# FINAL

# QUESTION 1: Caffeine & Sleep Study

#a.

#The appropriate test to use would be the paired t-test because

# there are two vectors, and each person was tested twice. Meaning

#the vectors create pairs (Caffeine, placebo)

#b.

#Null Hypothesis: There is no difference in reaction time between caffeine and placebo. (mu\_C = mu\_P)

#Alternative Hypothesis: There is a difference in reaction time between caffeine and placebo ( mu\_C != mu\_P)

#c.

# Data Sets:

Reaction\_Caffeine <- c(260, 275, 249, 280, 271, 265, 289, 254, 260, 268, 276, 281, 263, 258,

274, 270, 255, 272, 267, 278)

Reaction\_Placebo <- c(270, 280, 260, 290, 276, 270, 295, 258, 265, 270, 282, 286, 268, 260,

277, 275, 260, 275, 271, 283)

# Running T-test:

t.test(Reaction\_Caffeine, Reaction\_Placebo, paired = TRUE) #Output: Paired t-test

#data: Reaction\_Caffeine and Reaction\_Placebo

#t = -9.668, df = 19, p-value = 9.042e-09

#alternative hypothesis: true mean difference is not equal to 0

#95 percent confidence interval:

#-6.447402 -4.152598

#sample estimates:

#mean difference

#-5.3

#d.

# Results:

#P-Value: 9.042e-09

#Alpha: 0.05

#95% Confidence Interval: -6.447402 -4.152598

#Mean Difference: -5.3

# From the t-test we can conclude that the null hypothesis is invalid, meaning the reaction times between caffeine

# and placebo are different. The mean difference between the two vectors is -5.3 meaning Reaction\_Placebo was higerh

#with an average difference of 5.3 for each par.

# QUESTION 2: Three Teaching Methods

#a.

#The method to use would be One-way ANOVA because we have three independent groups

#b.

# Independence of observations

# Normality within each group

# Homogeneity of variances

#c.

Method <- factor(rep(c("A", "B", "C"), each = 6))

Score <- c(84, 80, 78, 82, 85, 79, 90, 87, 88, 91, 89, 85, 70, 74, 72, 76, 75, 73)

anova\_Result = aov(Score ~ Method)

summary(anova\_Result) # Output: Df Sum Sq Mean Sq F value Pr(>F)

#Method 2 676 338.0 58.95 7.84e-08 \*\*\*

#Residuals 15 86 5.7

#---

#Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

# Result:

# P-Value: 7.84e-08

# Alpha: 0.05

# CONCLUSION

# Since P-Value < Alpha (7.84e-08 < 0.05), one group must differ greatly.

#d.

# Find Group That Differs

TukeyHSD(Anova\_result) # Output: Tukey multiple comparisons of means

#95% family-wise confidence level

#Fit: aov(formula = Exam\_scores ~ method, data = df)

#$method

#diff lwr upr p adj

#Method2-Method1 -9.0 -12.36052 -5.63948 0.0000324

#Method3-Method1 -3.2 -6.56052 0.16052 0.0624803

#Method3-Method2 5.8 2.43948 9.16052 0.0016216

# Using Tukey, we can see a big difference between method2 and method1, with method1 being bigger.

# Method3 is still smaller than method1, but not as much as method2. Method2 is by far the worst method

# and should no be repeated next year. Method1 is the best to continue, method3 can be continue for further data.

#QUESTION 3: BONUS

# Normality

shapiro.test(Score[Method == "A"]) # Output: hapiro-Wilk normality test

#data: Score[Method == "A"]

#W = 0.94009, p-value = 0.6599

shapiro.test(Score[Method == "B"]) # Output: Shapiro-Wilk normality test

#data: Score[Method == "B"]

#W = 0.98259, p-value = 0.9637

shapiro.test(Score[Method == "C"]) #Output: Shapiro-Wilk normality test

#data: Score[Method == "C"]

#W = 0.98259, p-value = 0.9637

# Homogeneity of Variances

library(car)

leveneTest(Score ~ Method) # Output: Levene's Test for Homogeneity of Variance (center = median)

#Df F value Pr(>F)

#group 2 0.6349 0.5436

#15

# CONCLUSTION:

# All p-values are above 0.05 meaning are assumptions for normality and equal variance hold up.

# The results from ANOVA are reliable

# QUESTION 4: SHORT ANSWERS

#a.

#Type 1 error is when you reject null hypothesis when it is actually true,

# and type 2 is when you do not reject null hypothesis when it is false.

# The worst error for medical research would be type 1 because it could lead to

# harmful or ineffective treatment.

#b. The p-value tells us the probability of observing the test statistic assuming

# null hypothesis (mu) is true. The 95% confidence interval tells us the range in

# which the mean lies with 95% conductibility. If confidence interval does not include

# mu, than the proposed mu is significantly incorrect.

# QUESTION 5: Linear Regression

#a.

Score <- c(82, 88, 91, 79, 85, 90, 76, 84, 83, 77)

Hours\_Studied <- c(10, 12, 15, 8, 11, 14, 6, 10, 9, 7)

Attendance <- c(90, 95, 97, 85, 92, 96, 80, 89, 88, 84)

Regression\_model = lm(Score ~ Hours\_Studied + Attendance)

summary(Regression\_model) # Output: Call:

#lm(formula = Score ~ Hours\_Studied + Attendance)

#Residuals:

#Min 1Q Median 3Q Max

#-1.43105 -0.43243 -0.07768 0.57539 1.37359

#Coefficients:

#Estimate Std. Error t value Pr(>|t|)

#(Intercept) 39.8367 19.8259 2.009 0.0845 .

#Hours\_Studied 1.0747 0.5389 1.994 0.0864 .

#Attendance 0.3650 0.2808 1.300 0.2349

#---

#Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

#Residual standard error: 0.9901 on 7 degrees of freedom

#Multiple R-squared: 0.9717, Adjusted R-squared: 0.9636

#F-statistic: 120.2 on 2 and 7 DF, p-value: 3.813e-06

#b.

# Intercept = 39.8367

# Hours\_Studied = 1.0747

# Attendance = 0.3650

# For this study, intercept is the base score (if hour\_studies = 0 and attendance = 0),

# than for every extra hour of studying increase the predicted score by 1.0747 and for

# every 1% increase in attendance increase predicted score by 0.3650.

#c.

#Multiple R-Squared = 0.9717 (97%)

#Adjusted R-Squared = 0.9636 (96%)

# Based on the data this model is a good fit, because the model explains 97% of exam

# variance, and even when adjusted for several predictors it is still 96%.