

Calculation

from the given problem, $n=400$, $M=216$, $p_0=q_0=\frac{1}{2}$

let us setup the hypothesis that the coin is unbiased. Also let p be prob. of getting head then acc. to the assumption, the hypothesis are

$$H_0: p=p_0=\frac{1}{2} \text{ v/s } H_1: p \neq p_0(\frac{1}{2})$$

now to test H_0 , we use test statistic?

$$Z = \frac{216 - 400 \times \frac{1}{2}}{\sqrt{400 \times \frac{1}{2} \times \frac{1}{2}}} = 1.6$$

$$Z_{\text{cal}} = 1.6$$

So, at 5% LOS the Z_{tab} is taken from table, $Z_{\text{tab}} = 1.96$

Here, $Z_{\text{cal}}(1.6) < Z_{\text{tab}}(1.96)$, So we accept H_0 means that the coin is unbiased

PRACTICAL-1

29/09/2025

1

Aim: Testing of hypothesis in large sample test

Problem: A coin tossed for 400 times and the head turned up 216 times. Test the hypothesis that the coin is unbiased.

Using formula: To test the hypothesis that the coin is unbiased and let p be the prob. of getting head so we have the hypothesis-
 $H_0: p=p_0=\frac{1}{2} \text{ v/s } H_1: p \neq p_0(\frac{1}{2})$

In this case, to test H_0 , we use test statistic

$$Z = \frac{X - np_0}{\sqrt{np_0q_0}} \sim N(0,1)$$

this is the calculated value of Z if $Z_{\text{cal}} < Z_{\text{tab}}$ then we accept H_0 , otherwise we reject H_0 .

Result: Here, $Z_{\text{cal}}(1.6) < Z_{\text{tab}}(1.96)$, So we accept H_0 , means that the coin is unbiased.

Calculation

from the given problem, $X = 3240$, $n = 9000$, $p = \frac{1}{3}$

Now, test statistic

$$Z = \frac{3240 - 9000 \left(\frac{1}{3}\right)}{\sqrt{9000 \times \frac{1}{3} \times \frac{2}{3}}} = \frac{240}{\sqrt{2000}} = \frac{240}{44.72}$$

$$Z_{cal} = 5.36$$

Since $|Z| > 3$, H_0 is rejected means the die is can't be regarded as unbiased.

To get probable limit we have,

$$\hat{p} \pm 3\sqrt{\hat{p}\hat{q}}, \text{ Here } \hat{p} = \frac{X}{n} = \frac{3240}{9000} = 0.36$$

$$\hat{q} = 1 - 0.36 = 0.64$$

The probable limit for probⁿ of success may be taken as

$$\hat{p} \pm 3\sqrt{\hat{p}\hat{q}} = \hat{p} \pm 3\sqrt{\hat{p}\hat{q}}$$

$$0.36 \pm 3\sqrt{0.36 \times 0.64} = 0.36 \pm 3 \times \frac{0.6 \times 0.8}{2000}$$

$$= 0.36 \pm 0.015$$

Here, the probⁿ of getting 3 or 4 almost certainly lies

b/w 0.345 & 0.375

PRACTICAL - 2

24/09/2025

2

Aim: Testing of hypothesis in large sample test

Problem: A die is thrown 9000 times and a throw of 3 or 4 is observed 3240 times, show that the die can't be regarded as an unbiased one and find the limits b/w which the probⁿ of a throw of 3 or 4 lies.

Theory & formula: Here, we want to test that die is not biased one. Also let p is the probⁿ of getting 3 or 4. So, first we set up the hypothesis

$$H_0: p = p_0 = \frac{1}{3} \text{ vs } H_1: p \neq p_0 \left(\frac{1}{3}\right)$$

To test H_0 , the test statistic is given by

$$Z = \frac{X - np_0}{\sqrt{np_0q_0}} \sim N(0,1)$$

if the Z_{cal} is less than Z_{tab} , then we accept H_0 . otherwise, we reject H_0 .

Now to get the probable limit we have,

$$\left[\hat{p} \pm 3\sqrt{\hat{p}\hat{q}} \right]$$

Result: Since, $|z| > 3$ so we reject H_0
means that the die is biased.

And the possible limit are (0.345 and 0.375)

~~As~~
~~aslo~~

Calculations

The sample proportion for town A

$$\hat{p}_1 = \frac{400}{1000} = 0.4$$

And sample proportion for town B

$$\hat{p}_2 = \frac{450}{900} = 0.5$$

Common proportion \hat{p} is given by

$$\hat{p} = \frac{400 + 450}{1000 + 900} = \frac{850}{1900} = \frac{4}{9} = 0.44$$

$$\hat{q} = 1 - 0.44 = 0.56$$

Now to test H_0 , we use test statistic

$$Z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q}\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}} = \frac{0.4 - 0.5}{\sqrt{0.44 \times 0.56 \left[\frac{1}{1000} + \frac{1}{900}\right]}} = \frac{-0.1}{0.0235}$$

$$Z_{cal} = -4.255 \Rightarrow |Z| = 4.255$$

Now for table, Z_{tab} at 5% LOS is given by

$$Z_{tab} = 1.96$$

So, in this case, $|Z| > 1.96$ so we reject H_0 means that the consumption of wheat in town A & B are not same.

PRACTICAL-3

24/09/25

4

Aim: Testing the hypothesis in large sample test

Problem: In a random sample of 1000 people from town A, 400 are found to be consumers of wheat. In a sample of 900 from town B, 450 are found to be consumers of wheat. Does this data reveal a significant diff. b/w town A & B?

Theory & Formula: Let us set up the hypothesis that the proportion of wheat consumers in two town, say p_1 & p_2 are same. $H_0: p_1 = p_2$ vs $H_1: p_1 \neq p_2$

First, we have calculated sample proportion of wheat consumers in town A is $\hat{p}_1 = \frac{x_1}{n_1}$, similarly $\hat{p}_2 = \frac{x_2}{n_2}$

Now, common proportion of wheat consumer is given by

$$\hat{p} = \frac{x_1 + x_2}{n_1 + n_2} \quad \text{and} \quad \hat{q} = 1 - \frac{x_1 + x_2}{n_1 + n_2}$$

Now to test H_0 , we use test statistic

$$Z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}\hat{q}\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$$

If the value of Z-statistic is less than tabulated value of Z at 5% LOS then we accept H_0 . Otherwise, we reject H_0 .

Result: we have $|Z_{cal}| = 4.255$ & $Z_{tab} = 1.96$ thus $|Z| > 1.96$, so we reject H_0 means that data does not reveal that consumption of wheat in town A & B are same.

Calculation

First of all, we calculate sample mean & S.D. from the following data.

C.I.	f	X-M	fM	fM ²
15.5-20.5	12	18	216	3888
20.5-25.5	22	23	506	11638
25.5-30.5	20	28	560	15680
30.5-35.5	30	33	990	32670
35.5-40.5	16	38	608	23104
			2880	86980

$$\bar{X} = \frac{2880}{100} = 28.8 \text{ years}, \quad S = \sqrt{\frac{1}{N} \sum f(x_i - \bar{X})^2} = \sqrt{\frac{1}{100} \sum f(x_i - \bar{X})^2} = 6.35 \text{ years}$$

Since the sample is large, $\hat{\sigma} \approx S = 6.35$ years. Now to test H_0 ,

$$Z = \frac{28.8 - 30.5}{6.35/\sqrt{100}} = Z = -2.681$$

$$|Z| = 2.681$$

Since, the $|Z_{cal}| = 2.681 >$ the critical value of Z at 5% LOS. So, we reject the hypothesis means the insurance agent is correct.

PRACTICAL - 4

24/11/2015

5

Aim: Testing the hypothesis in large sample test

Problem: An insurance agent has claimed that avg. age of policy holder who insured through him is less than the avg. from all agent which is 30.5 years. A random sample of 100 policy-holders who had insured through him gave the following age distⁿ.

age limit	no. of persons
16-20	12
21-25	22
26-30	20
31-35	30
36-40	16

Calculate mean & S.D. of this distⁿ and then use value to test his claim at 5% LOS.

Theory & formula: First of all, we calculate mean & S.D. from the given distⁿ then we set up the hypothesis i.e. $H_0: \mu = 30.5$ yrs vs $H_1: \mu < 30.5$ yrs.

Now to test H_0 , we apply the test statistic

$$Z = \frac{\bar{X} - \mu_0}{\frac{S}{\sqrt{n}}} \sim N(0,1)$$

where \bar{X} = sample mean
 S = sample S.D.

If the calculated value of Z is less than tabulated value of Z at 5% LOS then we accept H_0 . Otherwise, we reject H_0 .

Result: Since, the $|Z_{cal}| = 2.681 >$ the critical value of Z i.e. $Z > 1.645$ at 5% LOS. So we reject the hypothesis means insurance agent claim is correct.

~~28~~
06/10/25

Calculation

The usual notation, we are given that $n_1 = 1000$, $\bar{x}_1 = 67.5''$
 $n_2 = 2000$, $\bar{x}_2 = 68''$

From the hypothesis, we are given $S.D. = 2.5''$
 Then under H_0 , we have

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sigma \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$Z = \frac{67.5 - 68}{2.5 \sqrt{\frac{1}{1000} + \frac{1}{2000}}} = \frac{-0.5}{0.0968}$$

$$Z = -5.16$$

$$|Z| = 5.16$$

This is calculated value of Z

Now, we have

$|Z| > 3$, so we reject H_0 means that the samples are certainly not from the same population with $S.D. = 2.5''$.

PRACTICAL - 5

8/10/25
9 7

Aim: To test the hypothesis in large sample test

Problem: The mean of 2 single large samples of 1000 & 2000 members are $67.5''$ and $68''$ respectively.

Can samples be regarded as drawn from the same population of $S.D. = 2.5''$ at 5% LOS

Theory & formula: First we set up the null hypothesis

$$H_0: \mu_1 = \mu_2 \text{ and } \sigma = 2.5$$

$$H_1: \mu_1 \neq \mu_2$$

Here, to test H_0 , we use the test statistic

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sigma \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \sim N(0, 1)$$

Here if $|Z| \leq 3$ then we accept H_0 . Otherwise, we reject H_0 .

Result: $|Z|$ calculated = 5.16

$$Z_{\text{tabulated}} = 3$$

Thus, $|Z| > 3$, so we reject H_0 means that the samples are certainly not from the same population with $S.D. = 2.5''$.

Calculations
 is given in excel:

PRACTICAL - 6

27/11/25
 3

Aim: To test the goodness of fit

Problem: The demand for a particular spare part in a factory was found to vary day to day. In a sample study, the following information was obtained

Days:	M	T	W	Th	F	Sat
Demand:	1124	1125	1110	1120	1126	1115

Test the hypothesis that the no. of parts demanded does not depend on the day of week [Given that χ^2 at S.D.O.F. at 5% LOS is 11.07]

Theory & formula: First of all, we set up the hypothesis

H_0 : the no. of parts demanded does not depend on the day of the week

H_1 : the no. of parts demanded does depend on the day of the week

Now in the given case, we are given the observed frequencies

To find the expected frequencies, we have

$$\text{Expected freq. } (E_i) = \frac{\sum O_i}{n}$$

Now here we apply the test statistic

$$\chi^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i}$$

This value is known as calculated value of χ^2 i.e. χ^2_{cal}

Thus, if $\chi^2_{cal} \leq \chi^2_{tab}$ then we accept H_0 .
 otherwise we reject H_0 .

Result: Here, $I^2(\text{cal}) < I^2(\text{bb})$ so we accept H_0
means that the no. of parts demanded does not
depend on the day of the week.

Calculation

we are given that, $\mu = 0.700$ inches, $\bar{x} = 0.742$ inches
 $S = 0.040$ inch and $n = 10$

Test statistic, under H_0 :

$$t = \frac{\bar{x} - \mu}{S/\sqrt{n}} = \frac{0.742 - 0.700}{0.040/\sqrt{10}} = 3.15$$

$$t_{cal} = 3.15$$

Now tabulated value for $(n-1) = 9$ d.o.f. & at 5% LOS is 2.26

So here, $t_{cal}(3.15) > t_{tab}(2.26)$

Thus, we have $t_{cal}(3.15) > t_{tab}(2.26)$. So, we reject H_0 means that the product is not conforming to specifications.

PRACTICAL - 10

12/11/2025

Aim: To test the application based on t-test

Problem: A machinist is making engine parts with axle diameter of 0.7 inch. A random sample of 10 parts show a mean diameter of 0.742 inch with a St. deviation of 0.040 inch. Compute the statistic you would use to test whether the work is meeting the specification. Also state how you would proceed further.

Theory & formula: First of all, we set up the hypothesis.

Null hypothesis (H_0): the product is conforming to specifications ($\mu = 0.7$)
means $H_0: \mu = 0.700$

Alternate: product is not conforming to specifications

$$H_1: \mu \neq 0.700$$

Now to test the hypothesis, we use the test statistic

$$t = \frac{\bar{x} - \mu}{S/\sqrt{n}} = \frac{\bar{x} - \mu}{S/\sqrt{n-1}} \sim t(n-1)$$

This is the value of t calculated

if $t_{cal} < t_{tab}$ then we accept H_0

if $t_{cal} > t_{tab}$ then we reject H_0

t_{tab} can be taken from table at 5% LOS at $(n-1)$ d.o.f.

Result: Here, $t_{cal}(3.15) > t_{tab}(2.26)$. So, we reject H_0 means that the product is not conforming to specifications.

Calculation

we find \bar{x} , s^2

X	$X - \bar{x}$	$(X - \bar{x})^2$
70	-27.2	739.84
120	27.8	772.84
110	17.8	316.44
101	8.8	77.44
88	-7.2	51.84
83	-12.2	148.84
95	-2.2	4.84
107	9.8	96.04
100	2.8	7.84
972		1833.6

Here, $n = 10$, $\bar{x} = \frac{972}{10} = 97.2$, $s^2 = \frac{1833.6}{9} = 203.73$

$$|t| = \frac{97.2 - 100}{\sqrt{203.73/10}} = \frac{2.8}{4.514} = 0.62$$

t_{tab} is 2.26

& t_{cal} is 0.62

Here, we have $t_{\text{cal}}(0.62) < t_{\text{tab}}(2.26)$. So we accept H_0
 means that the data are consistent with assumption of mean IQ of 100 in poplⁿ

PRACTICAL-11

12/11/2025

Aim: To test application based on t-distribution

Problem: A random sample of 10 boys had the following I.Q's:

70, 120, 110, 101, 88, 83, 95, 98, 107, 100. Do these data support the assumption of a poplⁿ mean I.Q. of 100? ~~And~~ this is a ~~testable~~ range in which most of the mean I.Q. values of samples of 10 boys lie.

Theory & Formula: First of all we set up Null hypothesis

H_0 : The data are consistent with assumption of mean I.Q. of 100 in poplⁿ i.e., $\mu = 100$

H_1 : $\mu \neq 100$

Now to test hypothesis, we use test statistic

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} \sim t_{(n-1)}$$

This is value of t_{cal}

if $t_{\text{cal}} < t_{\text{tab}}$ then we accept H_0 . otherwise we reject H_0 .

t_{tab} can be taken from table at 5% L.O.S at $n-1$ d.o.f

Result: Here, $t_{\text{cal}}(0.62) < t_{\text{tab}}(2.26)$. So, we accept

H_0 means that the data are consistent with assumption of mean I.Q. of 100 in poplⁿ

Calculations

we find Sample mean & S.D.

x	70	67	62	68	61	68	70	64	64	66	Total = 660
x - \bar{x}	4	1	-4	2	-5	2	4	-2	-2	0	0
(x - \bar{x}) ²	16	1	16	4	25	4	16	4	4	0	90

$$\bar{x} = \frac{\sum x}{n} = \frac{660}{10} = 66$$

$$S^2 = \frac{1}{n-1} \sum (x - \bar{x})^2 = \frac{90}{9} = 10$$

Test Statistic under H_0 is

$$t = \frac{66 - 64}{\sqrt{10/10}} = 2$$

which follows (10-1) = 9 d.o.f.

Since, $t_{cal}(2) > t_{tab}(1.83)$, we reject H_0 means that the avg. height is greater than 64 inches.

PRACTICAL-12

12/11/2025

Aim: To test application based on t-distribution

Problem: The heights of 10 males of a given locality are found to be 70, 67, 62, 68, 61, 68, 70, 64, 64, 66 inches. Is it reasonable to believe that the avg. height is greater than 64 inches? Test at 5% LOS assuming that for 9 d.o.f. $P(t > 1.83) = 0.05$.

Theory & Formula: First of all we set up Null hypothesis

$$H_0: \mu = 64 \text{ inches}, H_1: \mu > 64 \text{ inches}$$

Now to test hypothesis, we use test statistic

$$t = \frac{\bar{x} - \mu}{\sqrt{S^2/n}} \sim t_{(n-1)}$$

This is test.

If $t_{cal} < t_{tab}$ then we accept H_0 . Otherwise, we reject H_0 .

At 9 d.o.f, t_{tab} for right tail test at 5% LOS is 1.83.

Result: Here, $t_{cal}(2) > t_{tab}(1.83)$. So, we reject H_0 means that the avg. height is greater than 64 inches.

Calculation

Dist A

Dist B

X	X- \bar{X}	(X- \bar{X}) ²
25	-3	9
32	4	16
30	2	4
34	6	36
24	-4	16
19	-9	81
32	4	16
21	-4	16
20	-5	25
31	3	9
35	7	49
25	-3	9
Σ	0	350

Y	Y- \bar{Y}	(Y- \bar{Y}) ²
44	19	361
34	9	81
22	-3	9
10	-15	225
47	17	289
21	1	1
40	10	100
30	0	0
32	2	4
25	-5	25
18	-12	144
21	-4	16
35	5	25
29	-1	1
22	-8	64
Σ	0	1410

$$\Sigma X = 336, \Sigma Y = 450, \Sigma XY = 1410$$

$$\bar{X} = \frac{336}{12} = 28, \bar{Y} = \frac{450}{10} = 45$$

$$S^2 = \frac{1}{n-1} [\Sigma (X-\bar{X})^2 + \Sigma (Y-\bar{Y})^2] = 71.6$$

$$t = \frac{\bar{X} - \bar{Y}}{\sqrt{S^2 \left(\frac{1}{n} + \frac{1}{m} \right)}} = -0.609$$

t_{cal} for t_{tab} at (12+10-2) d.f. = 25 i.e. 2.06

Since, |t_{cal} (-0.609)| < t_{tab} (2.06), so we accept H₀
 means that there is no significant difference b/w the mean increment in weight

PRACTICAL-13

20/11/25

Aim: To test the difference b/w mean

Problem: Below are given the gain in weights (in lbs) of pigs fed on two diets A and B.

Dist A: 25, 32, 30, 34, 24, 19, 32, 29, 31, 35, 25
 Dist B: 40, 34, 22, 10, 47, 21, 40, 30, 32, 25, 18, 21, 29, 22

- test, if the two diets differ significantly or not as regards their effect on increase in weight

Theory & Formula: First of all, we set up the hypothesis (null)

H₀: There is no significant difference b/w the mean increase in weight i.e. $\mu_A = \mu_B$

$$H_1: \mu_A \neq \mu_B$$

To test the H₀, we use test statistic

$$t = \frac{\bar{X} - \bar{Y}}{\sqrt{S^2 \left(\frac{1}{n} + \frac{1}{m} \right)}}$$

This is calculated value of t
 tabulated value of t is taken from table at (n+m-2) d.f.
 If t_{cal} < t_{tab}, we accept H₀. Otherwise, if
 t_{cal} > t_{tab}, we reject H₀.

Result: Here, |t_{cal} (-0.609)| < t_{tab} (2.06). So we accept H₀
 means that there is no significant difference b/w the mean increment in weight i.e. $\mu_A = \mu_B$

Calculation

Given, $n_1 = 8$, $\bar{x}_1 = 1234$, $s_1 = 36$, $n_2 = 7$, $\bar{x}_2 = 1036$, $s_2 = 40$

$$s^2 = \frac{1}{n_1 + n_2 - 2} [s_1^2(n_1 - 1) + s_2^2(n_2 - 1)]$$

$$= \frac{1}{8 + 7 - 2} [8 \times 36^2 + 7 \times 40^2]$$

$$= \frac{1}{13} [8 \times 1296 + 7 \times 1600] = 1859.08$$

$$\bar{x} = \frac{1234 + 1036}{8 + 7} = 9.39$$

value of $t_{\alpha/2}$ at $(8+7-1)$ d.o.f. is 1.77 (for right-tailed test)

Since, $t_{\text{cal}}(9.39) > t_{\text{tab}}(1.77)$. So, we reject H_0 means that type 1 is superior to type 2.

PRACTICAL-14

14
2.10.25

Aim: To test the difference b/w mean

Problem: Samples of two types of electric light bulbs were tested for length of life and following data were obtained:

Sample No.
Sample Mean
Sample S.D.

Type 1
 $n_1 = 8$
 $\bar{x}_1 = 1234$ hrs
 $s_1 = 36$ hrs

Type 2
 $n_2 = 7$
 $\bar{x}_2 = 1036$ hrs
 $s_2 = 40$ hrs

To test the difference in the means sufficient to warrant that type 1 is superior to type 2 regarding length of life.

Theory & Formula: First of all, we set up the hypothesis

H_0 : The two types 1 and 2 of electric bulbs are identical i.e. $\mu_1 = \mu_2$

H_1 : $\mu_1 > \mu_2$

To test H_0 , we use test statistic

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} \sim (n_1 + n_2 - 2)$$

This is calculated

value of $t_{\text{calculated}}$ from table at $(n_1 + n_2 - 2)$ degree of freedom. If $t_{\text{cal}} < t_{\text{tab}}$, we accept H_0 . Otherwise, if $t_{\text{cal}} > t_{\text{tab}}$, we reject H_0 .

Result: Here, $t_{\text{cal}}(9.39) > t_{\text{tab}}(1.77)$. So, we reject H_0 means that type 1 is superior to type 2.

Calculations

d	5	2	8	-1	3	0	-2	1	5	0	4	6	3	Total
d ²	25	4	64	1	9	0	4	1	25	0	16	36	9	185

$$S^2 = \frac{1}{n-1} \sum (d_i - \bar{d})^2 = \frac{1}{n-1} \left[\sum d_i^2 - \frac{(\sum d_i)^2}{n} \right]$$

$$= \frac{1}{11} \left[185 - \frac{(31)^2}{12} \right] = \frac{1}{11} (185 - 80.9) = 9.5382$$

$$\bar{d} = \frac{\sum d_i}{n} = \frac{31}{12} = 2.58$$

$$t = \frac{\bar{d} \times \sqrt{n}}{\sqrt{S^2}} = \frac{2.58 \times \sqrt{12}}{\sqrt{9.5382}} = \frac{2.58 \times 3.464}{3.09} = 2.89$$

t_{tab} taken from table at (n-1) d.o.f. is 1.8

Since, $t_{cal}(2.89) > t_{tab}(1.8)$, we reject H_0 means that the stimulus, in general, is accompanied by a increase in blood pressure.

PRACTICAL-15

15
20/11/25

Aim: Application based on paired t-test

Problem: A certain stimulus administered to each of the 12 patients resulted in following increase of blood pressure:

5, 2, 8, -1, 3, 0, -2, 1, 5, 0, 4, 6

Can it be concluded that the stimulus will indeed be accompanied by an increase in blood pressure?

Proof/Formulas: First of all, we set up the hypothesis

H_0 : there is no significant difference in the blood pressure readings of the patients before & after the drug i.e. $(\mu_1 = \mu_2)$

H_1 : $\mu_1 < \mu_2$

To test H_0 , we use test statistic

$$t = \frac{\bar{d}}{S/\sqrt{n}} \sim t_{(n-1)}$$

This is calculated

Value of t_{calculated} can be taken from table at (n-1) d.o.f.

If $t_{cal} < t_{tab}$, we accept H_0 . Otherwise if

$t_{cal} > t_{tab}$, we reject H_0 .

Result: Here, $t_{cal}(2.89) > t_{tab}(1.8)$. So, we reject H_0 means that the stimulus, in general, is accompanied by an increase in blood pressure.

Calculation

As shown in excel:

Digits	observed	expected freq (O _i - E _i)	(O _i - E _i) ²	(O _i - E _i) ² / E _i
0	9126	10000	28	0.076
1	1137	10000	107	11.449
2	997	10000	-2	0.009
3	966	10000	-34	1.136
4	1075	10000	75	3.825
5	911	10000	-67	4.489
6	1137	10000	107	11.449
7	972	10000	-28	0.784
8	964	10000	-36	1.296
9	853	10000	-147	21.609
TOTAL	10000	10000		58.542

χ^2_{cal}	58.542
χ^2_{tab}	16.919
$\chi^2_{cal} > \chi^2_{tab}$, so we reject H ₀	

PRACTICAL - 7

16
20/11/25

Aim: To test goodness of fit

Problem: The following figures show the distribution of digits in no. chosen at random from a telephone directory:

Digits:	0	1	2	3	4	5	6	7	8	9	Total
Frequency:	1026	1107	997	966	1075	933	1107	972	964	853	10,000

Test whether the digits may be taken to occur equally frequently in directory.

Theory & Formula: First of all, we set up the hypothesis

H₀: The digits taken occur equally frequently in directory

H₁: The digits take do not occur equally frequently in directory

Now in given case, we have the observed freq.

To have expected freq., we have

$$\text{Expected freq. (E}_i\text{)} = \frac{\sum O_i}{n}$$

Now, we apply test statistic

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

This is χ^2_{cal} .

Thus, if $\chi^2_{cal} \leq \chi^2_{tab}$ then we accept H₀. Otherwise we reject H₀.

Result: Now, $\chi^2_{cal} > \chi^2_{tab}$. So we reject H₀ means that the digits taken do not occur equally frequently in directory.

Calculation

As shown is used:

days	observed	expected freq	$O_i - E_i$	$(O_i - E_i)^2$	$(O_i - E_i)^2 / E_i$
sun	14	12	2	4	0.33333333
mon	16	12	4	16	1.33333333
tues	8	12	-4	16	1.33333333
wed	12	12	0	0	0
thurs	11	12	-1	1	0.08333333
fri	9	12	-3	9	0.75
sat	14	12	2	4	0.33333333
TOTAL	84				4.16666667

$\chi^2_{(cal)}$	4.16666667
$\chi^2_{(tab)}$	17.59
$\chi^2_{(cal)} < \chi^2_{(tab)}$, so we accept H_0	

PRACTICAL - 8

17
20/11/25

Aim: To test goodness of fit

Problem: The following table gives the no. of air craft accidents that occur during the various days of the week. Find whether the accidents are uniformly distributed over the week.

Days	Sun	Mon	Tues	Weds	Fri	Sat	Sun
Accidents	14	16	8	12	9	14	12

Given: values of χ^2 are significant at 5, 6, 7, degrees of freedom (11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 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815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000, 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011, 1012, 1013, 1014, 1015, 1016, 1017, 1018, 1019, 1020, 1021, 1022, 1023, 1024, 1025, 1026, 1027, 1028, 1029, 1030, 1031, 1032, 1033, 1034, 1035, 1036, 1037, 1038, 1039, 1040, 1041, 1042, 1043, 1044, 1045, 1046, 1047, 1048, 1049, 1050, 1051, 1052, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1072, 1073, 1074, 1075, 1076, 1077, 1078, 1079, 1080, 1081, 1082, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100, 1101, 1102, 1103, 1104, 1105, 1106, 1107, 1108, 1109, 1110, 1111, 1112, 1113, 1114, 1115, 1116, 1117, 1118, 1119, 1120, 1121, 1122, 1123, 1124, 1125, 1126, 1127, 1128, 1129, 1130, 1131, 1132, 1133, 1134, 1135, 1136, 1137, 1138, 1139, 1140, 1141, 1142, 1143, 1144, 1145, 1146, 1147, 1148, 1149, 1150, 1151, 1152, 1153, 1154, 1155, 1156, 1157, 1158, 1159, 1160, 1161, 1162, 1163, 1164, 1165, 1166, 1167, 1168, 1169, 1170, 1171, 1172, 1173, 1174, 1175, 1176, 1177, 1178, 1179, 1180, 1181, 1182, 1183, 1184, 1185, 1186, 1187, 1188, 1189, 1190, 1191, 1192, 1193, 1194, 1195, 1196, 1197, 1198, 1199, 1200, 1201, 1202, 1203, 1204, 1205, 1206, 1207, 1208, 1209, 1210, 1211, 1212, 1213, 1214, 1215, 1216, 1217, 1218, 1219, 1220, 1221, 1222, 1223, 1224, 1225, 1226, 1227, 1228, 1229, 1230, 1231, 1232, 1233, 1234, 1235, 1236, 1237, 1238, 1239, 1240, 1241, 1242, 1243, 1244, 1245, 1246, 1247, 1248, 1249, 1250, 1251, 1252, 1253, 1254, 1255, 1256, 1257, 1258, 1259, 1260, 1261, 1262, 1263, 1264, 1265, 1266, 1267, 1268, 1269, 1270, 1271, 1272, 1273, 1274, 1275, 1276, 1277, 1278, 1279, 1280, 1281, 1282, 1283, 1284, 1285, 1286, 1287, 1288, 1289, 1290, 1291, 1292, 1293, 1294, 1295, 1296, 1297, 1298, 1299, 1300, 1301, 1302, 1303, 1304, 1305, 1306, 1307, 1308, 1309, 1310, 1311, 1312, 1313, 1314, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322, 1323, 1324, 1325, 1326, 1327, 1328, 1329, 1330, 1331, 1332, 1333, 1334, 1335, 1336, 1337, 1338, 1339, 1340, 1341, 1342, 1343, 1344, 1345, 1346, 1347, 1348, 1349, 1350, 1351, 1352, 1353, 1354, 1355, 1356, 1357, 1358, 1359, 1360, 1361, 1362, 1363, 1364, 1365, 1366, 1367, 1368, 1369, 1370, 1371, 1372, 1373, 1374, 1375, 1376, 1377, 1378, 1379, 1380, 1381, 1382, 1383, 1384, 1385, 1386, 1387, 1388, 1389, 1390, 1391, 1392, 1393, 1394, 1395, 1396, 1397, 1398, 1399, 1400, 1401, 1402, 1403, 1404, 1405, 1406, 1407, 1408, 1409, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1417, 1418, 1419, 1420, 1421, 1422, 1423, 1424, 1425, 1426, 1427, 1428, 1429, 1430, 1431, 1432, 1433, 1434, 1435, 1436, 1437, 1438, 1439, 1440, 1441, 1442, 1443, 1444, 1445, 1446, 1447, 1448, 1449, 1450, 1451, 1452, 1453, 1454, 1455, 1456, 1457, 1458, 1459, 1460, 1461, 1462, 1463, 1464, 1465, 1466, 1467, 1468, 1469, 1470, 1471, 1472, 1473, 1474, 1475, 1476, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1484, 1485, 1486, 1487, 1488, 1489, 1490, 1491, 1492, 1493, 1494, 1495, 1496, 1497, 1498, 1499, 1500, 1501, 1502, 1503, 1504, 1505, 1506, 1507, 1508, 1509, 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1842, 1843, 1844, 1845, 1846, 1847, 1848, 1849, 1850, 1851, 1852, 1853, 1854, 1855, 1856, 1857, 1858, 1859, 1860, 1861, 1862, 1863, 1864, 1865, 1866, 1867, 1868, 1869, 1870, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 205

Calculation

$p = \text{prob. of male birth} = \frac{1}{2} = q$

$p(x) = \text{prob. of } x \text{ male births in family of } 5$
 $= {}^5C_x p^x q^{5-x} = {}^5C_x \left(\frac{1}{2}\right)^5$

The freq. of 3 male births is given by:
 $f(3) = N \cdot p(3) = 320 \times {}^5C_3 \times \left(\frac{1}{2}\right)^5$
 $= 10 \times 5$

now for $x=0, 1, 2, 3, 4, 5$, we get expected freq.

further, as shown in table:

boys	observed	expected freq	$O_i - E_i$	$(O_i - E_i)^2$	$\frac{(O_i - E_i)^2}{E_i}$
5	14	10	4	16	1.6
4	56	50	6	36	0.72
3	110	100	10	100	1
2	88	100	-12	144	1.44
1	40	50	-10	100	2
0	12	10	2	4	0.4
TOTAL					7.16

$\chi^2_{(2)}(\text{cal})$	7.16
$\chi^2_{(2)}(\text{tab})$	11.67

$\chi^2_{(2)}(\text{cal}) < \chi^2_{(2)}(\text{tab})$, so we accept H_0

PRACTICAL-9

18
20/11/25

Aim: To test goodness of fit

Problem: A survey of 320 families with 5 children each resulted following:

No. of boys:	5	4	3	2	1	0
No. of girls:	0	1	2	3	4	5
No. of families:	14	56	110	88	40	12

To this result consistent with hypothesis that male & female births are equally probable?

Solution: First of all, we set up the hypothesis

H_0 : The result is consistent with hypothesis that male & female births are equally probable

H_1 : The result is not consistent with

To test H_0 , we use test statistic

$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$, this is χ^2_{cal}

for expected freq. $(E_i) = \frac{N \times {}^5C_x}{2^5}$, this is χ^2_{tab}

if $\chi^2_{\text{cal}} \leq \chi^2_{\text{tab}}$ then we accept H_0 otherwise we reject H_0 .

Result: Now, $\chi^2_{\text{cal}} < \chi^2_{\text{tab}}$ So we accept H_0 means that the result is consistent with hypothesis that male & female births are equally probable.