Table 3: Lives of 100 Electric Bulbs

511.6	977.7	600.2	1099.7	803.7
923.4	1108.3	906.7	759.6	1111.9
918.3	1051.1	992.5	817.2	665.3
1143.6	848.4	939.8	1163.0	715.2
936.1	750.5	991.2	1199.5	950.2
1161.7	1027.7	995.1	966.5	1146.5
848.0	956.8	1100.0	955.2	1023.0
900.5	982.3	699.2	1069.8	1245.3
1059.5	1091.0	850.7	1219.3	1012.6
1053.2	939.5	777.8	749.6	980.8
1091.3	1016.3	930.4	1242.2	1131.4
1314.7	1137.2	763.1	1294.4	917.3
1204.1	980.1	922.3	1057.7	907.2
808.0	857.7	1127.1	934.3	1262.3
965.4	873.4	955.1	806.5	1033.0
1068.3	950.3	930.6	1000.1	898.5
1293.1	940.9	1293.8	1035.2	706.0
880.9	912.2	803.5	922.6	846.1
1092.3	1182.0	985.2	945.3	835.0
1001.5	1048.8	895.1	1067.2	1062.8

Bins		Frequency	Cummulative Frequency
	510.5	0	0
510.6	590.5	1	1
590.6	670.5	2	3
670.6	750.5	5	8
750.6	830.5	8	16
830.6	910.5	13	29
910.6	990.5	26	55
990.6	1070.5	20	75
1070.6	1150.5	12	87
1150.6	1230.5	6	93
1230.6	1310.5	6	99
1310.6	1390.5	1	100
1390.6		0	100

Table 3: Lives of 100 Electric Bulbs

					Class Boundaries (Bins)	
511.6	977.7	600.2	1099.7	803.7	430.55	510.55
923.4	1108.3	906.7	759.6	1111.9	510.55	590.55
918.3	1051.1	992.5	817.2	665.3	590.55	670.55
1143.6	848.4	939.8	1163.0	715.2	670.55	750.55
936.1	750.5	991.2	1199.5	950.2	750.55	830.55
1161.7	1027.7	995.1	966.5	1146.5	830.55	910.55
848.0	956.8	1100.0	955.2	1023.0	910.55	990.55
900.5	982.3	699.2	1069.8	1245.3	990.55	1070.55
1059.5	1091.0	850.7	1219.3	1012.6	1070.55	1150.55
1053.2	939.5	777.8	749.6	980.8	1150.55	1230.55
1091.3	1016.3	930.4	1242.2	1131.4	1230.55	1310.55
1314.7	1137.2	763.1	1294.4	917.3	1310.55	1390.55
1204.1	980.1	922.3	1057.7	907.2		
808.0	857.7	1127.1	934.3	1262.3		
965.4	873.4	955.1	806.5	1033.0		
1068.3	950.3	930.6	1000.1	898.5		
1293.1	940.9	1293.8	1035.2	706.0		
880.9	912.2	803.5	922.6	846.1		
1092.3	1182.0	985.2	945.3	835.0		
1001.5	1048.8	895.1	1067.2	1062.8		

Bin	*Frequency*
510.55	0
590.55	1
670.55	2
750.55	5
830.55	8
910.55	13
990.55	26
1070.55	20
1150.55	12
1230.55	6
1310.55	6
1390.55	1
More	0

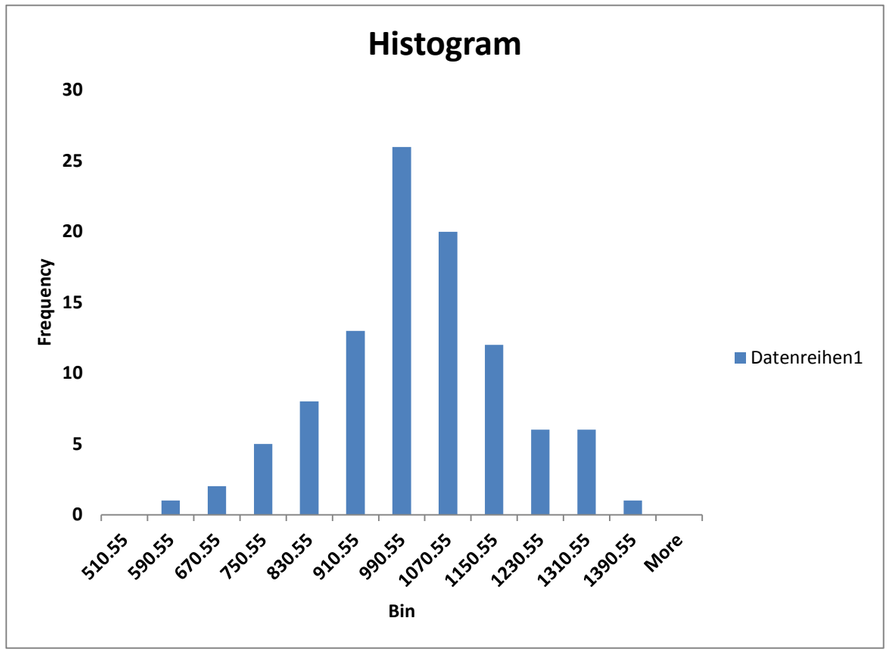


Table 3: Lives of 100 Electric Bulbs

511.6	977.7	600.2	1099.7	803.7
923.4	1108.3	906.7	759.6	1111.9
918.3	1051.1	992.5	817.2	665.3
1143.6	848.4	939.8	1163.0	715.2
936.1	750.5	991.2	1199.5	950.2
1161.7	1027.7	995.1	966.5	1146.5
848.0	956.8	1100.0	955.2	1023.0
900.5	982.3	699.2	1069.8	1245.3
1059.5	1091.0	850.7	1219.3	1012.6
1053.2	939.5	777.8	749.6	980.8
1091.3	1016.3	930.4	1242.2	1131.4
1314.7	1137.2	763.1	1294.4	917.3
1204.1	980.1	922.3	1057.7	907.2
808.0	857.7	1127.1	934.3	1262.3
965.4	873.4	955.1	806.5	1033.0
1068.3	950.3	930.6	1000.1	898.5
1293.1	940.9	1293.8	1035.2	706.0
880.9	912.2	803.5	922.6	846.1
1092.3	1182.0	985.2	945.3	835.0
1001.5	1048.8	895.1	1067.2	1062.8

Class Boundaries (Bins)		Frequency (f)	Average Life In Hours (x)	y=(x-950.5) /80	f*y	f*y2
430.55	510.55	0	470.55	-6	0	0
510.55	590.55	1	550.55	-5	-5	25
590.55	670.55	2	630.55	-4	-8	32
670.55	750.55	5	710.55	-3	-15	45
750.55	830.55	8	790.55	-2	-16	32
830.55	910.55	13	870.55	-1	-13	13
910.55	990.55	26	950.55	0	0	0
990.55	1070.55	20	1030.55	1	20	20
1070.55	1150.55	12	1110.55	2	24	48
1150.55	1230.55	6	1190.55	3	18	54
1230.55	1310.55	6	1270.55	4	24	96
1310.55	1390.55	1	1350.55	5	5	25
More		0	1430.55	6	0	0
		100			**34**	**390**

Based on Grouped Data

μ' =	**0.34**
Mean μ =	**977.75**
Variance σ2 =	**24220.16**
Standard Deviation σ =	**155.63**

Based on Raw Data

CALCULATIONS USING FORMULAS

MEAN	**978.26**
SD	**157.63**
MEDIAN	**972.10**

Income of Four Businesses

Business	Income (in Lakhs)
B1	100
B2	200
B3	300
B4	400

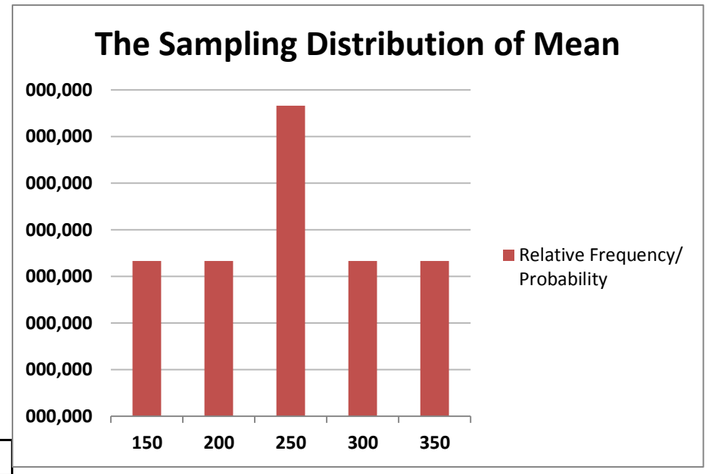
Population	
Mean (μ) =	250
S.D. (σ) =	#NAME?

Sl.No. (i)	Sample Elements	Sample Means $(\bar{x}_i)$
1	B1, B2	150
2	B1, B3	200
3	B1, B4	250
4	B2, B3	250
5	B2, B4	300
6	B3, B4	350

Grand MEAN $\bar{(\bar{X}}_{\bar{}}$ 250
(it is same as population mean)

Sampling distribution of $\bar{X}$

Values of $\bar{X}$	No of Samples yielding this value of mean (Frequency)	Relative Frequency/ Probability $P(\bar{X})$
150	1	0.16667
200	1	0.16667
250	2	0.33333
300	1	0.16667
350	1	0.16667
Total	**6**	**1.00000**



Standard Error of Sample Mean

Sample	Sample Means	For σ2x			Directly using Function
1	150	10000	$\sigma_{\bar{X}}^2$	4166.6667	#NAME?
2	200	2500	$\bar{\sigma}_{\bar{X}}$ =	64.5497	#NAME?
3	250	0			
4	250	0	FPC =	0.8165	
5	300	2500	$\sigma/\sqrt{n}$=	#NAME?	
6	350	10000	$\sigma_{\bar{X}}$ =	#NAME?	
TOTAL		25000			

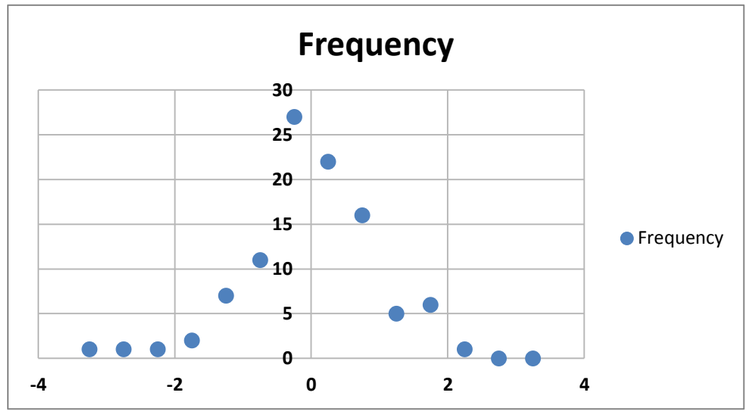
Table 3: Lives of 100 Electric Bulbs

511.6	977.7	600.2	1099.7	803.7
923.4	1108.3	906.7	759.6	1111.9
918.3	1051.1	992.5	817.2	665.3
1143.6	848.4	939.8	1163.0	715.2
936.1	750.5	991.2	1199.5	950.2
1161.7	1027.7	995.1	966.5	1146.5
848.0	956.8	1100.0	955.2	1023.0
900.5	982.3	699.2	1069.8	1245.3
1059.5	1091.0	850.7	1219.3	1012.6
1053.2	939.5	777.8	749.6	980.8
1091.3	1016.3	930.4	1242.2	1131.4
1314.7	1137.2	763.1	1294.4	917.3
1204.1	980.1	922.3	1057.7	907.2
808.0	857.7	1127.1	934.3	1262.3
965.4	873.4	955.1	806.5	1033.0
1068.3	950.3	930.6	1000.1	898.5
1293.1	940.9	1293.8	1035.2	706.0
880.9	912.2	803.5	922.6	846.1
1092.3	1182.0	985.2	945.3	835.0
1001.5	1048.8	895.1	1067.2	1062.8

Z value	z values of lives of electric bulbs				
-3	-2.96	0.00	-2.40	0.77	-1.11
-2.5	-0.35	0.82	-0.45	-1.39	0.85
-2	-0.38	0.46	0.09	-1.02	-1.99
-1.5	1.05	-0.82	-0.24	1.17	-1.67
-1	-0.27	-1.44	0.08	1.40	-0.18
-0.5	1.16	0.31	0.11	-0.07	1.07
0	-0.83	-0.14	0.77	-0.15	0.28
0.5	-0.49	0.03	-1.77	0.58	1.69
1	0.52	0.72	-0.81	1.53	0.22
1.5	0.48	-0.25	-1.27	-1.45	0.02
2	0.72	0.24	-0.30	1.67	0.97
2.5	2.13	1.01	-1.36	2.01	-0.39
3	1.43	0.01	-0.36	0.50	-0.45
	-1.08	-0.76	0.94	-0.28	1.80
	-0.08	-0.67	-0.15	-1.09	0.35
	0.57	-0.18	-0.30	0.14	-0.51
	2.00	-0.24	2.00	0.36	-1.73
	-0.62	-0.42	-1.11	-0.35	-0.84
	0.72	1.29	0.04	-0.21	-0.91
	0.15	0.45	-0.53	0.56	0.54

Bin	*Mean Z*	*Frequency*
-3	-3.25	1
-2.5	-2.75	1
-2	-2.25	1
-1.5	-1.75	2
-1	-1.25	7
-0.5	-0.75	11
0	-0.25	27
0.5	0.25	22
1	0.75	16
1.5	1.25	5
2	1.75	6
2.5	2.25	1
3	2.75	0
More	3.25	0

Sample	
Mean	978.3
SD	157.6326
z value	
Mean	0.0
SD	1



P(A < Z < B)

		P(Z<k)	P(A < Z < B)= P(Z<B)-P(Z<A)
A	-1	#NAME?	
B	1	#NAME?	#NAME?

Problem 3: The t-value calculation

Refer to Figure 5 of Unit 4

	(i)	(ii)	(iii)	(iv)
TOTAL Unshaded area =			0.99	
Shaded area to the right (α)=	0.05			0.01
Number of such shaded areas (tails)	2			2
Total Shaded Area(Probability in two tails)=	0.1	0.05	0.01	0.02
The degree of Freedom (v) =	9	9	9	9
The calculated value of t =	**1.8331**	**2.2622**	**3.2498**	**2.8214**

Problem 4: Calculation of Probability

	(i)	(ii)
Number of Observations (n) =	26	14
The degree of Freedom (v) =	25	13
Given t value =	2.485	1.771
Number of Tails (as you want to equate these values with t table)	1	1
The calculated value of Probability =	**0.01**	**0.05**

Example 4: The claim of manufacturer of fuse

Mean time of sample (x bar)	10.63	10.63	10.63
Standard deviation of the sample (s)	2.48	2.48	2.48
Mean of the population (μ)	12.40	12.40	12.40
Number of observations (n)	20	20	20
The Calculated value of ***t cal*** using the formula	**-3.19**	**-3.19**	**-3.19**
Probaility for the given α (Since two tailed, probability = α×2)	0.100	0.020	0.002
Degrees of freedom	19	19	19
The tabulated value of (in the Left-Tail) ttab	**-1.729**	**-2.539**	**-3.579**
Reject the null hypothesis (claim) if tcal < ttab	**REJECT CLAIM**	**REJECT CLAIM**	**ACCEPT CLAIM**
Let the value for α = 5%, 1%, 0.1%	0.05	0.01	0.001
p-Value for the test (Compare with α and Reject Ho if p<α)	0.002400778		

Example 5: The chi-square value calculation using spreadsheet		
	(i)	(ii)
The value of α =	0.05	0.01
The degree of Freedom (ν) =	5	5
The value of chi-square	**11.070**	**15.086**

Problem 5: Calculating Chi-square using formula and checking it against standard tabulated value		
Size of Random Sample (n) =	20	
The degree of Freedom (ν) =		19
Population variance σ2	1.26E-04	
Sample variance s2 limit	2.00E-04	
Calculated Chi-square value =	**30.16**	
Probability (using Chi-square and ν)		**0.05**

	Tails			
	Left	**Right**	**Left**	**Right**
	5%	5%	2.5%	2.5%
Probability =	95%	5%	97.5%	2.5%
d.f. =	9	9	9	9
Chi Sq =	**3.3251**	**16.9190**	**2.7004**	**19.0228**

Example 6: The probability calculations using F-distribution

	(i)	(ii)
The degree of Freedom (v1) =	40	40
The degree of Freedom (v2) =	30	30
Value of F-variable	1.79	2.3
Probability	**0.050**	**0.010**

Problem 6: Calculation of difference in variance using F-distribution

Size of Random Sample (n1) =	7		7
Size of Random Sample (n2) =	13		13
The degree of Freedom (v1) =	6		6
The degree of Freedom (v2) =	12		12
Value of F-variable	3.00	**TO BE CALCULATED**	**4.82**
Probability (p)	**0.05**		0.01
$\boldsymbol{F_{(1-\alpha,12,6)}=1/F_{(\alpha,6,12)}}$	3		

Data of reading speed of 10 Students before and after taking a course on Reading

Before	9.4	10.3	8.4	6.8	7.8	9.8	9.2	11.2	9.4	9.0
After	9.3	10.6	8.8	7.0	7.7	10.0	9.8	11.7	9.7	9.0

Hypothesis (H0): No difference in the means, that is, there is no difference in students reading abilities after the course

t-Test: Paired Two Sample for Means using Data Analysis…

	Variable 1	*Variable 2*
Mean	9.130	9.360
Variance	1.556	1.834
Observations	10	10
Pearson Correlation	0.986	
Hypothesized Mean Difference	0	
df	9	
t Stat	-3.023	
P(T<=t) one-tail	0.007	
t Critical one-tail	1.833	
P(T<=t) two-tail	**0.014**	
t Critical two-tail	2.262	

t-Test: Paired Two Sample for Means using function ttest(….)

Calculated Significance Level **0.007**

Significance Level α **0.05**

Flower Type	Observed Number (Oi)	Ratio	Probability (pi)	Expected Number (Ei) (=npi)	(Oi - Ei)2/Ei
MG	84	9	0.56	90	0.40
MR	35	3	0.19	30	0.83
RG	28	3	0.19	30	0.13
RR	13	1	0.06	10	0.90
Total	**160**	**16**	**1.00**	**160**	**2.27**
	n				**Calculated U**

Number of Classes	**4**
Degrees of Freedom	**3**
Significance Level α	**0.05**
Chi Square value at α	**7.81**

Hypothesis (H0) **Do not Reject Ho** **"IF(Chi-square at alpha>= calculated U) then Reject Ho else Do not Reject Ho"**

Sales (in 1000 litres)	Upper Limit of the Interval	Observed Frquency (f) of Number of days (Oi)	Mid Point of Interval (x)	y = (x-40)/1.5	y × f	y2 × f	Z-value for upper limit of the Interval	Cummulative One Tailed Probability	Probility for the Interval	Expected Frquency of Number of days (Ei = n × pi)	Modified Observed Frquency (Oi)	(Oi - Ei)2/Ei	Expected Frquency (rounded off)
Less than 34.0	34	0	33.25	-4.5	0.00	0.00	-2.4	0.0082	0.0082	1.6395			2
34.0-35.5	35.5	13	34.75	-3.5	-45.50	159.25	-1.8	0.0359	0.0277	5.5466	7.1861	4.7038	6
35.5-37.0	37	20	36.25	-2.5	-50.00	125.00	-1.2	0.1151	0.0791	15.8279	15.8279	1.0997	16
37.0-38.5	38.5	35	37.75	-1.5	-52.50	78.75	-0.6	0.2743	0.1592	31.8367	31.8367	0.3143	32
38.5-40.0	40	43	39.25	-0.5	-21.50	10.75	0	0.5000	0.2257	45.1494	45.1494	0.1023	45
40.0-41.5	41.5	51	40.75	0.5	25.50	12.75	0.6	0.7257	0.2257	45.1494	45.1494	0.7581	45
41.5-43.0	43	27	42.25	1.5	40.50	60.75	1.2	0.8849	0.1592	31.8367	31.8367	0.7348	32
43.0-44.5	44.5	10	43.75	2.5	25.00	62.50	1.8	0.9641	0.0791	15.8279	15.8279	2.1458	16
44.5-46.0	46	1	45.25	3.5	3.50	12.25	2.4	0.9918	0.0277	5.5466	7.1861	5.3252	6
46.0 or more	More	0	46.75	4.5	0.00	0.00	More	1.0000	0.0082	1.6395			2
	n =	200			-75.00	522.00			**1.0000**	200.0000	**U**	**15.18**	
	a =	40.00			μ' -0.38								
	b =	1.5			μ 39.44								
					Varaince y	2.47							
					Varaince x	5.56							
					SD	2.36							

Estimatd Values of	μ	σ
Computed here	39.44	2.36
Given in the unit	40	2.5
Used in Computations above	40.00	2.50

Number of Classes	**10**
Degrees of Freedom	**7**
Significance Level α	**0.05**
Chi Square value at α	**14.07**
Hypothesis (H0)	**Rejected**

How d.f. is calculated	
Estimation of μ	0
Estimation of σ	0
Pooled classes	2
Total =	2

Method 1

Feature 1 (Imporatance to Price)	Feature 2(Income)						TOTAL	(Oij-Eij)2/Eij		
	Low		Middle		High			Low	Middle	High
	Oi1	Ei1	Oi2	Ei2	Oi3	Ei3				
Great	79	63.58	58	61.2	33	45.22	170	3.7398	0.1673	3.3023
Moderate	48	59.092	65	56.88	45	42.028	158	2.082	1.1592	0.2102
Low	60	64.328	57	61.92	55	45.752	172	0.2912	0.3909	1.8693
TOTAL	187		180		133		500	U	=	13.212

Here, Eij = (Sum of entries of ith row)×(Sum of entries of jth column)/(Total Sample Size)

Number of Rows	**3**
Number of Columns	**3**
Degrees of Freedom = (rows -1) × (column -1)	
Degrees of Freedom	**4**
Significance Level α	**0.02**
Chi Square value at α	**11.67**
Hypothesis (H0)	**Rejected**

Method 2

Feature 1 (Imporatance to Price)	Feature 2(Income)			TOTAL
	Low	Middle	High	
	Oi1	Oi2	Oi3	
Great	79	58	33	170
Moderate	48	65	45	158
Low	60	57	55	172
TOTAL	187	180	133	500
	Ei1	Ei2	Ei3	
Great	63.58	61.2	45.22	
Moderate	59.092	56.88	42.028	
Low	64.328	61.92	45.752	

Calculated P-vlaue	**0.0103**
Significance Level α	**0.02**
Hypothesis (H0)	**Rejected**

Using CHITEST(Actual_range, Expected_Range) function