Practical 8

Interval estimation of a population mean: σ known

1. Construct a 95% confidence interval for the population mean of amount spent per shopping trip in **Lloyd's** departmental store. On the computer, open the **Lloyd's** file on ClickUP in the ***Data files for Practicals*** folder.

   Complete column C as in Figure P1.1 below.
   Type in cell D4: **=COUNT(A2:A101)** which will give the sample size.
   Type in cell D5: **=AVERAGE(A2:A101)** to calculate the sample mean.
   Type in cell D7: **=20** the population standard deviation is **given**.
   The confidence coefficient is 0.95 (type in cell D8: **0.95**).
   The level of significance is 1 – 0.95 = 0.05 (type in cell D9: **=1-D8**).
   Type in cell D11: **=CONFIDENCE.NORM(D9,D7,D4)** to calculate the margin of error $z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$.
   The point estimate for the population mean is the sample mean. Type in cell D13: **=D5.**
   The lower limit of the confidence interval is $\bar{x}$ – (margin of error). So type in cell D14: **=D13 -D11.**
   The upper limit of the confidence interval is $\bar{x}$ + (margin of error). So type in cell D15: **=D13 + D11.**

   Compare your answer with Figure P1.1 and P1.2 below.

Figure P1.1 – Formula sheet

	A	B	C	D
1	**Amount Spent**		**Interval Estimate of a Population Mean**	
2	72		**Population Standard Deviation Known**	
3	91			
4	74		Sample Size	=COUNT(A2:A101)
5	115		Sample Mean	=AVERAGE(A2:A101)
6	71			
7	120		Population Standard Deviation	20
8	37		Confidence Coefficient	0.95
9	96		Level of Significance	=1-D8
10	91			
11	105		Margin of Error	=CONFIDENCE.NORM(D9,D7,D4)
12	104			
13	89		Point Estimate	=D5
14	70		Lower Limit	=D13-D11
15	125		Upper Limit	=D13+D11
16	43			
17	61			

Rows 80 – 101 are hidden

Figure P1.2 – Value sheet

	A	B	C	D
1	**Amount Spent**		**Interval Estimate of a Population Mean**	
2	72		**Population Standard Deviation Known**	
3	91			
4	74		Sample Size	100
5	115		Sample Mean	82
6	71			
7	120		Population Standard Deviation	20
8	37		Confidence Coefficient	0.95
9	96		Level of Significance	0.05
10	91			
11	105		Margin of Error	3.92
12	104			
13	89		Point Estimate	82.00
14	70		Lower Limit	78.08
15	125		Upper Limit	85.92
16	43			
17	61			

Rows 80 – 101 are hidden

Interval estimation of a population mean: σ unknown

2. Construct a 95% confidence interval for the population mean training time for the data in the **Scheer** file. On the computer, open the **Scheer** file on ClickUP in the ***Data files for Practicals*** folder.

   Complete column C as in Figure P4.1 below.
   Type in cell D4: **=COUNT(A2:A21)** which will give the sample size.
   Type in cell D5: **=AVERAGE(A2:A21)** to calculate the sample mean.
   Type in cell D6: **=STDEV(A2:A21)** to calculate the sample standard deviation.
   The confidence coefficient is 0.95 (type in cell D8: **0.95**).
   The level of significance is 1 – 0.95 = 0.05 (type in cell D9: **=1-D8**).
   The degrees of freedom is n-1 so type into cell D10: **=D4-1**.
   The t-value corresponding to the upper tail area of $\alpha/2$ can be calculated by entering the following in cell D11: **=T.INV(D9,D10)**.

   The standard error $\frac{s}{\sqrt{n}}$ can be calculated by entering the following in cell D13: **=D6/SQRT(D4)**.

   The margin of error $t_{\alpha/2}\frac{s}{\sqrt{n}}$ can be calculated by entering the following in cell D14: **=D11*D13.**
   The point estimate for the population mean is the sample mean. Type in cell D16: **=D5.**
   The lower limit of the confidence interval is $\bar{x}$ – (margin of error). So type in cell D17: **=D16 -D14.**
   The upper limit of the confidence interval is $\bar{x}$ + (margin of error). So type in cell D18: **=D16 + D14.**
   Compare your answer with Figure P4.1 and P4.2 below.

Figure P2.1

	A	B	C	D
1	**Days**		**Interval Estimation of a Population Mean**	
2	52		**Using the t Distribution**	
3	44			
4	55		Sample Size	=COUNT(A2:A21)
5	44		Mean	=AVERAGE(A2:A21)
6	45		Standart deviation	=STDEV(A2:A21)
7	59			
8	50		Confidence Coefficient	0.95
9	54		Level of significance (alpha)	=1-D8
10	62		Degrees of Freedom	=D4-1
11	46		t Value	=T.INV.2T(D9,D10)
12	54			
13	42		Standard error	=D6/SQRT(D4)
14	60		Margin of error	=D11*D13
15	62			
16	43		Point Estimate	=D5
17	42		Lower limit	=D16-D14
18	48		Upper limit	=D16+D14
19	55			

Note that we do not divide α by 2. Excel calculates the t value for a two-tailed t distribution.

Figure P2.2

	A	B	C	D	E
1	**Days**		**Interval Estimate of a Population Mean**		
2	52		**Using the t Distribution**		
3	44				
4	55		**Sample size**	20	
5	44		**Mean**	51.5	
6	45		**Standard deviation**	6.840283	
7	59				
8	50		**Confidence Coefficient**	0.95	
9	54		**Level of Significance (alpha)**	0.05	
10	62		**Degrees of Freedom**	19	
11	46		**t Value**	2.093025	
12	54				
13	42		**Standard error**	1.529534	
14	60		**Margin of error**	3.201352	
15	62				
16	43		**Point Estimate**	51.5	
17	42		**Lower limit**	48.29865	
18	48		**Upper limit**	54.70135	
19	55				

3. Excel 2010's **Descriptive Statistics tool** can also be used to compute the margin of error when the t distribution is used. *Detailed instructions in textbook from p.366 and Figure 8.7 on p367.*
   Step 1. Click the **Data** tab on the **Ribbon**
   Step 2. In the **Analysis** group, click **Data Analysis**
   Step 3. Choose **Descriptive Statistics** from the list of Analysis tools
   Step 4. Complete the dialog box as below.

   Click **OK** and the results follow in figure P3.1:
   Figure P3.1

	A	B	C	D
1	*Days*			
2				
3	Mean	51.5		
4	Standard Error	1.529534		
5	Median	53		
6	Mode	44		
7	Standard Deviation	6.840283		
8	Sample Variance	46.78947		
9	Kurtosis	-1.39138		
10	Skewness	0.012059		
11	Range	20		
12	Minimum	42		
13	Maximum	62		
14	Sum	1030		
15	Count	20		
16	Confidence Level(95.0%)	3.201352		
17				

The value of the margin of error apppears in cell D16.

Therefore we can calculate the 95% confidence interval as follow:

$$\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$$

$$51.5 \pm 3.201352$$

$$(48.299, 54.701)$$

4. Assume the following data show a sample of the prescription cost in dollars for Zocor, a drug used to lower cholesterol.

   110 112 115 99 100 98 104 126

   Construct a 90% confidence interval for the population mean cost for prescription of Zocor.

$$\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$$

$$108 \pm 1.895\left(\frac{9.666}{\sqrt{8}}\right)$$

$$(101.524; 114.476)$$

Compare your answer with Figure P4.1 below.

Figure P4.1

	A	B	C	D	E
1	**Training Time**		**Interval Estimate of a Population Mean**		
2	110		**Using the *t* Distribution**		
3	112				
4	115		**Sample size**	8	
5	99		**Mean**	108.00	
6	100		**Standard Deviation**	9.67	
7	98				
8	104		**Confidence Coefficient**	0.9	
9	126		**Level of Significance (alpha)**	0.1	
10			**Degrees of Freedom**	7	
11			***t* Value**	1.895	
12					
13			**Standard Error**	3.42	
14			**Margin of Error**	6.47	
15					
16			**Point Estimate**	108.00	
17			**Lower Limit**	101.53	
18			**Upper Limit**	114.47	
19					

Interval estimation of a population proportion

5. Construct a 95% confidence interval for the population proportion of woman golfers who are satisfied with availability of tea times for the data in the **TeeTimes** file. On the computer, open the **TeeTimes** file on ClickUP in the ***Data files for Practicals*** folder.

Complete column C as in Figure P5.1 below.
Type in cell D3: **=COUNT(A2:A901)** which will give the sample size.
Type in cell D4: **Yes** for response of interest.
Type in cell D5: **=COUNTIF(A2:A901,D4)** to calculate the count of response.
To calculate the sample proportion type in cell D6: **=D5/D3.**
The confidence coefficient is 0.95 (type in cell D8: **0.95**).
The level of significance is 1 – 0.95 = 0.05 (type in cell D9: **=1-D8**).
The z-value corresponding to the upper tail area of $\alpha/2$ can be calculated by entering the following in cell D10: **=NORM.S.INV(**1-D9/2).
The standard error $\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$ can be calculated by entering the following in cell D12: **=SQRT(D6*(1-D6)/D3)**.

The margin of error $z_{\alpha/2}\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$ can be calculated by entering the following in cell D13: **=D10*D12.**
The point estimate for the population proportion is the sample proportion. Type in cell D15: **=D6.**
The lower limit of the confidence interval is $\bar{p}$ – (margin of error). So type in cell D16: **=D15 -D13.**
The upper limit of the confidence interval is $\bar{p}$ + (margin of error). So type in cell D17: **=D15 + D13.**
Compare your answer with Figure P5.1 and P5.2 below.

Figure P5.1

	A	B	C	D	E
1	**Response**		**Interval Estimation of a Population Proportion**		
2	Yes				
3	No		Sample size	=COUNT(A2:A901)	
4	Yes		Response of Interest	Yes	
5	Yes		Count of Response	=COUNTIF(A2:A901,D4)	
6	No		Sample Proportion	=D5/D3	
7	No				
8	No		Confidence Coefficient	0.95	
9	Yes		Level of Significance (alpha)	=1-D8	
10	Yes		z Value	=NORM.S.INV(1-D9/2)	
11	Yes				
12	No		Standard error	=SQRT(D6*(1-D6)/D3)	
13	No		Margin of error	=D10*D12	
14	Yes				
15	No		Point estimate	=D5/D3	
16	No		Lower limit	=D15-D13	
17	Yes		Upper limit	=D15+D13	
18	No				

Note: Rows 19 – 901 are hidden

Figure P5.2

	A	B	C	D	E	F
1	**Response**		**Interval Estimation of a Population Proportion**			
2	Yes					
3	No		**Sample size**	900		
4	Yes		**Response of Interest**	Yes		
5	Yes		**Count of Response**	396		
6	No		**Sample proportion**	0.44		
7	No					
8	No		**Confidence Coefficient**	0.95		
9	Yes		**Level of Significance (alpha)**	0.05		
10	Yes		**z Value**	1.96		
11	Yes					
12	No		**Standard Error**	0.0165		
13	No		**Margin of Error**	0.0324		
14	Yes					
15	No		**Point Estimate**	0.44		
16	No		**Lower Limit**	0.4076		
17	Yes		**Upper limit**	0.4724		
18	No					

Note: Rows 19 – 901 are hidden