Part 1 – Hypothesis testing

1.a Null and alternative hypothesis

Problem: Coworker believed that male customers are more loyal customers on average. In the other word, he believed that the mean/average of the male customer is higher than female customer (so this is what the coworker expected – hence this is the alternative hypothesis).

Null Hypothesis (H_0) – Male customers are not more loyal than female customers on average.

Alternative Hypothesis (H_a) - Male customer are more loyal than female customer on average.

1.b Conclusion

Solution: The p-value = 0.1477%. At the 5% significance level, we reject the null hypothesis that the male customers are not more loyal than the female customers and accept the alternative hypothesis that the male customer are more loyal than the female customers.

	1a and 1b			
	Male Tenure	**Female Tenure**		
n	3555	3488	df	7041
Mean	34.12	32.24	t-stat	3.18
Std Dev	25.11	24.46	Two-tailed p-value	0.1477%
			Two-tailed p-value	0.1477%

1.c Null and alternative hypothesis

Problem: Another coworker think that age is related to customer royalty. He believes that male senior citizens and female senior citizens have different level of loyalty on average. On the other word – the mean of senior male tenure and the mean of senior female tenure are different. Hence this is the alternative hypothesis.

Null Hypothesis (H_0) – The mean of senior male tenure and the mean of senior female tenure are the indifferent.

Alternative Hypothesis (H_a) – The mean of senior male tenure and the mean of senior female tenure are different.

1.d Conclusion

Solution: The two tailed p-value = 0.00%. At the 5% significance level, we reject the null hypothesis that the mean of senior male tenure and the mean of senior female tenure are indifferent. And we accept the alternative hypothesis that the mean of senior male tenure and the mean of senior female tenure are different.

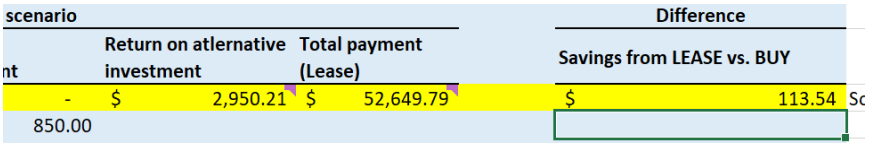
	1c and 1d			
	Senior Male Tenure	**Senior Female Tenure**		
n	574	568	df	1140
Mean	44.05	32.62	t-stat	7.91
Std Dev	24.69	24.14	Two-tailed p-value	0.00%
			Two-tailed p-value	0.00%

Part 2. Modelling

2.a Saving if leasing the car.

The total amount of saving would be $113.54.

I described very carefully each steps and calculations in the comment section of the Excel spreadsheet's comment sections (the purple sign). The reason I did not write the description here is because the question did not ask for explanation specifically.

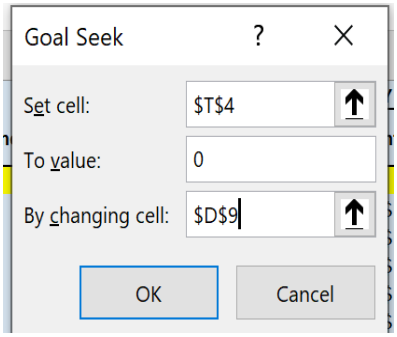


scenario			Difference
nt	Return on atlernative investment	Total payment (Lease)	Savings from LEASE vs. BUY
-	$ 2,950.21	$ 52,649.79	$ 113.54 Sc
850.00			

2.b Minimum monthly lease so buying the car is more attractive.

Problem: So currently, leasing the car is financially more attractive. As car monthly leasing fee increase – leasing a car would be less attractive. Keeping all other model parameter constant, check the minimum monthly lease such that buying the car is financially more attractive.

Hence, I use WHAT-IF ANALYSIS to set the Saving from LEASE VS BUY to 0 – keeping other parameter constant, to check what is the minimum monthly lease such that buying the car is financially more attractive.

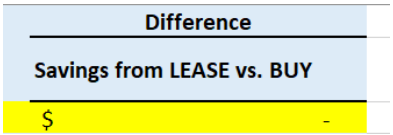


I try to predict how there is not beneficial differences between buying and leasing the car. In the other word, Savings from LEASE AND BUY = 0. I will try to change the monthly leasing payment to achieve this goal.

For Set cell – I set it to the Cell under savings from LEASE vs BUY.

To value is set to 0 –

By changing cell is set to the Monthly payment



Difference
Savings from LEASE vs. BUY
$ -

After running the What-If Analysis, I found out that when monthly leasing payment = $853.15, the saving difference between leasing and buying will be zero.

Monthly payment	$1,048.98	$ 853.15	PMT

If I decrease the monthly lease by 1 cent ($853.14) the total payment for the BUY scenario is $52,763.33 which is still less attractive to the LEASE scenario (which is $52,762.83) by $0.50.

	Buy	Lease	s
Car price	$ 50,000	$ 50,000	
Downpayment (%)	15,000.00		
Residual value		$ 25,000	
Term (years)	3	3	3 years = 36 mont
Interest rate	5%		1 month = 0.4167%
Monthly payment	$1,048.98	$ 853.14	PMT

	BUY scenario					LEASE scenario					Difference
Time	Downpayment	Accumulated c	Interest on d	Monthly payment	Total payment (Buy)	Residual valu	Alternative investr	Lease payment	Return on alternative	Total payment (Lease)	Savings from LEASE vs. BU
0	$ 15,000	$ 35,000			$ 52,763.33	$ 50,000	$ 15,000	$ -	$ 2,950.21	$ 52,762.83	$ 0.50
1		$ 34,096.85	$ 145.83	$1,048.98			$ 15,075.0	$ 853.14			
2		$ 33,189.94	$ 142.07	$1,048.98			$ 15,150.4	$ 853.14			
3		$ 32,279.25	$ 138.29	$1,048.98			$ 15,226.1	$ 853.14			
4		$ 31,364.77	$ 134.50	$1,048.98			$ 15,302.3	$ 853.14			
5		$ 30,446.47	$ 130.69	$1,048.98			$ 15,378.8	$ 853.14			

Hence, I can conclude that the minimum monthly lease such that buying that car is financially more attractive is $853.16 by $0.27 (because at $853.15 there will be no difference between leasing or buying). Higher monthly lease will make the buying scenario even more attractive.

Part 3. Regression Analysis

3.a & 3.b Estimated regression model and interpretation

The estimated regression model is

$$Sales = 120.52 + 65.57\ x\ Macro + 21.77x\ Social\ Media + \varepsilon_i$$

Examination of the estimated coefficient:

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*L*
Intercept	120.52	3.51	34.30	0.00	
Macro	65.57	3.44	19.08	0.00	
Social Media	21.77	0.78	28.00	0.00	

According to the P-value, these two attributes (Macro and Social Media) and the intercepts are statistically significant (P-value = 0.00 for all 3).

1. Intercept: When the other variable (Macro and Social Media) equal 0, the value of the dependent variable Sales would be 120.52. Which make sense because even without any marketing or advertisement, the business still can operate and sell product.
2. Macro: Compared to Nano Influencer, Macro Influencer will generate $65.67 higher on average when holding all other variable constant.
    - When the influence type is Macro, Dummy variable is switched on (=1).
      Sales = 120.52 + 65.67 x 1 = 186.19
    - When the influence type is Nano, Dummy variable is switched off (=0).
      Sales = 120.52 + 65.67 x 0 = 120.52

3. Social media: Holding all the other variable constant, the Social Media (or advertisement) has a positive influence on sale – increased by $21.77 on average.

Estimate	Macro	Nano
Intercept	1	1
Macro	1	0
Social Media	1	1
Average Sales	$207.86	$142.29
Return Gap	46%	
n	1117	1135

As mentioned above, on average, the Macro generate $65.67 higher compared to Nano influencer (207.86 – 142.29 = 65.67). The return gap is about 46%.

3.c Estimated regression model (Macro better)

I construct a new interaction variable which is the interaction between Influence type (Macro) and Social Media.

The regression model is

$$Sales = 119.24 + 68.10\ x\ Macro + 22.16\ x\ Social\ Media - 0.76\ x\ Macro\ x\ Social\ Media + \varepsilon_i$$

	Coefficients	Standard Error	t Stat	P-value	
Intercept	119.24	4.38	27.23	0.00	
Macro	68.10	6.21	10.97	0.00	
Social Media	22.16	1.11	19.89	0.00	
Interaction	-0.76	1.56	-0.49	0.62	

3.d Estimated regression model (Macro better)

Sales = 119.24 + 68.10 x Macro + 22.16 x Social Media - 0.76 x Macro x Social Media + ε_i

1. For Macro (Dummy variable Macro switch on – Macro = 1)

Sales = 119.24 + 68.10 x 1 + 22.16 x Social Media - 0.76 x 1 x Social Media + ε_i

Sales = 119.24 + 68.10 + 22.16 x Social Media - 0.76 x Social Media + ε_i

Sales = 187.34 + 21.40 x Social Media + ε_i

2. For Nano (Dummy variable Macro switch off – Macro = 0)

Sales = 119.24 + 68.10 x 0 + 22.16 x Social Media - 0.76 x 0 x Social Media + ε_i

Sales = 119.24 + 0 + 22.16 x Social Media - 0 + ε_i

Sales = 119.24 + 22.16 x Social Media + ε_i

Interpretation: According to equation above, the slope of the nano influence type is bigger than macro (22.16 >21.40) . Which mean nano has a higher impact on the Sales per advertisement dollar spent compared to macro in a longer run. Initially, the Macro Influencer does provide greater return on sale compared to nano (187.34 > 119.24) – this is what the marketing manager belief. However, in a longer run, where Social Media value get larger, the Nano Influencer Sale model will outperform the Macro Influencer Sale model.

But the p-value of interaction is 0.62 (62%) – which is not very statistically significant. If we look at the model very carefully, the interaction term has an impact of -0.76 x Social media on the Sales for Macro.

$$\text{Sales} = 119.24 + 68.10 + 22.16 \text{ x Social Media} - 0.76 \text{ x Social Media} + \varepsilon_i$$

And, Nano does not have this impact (Macro = 0, 0 x 0.76 x Social Media =0).

$$\text{Sales} = 119.24 + 0 + 22.16 \text{ x Social Media} - 0 + \varepsilon_i$$

If this interaction term is not statistically significant, then we cannot conclude that this new independent variable (interaction) can impact the Sale. Hence, we cannot conclude that there is a correlation between the Influence Type (Macro or Nano) and the return to sale per advertisement dollar spent.

In conclusion, the result does not support the marketing manager belief that Macro Influencer provide a greater return to sales per advertisement dollar spent but it also did not reject it.