17-04 Statistics

1, ANOVA

Var 1	
x	x^2
27	729
43	1849
64	4096
62	3844
44	1936
54	2916
57	3249
49	2401
31	961
69	4761
500	26742

Var 2	
x	x^2
63	3969
43	1849
52	2704
58	3364
54	2916
50	2500
65	4225
53	2809
43	1849
49	2401
530	28586

Var 3	
x	x^2
52	2704
60	3600
37	1369
40	1600
23	529
39	1521
55	3025
52	2704
43	1849
39	1521
440	20423

(i) Coractia term:

$$C_x = \frac{\Sigma(x)^2}{n} = \frac{(500 + 530 + 440)^2}{30}$$

$$= \frac{2500^{83}}{30}$$

$$= 8333.3$$

$$= \frac{(1470)^2}{30}$$

$$= \frac{2160900}{30} = 72030$$

(ii) Sum of square total:

$$SST = \Sigma x^2 - C_x$$

$$= 26742 + 28586 + 20422 - 72030$$

$$= 75750 - 72030$$

$$= 3720$$

(iii) Sum of squares among groups:

$$SSA = \frac{\Sigma(x)^2}{n} - C_x$$

$$= \left(\frac{500^2}{10} + \frac{530^2}{10} + \frac{440^2}{10}\right) - 72030$$

$$= (25000 + 28090 + 19360) - 72030$$

$$= 72450 - 72030$$

$$= 420$$

(iv) Sum of squares within groups:

$$SSW = SST - SSA$$

$$= 3720 - 420$$

$$= 3300$$

(v) Mean of sum of squares among groups:

$$M_{SSA} = \frac{SSA}{K-1} \quad \because K = 3$$

$$= \frac{420}{3-1}$$

$$= \frac{420}{2}^{210}$$

$$= 210$$

(vi) Mean of sum of squares within groups

$$M_{SSW} = \frac{SSW}{n-K}$$

$$= \frac{330}{30-3}$$

$$= \frac{330}{27}$$

$$= 12.22$$

(vii) F-Ratio:

$$\frac{M_{SSA}}{M_{SSW}} = \frac{210}{12.22}$$

$$= 17.18$$

Compare F-Ratio with F-Table

Source of Variance	df	SS	Mss	F-Ratio
Among groups	k-1 → 2	420	210	17.18
Within groups	N-k → 27	3300	12.22	

From F-table

2.51061

17.18 is greater than 2.51061 so, reject null Hypothesis and Accept Alternate Hypothesis

6) Given:

$\mu = 15$

$\sigma = 14$

$n = 169$

$H_0 = 15$

$H_a \neq 15$

$\bar{X} = 16$

$\alpha = 0.10$, 90% Confidence level

Solution:

Calculate Z-Value.

$$Z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

$$= \frac{16 - 15}{14/\sqrt{169}}$$

$$= \frac{1}{14/13}$$

$$= \frac{1}{1.076}$$

$Z = 0.929$

	Value of Z
90%	1.64
95%	1.96
99%	2.55

So, for 90% confidence interval 1.64 is a Value of Z

Here, the calculated Z Value $0.929 < 1.64$.

So, the null Hypothesis, H_0 is accepted.

∴ The national average describes the mean Commuting distance for all workers in Newyork area.

5) Given:

$\mu = 105$

$H_0 = 105$

$H_a > 105$

$s = 14$

$n = 25$, $dof = n-1 = 24$

$\bar{x} = 125$

Solution:

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

$$= \frac{125 - 105}{14/\sqrt{25}}$$

$$= \frac{20}{14/5}$$

$$= \frac{20}{2.8}$$

$$t = 7.14$$

From t-table,

The Observed Value between 24, 0.05 is } = 1.711

$7.14 > 1.711$

So, The null Hypothesis is wrong

So reject $H_0 = 105$

Here, the book Enhancement went success.

4) Given:

$\mu = \cancel{100.3}$ 100.83

$\sigma = \sqrt{\text{Variance}}$

$$\text{Variance} = \frac{\sum (x_i - \mu)^2}{n}$$

$$= \frac{(100.5 - 100.83)^2 + (101.3 - 100.83)^2 + (99.5 - 100.83)^2 +}{10}$$

$$\frac{(98.6 - 100.83)^2 + (104 - 100.83)^2 + (103.1 - 100.83)^2 +}{10}$$

$$+ \frac{(100.5 - 100.83)^2 + (99.8 - 100.83)^2 + (98.6 - 100.83)^2}{10}$$

$$+ \frac{(102.4 - 100.83)^2}{10}$$

$$= \frac{-0.1089 + 0.2209 - 1.7689 - 4.9729 + 10.0489 +}{10}$$

$$\frac{5.1529 + 0.1089 - 1.0609 - 4.9729 + 2.4649}{10}$$

$$= \frac{5.0031}{10} = 0.5$$

$\sigma = \sqrt{0.5}$

$\sigma = 0.707$

$n = 10$, $dof = n-1 = 9$, 0.025

$\alpha = 0.05$, $\frac{\alpha}{2} = 0.025$

Solution:

$$\bar{x} - t * \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{x} + t * \frac{\sigma}{\sqrt{n}}$$

$$100.83 - 2.262 * \frac{0.707}{\sqrt{10}} \leq 100 \leq 100.83 + 2.262 * \frac{0.707}{\sqrt{10}}$$

$$98.568 * \frac{0.707}{3.16} \leq 100 \leq 103 * \frac{0.707}{3.16}$$

$$98.568 * 0.22 \leq 100 \leq 103 * 0.22$$

$$21.6 \leq 100 \leq 22.6$$

2) ANOVA

Financial		Energy		Utilities	
x	x^2	x	y^2	x	x^2
10.74	115.7	12.72	161.7	11.88	141.1
15.05	226.5	13.91	193.4	5.86	34.3
17.01	289.3	6.93	41.3	13.46	181.1
5.07	25.7	11.19	125.2	9.9	98.01
19.5	350.2	18.79	353.06	3.95	15.6
8.16	66.5	20.73	429.7	3.44	11.8
10.38	107.7	9.6	92.16	7.11	50.5
6.75	45.5	17.4	302.7	15.7	246.4
92.68	1257.1	110.77	1699.2	71.3	778.81

(i) Correction term:

$$C_x = \frac{\Sigma(x)^2}{n} = \frac{(92.68 + 110.77 + 71.3)^2}{24}$$

$$= \frac{(274.75)^2}{24}$$

$$= \frac{75487.5}{24}$$

$$C_x = 3145.3$$

(ii) Sum of squares total:

$$SST = \Sigma x^2 - Cx$$

$$= 1257.1 + 1699.2 + 778.81 - 3145.3$$

$$= 3735.11 - 3145.3$$

$$SST = 589.81$$

(iii) Sum of squares among groups:

$$SSA = \frac{\Sigma(x)^2}{n} - Cx$$

$$= \left(\frac{(92.68)^2}{24} + \frac{(110.77)^2}{24} + \frac{(71.3)^2}{24}\right) - 3145.3$$

$$= \left(\frac{8589.5}{8} + \frac{12269.9}{8} + \frac{5083.6}{8}\right) - 3145.3$$

$$= (357.8 + 511.2 + 211.81) - 3145.3$$

$$= 1080.81 - 3145.3 = (1073 + 1533 + 635) - 3145.3$$

$$= -2064.49 \qquad = 96$$

(iv) SSW:

$$SSW = SST - SSA$$

$$= 589.81 - 96 + 2064.49$$

$$= 2654.3 \qquad = 493.8$$

(v) M_{SSA}

$$M_{SSA} = \frac{SSA}{K-1}$$

$$= \frac{96}{2}$$

$$= 48$$

(vi) M_{SSW}

$$M_{SSW} = \frac{SSW}{n-K}$$

$$= \frac{493}{21}$$

$$= 23.5$$

(vii) F Ratio:

$$\frac{M_{SSA}}{M_{SSW}} = \frac{48}{23.5}$$

$$= 2.04$$