STAT3355(HW-7)

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Problem 1

```r
# Step 1: Define the data
fill_data <- c(15.997, 16.005, 15.981, 15.954, 15.986,
               16.021, 15.985, 16.001, 16.018, 16.056)

# Step 2: Specify the hypothesized mean and significance level
mu_0 <- 16.00   # Hypothesized mean
alpha <- 0.05   # Significance level

# Step 3: Perform calculations
sample_mean <- mean(fill_data)     # Sample mean
sample_sd <- sd(fill_data)         # Sample standard deviation
n <- length(fill_data)             # Sample size

# Test statistic
t_stat <- (sample_mean - mu_0) / (sample_sd / sqrt(n))

# Degrees of freedom
df <- n - 1

# p-value for the one-sided test
p_value <- pt(t_stat, df)

# Critical value for a one-sided t-test
critical_value <- qt(alpha, df)

# Display results
cat("Sample Mean:", sample_mean, "\n")
```

```
## Sample Mean: 16.0004
```

```r
cat("Sample Standard Deviation:", sample_sd, "\n")
```

```
## Sample Standard Deviation: 0.02755278
```

```r
cat("Test Statistic (t):", t_stat, "\n")
```

```
## Test Statistic (t): 0.04590866
```

```r
cat("Degrees of Freedom:", df, "\n")
```

```
## Degrees of Freedom: 9
```

```r
cat("Critical Value (t):", critical_value, "\n")
```

```
## Critical Value (t): -1.833113
```

```r
cat("p-value:", p_value, "\n")
```

```
## p-value: 0.5178072
```

```r
# Step 4: Decision
if (p_value <= alpha) {
  cat("Decision: Reject the null hypothesis. The mean fill is less than 16.00 ounces.\n")
} else {
  cat("Decision: Fail to reject the null hypothesis. Insufficient evidence that the mean fill is less t
}
```

```
## Decision: Fail to reject the null hypothesis. Insufficient evidence that the mean fill is less than
```

Problem 2

```r
# Step 1: Given data
x_bar <- 8.412  # Sample mean
s <- 1.512      # Sample standard deviation
n <- 60         # Sample size
mu_0 <- 8.2     # Hypothesized mean
alpha <- 0.05   # Significance level

# Step 2: Calculate the test statistic (t)
t_stat <- (x_bar - mu_0) / (s / sqrt(n))

# Degrees of freedom
df <- n - 1

# Step 3: Calculate the p-value for the one-sided t-test
p_value <- 1 - pt(t_stat, df)

# Step 4: Critical value for a one-sided t-test
critical_value <- qt(1 - alpha, df)

# Step 5: Display results
cat("Test Statistic (t):", t_stat, "\n")
```

```
## Test Statistic (t): 1.086075
```

```r
cat("Critical Value (t):", critical_value, "\n")
```

```
## Critical Value (t): 1.671093
```

```r
cat("p-value:", p_value, "\n")
```

```
## p-value: 0.1409317
```

```r
# Step 6: Decision
if (p_value <= alpha) {
  cat("Decision: Reject the null hypothesis. There is sufficient evidence to suggest that the mean enga
} else {
  cat("Decision: Fail to reject the null hypothesis. There is insufficient evidence to suggest that the
}
```

```
## Decision: Fail to reject the null hypothesis. There is insufficient evidence to suggest that the mea
```

Problem 3

```r
# Given data
x <- 130   # Number of stressed students
n <- 200   # Sample size
p0 <- 0.70 # Hypothesized population proportion

# Sample proportion
p_hat <- x / n

# Step 1: Calculate the z-test statistic
z_stat <- (p_hat - p0) / sqrt((p0 * (1 - p0)) / n)

# Step 2: Calculate the p-value for a two-tailed test
p_value <- 2 * (1 - pnorm(abs(z_stat)))  # Two-tailed test

# Step 3: Display results
cat("Test Statistic (z):", z_stat, "\n")
```

```
## Test Statistic (z): -1.543033
```

```r
cat("p-value:", p_value, "\n")
```

```
## p-value: 0.1228226
```

```r
# Step 4: Decision
alpha <- 0.05
if (p_value <= alpha) {
  cat("Decision: Reject the null hypothesis. There is evidence to suggest the proportion of stressed st
} else {
  cat("Decision: Fail to reject the null hypothesis. There is insufficient evidence to suggest the prop
}
```

```
## Decision: Fail to reject the null hypothesis. There is insufficient evidence to suggest the proporti
```

Problem 4

```r
# Given data
x1 <- 2.00   # Mean for ages 18-50
s1 <- 0.812  # Standard deviation for ages 18-50
n1 <- 350    # Sample size for ages 18-50

x2 <- 1.85   # Mean for ages > 50
s2 <- 0.837  # Standard deviation for ages > 50
n2 <- 150    # Sample size for ages > 50

# Step 1: Calculate the t-statistic
t_stat <- (x1 - x2) / sqrt((s1^2 / n1) + (s2^2 / n2))

# Step 2: Calculate the degrees of freedom using Welch-Satterthwaite equation
df <- ((s1^2 / n1 + s2^2 / n2)^2) / ((s1^2 / n1)^2 / (n1 - 1) + (s2^2 / n2)^2 / (n2 - 1))

# Step 3: Calculate the p-value for a one-sided test
p_value <- 1 - pt(t_stat, df)

# Step 4: Display results
cat("Test Statistic (t):", t_stat, "\n")
```

```
## Test Statistic (t): 1.852798
```

```r
cat("Degrees of Freedom:", df, "\n")
```

```
## Degrees of Freedom: 274.3818
```

```r
cat("p-value:", p_value, "\n")
```

```
## p-value: 0.03249249
```

```r
# Step 5: Decision
alpha <- 0.05
if (p_value <= alpha) {
  cat("Decision: Reject the null hypothesis. There is evidence to suggest that people over 50 years old
} else {
  cat("Decision: Fail to reject the null hypothesis. There is insufficient evidence to suggest that peo
}
```

```
## Decision: Reject the null hypothesis. There is evidence to suggest that people over 50 years old use
```

Problem 5

```r
# Given data
x1 <- 22  # Number of male students who play video games
n1 <- 30  # Sample size for males
```

```r
x2 <- 24  # Number of female students who play video games
n2 <- 40  # Sample size for females

# Step 1: Calculate sample proportions
p1_hat <- x1 / n1
p2_hat <- x2 / n2

# Step 2: Calculate the pooled proportion
p_hat <- (x1 + x2) / (n1 + n2)

# Step 3: Calculate the z-statistic
z_stat <- (p1_hat - p2_hat) / sqrt(p_hat * (1 - p_hat) * (1/n1 + 1/n2))

# Step 4: Calculate the p-value for a one-sided test
p_value <- 1 - pnorm(z_stat)

# Step 5: Display results
cat("Test Statistic (z):", z_stat, "\n")
```

```
## Test Statistic (z): 1.163038
```

```r
cat("p-value:", p_value, "\n")
```

```
## p-value: 0.1224071
```

```r
# Step 6: Decision
alpha <- 0.05
if (p_value <= alpha) {
  cat("Decision: Reject the null hypothesis. There is evidence to suggest that more male students play v
} else {
  cat("Decision: Fail to reject the null hypothesis. There is insufficient evidence to suggest that more
}
```

```
## Decision: Fail to reject the null hypothesis. There is insufficient evidence to suggest that more mal
```

Problem 6

```r
# Given data
n <- 75  # Sample size
x <- 30  # Number of college graduates without insurance
p0 <- 0.281  # Nationwide proportion of adults without insurance

# Step 1: Calculate the sample proportion
p_hat <- x / n

# Step 2: Calculate the z-statistic
z_stat <- (p_hat - p0) / sqrt(p0 * (1 - p0) / n)

# Step 3: Calculate the p-value for a two-sided test
```

```r
p_value <- 2 * (1 - pnorm(abs(z_stat)))  # Multiply by 2 for two-tailed test

# Step 4: Display results
cat("Test Statistic (z):", z_stat, "\n")
```

```
## Test Statistic (z): 2.292767
```

```r
cat("p-value:", p_value, "\n")
```

```
## p-value: 0.0218614
```

```r
# Step 5: Decision
alpha <- 0.05
if (p_value <= alpha) {
  cat("Decision: Reject the null hypothesis. There is evidence that the proportion of college graduates
} else {
  cat("Decision: Fail to reject the null hypothesis. There is insufficient evidence to suggest that the
}
```

```
## Decision: Reject the null hypothesis. There is evidence that the proportion of college graduates wit
```

Problem 7

```r
# Given data
n1 <- 150  # Number of iPhones sold
x1 <- 14   # Number of iPhones returned
n2 <- 125  # Number of Samsung phones sold
x2 <- 15   # Number of Samsung phones returned

# Step 1: Calculate the sample proportions
p1_hat <- x1 / n1
p2_hat <- x2 / n2

# Step 2: Calculate the pooled proportion
p_pool <- (x1 + x2) / (n1 + n2)

# Step 3: Calculate the z-statistic
z_stat <- (p1_hat - p2_hat) / sqrt(p_pool * (1 - p_pool) * (1 / n1 + 1 / n2))

# Step 4: Calculate the p-value for a left-tailed test
p_value <- pnorm(z_stat)

# Step 5: Display results
cat("Test Statistic (z):", z_stat, "\n")
```

```
## Test Statistic (z): -0.7169175
```

```
cat("p-value:", p_value, "\n")
```

```
## p-value: 0.2367125
```

```
# Step 6: Decision
alpha <- 0.05
if (p_value <= alpha) {
  cat("Decision: Reject the null hypothesis. There is evidence that Apple has a smaller chance of being
} else {
  cat("Decision: Fail to reject the null hypothesis. There is insufficient evidence that Apple has a sma
}
```

```
## Decision: Fail to reject the null hypothesis. There is insufficient evidence that Apple has a smalle
```

Problem 8

```
# Load the UsingR package and dataset
library(UsingR)
```

```
## Loading required package: MASS

## Loading required package: HistData

## Loading required package: Hmisc

##
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:base':
##
##     format.pval, units
```

```
data(babies)

# Perform a two-sample t-test to compare mother's age and father's age
t_test_result <- t.test(babies$age, babies$dage)

# Display the test result
t_test_result
```

```
##
##  Welch Two Sample t-test
##
## data:  babies$age and babies$dage
## t = -11.067, df = 2301.5, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -3.962068 -2.769323
## sample estimates:
## mean of x mean of y
##  27.37136  30.73706
```

```r
# Extract p-value and make a decision
p_value <- t_test_result$p.value
alpha <- 0.05

# Print the conclusion
if (p_value <= alpha) {
  cat("Decision: Reject the null hypothesis. The mean age of mothers is significantly different from the
} else {
  cat("Decision: Fail to reject the null hypothesis. There is no significant difference between the mean
}
```

```
## Decision: Reject the null hypothesis. The mean age of mothers is significantly different from the mea
```