**Assignment_9.11476**

**Solution 1:**

$$H_0: \mu = Rs. 52 \quad vs \quad H_1: \mu > Rs. 52$$

$$n = 100, \quad \bar{x} = Rs. 52.80, \quad \sigma = Rs. 4.50, \quad \alpha = 0.05$$

Calculate the Z score as follows

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

$$= \frac{52.8 - 52}{\frac{4.50}{\sqrt{100}}} = \frac{0.8}{0.45} = \mathbf{1.778}$$

Now we need to compute the appropriate ***p-value*** based on our alternative hypothesis.

$$P(Z > Z^*) = P(Z > 1.778)$$

$$= 1 - P(Z < 1.778)$$

$$= 1 - 0.9623 = \mathbf{0.0377} < 0.05$$

Since the calculated *p-value* (**0.0377**) is less than the level of significance (**0.05**), we reject the null hypothesis and conclude that the average cost of the bookstore textbook is higher than Rs. 52

**Solution 2:**

$$H_0: \mu = 34 \quad vs \quad H_1: \mu < 32.5$$

$$n = 50, \quad \bar{x} = 32.5, \quad \sigma = 8, \quad \alpha = 0.01$$

Calculate the Z score as follows

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

$$= \frac{32.5 - 34}{\frac{8}{\sqrt{50}}} = \frac{-1.5}{1.13} = -\mathbf{1.33}$$

Now we need to compute the appropriate ***p-value*** based on our alternative hypothesis.

$$P(Z < Z^*) = P(Z < -1.33)$$

$$= 1 - P(Z < 1.33)$$

$$= 1 - 0.9082 = \mathbf{0.0918} > 0.01$$

From the above calculations the test statistic lies in the Acceptance Region for $H_0$ Therefore we fail to reject $H_0$

**Solution 3:**

$$H_0 : \mu = 1135 \quad vs \quad H_1 : \mu \neq 1031.31$$

$$n = 22, \quad \bar{x} = 1031.31, \quad \sigma = 240.37, \quad \alpha = 0.05/2$$

Calculate the Z score as follows

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

$$= \frac{1031.31 - 1135}{\frac{240.37}{\sqrt{22}}} = \frac{103.69}{51.25} = -\mathbf{2.023}$$

Now we need to compute the appropriate ***p-value*** based on our alternative hypothesis.

$$P(Z > Z^*) = P(-2.02 < Z > 2.02)$$

$$= 1 - P(Z < 2.02)$$

$$= 1 - 0.9783 = \mathbf{0.017} < \ 0.025$$

From the above calculations the test statistic lies in the rejection Region for H o
Therefore we reject H0

**Solution 4:**

$$H_0 : \mu = 48{,}432 \quad vs \quad H_1 : \mu \neq 48{,}574$$

$$n = 400, \quad \bar{x} = 48{,}574, \quad \sigma = 2000, \quad \alpha = 0.05$$

Calculate the Z score as follows

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

$$= \frac{48{,}432 - 48{,}574}{\frac{2000}{\sqrt{400}}} = \frac{-142}{100} = -\mathbf{1.42}$$

Now we need to compute the appropriate ***p-value*** based on our alternative hypothesis.

$$P(Z > Z^*) = P(-2.02 < Z > 2.02)$$

$$= 1 - P(Z < 2.02)$$

$$= 1 - 0.9222 = \mathbf{0.0217} < \ 0.025$$

From the above calculations the test statistic lies in the Acceptance Region for $H_0$
Therefore we fail to reject $H_0$

**Solution 5:**

$$H_0: \mu = 32.28 \quad vs \quad H_1: \mu \neq 31.67$$

$$n = 19, \quad \bar{x} = 31.67, \quad \sigma = 1.29, \quad \alpha = 0.05/2$$

Calculate the Z score as follows

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

$$= \frac{31.67 - 32.28}{\frac{1.29}{\sqrt{19}}} = \frac{-0.61}{0.3} = -\mathbf{2.03}$$

Now we need to compute the appropriate ***p-value*** based on our alternative hypothesis.

$$P(Z > Z^*) = P(-2.03 < Z > 2.03)$$

$$= 1 - P(Z < 2.03)$$

$$= 1 - 0.9788 = \mathbf{0.0212} < 0.025$$

From the above calculations the test statistic lies in the Acceptance Region for $H_0$. Therefore we fail to reject $H_0$

**Solution 6**

**B at μ = 52**

$$=\frac{48.81-52}{\frac{2.5}{\sqrt{16}}}=\frac{-3.19}{0.625}=-\mathbf{5.104}$$

$$=\frac{51.19-52}{\frac{2.5}{\sqrt{16}}}=\frac{-0.81}{0.625}=-\mathbf{1.30}$$

$$=P(-5.10\le Z\le -1.30)$$

$$=P(Z\le -1.30)-P(Z\le 5.10)$$

= (1-0.9032) – 0

=0.0968

**B at μ = 50.5**

$$=\frac{48.81-50.5}{\frac{2.5}{\sqrt{16}}}=\frac{-1.69}{0.625}=-\mathbf{2.7}$$

$$=\frac{51.19-50.5}{\frac{2.5}{\sqrt{16}}}=\frac{-0.69}{0.625}=-\mathbf{1.1}$$

$$=P(-2.7\le Z\le -1.1)$$

$$=P(Z\le -2.7)-P(Z\le 1.1)$$

= (1-0.9965) – (1-0.8643)

=0.1322

**□ at μ = 50**

$$=\frac{48.81-50}{\frac{2.5}{\sqrt{16}}}=\frac{-1.19}{0.625}=-1.904$$

$$=\frac{51.19-50}{\frac{2.5}{\sqrt{16}}}=\frac{1.19}{0.625}=1.904$$

$$=P(Z<-1.904)+P(Z>1.904)$$

=(1-0.9713)+ (1-0.9713)

=0.0574

**□ at μ = 50**

$$=\frac{48.42-50}{\frac{2.5}{\sqrt{16}}}=\frac{-1.58}{0.625}=-2.528$$

$$=\frac{51.58-50}{\frac{2.5}{\sqrt{16}}}=\frac{1.58}{0.625}=2.528$$

$$=P(Z<-2.528)+P(Z>2.528)$$

=(1-0.9943)+ (1-.9943)

=0.0114

| **Acceptance Region** | **Sample Size** | **α** | **B at μ = 52** | **B at μ = 50.5** |
|---|---|---|---|---|
| 48.5 < $x$ < 51.5 | 10 | 0.0574 | 0.2643 | 0.8923 |
| 48 < $x$ < 52 | 10 | 0.0114 | 0.5 | 0.9705 |
| 48.81 < $x$ < 51.19 | 16 | 0.0574 | 0.0968 | 0.1322 |
| 48.42 < $x$ < 51.58 | 16 | 0.0114 | 0.2514 | 0.95815 |

**Solution 7:**

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

$$= \frac{12 - 10}{\frac{1.5}{\sqrt{16}}} = \frac{2}{3.75}$$

$$= \mathbf{0.53}$$

**Solution 8:**

$$1 - \alpha = 0.99 \rightarrow \alpha = 1 - 0.99 = 0.01$$

$$df = n - 1 = 16 - 1 = 15$$

$$t^*{}_{0.99}(15) = -t^*{}_{0.01}(15) = -2.602$$

**Solution 9:**

$$\bar{x} = \frac{1}{16} \sum X_i = \frac{1}{16}(304 + 367 + \cdots + 333) = \mathbf{320}$$

$$s^2 = \frac{1}{16 - 1} \sum (X_i - \bar{X})^2 = \frac{1}{15} \left[(304 - 320)^2 + \cdots + (333 - 320)^2\right] = \mathbf{1702.93}$$

$$s = \sqrt{s^2} = \sqrt{1702.93} = \mathbf{41.27}$$

Thus $n = 16,$ $\bar{x} = 320,$ $s = 41.27,$ $\mu = 300,$ $\propto = 0.05$

$$H_0: \mu = 300 \quad vs \quad H_1: \mu > 300$$

We reject $H_0$ at 5% level of significance if $Z < -1.96$ or $Z > +1.96$

$$Z^* = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

$$= \frac{320 - 300}{\frac{41.27}{\sqrt{16}}} = \frac{20}{10.3175} = \mathbf{1.9384}$$

The appropriate ***p-value*** is given by

$$P(Z > Z^*) = P(Z > 1.9384)$$

$$= 1 - P(Z < 1.9384)$$

$$= 1 - 0.9737 = \mathbf{0.0263} < 0.05$$

The ***z-score*** falls within the acceptance region and the ***p-value*** is less than the level of significance which makes us ***fail to reject*** the NULL hypothesis and conclude that the sales have not increased.