PS1

Applied Stats 1

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Question 1

Section 1

Since number of observations = 25 which is smaller than 30, we will use a t-distribution with df = 24 to calculate confidence interval. We calculate the sample mean, sampling error and t-value to construct the CI.

```r
#Load data
y <- c(105, 69, 86, 100, 82, 111, 104, 110, 87, 108, 87, 90, 94, 113, 112, 98,
    80, 97, 95, 111, 114, 89, 95, 126, 98)
#Calculate lower and upper bound of confidence interval
sampling_mean <- mean(y)
sampling_sd <- sd(y)/sqrt(25)
t_value <- qt((1-0.9)/2 ,lower.tail = FALSE,df = 25 -1 )
CI <- c(sampling_mean - t_value*sampling_sd,sampling_mean + t_value*sampling_
    sd )
```

We have the result for 90% CI

```
93.95993 102.92007
```

Section 2

We follow the 5 step of hypothesis testing:

Step 1: Our assumption is that that the data is randomly selected, the sample is relatively small (25 < 30) and the data is quantitative. And according the the question, this will be an one-sided t-test

Step 2: Setting null and alternative hypothesis
H_0: The school mean $IQ \leq 100$

H_a: The school mean $IQ > 100$

Step 3: Calculating test statistics

```r
sample_mean <- mean(y)

#calculate t-statistic
t = (sample_mean - 100)/(sd(y)/sqrt(25))
```

We have t = -0.596

Step 4: Calculating p-value (in the direction of the alternative hypothesis)

```r
#calculae p-val
pt(t,df = 24,lower.tail = FALSE)
```

We have p-value = 0.72 which is much larger than 0.05.

Step 5: Conclusion
We do not have enough evidence to reject the null hypothesis that the school student's mean $IQ \leq 100$

Question 2

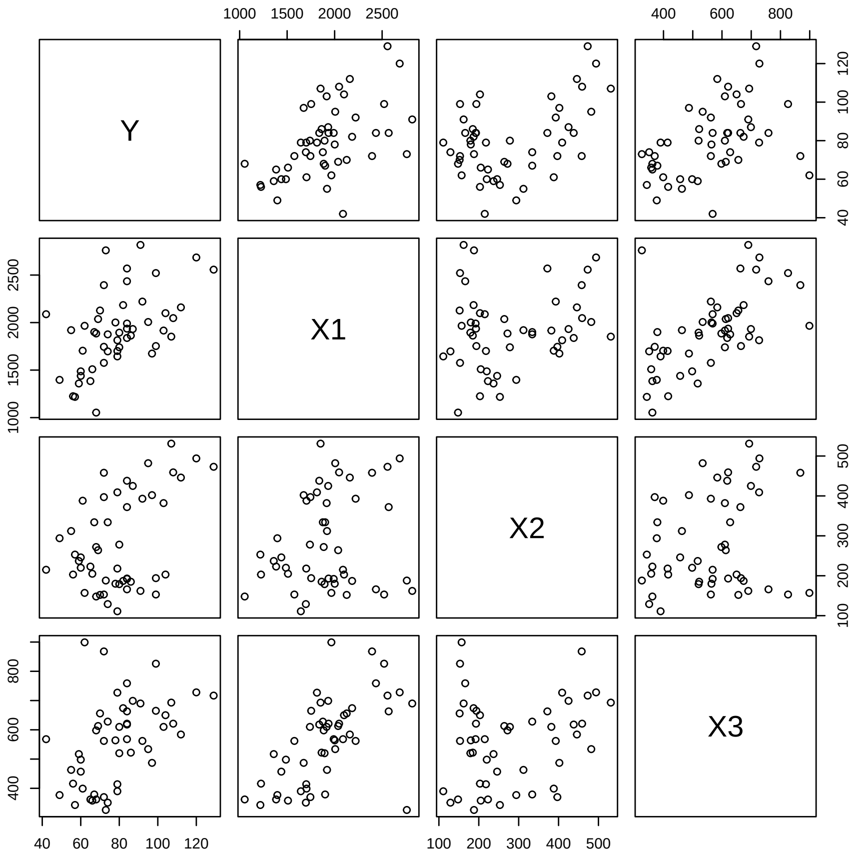
Section 1
We create scatterplot pairwise and examine variables relationship

```r
expenditure <- read.table("https://raw.githubusercontent.com/ASDS-TCD/StatsI_Fall2024/main/datasets/expenditure.txt", header=T)
# scatter plot of X1,X2,X3,Y pairwise
pdf("/Users/tpminh/Desktop/trinity asds/stat analysis 1/ps1/pairplot.pdf")
pairs(expenditure[2:5])
dev.off()
```

As seen from Figures 1:

- X1 and Y seem to be positively correlated, as X1 increases, Y generally increases
- X2 and Y relationship changed as Y increase. When Y is at their lower values, as Y increase X2 decrease. When Y is at their higher values, as Y increase X2 increase
- X3 and Y seem to be positively correlated
- X1 and X2 do not seem to be correlated
- X1 and X3 seem to be positively correlated
- X2 and X3 do not seem to be correlated

Figure 1: Scatterplot between variables.



Section 2

We use boxplot to examine relationship between Y and Region

```
pdf(”/Users/tpminh/Desktop/trinity asds/stat analysis 1/ps1/boxplot.pdf”)
boxplot(expenditure$Y ~ expenditure$Region)
dev.off()
```

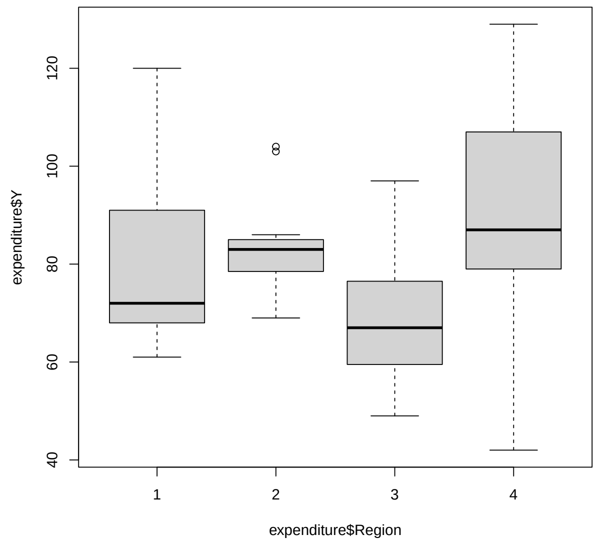
We can see that Region 4 has the highest median expenditures from Figures 2. But just to be sure, lets calculate the actual average of each region

```
aggregate(list(avg_exp = expenditure$Y), list(Region = expenditure$Region),
    FUN=mean)
```

Which give the result:

```
  Region  avg_exp
1      1 79.44444
2      2 83.91667
3      3 69.18750
```

Figure 2: Boxplot of expeniture by region.




```
4        4 88.30769
```

In conclusion Region 4 (West) have the highest expenditure with the highest median and also highest average of 88.3.

Section 3
Lets examine relationship between Y and X1

```
plot( expenditure$X1,expenditure$Y)
```

As seen from Figure 3, there are lot of data points indicate a positive correlation and linear relationship between Y and X1 when X1 increases from roughly 1200 to 1800. From 1800 onward, the positively correlated relationship is much weaker. In the range of X1 from 1800 to 2200, there are a lot of data points with higher Y than in the range X1 larger than 2200

Figure 4 changes the colour and symbol of scatterplot

```
plot( expenditure$X1,expenditure$Y, col = expenditure$Region, pch =
    expenditure$Region)
legend("topleft", c("1","2","3","4"), fill = 1:4)
```

Figure 3: Scatterplot between X1 and Y.

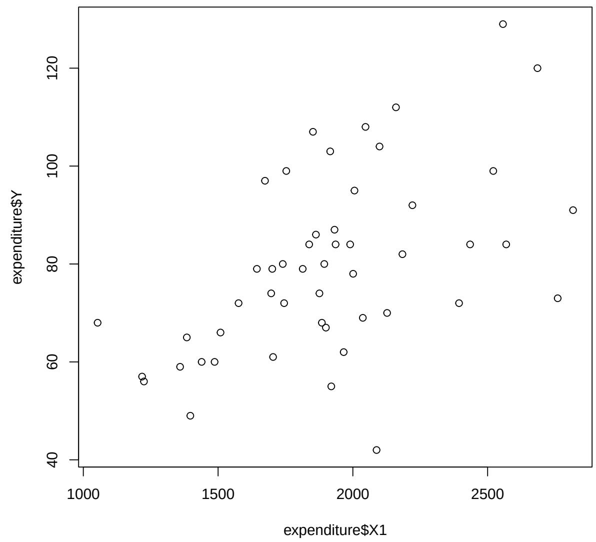


Figure 4: Scatterplot between X1 and Y with new colour and symbol.