• Testing of Hypotheses concerning the Population Mean (Z-Test)

1. Null & Alternative Hypotheses

Null	H_0;	$\mu = \mu_0$	$\mu \le \mu_0$	$\mu \ge \mu_0$
Alternative	H_1;	$\mu \ne \mu_0$	$\mu > \mu_0$	$\mu < \mu_0$

2. Significance Level

α = 5 % / 1 % or 0.05 / 0.01
If significance level is not given then we take 5% by default.

3. Critical Region(C.R)

For Two Tail Test ($\frac{1-\alpha}{2} = Z_{\alpha/2}$)

If Alternative H_1; $\mu \ne \mu_0$

C.R = $|Z| \ge Z_{\alpha/2}$ or $-Z_{\alpha/2} < Z < Z_{\alpha/2}$

For One Tail Test ($0.5 - \alpha = Z_{\alpha}$)

If Alternative H_1; $\mu > \mu_0$

C.R= $Z \ge Z_{\alpha}$

For One Tail Test ($0.5 - \alpha = Z_{\alpha}$)

If Alternative H_1; $\mu < \mu_0$

C.R= $Z \le -Z_{\alpha}$

4. Test Statistics

When population S.D (σ) is known

Z= $$\frac{\bar{X} - \mu_0}{\sigma / \sqrt{n}}$$

When population S.D (σ) is unknown & n>30

Z= $$\frac{\bar{X} - \mu_0}{S / \sqrt{n}}$$

5. Conclusion

- If z-cal is greater than or equal to z-tab so rejected H_0
- If z-cal is less than z-tab so accepted H_0

- **Testing of Hypotheses concerning the difference between two Population Mean ($\bar{X}_1 - \bar{X}_2$) (Z-Test)**

1. **Null & Alternative Hypotheses**

Null	H_0;	$\mu_1 - \mu_2 = \blacktriangle_0$	$\mu_1 - \mu_2 \le \blacktriangle_0$	$\mu_1 - \mu_2 \ge \blacktriangle_0$
Alternative	H_1;	$\mu_1 - \mu_2 \ne \blacktriangle_0$	$\mu_1 - \mu_2 > \blacktriangle_0$	$\mu_1 - \mu_2 < \blacktriangle_0$

2. **Significance Level**

α **=** 5 % / 1 % or 0.05 / 0.01
If significance level is not given then we take 5% by default.

3. **Critical Region(C.R)**

For Two Tail Test ($\frac{1-\alpha}{2} = Z_{\alpha/2}$ **)**

If Alternative H_1; $\mu_1 - \mu_2 \ne \blacktriangle_0$

C.R = $|Z| \ge Z_{\alpha/2}$ or $-Z_{\alpha/2} < Z < Z_{\alpha/2}$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1; $\mu_1 - \mu_2 > \blacktriangle_0$

C.R= $Z \ge Z_\alpha$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1; $\mu_1 - \mu_2 < \blacktriangle_0$

C.R= $Z \le -Z_\alpha$

4. **Test Statistics** $\therefore \blacktriangle_0 = \mu_1 - \mu_2$

When population S.D (σ **) is known**

$$Z = \frac{(\bar{X}_1 - \bar{X}_2) - \blacktriangle_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

When population S.D (σ **) is unknown &** n_1, n_2 **>30**

$$Z = \frac{(\bar{X}_1 - \bar{X}_2) - \blacktriangle_0}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

If $\blacktriangle_0$ is not given in question then we take $\blacktriangle_0$ =0.

5. **Conclusion**

- If z-cal is greater than or equal to z-tab so rejected H_0
- If z-cal is less than z-tab so accepted H_0

- **Testing of Hypotheses concerning the difference between two Population Mean ($\bar{X}_2 - \bar{X}_1$) (Z-Test)**

1. **Null & Alternative Hypotheses**

Null	H_0 ;	$\mu_2 - \mu_1 = \blacktriangle_0$	$\mu_2 - \mu_1 \le \blacktriangle_0$	$\mu_2 - \mu_1 \ge \blacktriangle_0$
Alternative	H_1 ;	$\mu_2 - \mu_1 \ne \blacktriangle_0$	$\mu_2 - \mu_1 > \blacktriangle_0$	$\mu_2 - \mu_1 < \blacktriangle_0$

2. **Significance Level**

α = 5 % / 1 % or 0.05 / 0.01
If significance level is not given then we take 5% by default.

3. **Critical Region(C.R)**

For Two Tail Test ($\frac{1-\alpha}{2} = Z_{\alpha/2}$ **)**

If Alternative H_1 ; $\mu_2 - \mu_1 \ne \blacktriangle_0$

C.R = $|Z| \ge Z_{\alpha/2}$ or $-Z_{\alpha/2} < Z < Z_{\alpha/2}$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1 ; $\mu_2 - \mu_1 > \blacktriangle_0$

C.R= $Z \ge Z_\alpha$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1 ; $\mu_2 - \mu_1 < \blacktriangle_0$

C.R= $Z \le -Z_\alpha$

4. **Test Statistics** $\therefore \blacktriangle_0 = \mu_2 - \mu_1$

When population S.D (σ) is known

$$Z = \frac{(\bar{X}_2 - \bar{X}_1) - \blacktriangle_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

When population S.D (σ) is unknown & n_1, n_2 >30

$$Z = \frac{(\bar{X}_2 - \bar{X}_1) - \blacktriangle_0}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

If $\blacktriangle_0$ is not given in question then we take $\blacktriangle_0 = 0$.

5. Conclusion

- If z-cal is greater than or equal to z-tab so rejected H_0
- If z-cal is less than z-tab so accepted H_0

- **Testing of Hypotheses concerning the Population Proportion (Z-Test)**

1. **Null & Alternative Hypotheses**

Null	H_0;	$P = P_0$	$P \le P_0$	$P \ge P_0$
Alternative	H_1;	$P \ne P_0$	$P > P_0$	$P < P_0$

2. Significance Level

α **=** 5 % / 1 % or 0.05 / 0.01
If significance level is not given then we take 5% by default.

3. Critical Region(C.R)

For Two Tail Test ($\frac{1-\alpha}{2} = Z_{\alpha/2}$ **)**

If Alternative H_1; $P \ne P_0$

C.R = $|Z| \ge Z_{\alpha/2}$ or $-Z_{\alpha/2} < Z < Z_{\alpha/2}$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1; $P > P_0$

C.R= $Z \ge Z_\alpha$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1; $P < P_0$

C.R= $Z \le -Z_\alpha$

4. Test Statistics

$$Z = \frac{\hat{P} - P_0}{\sqrt{P_0(1-P_0)/n}} \qquad \therefore \hat{P} = X/n$$

Or

$$Z = \frac{\hat{P} - P_0}{\sqrt{P_0 q_0)/n}} \qquad \therefore \hat{q} = 1 - \hat{P}$$

5. Conclusion

- If z-cal is greater than or equal to z-tab so rejected H_0
- If z-cal is less than z-tab so accepted H_0

- ## Testing of Hypotheses concerning the difference between two Population Proportion($P_1 - P_2$)(Z-Test)

1. **Null & Alternative Hypotheses**

Null	H_0 ;	$P_1 - P_2 = \Delta_0$	$P_1 - P_2 \leq \Delta_0$	$P_1 - P_2 \geq \Delta_0$
Alternative	H_1 ;	$P_1 - P_2 \neq \Delta_0$	$P_1 - P_2 > \Delta_0$	$P_1 - P_2 < \Delta_0$

2. Significance Level

α **=** 5 % / 1 % or 0.05 / 0.01
If significance level is not given then we take 5% by default.

3. Critical Region(C.R)

For Two Tail Test ($\frac{1-\alpha}{2} = Z_{\alpha/2}$ **)**

If Alternative H_1 ; $P_1 - P_2 \neq \Delta_0$

C.R = $|Z| \geq Z_{\alpha/2}$ or $-Z_{\alpha/2} < Z < Z_{\alpha/2}$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1 ; $P_1 - P_2 > \Delta_0$

C.R= $Z \geq Z_\alpha$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1 ; $P_1 - P_2 < \Delta_0$

C.R= $Z \leq -Z_\alpha$

4. **Test Statistics** $\therefore \Delta_0 = P_1 - P_2$

$$Z=\frac{(\hat{P}_1-\hat{P}_2)-\blacktriangle_0}{\sqrt{\frac{\hat{P}_1\hat{q}_1}{n_1}+\frac{\hat{P}_2\hat{q}_2}{n_2}}} \qquad \therefore \hat{P}_1=X_1/n_1 \qquad \hat{P}_2=X_2/n_2$$

Or

$$Z=\frac{(\hat{P}_1-\hat{P}_2)-\blacktriangle_0}{\sqrt{\hat{P}_c\hat{q}_c\left[\frac{1}{n_1}+\frac{1}{n_2}\right]}} \qquad \therefore \hat{P}_c=\frac{n_1\hat{P}_1-n_2\hat{P}_2}{n_1+n_2} \qquad \hat{q}_c=1-\hat{P}_c$$

If $\blacktriangle_0$ is not given in question then we take $\blacktriangle_0$ =0.

5. Conclusion

- If z-cal is greater than or equal to z-tab so rejected H_0
- If z-cal is less than z-tab so accepted H_0

- **Testing of Hypotheses concerning the difference between two Population Proportion(P_2-P_1)(Z-Test)**

1. **Null & Alternative Hypotheses**

Null	H_0 ;	$P_2-P_1=\blacktriangle_0$	$P_2-P_1\le\blacktriangle_0$	$P_2-P_1\ge\blacktriangle_0$
Alternative	H_1 ;	$P_2-P_1\ne\blacktriangle_0$	$P_2-P_1>\blacktriangle_0$	$P_2-P_1<\blacktriangle_0$

2. Significance Level

α = 5 % / 1 % or 0.05 / 0.01

If significance level is not given then we take 5% by default.

3. Critical Region(C.R)

For Two Tail Test ($\frac{1-\alpha}{2}=Z_{\alpha/2}$ **)**

If Alternative H_1; $P_2-P_1\ne\blacktriangle_0$

C.R = $|Z|\ge Z_{\alpha/2}$ or $-Z_{\alpha/2}<Z<Z_{\alpha/2}$

For One Tail Test ($0.5-\alpha=Z_\alpha$ **)**

If Alternative H_1; $P_2-P_1>\blacktriangle_0$

C.R= $Z\ge Z_\alpha$

For One Tail Test ($0.5-\alpha=Z_\alpha$ **)**

If Alternative H_1; $P_2-P_1<\blacktriangle_0$

C.R= $Z\le -Z_\alpha$

4. **Test Statistics**

$\therefore \blacktriangle_0 = P_2 - P_1$

$$Z = \frac{(\hat{P}_2 - \hat{P}_1) - \blacktriangle_0}{\sqrt{\frac{\hat{P}_1 \hat{q}_1}{n_1} + \frac{\hat{P}_2 \hat{q}_2}{n_2}}}$$

$\therefore \hat{P}_1 = X_1 / n_1$ $\quad \hat{P}_2 = X_2 / n_2$

Or

$$Z = \frac{(\hat{P}_2 - \hat{P}_1) - \blacktriangle_0}{\sqrt{\hat{P}_c \hat{q}_c \left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$$

$\therefore \hat{P}_c = \frac{n_1 \hat{P}_1 - n_2 \hat{P}_2}{n_1 + n_2}$ $\quad \hat{q}_c = 1 - \hat{P}_c$

If $\blacktriangle_0$ is not given in question then we take $\blacktriangle_0 = 0$.

5. Conclusion

- If z-cal is greater than or equal to z-tab so rejected H_0
- If z-cal is less than z-tab so accepted H_0

- **Testing of Hypotheses concerning the Population Correlation Coefficient when ($\rho = \rho_0$ or $\rho \neq 0$) (Z-Test)** $\rho = Row$

1. **Null & Alternative Hypotheses**

Null	H_0;	$\rho = \rho_0$	$\rho \leq \rho_0$	$\rho \geq \rho_0$
Alternative	H_1;	$\rho \neq \rho_0$	$\rho > \rho_0$	$\rho < \rho_0$

2. Significance Level

α **=** 5 % / 1 % or 0.05 / 0.01
If significance level is not given then we take 5% by default.

3. Critical Region(C.R)

For Two Tail Test ($\frac{1-\alpha}{2} = Z_{\alpha/2}$ **)**

If Alternative H_1; $\rho \neq \rho_0$

C.R = $|Z| \geq Z_{\alpha/2}$ or $-Z_{\alpha/2} < Z < Z_{\alpha/2}$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1; $\rho > \rho_0$

C.R= $Z \geq Z_\alpha$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1; $\rho < \rho_0$

C.R= $Z \le -Z_\alpha$

4. Test Statistics

$$Z = \frac{Z_f - \mu_z}{\sigma_z}$$

$$Z_f = 1.1513\log\left[\frac{1+r}{1-r}\right] \qquad \mu_z = 1.1513\log\left[\frac{1+\rho}{1-\rho}\right]$$

$$\sigma_z = \frac{1}{\sqrt{n-3}}$$

5. Conclusion

- If z-cal is greater than or equal to z-tab so rejected H_0
- If z-cal is less than z-tab so accepted H_0

- **Testing of Hypotheses concerning the difference between Population of two Correlation Coefficient ($r_1 - r_2$) (Z-Test)** $\rho = Row$

1. **Null & Alternative Hypotheses**

Null H_0; $\rho_1 - \rho_2 = \blacktriangle_0$ $\rho_1 - \rho_2 \le \blacktriangle_0$ $\rho_1 - \rho_2 \ge \blacktriangle_0$
Alternative H_1; $\rho_1 - \rho_2 \ne \blacktriangle_0$ $\rho_1 - \rho_2 > \blacktriangle_0$ $\rho_1 - \rho_2 < \blacktriangle_0$

2. Significance Level

α **=** 5 % / 1 % or 0.05 / 0.01
If significance level is not given then we take 5% by default.

3. Critical Region(C.R)

For Two Tail Test ($\frac{1-\alpha}{2} = Z_{\alpha/2}$)

If Alternative H_1; $\rho_1 - \rho_2 \ne \blacktriangle_0$

C.R = $|Z| \ge Z_{\alpha/2}$ or $-Z_{\alpha/2} < Z < Z_{\alpha/2}$

For One Tail Test ($0.5 - \alpha = Z_\alpha$)

If Alternative H_1; $\rho_1 - \rho_2 > \blacktriangle_0$

C.R= $Z \ge Z_\alpha$

For One Tail Test ($0.5 - \alpha = Z_\alpha$)

If Alternative H_1 ; $\rho_1 - \rho_2 < ▲_0$

C.R= $Z \le -Z_\alpha$

4. **Test Statistics**

$$Z = \frac{(Z_{f1} - Z_{f2}) - ▲_0}{\sigma_{Z1-Z2}} \qquad \therefore ▲_0 = \rho_1 - \rho_2$$

$$Z_{f1} = 1.1513 \log\left[\frac{1+r_1}{1-r_1}\right] \qquad Z_{f2} = 1.1513 \log\left[\frac{1+r_2}{1-r_2}\right]$$

$$\sigma_{Z1-Z2} = \sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}$$

If $▲_0$ is not given in question then we take $▲_0$ =0.

5. Conclusion

- If z-cal is greater than or equal to z-tab so rejected H_0
- If z-cal is less than z-tab so accepted H_0

Testing of Hypotheses concerning the difference between Population of two Correlation Coefficient ($r_2 - r_1$) (Z-Test)

$\rho = Row$

1. **Null & Alternative Hypotheses**

Null	H_0 ;	$\rho_2 - \rho_1 = ▲_0$	$\rho_2 - \rho_1 \le ▲_0$	$\rho_2 - \rho_1 \ge ▲_0$
Alternative	H_1 ;	$\rho_2 - \rho_1 \ne ▲_0$	$\rho_2 - \rho_1 > ▲_0$	$\rho_2 - \rho_1 < ▲_0$

2. Significance Level

α **=** 5 % / 1 % or 0.05 / 0.01

If significance level is not given then we take 5% by default.

3. Critical Region(C.R)

For Two Tail Test ($\frac{1-\alpha}{2} = Z_{\alpha/2}$ **)**

If Alternative H_1 ; $\rho_2 - \rho_1 \ne ▲_0$

C.R = $|Z| \ge Z_{\alpha/2}$ or $-Z_{\alpha/2} < Z < Z_{\alpha/2}$

For One Tail Test ($0.5 - \alpha = Z_\alpha$ **)**

If Alternative H_1 ; $\rho_2 - \rho_1 > ▲_0$

C.R= $Z \ge Z_\alpha$

For One Tail Test ($0.5-\alpha=Z_\alpha$)

If Alternative H_1 ; $\rho_2-\rho_1<\blacktriangle_0$

C.R= $Z\le -Z_\alpha$

4. **Test Statistics**

$$Z=\frac{(Z_{f2}-Z_{f1})-\blacktriangle_0}{\sigma_{Z2-Z1}} \qquad \therefore \blacktriangle_0=\rho_2-\rho_1$$

$$Z_{f1}=1.1513\log\left[\frac{1+r_1}{1-r_1}\right] \qquad Z_{f2}=1.1513\log\left[\frac{1+r_2}{1-r_2}\right]$$

$$\sigma_{Z2-Z1}=\sqrt{\frac{1}{n_1-3}+\frac{1}{n_2-3}}$$

If $\blacktriangle_0$ is not given in question then we take $\blacktriangle_0$ =0.

5. Conclusion

- If z-cal is greater than or equal to z-tab so rejected H_0
- If z-cal is less than z-tab so accepted H_0