	DEPARTMENT OF APPLIED COMPUTING		
UTM UNIVERSITI TEKNOLOGI MALAYSIA	**SUBJECT:** PROBABILITY & STATISTICAL DATA ANALYSIS		
	ASSESSMENT: PROJECT 2	**CODE:** SECI 2143	**WEEK:** -

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PROJECT 2

ANSWERS SHEET

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i. Data Set

mean, var, std Asus
mean, var, std HP
X – RAM size
Y - Price
sum of product xy
sum of x
sum of y
sum of x²
sum of y²

ii. Introduction

We chose our topic to be which computer is the cheapest between two brands. The reason why we choose this is because, since the pandemic, everything is done through the internet and from home, so it necessary for most people who usually use the facilities at their office/school to buy personal computers to do their work. And, since the economy is in a very unstable state, we need to find the cheapest PC among the top PC manufacturers. So, we are interested in conducting tests on this topic to help even ourselves in the future.

The two brands we chose to conduct our tests were ASUS and HP. We'll be testing with reference to the specifications these two brands offer on their computers to the consumers, as well as their prices, and see which one is more affordable (and better) than the other.

iii. Hypothesis 2-Sample Test Analysis

Two brands of laptop are being analysed to determine which of it is cheaper. The price of every laptops from each brand is recorded and the data is shown in Dataset. Our team thought that laptop with brand HP is cheaper than ASUS assuming the variances is equal knowing that the variance is unknown. To proof this hypothesis, we conduct the t-test with $\alpha = 0.05$.

μ_1: Mean of HP laptops' prices

μ_2: Mean of ASUS laptops' prices

The parameters of interest are $\mu 1$ and $\mu 2$, the mean process yield using catalysts 1 and 2, respectively, and we want to know if

$H_0: \mu_1 = \mu_2$

$H_1: \mu_1 < \mu_2$

Given $\alpha = 0.05$. The test statistic is

$$t_0 = \frac{\overline{x_1} - \overline{x_2} - 0}{S_P \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Reject H_0 if $t_0 < -t_{\alpha, n_1 + n_2 - 2}$

$-t_{\alpha, n_1 + n_2 - 2} = -t_{0.05, 430}$

$-t_{0.05, 430} = -1.645$

Reject H_0 if $t_0 < -1.645$

Computation:

$\overline{x_1} = 1067.77, \overline{x_2} = 1104.17, s_1 = 617.51, s_2 = 702.49, n_1 = 274, n_2 = 158$

$$S_P{}^2 = \frac{(n_1 - 1)s_1{}^2 + (n_2 - 1)s_2{}^2}{n_1 + n_2 - 2}$$

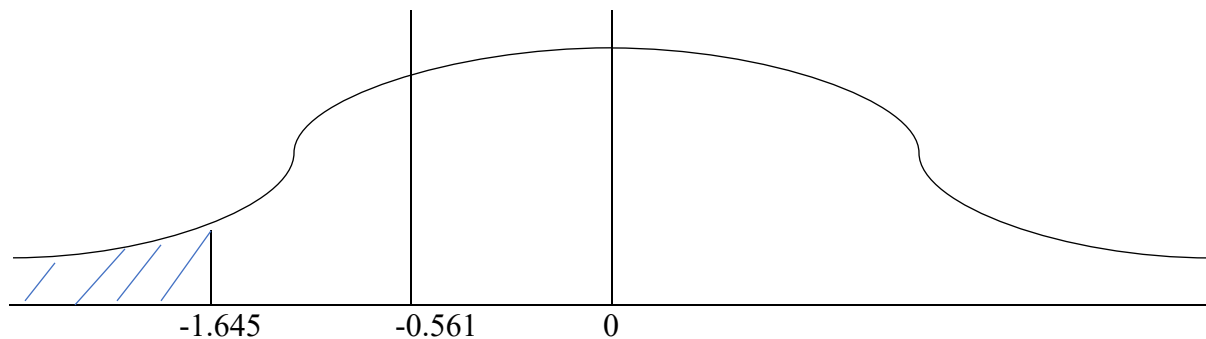$$S_P{}^2 = \frac{(274 - 1)(381316.17) + (158 - 1)(493492.53)}{274 + 158 - 2}$$

$$S_p = \sqrt{\frac{104099314.41 + 77478327.21}{430}}$$

$$S_P = 649.83$$

$$t_0 = \frac{1067.77 - 1104.17 - 0}{649.83\sqrt{\dfrac{1}{274} + \dfrac{1}{158}}}$$

$$t_0 = \frac{-36.4}{64.9139}$$

$$t_0 = -0.561$$

Conclusion:

Since $t_0 > -1.645$, we accept H_0. At the 5% level of significance, we do not have strong evidence to support H_1.


Explanation:

Because we accept the hypothesis where $\mu_1 = \mu_2$, we get to say that both brands provide the laptop with equal price. So, we can say that what our team thought is not true because we don't have evidence whether the HP or ASUS is the cheaper one.

Correlation Analysis

The variables used in this test are the prices of both laptops' brands (ASUS and HP and their respective RAM size of the laptop brands in the sample which can determine the value of the laptop by performance. So, here we can see which brand of laptop is cheaper when we compared it together with its specification. Noted RAM size is in gigabyte (GB) and Laptop price is in Euro.

HP brand
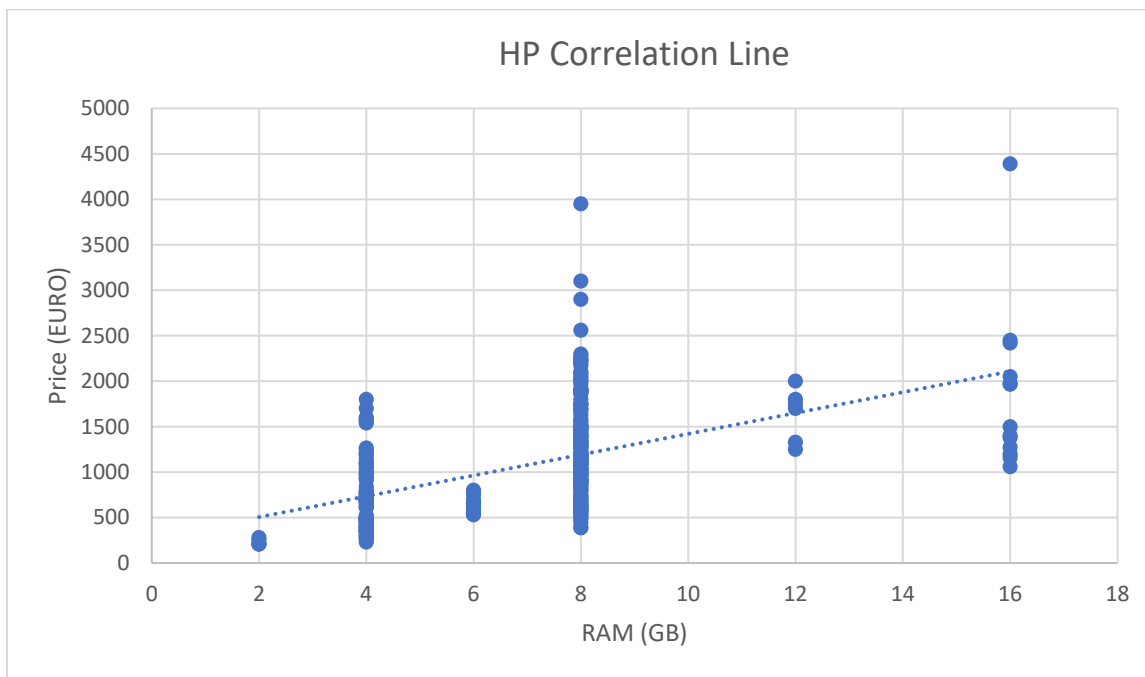
HP Brand r value

$$\Sigma xy = 2285089.2, \Sigma x = 1894, \Sigma y = 292570.31, \Sigma x^2 = 15388, \Sigma y^2 = 416498534, n = 274$$

$$r = \frac{\Sigma xy - (\Sigma x \Sigma y)/n}{\sqrt{\left[(\Sigma x^2) - \frac{(\Sigma x)^2}{n}\right]\left[(\Sigma y^2) - \frac{(\Sigma y)^2}{n}\right]}}$$

$$r = \frac{2285089.2 - (1894)(292570.31)/274}{\sqrt{\left[(15388) - \frac{(1894)^2}{274}\right]\left[(416498534) - \frac{(292570.31)^2}{274}\right]}}$$

$$r = \frac{262{,}723.62649635}{488{,}877.6809640748}$$

$$r = 0.5374$$

We know r = 0.5374 but we still don't know whether there is a linear correlation or not. So, we are doing the significance test to proof this hypothesis with $\alpha = 0.05$.

$H_0: \rho = 0$ (no linear correlation)

$H_A: \rho \neq 0$ (linear correlation exists)

Reject H_0 if $t > t_{\frac{\alpha}{2}, n-2}$ and $t < -t_{\frac{\alpha}{2}, n-2}$

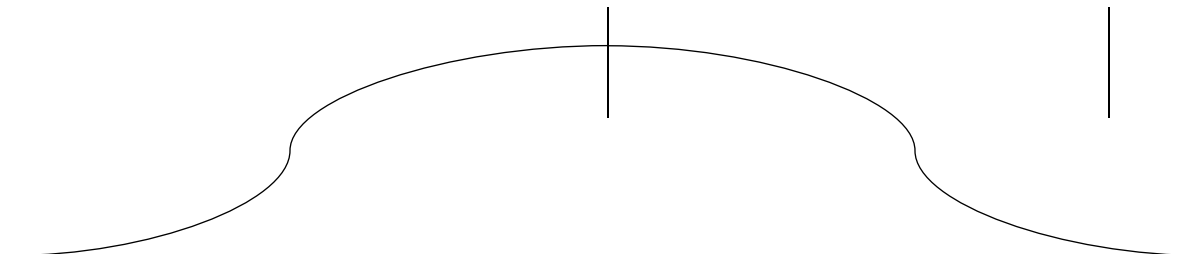$t_{\frac{\alpha}{2}, n-2} = t_{0.025, 272}$

$t_{0.025, 272} = 1.960$

Reject H_0 if $t > 1.960$ or $t < -1.960$
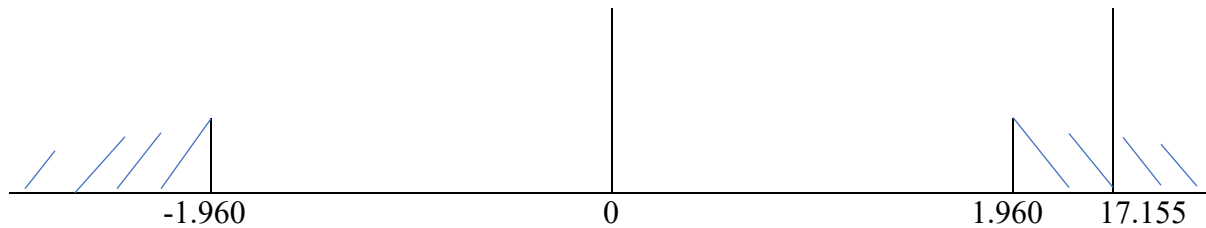
$$t = \frac{r}{\sqrt{\frac{1 - r^2}{n - 2}}}$$

$$t = \frac{0.5374}{\sqrt{\frac{1 - 0.5374^2}{274 - 2}}}$$

$$t = \frac{0.5374}{0.0313263354531745}$$

$$t = 17.155$$
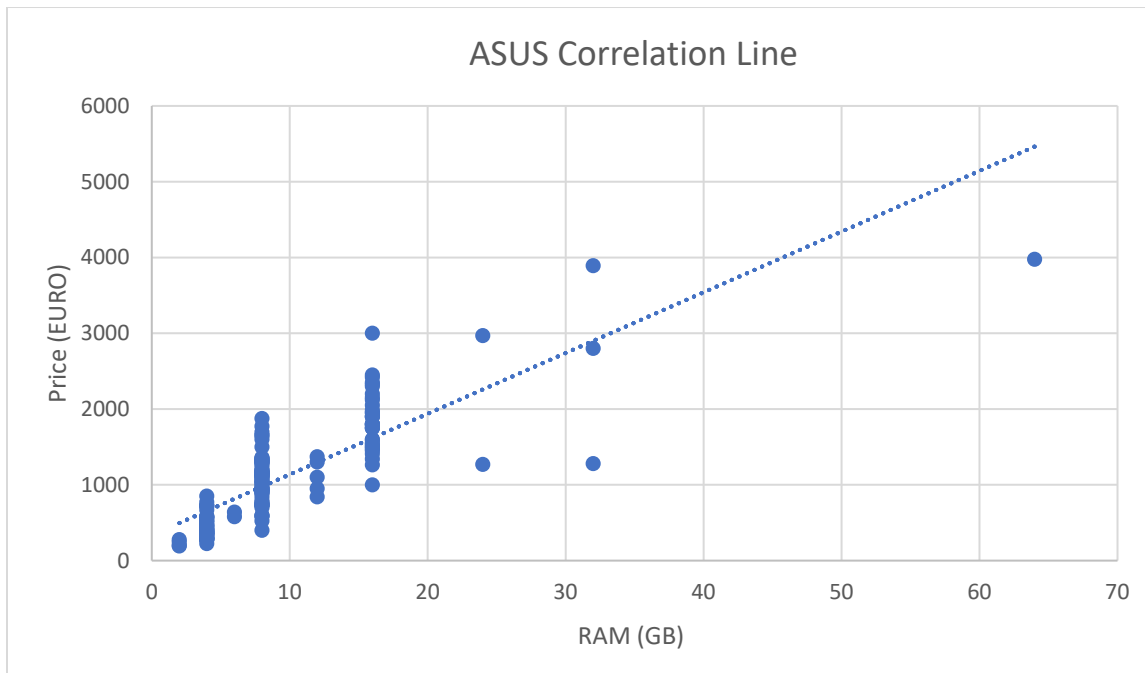
-1.960   0   1.960   17.155

Conclusion:

Since $t > 1.960$, we reject H_0 because there is sufficient evidence of a linear relationship between RAM size and laptop price of HP brands at the 5% level of significance.

Explanation:

The correlation coefficient of HP brands is 0.5374. It shows us that the relationship between RAM size and price of HP brands' laptops is moderate and proof that the price of the laptop is considered affordable with the RAM size that the HP company offered. Because it is a positive correlation, it can be seen that the price increases as the RAM sizes increases.

iv. Correlation
ASUS brands

ASUS Brand r value

$\Sigma xy = 2328261.66, \Sigma x = 1516, \Sigma y = 174458.76, \Sigma x^2 = 22712,$

$\Sigma y^2 = 270110345.1, n = 158$

$$r = \frac{\Sigma xy - (\Sigma x \Sigma y)/n}{\sqrt{\left[(\Sigma x^2) - \frac{(\Sigma x)^2}{n}\right]\left[(\Sigma y^2) - \frac{(\Sigma y)^2}{n}\right]}}$$

$$r = \frac{2328261.66 - (1516)(174458.76)/158}{\sqrt{\left[(22712) - \frac{(1516)^2}{158}\right]\left[(270110345.1) - \frac{(174458.76)^2}{158}\right]}}$$

$$r = \frac{654340.9}{795420.77694}$$

$$r = 0.8226$$

We know r = 0.8226 but we still don't know whether there is a linear correlation or not. So, we are doing the significance test to proof this hypothesis with $\alpha = 0.05$.

$H_0: \rho = 0$ (no linear correlation)

$H_A: \rho \neq 0$ (linear correlation exists)

Reject H_0 if $t > t_{\frac{\alpha}{2}, n-2}$ and $t < -t_{\frac{\alpha}{2}, n-2}$

$t_{\frac{\alpha}{2}, n-2} = t_{0.025, 156}$

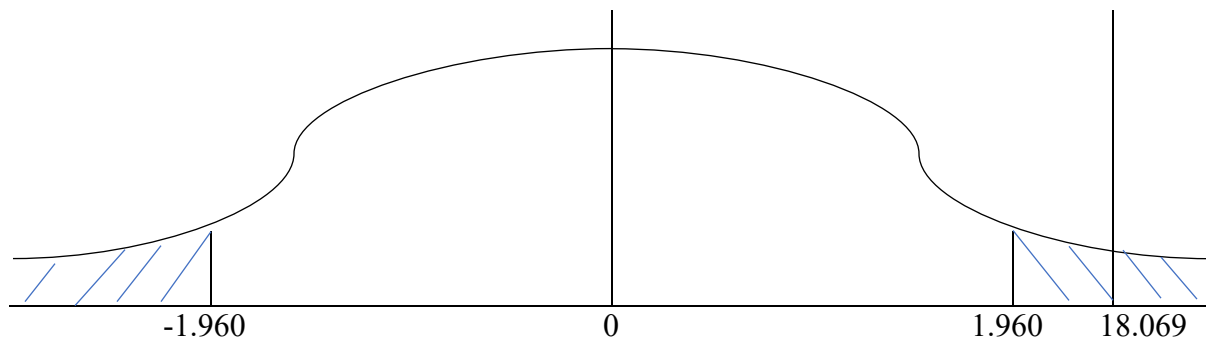$t_{0.025, 156} = 1.960$

Reject H_0 if $t > 1.960$ or $t < -1.960$

$$t = \frac{r}{\sqrt{\frac{1 - r^2}{n - 2}}}$$

$$t = \frac{0.8226}{\sqrt{\frac{1 - 0.8226^2}{158 - 2}}}$$

$$t = \frac{0.8226}{0.0455260731156697}$$

$$t = 18.069$$

Conclusion:

Since $t > 1.960$, we reject H_0 because there is sufficient evidence of a linear relationship between RAM size and laptop price of ASUS brands at the 5% level of significance.

Explanation:

The correlation coefficient of ASUS brands is 0.8226. It shows us that the relationship between RAM size and price of ASUS brands' laptops is strong and proof that the price of the laptop is affordable with the RAM size that the ASUS company offered. Because it is a positive correlation, it can be seen that the price increases as the RAM sizes increases.

Result of the Correlation Analysis:

From the correlation analysis, we can see that the ASUS brand is more affordable than HP brands laptop if we compared it with RAM size offered because the correlation coefficient of ASUS brand

has a greater magnitude than HP brands. So, we can say that the ASUS brand is cheaper than HP brand when we compared the specification of the laptop offered.

v. Regression test

The variables used in this test are the prices of both laptop brands (ASUS and HP) and their respective RAM of the laptop brands in the sample which can determine the value of the laptop by performance.

note: RAM (GB), PRICE (EURO)

ASUS Regression Line:

Asus Price(Euro)

$y = 80.129x + 335.34$
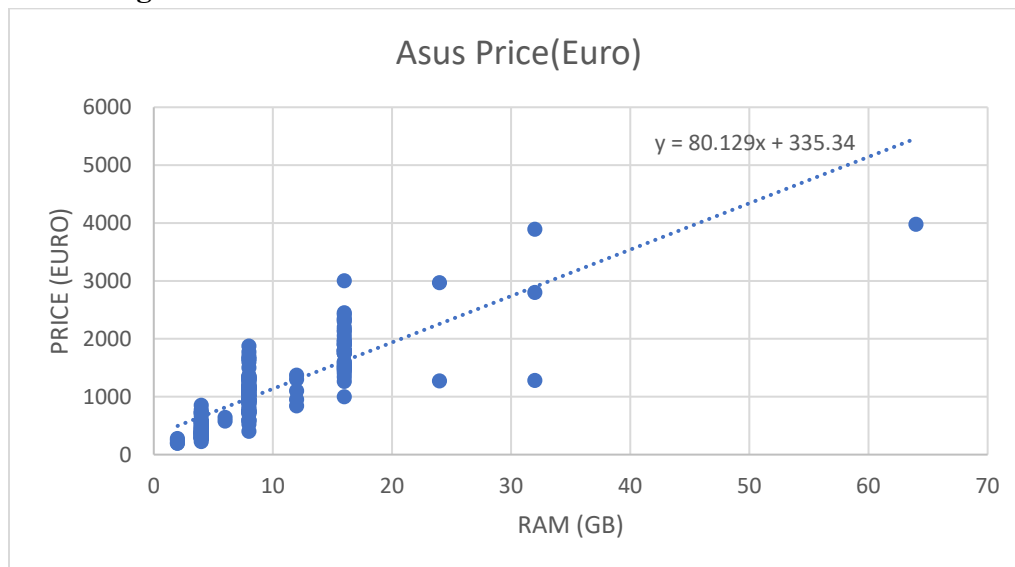
Mean of RAM(x) $= \frac{1516}{158} = 9.59$

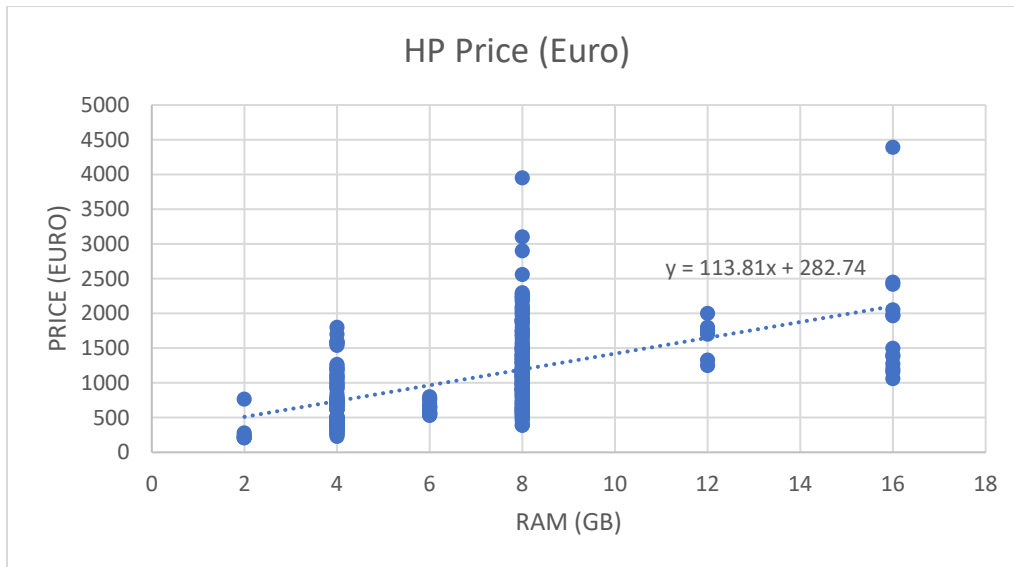Mean of Price(y) $= \frac{174458.76}{158} = 1104.17$

$$b_1 = \frac{2328262 - \frac{1516 \times 174458.76}{158}}{22712 - \frac{1516^2}{158}} = 80.12917$$

$$b_0 = 1104.17 - 9.59 \times (80.12917) = 335.33504$$

$$\hat{y} = 335.33504 + 80.12917x$$

HP Regression Line:

HP Price (Euro)

y = 113.81x + 282.74

Mean of RAM(x)= $\frac{1144}{274}$ = 6.9

Mean of Price(y)= $\frac{155806.98}{274}$ = 1067.77

$b_1 = \frac{1310596 - \frac{1144 \times 155806.98}{274}}{9768 - \frac{1144^2}{274}}$ = 113.81

$b_0 = 1104.17 - 9.59 \times (80.12917) = 282.74$

$\hat{y} = 282.74 + 113.81x$

ASUS R² Value:

SSR = $\sum(\hat{y} - \bar{y})^2$ = 52431569.78

SST = $\sum(y - \bar{y})^2$ = 77478326.5

$R^2 = \frac{SSR}{SST} = \frac{52431569.78}{77478326.5}$ = 0.67

Explanation: 67% of the variation in ASUS laptop prices is explained by variation in RAM. This means that a bit over half of the ASUS laptop prices can be high because the RAM is high and can be low because the RAM is low.

HP R² Value:

SSR = $\sum(\hat{y} - \bar{y})^2$ = 30039145.02

SST = $\sum(y - \bar{y})^2$ = 104099314

$R^2 = \frac{SSR}{SST} = \frac{30039145.02}{104099314}$ = 0.28

Explanation: 28% of the variation in HP laptop prices is explained by variation in RAM. This means that only a few percent of HP laptop prices in the sample are affected by the RAM

size. Therefore, most of the laptops in the sample may have a high price but low RAM which is supported by the scatter plot.

Explanation:

From the ASUS brand scatter plot, we can say that most of the sample taken had 8GB or 16GB of RAM. The 8GB RAM variation of the ASUS laptops range from 400 Euros to just below 2000 Euros whereas the 16GB variation cost between 1000 Euros to above 2000 Euros. ASUS sample has a few outliers.

HP laptops have a wider variation 4GB of RAM, but the prices fall in the same area as the 8GB of RAM laptops from ASUS which is up to 2000 Euros. Prices of ASUS laptops with 4GB RAM only reach up to around 1000 Euros which is a notable difference in price.

Disregarding the other aspects that you might consider from a laptop, ASUS is definitely a better value laptop to buy considering the size of RAM only.

vi. Chi-Square Test of Independence (Association)

The variables used in this test is the price range of both brands. Considering 0.05 significance level.

Hypothesis:

$H_0 = 0$ (There is no association between the price of the laptop and the brand of the laptop)

$H_a \neq 0$ (There is an association between the price of the laptop and the brand of the laptop)

Test Statistic:

Observed:

PRICE (EURO)	ASUS	HP	Total
BELOW 400 EURO	28	28	56
BELOW 600 EURO	21	38	59
BELOW 1000 EURO	30	78	108
BELOW 2000 EURO	64	110	174
ABOVE 2000 EURO	14	20	34
Total	157	274	431

Expected:

PRICE (EURO)	ASUS	HP	Total
BELOW 400 EURO	157*56/431	274*56/431	56
BELOW 600 EURO	157*59/431	274*59/431	59

BELOW 1000 EURO	157*108/431	274*108/431	108
BELOW 2000 EURO	157*174/431	274*174/431	174
ABOVE 2000 EURO	157*34/431	274*34/431	34
Total	157	274	431

PRICE (EURO)	ASUS	HP	Total
BELOW 400 EURO	20.4	35.6	56
BELOW 600 EURO	21.49	37.51	59
BELOW 1000 EURO	39.34	68.66	108
BELOW 2000 EURO	63.38	110.62	174
ABOVE 2000 EURO	12.39	21.61	34
Total	157	274	431

$$x^2 = \frac{(28-20.4)^2}{20.4} + \frac{(28-35.6)^2}{35.6} + \frac{(21-21.49)^2}{21.49} + \frac{(38-37.51)^2}{37.51} + \frac{(30-39.34)^2}{39.34} + \frac{(78-68.66)^2}{68.66} + \frac{(64-63.38)^2}{63.38} + \frac{(110-110.62)^2}{110.62} + \frac{(14-12.39)^2}{12.39} + \frac{(20-21.61)^2}{21.61} = 8.302$$

Critical Value:

$x^2_{df=4,\alpha=0.05} = 9.488$

Graph:
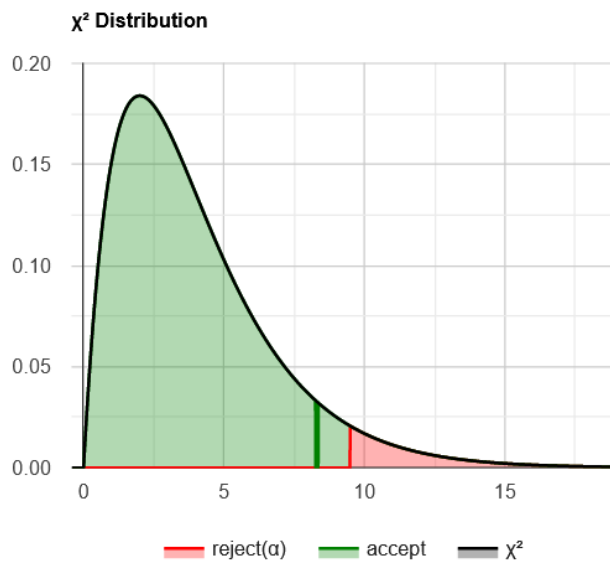
Decision:

8.302<9.488. The test value is smaller than the critical value, thus fails to reject H_0 at $\alpha=0.05$

Conclusion:

There is no evidence of an association between the price of the laptop and the brand of the laptop meaning that both laptops have similar prices within their respective range.

Explanation:

As seen from the graph and tests, we can claim that the association between price and laptop and brands have no relationship, in this case choosing a brand based on the price wouldn't be effective. Therefore, we need to know what we use our laptops for, whether it is for gaming, digital art editing, light/heavy office work. From there, we can choose a brand based on other things such as the monitor refresh rate, CPU, RAM, weight, etc.

vii. Conclusion

After conducting our tests, we concluded that ASUS is more affordable than HP. Simply put, it is because ASUS offers more RAM in their PCs than HP and for a much lower price too, and that is true - HP loves overpricing their products. Practically speaking, the more RAM you have, the better the performance you will get. And so, ASUS wins in this easily, and it is more affordable too.