Nguyen Khuat Son Tra (48144134)
BUSA6004 – Assignment 1 (Semester 1, 2024)

Question 1:

a/ To begin with, we have the hypothesis states at $\alpha = 0.05$ as follows:

Ho = The actual average content of the bottle is 750 ml.

H1 = The actual average content of the bottle is not 750 ml.

For this question, since the population standard deviation is unknown and the sample size is large enough (40 < 25),, we would use z-test. First, we have the formula for z-value as follow:

$$z = \frac{\overline{x} - \mu}{\frac{s}{\sqrt{n}}}$$

Thus, we have:

$$z = \frac{748.6 - 750}{\frac{2.5}{\sqrt{40}}}$$

$$z \approx -3.5$$

Since this is a two-tailed z-test, we have critical value of z at 95% confidence level is ± 1.96.

Now, as compare: $|-3.52| > 1.96$.

Therefore, we reject the null hypothesis that the actual average content of the bottle is 750 ml at 95% confidence level.

b/ To calculate the Margin of Error (MOE) at 95% confidence level, we follow the formula:

$$MOE = z_{\alpha/2} \times \frac{s}{\sqrt{n}}$$

Thus, we have (checked and computed by Excel):

$$MOE = 1.96 \times \frac{2.5}{\sqrt{40}} \approx 0.7747$$

Next, we construct 95% confidence interval using the formula $(\overline{x} - MOE, \overline{x} + MOE)$ in Excel:

$$Confidence\ Interval \approx (748.6 - 0.7747, 748.6 + 0.7747)$$

$$\approx (747.8, 749.4)$$

After checking, the result from the (a) is still the same. As our computed confidence interval (747.82, 749.39), we can conclude that the actual average content of the bottles is between 747.82 ml to 749.39 ml at 95% confidence level, which the claimed actual average content of the bottles (750ml) falls outside. Thus, we reject the null hypothesis that the actual average content of the bottles is 750ml (95% confidence level).

Question 2:

a/ For this question, since the population standard deviation is unknown and the sample size is small (10 < 25), we would use a t-test with degree of freedom is 9 (n-1 = 10-1).

To begin, we have the formula for the margin of error (MOE) at 95% confidence interval using a t-test as follow: $MOE = t_{\alpha/2} \times \frac{s}{\sqrt{n}}$. Thus, substituting the values, we have:

$$MOE = 2.26 \times \frac{0.60}{\sqrt{10}} \approx 0.4524$$

Next, we construct 95% confidence interval using the formula $(\overline{x} - MOE, \overline{x} + MOE)$:

$$Confidence\ Interval \approx (1.65 - 0.4524, 1.65 + 0.4524)$$

$$\approx (1.2, 2.1)$$

At 95% confidence level, we can conclude that the average weight of the chicken is approximately from 1.2 kg to 2.1 kg.

Thus, it is possibly true that the statement of the chicken establishment, which claims an average weight of 1.8kg. However, this cannot be a definitive conclusion since the confidence interval only provides a range of plausible values for the true average weight and cannot be used to reject the null hypothesis.

b/ To begin with, we have the hypothesis states at $\alpha = 0.05$ as follows:

Ho = The establishment claim is true; its chicken average weight is 1.8 kg.

H1 = The establishment claim is false; its chicken average weight is not 1.8 kg

Since the sample size (n) is 10, which is smaller than 25, we have t-value as follows.

$$t = \frac{\overline{x} - \mu}{\frac{s}{\sqrt{n}}}$$

Thus, we have:

$$t = \frac{1.65 - 1.8}{\frac{0.6}{\sqrt{10}}}$$

$$t \approx -0.79$$

Since this is a two-tailed test, we have critical value of t at 95% confidence level is $\approx \pm 2.26$.

Now, as compare: $|-0.79| < 2.26$.

Thus, as -0.79 falls within the range of ± 2.26 for a two-tailed t-test at a 95% confidence level with 9 degrees of freedom, we fail to reject the null hypothesis that the establishment claim is true; its chicken average weight is 1.8 kg.

c/ Using the p-value approach:

To begin, we have t-value (question 2b) is -0.79. Thus, we have:

$$|t| = 0.79$$

Since this is a two-tailed t-test, we find the cumulative probability at $|t| = 0.79$ in Excel. We have:

$$p\_value \approx 0.45$$

Thus, since this p-value is greater than the significance level ($\alpha = 0.05$), we fail to reject the null hypothesis since the result is not statistically significant to reject the null hypothesis. This result is consistent with our findings from both Question 2(b) and 2(a), where we used the t-critical value comparison and calculated the 95% confidence interval, respectively.

Appendix A: Excel Screenshot

	A	B	C	D	E	F	G	H	I	J	K
1	**Question 1b:**					**Question 2a:**					
2	95% z =	1.96				95% t =	2.26				
3	s =	2.5				s =	0.6				
4	n =	40	(> 25)			df =	9	(< 25)			
5	MOE =	0.7747	=B2*(B3/SQRT(B4))			MOE =	0.4524	=G2*(G3/SQRT(G4))			
6											
7	Construct 95% confidence interval					Construct 95% confidence interval					
8	xbar =	748.6				xbar =	1.65				
9											
10	lower CI	747.8	=B8-B5			lower CI	1.2	=G8-G5			
11	upper CI	749.4	=B8+B5			upper CI	2.1	=G8+G5			
12											
13	**Question 1a:**					**Question 2b:**					
14	95% z =	1.96	=NORM.S.INV(0.975)			95% t =	2.26	=T.INV.2T(0.05,9)			
15	xbar =	748.6				xbar =	1.65				
16		750					1.8				
17											
18	s =	2.5				s =	0.6				
19	n =	40				n =	10				
20	z-value =	-3.5	=(B15-B16)/(B18/SQRT(B19))			t value =	-0.79	=(G15-G16)/(G18/SQRT(G19))			
21											
22						**Question 2c:**					
23						t=	0.79				
24						p-value =	0.45	> 0.05	=T.DIST.2T(G23,G4)		