Hypothesis Testing of Single mean

(b) When population Variance (σ_p) is Unknown

(i) Population normal & infinite, Sample Size Small: H_a may be one sided or two sided

$$\boxed{t = \frac{\overline{X} - \mu_{H_0}}{\sigma_s / \sqrt{n}}}$$

where $\overline{X}$ = Sample mean

μ_{H_0} = Population mean

σ_s = Sample standard deviation

$$\sigma_s = \sqrt{\frac{\Sigma(X - \overline{X})^2}{n-1}}$$

degree of freedom (df) = $n-1$

(ii) Population normal & finite Sample Size Small
H_a may be one sided or two sided

$$t = \frac{\overline{X} - \mu_{H_0}}{(\sigma_s/\sqrt{n}) \times \left[\sqrt{(N-n)/(N-1)}\right]}$$

with $df = (n-1)$

$$\sigma_s = \sqrt{\frac{\Sigma(X - \overline{X})^2}{n-1}}$$

(eg 1) Prices of Shares of a company on different days in 2 month were found to be :- Rs

572, 545, 575, 570, 580, 565, 568, 571, 572, 592

Test at 5% level of Significance if the price of Shares on an average is Rs 575

Ans

$H_0 : \mu = 575$
$H_a : \mu \neq 575$

Since population variance is unknown and Sample Size is Small as the prices of only 10 day are given hence t- test will be used to Solve the problem

$$t = \frac{\bar{x} - \mu_{H_0}}{\sigma_s / \sqrt{n}}$$

Day	x (Price)	$(x-\bar{x})$	$(x-\bar{x})^2$
1	572	-1	1
2	545	-26	676
3	575	+4	16
4	570	-1	1
5	580	+9	81
6	565	-6	36
7	568	-3	9
8	571	0	0
9	572	+1	1
10	592	+21	441
$\boxed{n=10}$	$\boxed{\Sigma x = 5710}$		$\boxed{\Sigma(x-\bar{x})^2 = 1262}$

$$\bar{X} = \frac{\Sigma x}{n} = \frac{5710}{10} = 571$$

$$\boxed{\bar{X} = 571}$$

$$\sigma_s = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}}$$

$$= \sqrt{\frac{1262}{10-1}} = \sqrt{\frac{1262}{9}}$$

$$\sigma_s = 11.84$$

$$t = \frac{571-575}{11.84/\sqrt{10}} = -1.06$$

Ha is two sided hence tabulated value of t for two sided test at 5% level of significance with (10-1) = 9 degree of freedom is 2.262

$$|\text{calculated } (t)| < |\text{Tabulated } (t)|$$
$$|1.06| < |2.262|$$

therefore null hypothesis accepted that the average share price is Rs 575 (eg)(2) Life of a random Sample of 10 CFL bulbs out of a pack of 50 bulbs Carton Shows the following readings:

Item	1	2	3	4	5	6	7	8	9	10
Life ('000hrs)	3.8	4.5	4.0	4.0	5.3	4.2	3.9	4.5	4.3	5.5

Test at 1% level of Significance if the life of bulbs is 4000 hours

Ans (Hint)

Whole process is Similar only the difference here is the size of population i.e. N = 50 is given so

$$t = \frac{\bar{X} - \mu_{H_0}}{(\sigma_s/\sqrt{n}) \times \left[\sqrt{\left(\frac{N-n}{N-1}\right)}\right]}$$

will be used.

and tabulated value of t at 1%
or (.01) level of Significance with degree of freedom 9 is (3.25) for two Sided test

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(3) An ice-cream vendor has an average sale of Rs 500 per day. Due to establishment of a school in the locality he expects the ice cream sale to increase. The sale for the first two weeks after the start of school are as under:-

547, 507, 550, 613, 490, 580, 570, 460, 595, 585, 530, 526, 549 570.

Can it be ~~[illegible]~~ concluded that the ice-cream vendor's sale have increased? Test at 5% level of significance.