MATH1324 Assignment 1

Code ▾

Modeling Body Measurements

Student Details

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Problem Statement

Body Measurement dataset includes 12 body girth measurements and 9 skeletal measurements along with the age, weight and height for 247 Men and 260 Women. The main goal is to analyse the dataset to find the parametric which best fits the normal distribution for both, Male and Female. After examining and investigating all the parametrics included in the dataset, bit.di (Bitrochanteric diameter) appeared as an appropriate choice for the variable of interest. This report discusses two approached, one is QQ Plots and the other is Shapiro Wilk Test to test the normality of the chosen variable.

Load required Packages

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```
library(readxl)
library(ggpubr)
library(ggplot2)
library(dplyr)
```

Importing the Body Measurements Dataset

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```
bdims_csv <- read_excel("./bdims.csv.xlsx", col_types = c("numeric", "numeric", "numeric", "numeric", "numeric","numeric","numeric","numeric", "numeric", "numeric", "numeric", "numeric","numeric", "numeric","numeric", "numeric", "numeric", "numeric", "numeric", "numeric", "numeric","numeric", "numeric", "numeric", "text"))

# change the "sex" column to a factor
bdims_csv$sex <- factor(bdims_csv$sex, levels = c("1.0","0.0"), labels = c("M", "F"))

# filter the data set separately for Male and Female
female_data <- bdims_csv[ which( bdims_csv$sex == "F"), ]
male_data <- bdims_csv[ which( bdims_csv$sex == "M"), ]

# assign Bitochanteric diameter as the variable of interest for Male and Female
female_bitdi = female_data$bit.di
male_bitdi = male_data$bit.di
```

Approach to choose the variable that best fits the normal curve

Shapiro Wilk Test

Shapiro Wilk Test examines the null hypothesis that the underlying distribution of the variable is normally distributed. In order to support our hypothesis we perform Shapiro Wilk Test on the variables of interest. The null hypothesis in this test is that the data is normally distributed. If the p-value is less than 0.05 (alpha value) then the null hypothesis is rejected which means that the data is not normally distributed.

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```
shapiro.test(female_bitdi)
```

```


    Shapiro-Wilk normality test

data:  female_bitdi
W = 0.99679, p-value = 0.8804
```

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```
shapiro.test(male_bitdi)
```

```


    Shapiro-Wilk normality test

data:  male_bitdi
W = 0.99557, p-value = 0.7026
```

As shown above the p-value for female and male bitochanteric diameter is .8804 and .7026 respectively, which means there are 88% and 70% chances that the female and male diameter data is normally distributed. However, a p-value greater than 0.05 does not guarantee that the underlying data is normally distributed. Therefore we use another approach which is more reliable than this test.

QQ Plots

Quantile-Quantile plots are used to determine if the variable follows various theoritical distributions. For eg: Normal Distribution. We use ggqqplot() function from “ggpubr” library to visualize the plot. qqggplot() function internally sorts the variable data i.e Bitochanteric Diameter and plots the quantiles against the standard normal distribution (mean = 0, sd = 1)

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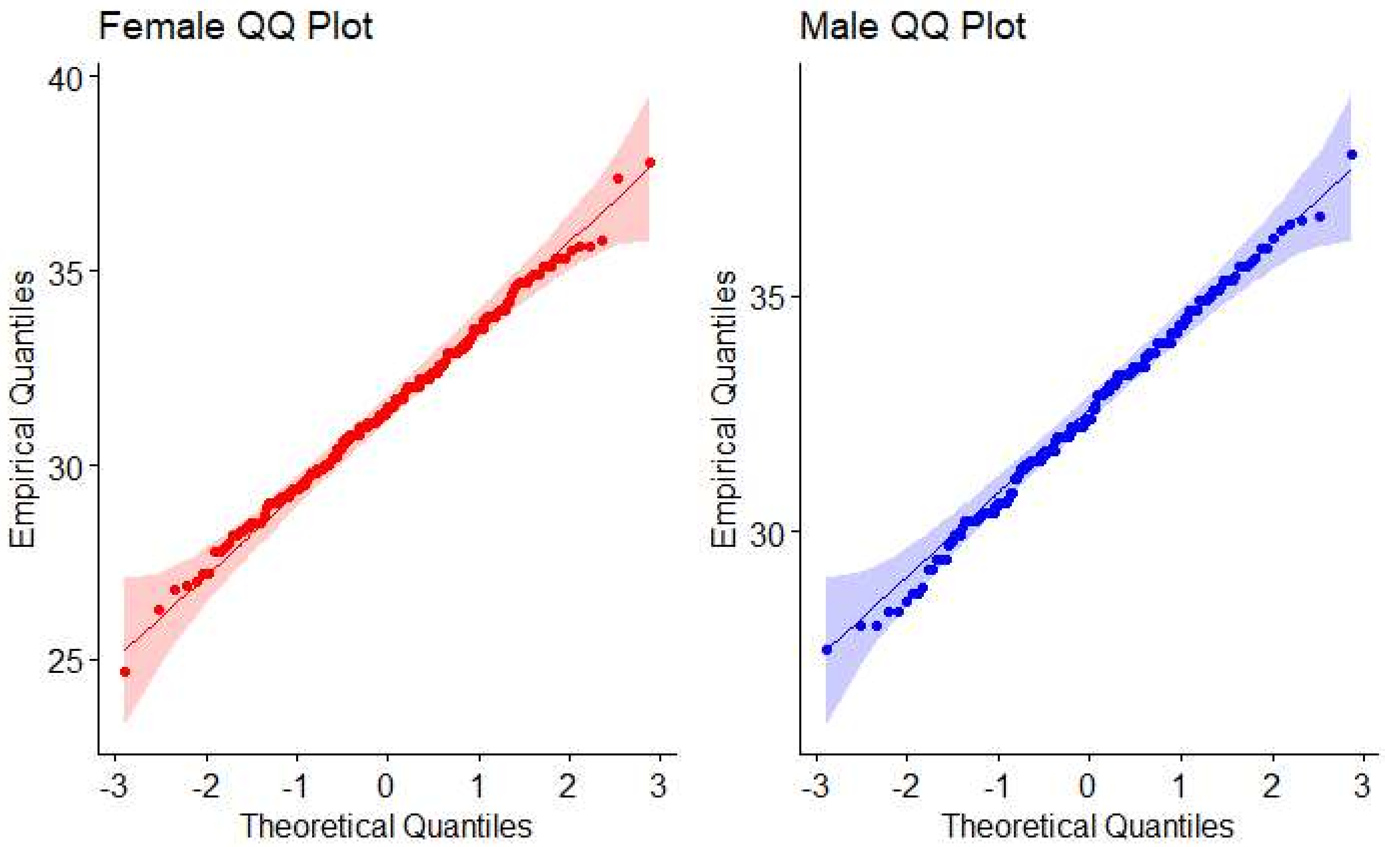
```
female_qqplot <- ggqqplot(female_bitdi, xlab = "Theoretical Quantiles", ylab = "Empirical Quanti
les", title = "Female QQ Plot", color = "red")
male_qqplot <- ggqqplot(male_bitdi, xlab = "Theoretical Quantiles", ylab = "Empirical Quantiles"
, title = "Male QQ Plot", color = "blue")
figure <- ggarrange(female_qqplot, male_qqplot, nrow = 1, ncol = 2)
figure
```



From the above image we can depict that the data points lie almost close to the normal line for both the QQ Plots. Thus, assuming Bitochanteric Diameter is normally distributed is a plausible hypothesis.

Summary Statistics

From the above insights we choose Bitochanteric Diameter as the variable of interest. We calculate descriptive statistics (i.e., mean, median, standard deviation, first and third quartile, interquartile range, minimum and maximum values) for Bitochanteric diameter seperately for Men and Women.

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```
# use summarise() function from 'dplyr' to display the summary statistics grouped by 'sex'
bdims_csv %>% group_by(sex) %>% summarise(Min = min(bit.di), Q1 = quantile(bit.di,probs = .25),
 Median = median(bit.di), Q3 = quantile(bit.di,probs = .75), Max = max(bit.di), Mean = mean(bit.
di), SD = sd(bit.di), IQR = IQR(bit.di))
```

sex <fctr>	Min <dbl>	Q1 <dbl>	Median <dbl>	Q3 <dbl>	Max <dbl>	Mean <dbl>	SD <dbl>	IQR <dbl>
M	27.5	31.4	32.4	33.8	38.0	32.52672	1.865131	2.4

sex	Min	Q1	Median	Q3	Max	Mean	SD	IQR
<fctr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
F	24.7	30.0	31.5	32.9	37.8	31.46154	2.049179	2.9

2 rows

We know that for a perfectly normally distributed data both the mean and median are same. But from the above statistics we can see that for female bit.di Mean is slightly less than Median (~0.04) which indicates that the data is almost normally distributed and for male bit.di Mean is slightly greater than Median (~0.07) which also states that the data is nearly normally distributed.

Distribution Fitting

In order to visualize the extent to which our empirical distribution fits the normal distribution we plot the Histogram for the Bitochanteric diameter with a normal distribution overlay grouped by sex.

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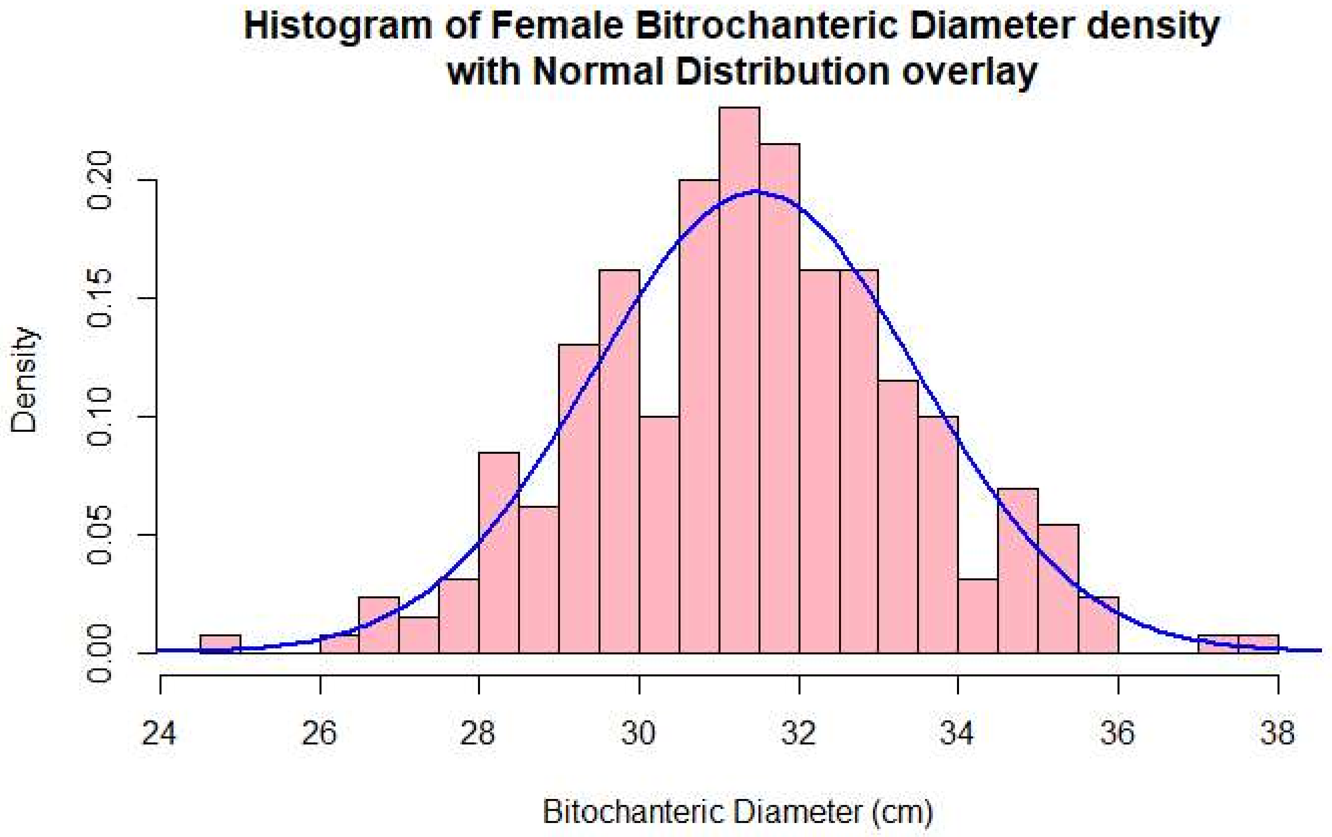
```
normal_var <- seq(20, 40, by=.1)

fig1 <- hist(female_bitdi, freq=F, breaks=20, col="lightpink", xlab = "Bitochanteric Diameter (c
m)", main="Histogram of Female Bitrochanteric Diameter density \n with Normal Distribution overl
ay")
fig1 <- lines(normal_var, dnorm(normal_var, mean(female_bitdi), sd(female_bitdi)), col="blue", l
wd = 2)
```



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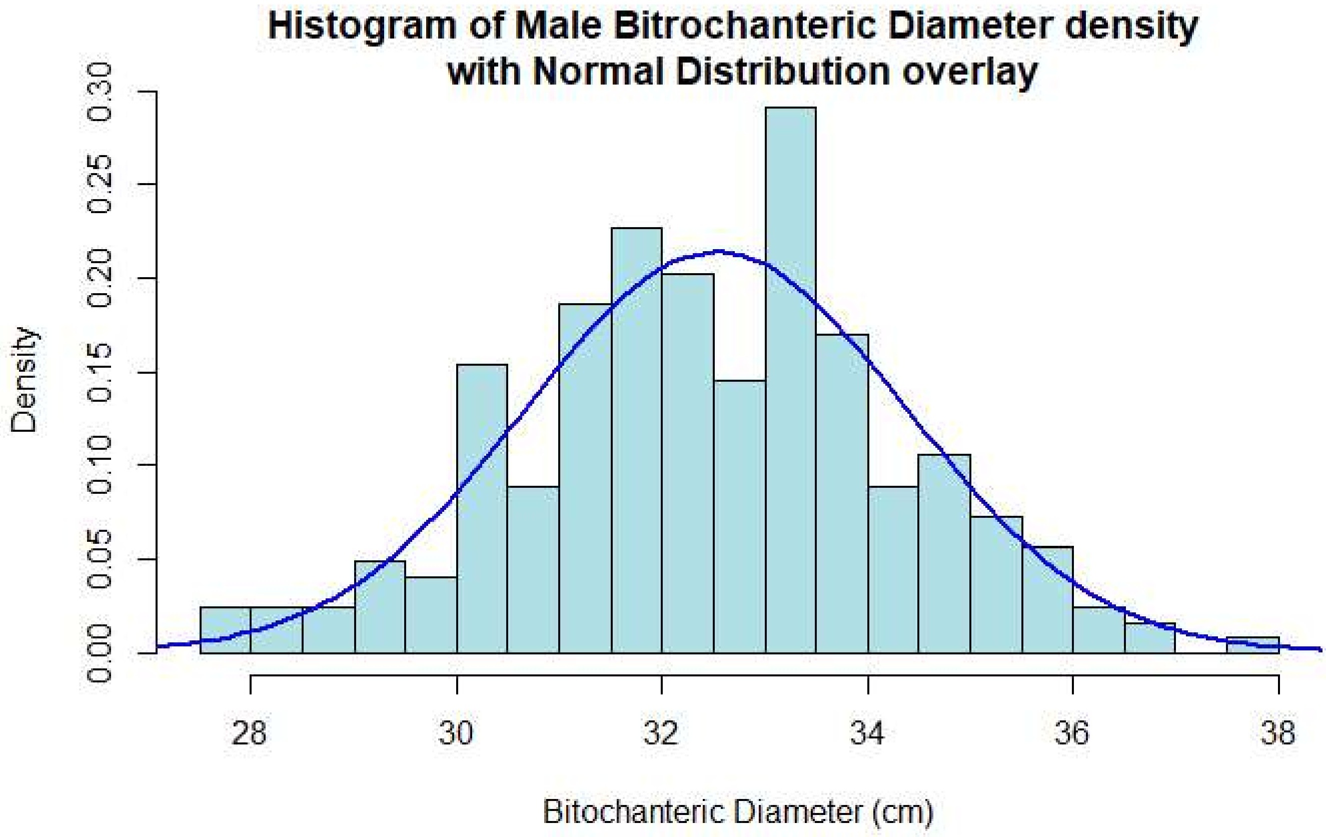
```
fig2 <- hist(male_bitdi, freq=F, breaks=20, col="powderblue", xlab = "Bitochanteric Diameter (c
m)", main="Histogram of Male Bitrochanteric Diameter density \n with Normal Distribution overla
y",)
fig2 <- lines(normal_var, dnorm(normal_var, mean(male_bitdi), sd(male_bitdi)), col="blue", lwd =
2)
```



Interpretation

Looking at the above plots we can visualize that upto certain extent the Histogram densities for both the genders imitates the normal distribution curve. Also, it is clear from the figure that Histogram of the female bit.di is more inclined to follow the Normal distribution than the male bit.di, thus, supporting the Shapiro test result which showed that there are ~88% chances for female bit.di and ~70% chances for the male bit.di to follow the normal curve.