**Question Four (8 Marks)**

Run the following R codes and interpret the out puts

install.packages("lme4")

install.packages("Matrix")

library(lme4)

library(nlme)

library(ggplot2)

library(dplyr)

library(lattice)

library(geepack)

PRlong <- Orthodont

head(Orthodont)

View(Orthodont)

str(PRlong)

dim(PRlong)

PRlong$gender <- ifelse(PRlong$Sex == "Male", "M", "F")

data.frame(PRlong$gender)

PRlong$gender <- ifelse(PRlong$Sex == "Male", "M", "F")

data.frame(PRlong$gender)

tail(PRlong[, c("Subject", "age", "distance", "gender", "Sex")], 20)

PRlong <- PRlong %>% arrange(Subject)

PRlong

PRlong$Sage <- 2 \* PRlong$age + 6

PRlong$Sage.c.8 <- PRlong$age - 8

PRlong$age <- as.factor(PRlong$age)

PRlong$Sgender <- as.factor(PRlong$gender)

PRlong$Subject <- as.factor(PRlong$Subject)

xyplot(distance ~ age | gender, data = PRlong, type = "b", lwd = 2, pch = 19, cex = 1.2, groups = Subject)

dental.grouped <- groupedData(distance ~ age | Subject, outer = ~ gender, data = PRlong)

plot(dental.grouped, display = "subject", outer = TRUE, aspect = 1, key = FALSE,

xlab = "Age", ylab = "Dental Growth (mm)", pch = 19, cex = 0.8,

main = "Potthoff & Roy (1964) Orthodontic Measurements on Children")