(1) H_0: There is no significant difference in the variance of the population and sample.

H_1: There is a significant difference in the variance of the population and sample.

V_1	V_1^2	V_2	V_2^2	V_3	V_3^2
27	729	63	3969	52	2704
43	1849	43	1849	60	3600
64	4096	52	2704	37	1369
62	3844	58	3364	40	1600
44	1936	54	2916	23	529
54	2916	50	2580	39	1521
57	3249	65	4225	55	3025
49	2401	53	2809	52	2704
31	961	43	1849	43	1849
69	4761	49	2401	39	1521
500	26742	530	28586	440	20422

Correction Term:

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

$$= 72,030$$

(4) Sum of squares of Total:

$SST = \Sigma x^2 - C_x = 26742 + 28536 + 20422 - 72030.$

$= 3720$

Sum of squares among groups

$SS_A = \frac{(\Sigma x^2)}{N} - C_x$

$\Rightarrow \frac{500^2}{10} + \frac{530^2}{10} + \frac{440^2}{10} - 72030$

$\Rightarrow 25000 + 28090 + 19,360 - 72030$

$\Rightarrow 420.$

Sum of squares within groups.

$SS_W = SS_T - SS_A.$

$= 3720 - 420.$

$\Rightarrow 3300.$

Mean Sum of Squares among groups.

$MSS_A = \frac{SSA}{K-1} \Rightarrow \frac{420}{10-1} \Rightarrow \frac{420}{9}$

$= 46.6667$

Mean Sum of squares within groups

$MSS_W = \frac{SSW}{N-K} \Rightarrow \frac{3300}{30-3} = \frac{3300}{27}$

$\Rightarrow \frac{1100}{9} = 122.2222$

$F\text{ratio} = \frac{MSS_W}{MSS_A} \Rightarrow \frac{122.2222}{46.6667}$

$\Rightarrow 2.619$

Source of variance	df	SS	MSS	F ratio
Among groups	3-1=2	420	46.6667	2.619.
within groups	30-3=27	3300	122.2222	

$d.f\left(\frac{27}{9}, 2\right) = 5.49\ (F_{tab})$.

F_{tab} is greater than F_{cal}. Hence Null hypothesis is accepted. ∴ there is no significant difference between the population variance and sample variance.

(2) H_0: There is no difference in the rate of return for any of the industries

H_1: There is a significance difference in the rate of return for any of the industries.

Finance		Energy		Utilities	
x	x^2	x	x^2	x	x^2
10.76	115.7776	12.72	161.7984	11.88	141.1344
15.05	226.5025	13.91	193.4881	5.86	34.3396
17.01	289.3401	6.43	41.3449	13.46	181.1716
5.07	25.7049	11.19	125.2161	9.9	98.01
19.5	380.25	18.79	353.0641	3.95	15.6025
8.16	66.5856	20.73	429.7329	3.44	11.8336
10.38	107.7444	9.6	92.16	7.11	50.5521
6.75	45.5625	17.4	302.76	15.7	246.49
92.68	1257.4676	110.77	1699.5645	71.3	779.1338

Correction term:

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

$$= 3145.3151$$

Sum of squares of total:

$$SST = \Sigma x^2 - Cx = 1257.4676 + 1699.5645 + 779.1338 - 3145.3151$$

$$= 590.8508$$

Sum of squares among groups

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

$$= \frac{92.68^2}{10} + \frac{110.77^2}{10} + \frac{71.3^2}{10} - 3145.3151$$

$$\Rightarrow 1073.6978 + 1226.9929 + 635.4613 - 3145.3151$$

$$\Rightarrow 7452.6903.$$

Sum of squares within groups:

$$SSW = SS_T - SS_A$$

$$= 7452.6903 - 590.8508$$

$$= 6861.8395.$$

Mean Sum of squares among groups

$$MSS_A = \frac{SSA}{N-1} \Rightarrow \frac{590.8508}{8-1} \Rightarrow$$

$$84.4073$$

$$MSS_W = \frac{SSW}{\text{Total} - K} \Rightarrow \frac{7452.6903}{24-3}$$

$$\Rightarrow 354.89$$

F ratio:

$$\frac{MSS_W}{MSS_A} = \frac{354.89}{84.4073}$$

$$= 4.2045.$$

Source of Variance	df	SS	MSS	F ratio
Among group	8-1=7	7452.6903 ~~84.4073~~	84.4073	4.2045 F_{cal}
within group	24-3=21	6861.8395 ~~354.89~~	354.89	

$df(21, 7) = 3.64 \ (F_{tab})$

H_0 is rejected and H_1 is accepted.

∴ There is a significant difference in the rate of return of industries.

③

H_0: population variance = sample variance

H_1: pop. variance ≠ sample variance

$$F = \frac{S_1^2}{S_2^2} = \frac{0.718}{0.6196}$$

$$= 1.1588$$

$df_1 = 10 - 1 = 9$

$df_2 = 10 - 1 = 9$

$F_{tab} = 5.35$

$F_{cal} = 1.1588$

$F_{tab} > F_{cal}$. So, Null hypothesis is accepted. i.e. the thickness of sheet is not changed due to machine, operator, manufacturing environment, raw material etc.

(6) $H_0: \mu = 100$ $H_1: \mu \neq 100$

mean, $\bar{x} = 100.83$

(+) Standard Deviation, $s = 1.7573$.

$n = 10$

$\nu = 10 - 1 = 9$.

At 95% level, $\alpha = 0.05$ and $\therefore \frac{\alpha}{2}$

$\therefore \frac{\alpha}{2} = 0.025$

$$\bar{x} - t_{n-1, \frac{\alpha}{2}} \frac{s}{\sqrt{n}} \leq \mu \leq \bar{x} + t_{n-1, \frac{\alpha}{2}} \frac{s}{\sqrt{n}}$$

$$100.83 - 2.262 * \frac{1.7573}{\sqrt{10}} \leq \mu \leq 100.83 + 2.262 * \frac{1.7573}{\sqrt{10}}$$

$$100.83 - 2.262 \times \frac{1.7573}{3.1623} \leq \mu \leq 100.83 + 2.262 \times \frac{1.7573}{3.1623}$$

$$100.83 - 1.257 \leq \mu \leq 100.83 + 1.257$$

$$99.573 \leq \mu \leq 102.087$$

The batch mean is 100. The researcher is 95% confident that the average speed of the batch of cars is between 99.573 and 102.087 mph.

(5) $H_0 : \mu = 105$

$H_1 : \mu \neq 105$

$\bar{x} = 125$

$s = 14$

$n = 25$ $\quad d.f = 25 - 1 = 24$

$\alpha = 95\%$

$$t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}} \Rightarrow \frac{125 - 105}{14/\sqrt{25}}$$

$$= \frac{20}{2.8} \Rightarrow 7.1429.$$

$t_{tab} = 2.064.$

$t_{cal} = 7.1429.$

$t_{cal} > t_{tab}$. Hence, the Null hypothesis is rejected and alternate hypothesis is accepted.

Hence, the enhancement of the book is not a success.

6. Null Hypothesis: H_0 $\mu = 13$

Alternate Hypothesis: H_1: $\mu \neq 13$.

where μ is the average commuting distance for all Chicago workers.

Given:

$\bar{X} = 15.5$

$\mu_0 = 13$.

$n = 169$

$\sigma = 13$

$$Z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \Rightarrow \frac{15.5 - 13}{13/\sqrt{169}} = 2.5 > 1.96.$$

$\because$ the calculated value of z is greater than the table value we reject H_0 hypothesis and accept H_1 hypothesis.

$\therefore$ The national average commuting distance does not describe the mean commuting distance for all workers in Chicago area.