Portfolio Task 3 - Multifactorial Experimental Design

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Load and Prepare Data

```
# Load dataset
# The dataset is stored in the Downloads > GRA 4158 > Task3 folder

df <- read.csv("~/Downloads/GRA 4158/Task3/Multifactorial_design_example.csv", sep = ";")

# Convert categorical variables to factors
df$messagetype <- as.factor(df$messagetype)
df$pricelevel <- as.factor(df$pricelevel)

# View first few rows
head(df)
```

```
##   response messagetype pricelevel
## 1      194           1          1
## 2      228           2          1
## 3      236           1          2
## 4      251           2          2
## 5      241           1          3
## 6      307           2          3
```

Summary Statistics

```
# Calculate group-wise means, standard deviations, and sample sizes
group_summary <- df %>%
  group_by(messagetype, pricelevel) %>%
  summarise(
    mean_response = mean(response),
    sd_response = sd(response),
    count = n()
  )
```

```
## `summarise()` has grouped output by 'messagetype'. You can override using the
## `.groups` argument.
```

```r
# Display the summary
group_summary
```

```
## # A tibble: 6 x 5
## # Groups:   messagetype [2]
##   messagetype pricelevel mean_response sd_response count
##   <fct>       <fct>              <dbl>       <dbl> <int>
## 1 1           1                   201.        9.18   200
## 2 1           2                   221.       10.3    200
## 3 1           3                   240.        9.78   200
## 4 2           1                   230.       10.5    200
## 5 2           2                   250.        9.72   200
## 6 2           3                   290.       10.3    200
```

Two-Way ANOVA

```r
# Fit a two-way ANOVA model with interaction term
anova_model <- aov(response ~ messagetype * pricelevel, data = df)

# View summary of the ANOVA
summary(anova_model)
```

```
##                          Df Sum Sq Mean Sq F value Pr(>F)
## messagetype               1 379781  379781  3815.6 <2e-16 ***
## pricelevel                2 504633  252316  2535.0 <2e-16 ***
## messagetype:pricelevel    2  28353   14176   142.4 <2e-16 ***
## Residuals              1194 118845     100
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Post-hoc Test: Tukey HSD

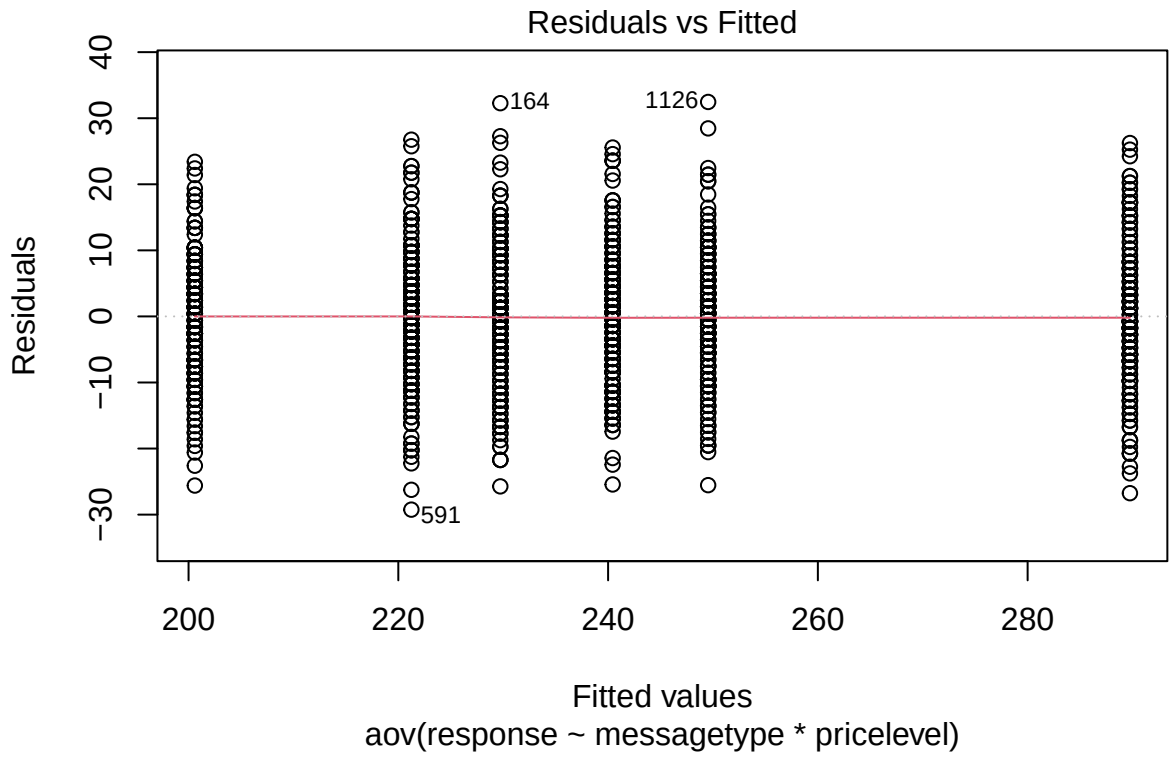
```r
# Conduct Tukey HSD post-hoc comparisons
TukeyHSD(anova_model)
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = response ~ messagetype * pricelevel, data = df)
##
## $messagetype
##      diff     lwr     upr p adj
## 2-1 35.58 34.4499 36.7101     0
##
## $pricelevel
##        diff      lwr      upr p adj
## 2-1 20.2300 18.57454 21.88546     0
## 3-1 49.9325 48.27704 51.58796     0
```

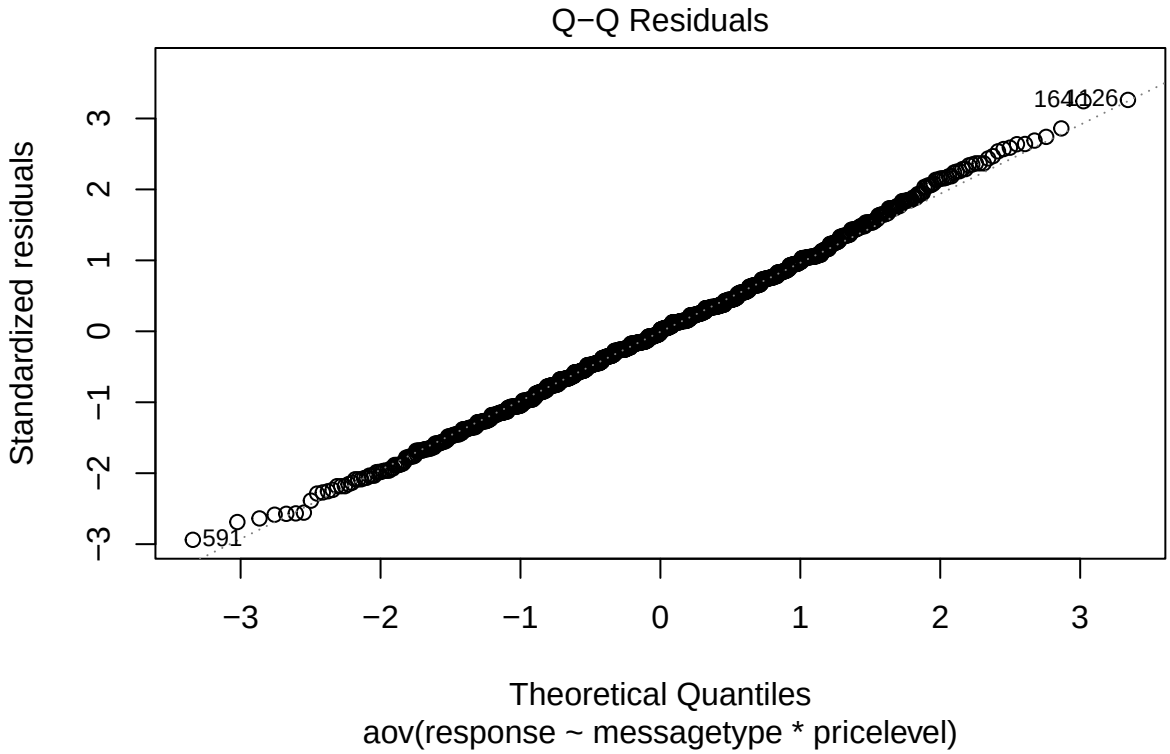
```
## 3-2 29.7025 28.04704 31.35796     0
##
## $`messagetype:pricelevel`
##           diff        lwr       upr p adj
## 2:1-1:1 29.125  26.277297 31.972703     0
## 1:2-1:1 20.645  17.797297 23.492703     0
## 2:2-1:1 48.940  46.092297 51.787703     0
## 1:3-1:1 39.835  36.987297 42.682703     0
## 2:3-1:1 89.155  86.307297 92.002703     0
## 1:2-2:1 -8.480 -11.327703 -5.632297     0
## 2:2-2:1 19.815  16.967297 22.662703     0
## 1:3-2:1 10.710   7.862297 13.557703     0
## 2:3-2:1 60.030  57.182297 62.877703     0
## 2:2-1:2 28.295  25.447297 31.142703     0
## 1:3-1:2 19.190  16.342297 22.037703     0
## 2:3-1:2 68.510  65.662297 71.357703     0
## 1:3-2:2 -9.105 -11.952703 -6.257297     0
## 2:3-2:2 40.215  37.367297 43.062703     0
## 2:3-1:3 49.320  46.472297 52.167703     0
```

Diagnostic Plots

```r
# Residuals vs Fitted
plot(anova_model, which = 1)
```

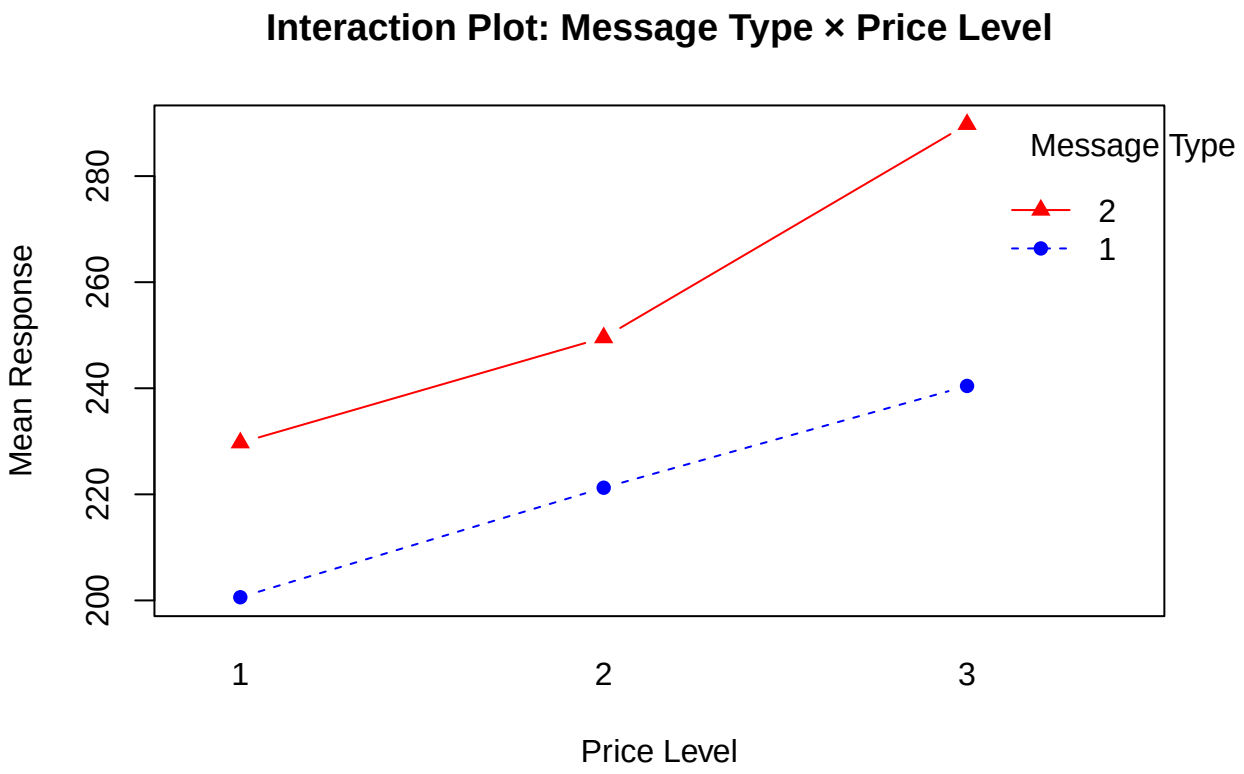


```r
# Q-Q Plot for normality
plot(anova_model, which = 2)
```



Interaction Plot

```r
# Plot the interaction between message type and price level
interaction.plot(
  x.factor = df$pricelevel,
  trace.factor = df$messagetype,
  response = df$response,
  fun = mean,
  type = "b",
  col = c("blue", "red"),
  pch = c(16, 17),
  xlab = "Price Level",
  ylab = "Mean Response",
  trace.label = "Message Type",
  main = "Interaction Plot: Message Type × Price Level"
)
```



Conclusion

```
cat("Both messagetype and pricelevel significantly affect the response.\n")
```

```
## Both messagetype and pricelevel significantly affect the response.
```

```
cat("There is also a significant interaction between them.\n")
```

```
## There is also a significant interaction between them.
```

```
cat("This suggests marketers should carefully pair messages with the right price strategy.\n")
```

```
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```