1.) Number of students in each group:Graphical user interface

Description automatically generated with low confidence

IQ summary per group

Text

Description automatically generated

Age summary per group:

Graphical user interface, text, application

Description automatically generated

Graphical Summaries:

Chart, box and whisker chart

Description automatically generated

Chart, box and whisker chart

Description automatically generated  
Chart, scatter chart

Description automatically generated

2.)

Step 1:

Set up the hypotheses and select the alpha level

* H0:μChemistryIQ=μMathIQ = μPhysicsIQ
* H1: μPhysicsIQ  ≠ μMathIQ or μPhysicsIQ  ≠ μChemistryIQ or μChemistryIQ ≠ μMathIQ
* α=0.05

Step 2: Select the appropriate test statistic

* + F=MSB/MSW

Step 3: k = 3, n = 45

(2, 42) degrees of freedom

α = .05

Decision Rule: Reject H0 if F is greater than or equal to 3.219942

Step 4

585.9/22.1 = 26.5

Text

Description automatically generated

Step 5

Since the F statistic is greater than the f critical value, we reject the null hypothesis that the means of the groups are equal

Tukey: The adjusted p values for two of the comparisons are small

Text

Description automatically generated

3.) Yes the results are the same, the F statistic is greater than the F critical value

Text

Description automatically generated

Text

Description automatically generated

The Beta value of -12.133 is the mean difference between Physics and Chemistry, Physics is less

The Beta value of -8.667 is the mean difference between Math and Chemistry, Math is less

4.) This analysis defines the factors of age and group against IQ. Here the F statistic for group is not greater than the critical value, but age is. Therefore age is the cause for the groups to be unequal, not the categorical subject studied by the individual groups.

Text

Description automatically generated

Least squares means are very similar after adjusting for age:

Text

Description automatically generated with medium confidence

R Code

rm(list=ls()); cat("\014")

#Set directory

setwd("C:/Users/HP/Documents/555")

getwd()

#1

#Import spreadsheet

student = read.csv("student.csv", header = TRUE)

as.data.frame(student)

is.factor(student$group)

student$group = factor(student$group)

is.factor(student$group)

attach(student)

summary(as.factor(student$group))

summary(age)

library(ggplot2)

library(dplyr)

grp\_tbl <- student %>% group\_by(group)

grp\_tbl

age\_tbl <- grp\_tbl %>% summarise(mean(age))

age\_tbl

iq\_tbl <- grp\_tbl %>% summarise(mean(iq))

iq\_tbl

boxplot(iq ~ group, main="IQ", xlab="group", ylab="iq")

boxplot(age ~ group, main="Age", xlab="group", ylab="age")

ggplot(student, aes(age,iq, colour = group)) +

geom\_point()

#2

#f critical value

qf(.95,2,42)

m<- aov(iq~group)

summary(m)

anova(m)

#Tukey

TukeyHSD(m)

#3

#Dummies

Physics <- ifelse(student$group=='Physics', 1, 0)

Math <- ifelse(student$group=='Math', 1, 0)

Chemistry <- ifelse(student$group=='Chemistry', 1, 0)

m2 <- lm(iq ~ Physics+ Math, data=student)

summary(m2)

anova(m2)

#4

#Ancova

install.packages("car")

library(car)

Anova(lm(iq ~ group + age), type=3)

# Least square means

install.packages("emmeans")

library(emmeans)

my.model<-lm(iq~group+age, data = student)

emm\_options(contrasts=c("contr.treatment", "contr.poly"))

emmeans(my.model, specs = "group")