6 76.5 103.4 81.1 81.9 ...
```

```r
#Stating the Hypotheses # We will

test the following:
```



```r
# 1.Main effect of Vaccine Type:
# H0: There is no difference in antibody titers between Vaccine_A and Vaccine_B. # H1: There is a
difference in antibody titers between Vaccine_A and Vaccine_B.

# 2.Main effect of Age Group:
# H0: There is no difference in antibody titers between Young and Elderly groups.
# H1: There is a difference in antibody titers between Young and Elderly groups.

# 3.Interaction effect between Vaccine Type and Age Group:
# H0: There is no interaction effect on antibody titers.
```

```r
# H1: There is an interaction effect between Vaccine Type and Age Group on antibody titers.
```

```r
# Convert columns to factors
vaccine_data$Vaccine_Type <- as.factor(vaccine_data$Vaccine_Type)

vaccine_data$Age_Group <- as.factor(vaccine_data$Age_Group) # Perform two-

way ANOVA

anova_model <- aov(Antibody_Titer ~ Vaccine_Type * Age_Group, data =
vaccine_data) summary(anova_model)
```

```
##                              Df Sum Sq Mean Sq F value Pr(>F)
## Vaccine_Type                  1    505   505.1   2.215 0.145
## Age_Group                     1     60    60.4   0.265 0.610
## Vaccine_Type:Age_Group 1             79    78.6   0.345 0.561
## Residuals                    36   8208   228.0
```

```r
# Results and Interpretation

# Based on the two-way ANOVA results:

# Main Effect of Vaccine Type:
#           - F(1, 36) = 2.215, p = 0.145
# - Since p > 0.05, the effect of vaccine type on antibody titer is not statistically significant. #
# Main Effect of Age Group:
#           - F(1, 36) = 0.265, p = 0.610
#                                       - Since p > 0.05, the effect of age group on antibody titer is not statistically sig
#
# Interaction Effect (Vaccine_Type × Age_Group):
#           - F(1, 36) = 0.345, p = 0.561
#                                     - Since p > 0.05, there is no significant interaction effect between vaccine type a

# Final Conclusion:
# There is no statistically significant effect of vaccine type, age group, or their interaction on antib
```