Question Bank

Module - V PART - A

1) It is claimed that a random sample of 49 tyres has a mean life of 15200kms. This sample was taken from population whose mean is 15150 kms and SD is 1200km. Examine the truth value of the claim at 0.05 level of significance.

$n = 49, \quad \mu = 15150$

$\bar{x} = 15200, \quad \sigma = 1200$

$\alpha = 0.05$

Null Hypothesis $H_0$ : $\mu = 15150$

Alternative Hypothesis $H_1$ : $\mu > 15150$

Level of significance : $\alpha = 0.05$

Test statistic:

$$z = \frac{\bar{x} - \mu}{\left[\frac{\sigma}{\sqrt{n}}\right]}$$

$$z = \frac{15200 - 15150}{\left[\frac{1200}{7}\right]}$$

$$z = \frac{\cancel{50} \times 7}{\cancel{1200}_{24}} = 0.29$$

$\therefore$ cal $|z| = 0.29$

Tab $|z| = 1.645$

$\therefore$ cal $|z| <$ Tab $|z|$

$\therefore$ Accept $H_0$

2) A manufacturer claims that at least 95% of the equipment which he supplied to a factory confirmed to specifications. An examination of sample of 200 pieces of equipment received 18 were faulty. Examine the truth value of the claim at 0.05 level.

$n = 200, \ \alpha = 0.05$

Let x be the no. of equipments which are good.

$\therefore x = 182$

$\therefore p =$ Sample proportion $= \frac{x}{200} = \frac{182}{200} = 0.91$

$P =$ population proportion $= 95\% = 0.95$

$Q = 1 - P = 1 - 0.95 = 0.05$

Null Hypothesis $H_0$ : $P = 0.95$

Alternative Hypothesis : $P < 0.95$

Level of significance : $\alpha = 0.05$

Test Statistic :

$$Z = \frac{p - P}{\sqrt{\frac{PQ}{n}}}$$

$$Z = \frac{0.91 - 0.95}{\sqrt{\frac{(0.95)(0.05)}{200}}}$$

$$Z = -2.59$$

tab $|z| = 1.645$

$\therefore$ cal $|z| >$ tab $|z|$

$\therefore$ Reject $H_0$

3] Among the items produced by a factory out of 500, 15 were defective. In another sample of 400, 20 were defective. Examine whether there is any significant difference b/w two proportions at 5

$n_1 = 500, \quad n_2 = 400$

$x_1 = 15, \quad x_2 = 20$

$P_1 = \frac{x_1}{n_1} = \frac{15}{500} = 0.03 \Rightarrow Q_1 = 0.97$

$P_2 = \frac{x_2}{n_2} = \frac{20}{400} = 0.05 \Rightarrow Q_2 = 0.95$

Null Hypothesis : $P_1 = P_2$

Alternative Hypothesis : $P_1 \neq P_2$

Level of Significance : $\alpha = 0.05$

Test Statistic :

$$Z = \frac{P_1 - P_2}{\sqrt{\frac{P_1 Q_1}{n_1} + \frac{P_2 Q_2}{n_2}}}$$

$$= \frac{0.03 - 0.05}{\sqrt{\frac{(0.03)(0.97)}{500} + \frac{(0.05)(0.95)}{400}}}$$

$$= \frac{-0.02}{0.133} = -0.150$$

Tab $|z| = 1.96$

$\therefore$ Cal $|z| <$ Tab $|z|$

$\therefore$ Accept $H_0$

4) A mechanist making engine parts with axle diameters of 0.700 inch. A random sample of 10 parts shown a mean diameter of 0.742 inch with a S.D of 0.040 inch. Compute the statistic you would use to Examine whether the work is meeting the specifications.

$n = 10, \ \bar{x} = 0.742, \ \sigma = 0.040$

$\mu = 0.700$

Null Hypothesis $H_0: \mu = 0.700$

Alternative Hypothesis $H_1: \mu > 0.700$

Level of significance : $\alpha = 0.05$

Test statistic :

$$Z = \frac{\bar{x} - \mu}{\left[\frac{\sigma}{\sqrt{n}}\right]}$$

$$= \frac{0.742 - 0.700}{\left(\frac{0.040}{\sqrt{10}}\right)}$$

$$= \frac{0.042 \times 3.16}{0.040}$$

$$= 3.318$$

$Tab|z| = 1.96$

$\therefore Cal|z| > Tab|z|$

$\therefore$ Reject $H_0$

5] To examine the hypothesis that the husbands are more intelligent than the wives, an investigator took a sample of 9 couples and administered them a test measures the I.Q. The results are as follows: where H: husbands IQ, W: wife's IQ. Examine the truth value of the hypothesis at LOS 0.05.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| H | 117 | 105 | 97 | 105 | 123 | 109 | 86 | 78 | 103 |
| W | 106 | 98 | 87 | 104 | 116 | 95 | 90 | 69 | 108 |

$n_1 = 9, \quad n_2 = 9$

$\bar{H} = 102.55, \quad \bar{W} = 97$

$$\sigma_H^2 = \frac{\Sigma(X_i - \bar{X})^2}{n} = \frac{208.80 + 6.00 + 30.80 + 6 + 418.20 + 41.60 + 273.90 + 602.70 + 0.20}{9}$$

$= 176.46$

$$\sigma_W^2 = \frac{81 + 1 + 100 + 49 + 361 + 4 + 49 + 784 + 121}{9} = 172.22$$

NH $H_0$ : Husbands are more intelligent than wives

AH $H_1$ : Husbands not intelligent than wives

LOS : $\alpha = 0.05$

Test statistic : $$z = \frac{\bar{H} - \bar{W}}{\sqrt{\frac{\sigma_H^2}{n_1} + \frac{\sigma_W^2}{n_2}}} = \frac{102.55 - 97}{\sqrt{\frac{176.46 + 172.22}{9}}}$$

$$z = \frac{5.55 \times 3}{\sqrt{348.68}} = \frac{16.65}{18.67} = 0.89$$

$\therefore$ cal $|z| <$ tab $|z|$

$\therefore$ Accept $H_0$

6) Pumpkins were grown under two experiments conditions. Two random samples of 11 and 9 pumpkins. The sample standard deviation of their weights as 0.8 and 0.5 respectively. Assuming that the weight distributions are normal, Examine the drum value of hypothesis that the true variances are equal.

$n_1 = 11, \quad n_2 = 9$

$S_1 = 0.8, \quad S_2 = 0.5$

$S_1^2 = 0.64, \quad S_2^2 = 0.25$

$F = \frac{S_1^2}{S_2^2} = \frac{0.64}{0.25} = 2.56$

NH $H_0$ : $\sigma_1^2 = \sigma_2^2$

AH $H_1$ : $\sigma_1^2 \neq \sigma_2^2$

LOS : $\alpha = 0.05$

Test statistic :

$F = 2.56$

degrees of freedom

$df_1 = n_1 - 1 = 10$

$df_2 = n_2 - 1 = 8$

$F_{0.05}(10, 8) = 3.35$

$\therefore$ Tab $|F| >$ cal $|F|$

$\therefore$ Accept $H_0$

7) From the following data, Calculate whether there is any significant liking in the habit of taking soft drinks among the categories of employees.

| Soft drinks | Clerks | Teachers | Officers |
|---|---|---|---|
| Pepsi | 10 | 25 | 65 |
| Thumbs Up | 15 | 30 | 65 |
| Fanta | 50 | 60 | 30 |

Expected Frequencies

$$E = \frac{\text{Row total} \times \text{column total}}{\text{Total}}$$

$H_0$: No association b/w employee & soft drink

$H_1$: There is association

Clerks : $\frac{100 \times 75}{350} = 21.43$

Teachers : $\frac{115 \times 75}{350} = 24.64$

Officers : $\frac{135 \times 75}{350} = 28.93$

$$\chi^2 = \frac{(10-21.43)^2}{21.43} + \frac{(25-24.64)^2}{24.64} + \frac{(65-28.93)^2}{28.93} + \dots$$

$\chi^2 = 61.84$

Dof $= (3-1)(3-1) = 4$

cal $\chi^2 >$ Tab $|\chi^2| = 9.488$

$\therefore$ Reject $H_0$

8) In an investigation on the machine performance the following results are obtained. Examine whether the performance of the machine is independent or not by using chi square test at 5% LOS

| | No. of units inspected | No. of defective | Non defective |
|---|---|---|---|
| Machine 1 | 375 | 17 | 358 |
| Machine 2 | 450 | 22 | 428 |
| Total | 825 | 39 | 786 |

Expected Frequency:

$$E_{ij} = \frac{\text{Row Total} \times \text{Column Total}}{\text{Grand Total}}$$

$E_{11} \Rightarrow$ Machine 1 (Defective):

$$E_{11} = \frac{375 \times 39}{825} = 17.73$$

$E_{12} \Rightarrow$ Machine 1 (Non-Defective):

$$E_{12} \Rightarrow \frac{375 \times 786}{825} = 357.27$$

$E_{21} \Rightarrow$ Machine 2 (Defective):

$$E_{21} \Rightarrow \frac{450 \times 39}{825} = 21.27$$

$E_{22} \Rightarrow$ Machine 2 (Non-Defective):

$$E_{22} = \frac{450 \times 786}{825} = 428.73$$

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

$$\chi^2 = \frac{(17-17.73)^2}{17.73} + \frac{(358-357.27)^2}{357.27} +$$

$$\frac{(22-21.27)^2}{21.27} + \frac{(428-428.73)^2}{428.73}$$

$$\chi^2 = 0.0574$$

$$Dof = (Rows-1) \times (Columns-1)$$

$$= (2-1)(2-1) = 1$$

$\chi^2_{(0.05)}$ at 1 dof = 3.841

$\therefore$ cal $|\chi^2| <$ tab $|\chi^2|$

$\therefore$ Accept $H_0$

NH $H_0$: The performance of the machine is independent.

AH $H_1$: The performance of the machine is not independent.

9] Samples of students were drawn from two universities and from their weights in kilograms mean and SD are calculated and shown below make a large sample. Examine the significance of difference b/w means.

| | Mean | SD | Sample size |
|---|---|---|---|
| University A | 55 | 10 | 10 |
| University B | 57 | 15 | 20 |

$\bar{x}_1 = 55$, $\bar{x}_2 = 57$, $n_1 = 10$

$s_1 = 10$, $s_2 = 15$, $n_2 = 20$

$$s^2 = \frac{s_1^2 n_1 + s_2^2 n_2}{n_1 + n_2 - 2} = \frac{1000 + 4500}{28} = 196.42$$

$s = 14.01$

NH $H_0 \Rightarrow \mu_1 = \mu_2$

AH $H_1 \Rightarrow \mu_1 \neq \mu_2$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = \frac{55 - 57}{14.01\left[\sqrt{\frac{1}{10} + \frac{1}{20}}\right]}$$

$$t = \frac{-2}{14.01\,(0.38)} = \frac{-2}{5.32} \doteq -0.37$$

$\alpha = 0.05$

~~do~~ dof $= n_1 + n_2 - 2 = 28$

tab $|t| = 2.048$

$\therefore$ cal $|t| <$ tab $|t|$

$\therefore$ Accept $H_0$

10) The measurements of the output of two units have given the following results. Assuming that both samples have been obtained from the normal populations at 10% significance level, examine whether the two populations have the same variance.

| | | | | | |
|---|---|---|---|---|---|
| Unit-A | 14.1 | 10.1 | 14.7 | 13.7 | 14.0 |
| Unit B | 14.0 | 14.5 | 13.7 | 12.7 | 14.1 |

$n_1 = 5, \quad n_2 = 5$

$$s^2 = \frac{\Sigma(x_i - \bar{x})^2}{n-1}, \quad \bar{x} = 13.32, \quad \bar{y} = 13.8$$

$$s_1^2 = \frac{0.60 + 16 + 0.36 + 0.16 + 0.01}{4} = \frac{17.13}{4} = 4.28$$

$s_1 = 2.06$

$$s_2^2 = \frac{0.04 + 0.49 + 0.01 + 1.21 + 0.09}{4} = \frac{1.84}{4} = 0.46$$

$s_2 = 0.67$

NH $H_0 = \sigma_1^2 = \sigma_2^2$

AH $H_1 = \sigma_1^2 \neq \sigma_2^2$

LOS : $\alpha = 0.10$

$$F = \frac{s_1^2}{s_2^2} = \frac{4.28}{0.46} = 9.30$$

$df_1 = 4, df_2 = 4, \quad F_{0.10}(4,4) = 4.107$

$\therefore$ cal $|F| >$ tab $|F|$

$\therefore$ Reject $H_0$

| PART-B LONG ANSWER QUESTIONS | | | | |
|---|---|---|---|---|
| 1 | A sample of 400 items is taken from a population whose standard deviation is 10. The mean of sample is 40. Examine whether the sample has come from a population with mean 38 also calculate 95% confidence interval for the population. | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 2 | The means of two large samples of sizes 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of S.D 2.5 inches? | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 3 | An ambulance service claims that it takes on the average 8.9 minutes to reach its destination in emergency calls. To check on This claim the agency which issues license to Ambulance service has then timed on fifty emergency calls getting a mean of 9.2 minutes with 1.6 minutes. Examine the claim at 5% LOS | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 4 | According to norms established for a mechanical aptitude test, the persons who are 18 years have an average weight of 73.2 with S.D 8.6 if 40 randomly selected persons have average 76.7 Examine the truth value of the hypothesis $H_0 :\mu =73.2$ against alternative hypothesis: $\mu > 73.2$. | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |

| | | | | |
|---|---|---|---|---|
| 5 | A sample of 100 electric bulbs produced by manufacturer 'A' showed a mean life time of 1190 hours and s .d. of 90 hours A sample of 75 bulbs produced by manufacturer 'B' Showed a mean life time of 1230 hours with s.d. of 120 hrs. Examine whether there is any difference between the mean life times of the two brands at a significance level of 0.05. | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 6 | A cigarette manufacturing firm claims that brand A line of cigarettes outsells its brand B by 8%. if it is found that 42 out of a sample of 200 smokers prefer brand A and 18 out of another sample of 100 smokers prefer brand B. Examine whether 8% difference is a valid claim. | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 7 | If 48 out of 400 persons in rural area possessed 'cell' phones while 120 out of 500 in urban area. Can it be accepted that the proportion of 'cell' phones in the rural area and Urban area is same or not. Use 5% of level of significance. | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 8 | Samples of students were drawn from two universities and from their weights in kilograms mean and S.D are calculated and shown below make a large sample Examine the significance of difference between means. | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |

| | Mean | Standard Deviation | Sample Size |
|---|---|---|---|
| University A | 55 | 10 | 400 |
| University B | 57 | 15 | 100 |

| | | | | |
|---|---|---|---|---|
| 9 | In a big city 325 men out of 600 men were found to be smokers. Does This information support the conclusion that the majority of men in This city are smokers? | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 10 | A sample of 26 bulbs gives a mean life of 990 hours with S.D of 20hrs. The manufacturer claims that the mean life of bulbs 1000 hrs. Examine whether the sample is up to the standard or not? | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 11 | A random sample of 10 boys had the following I. Q's 70,120,110,101,88,83,95, 98,107,100. Do the data support the assumption of population means I.Q of 100. Examine the truth value of the claim at 5% level of significance? | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 12 | Two random samples gave the following results. Examine whether the samples came from the same population or not? | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |

| Sample | size | Sample mean | Sum of squares of deviations from mean |
|---|---|---|---|
| I | 10 | 15 | 90 |
| II | 12 | 14 | 108 |

| | | | | |
|---|---|---|---|---|
| 13 | Two independent samples of items are given respectively had the following values. Examine whether there is any significant difference between their means? | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample I | 11 | 11 | 13 | 11 | 15 | 9 | 12 | 14 |
| Sample II | 9 | 11 | 10 | 13 | 9 | 8 | 10 | - |

| | | | | |
|---|---|---|---|---|
| 14 | Time taken by workers in performing a job by method 1 and method 2 is given below. Does the data show that variances of time distribution from population which these samples are drawn do not differ significantly? | Apply | Learner to recall the procedure of F-test for equality of variances and calculate test statistic value compare it with the tabulated value to draw the inference. | CO 6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Method 1 | 20 | 16 | 27 | 23 | 22 | 26 | - |
| Method 2 | 27 | 33 | 42 | 35 | 32 | 34 | 38 |

| | | | | |
|---|---|---|---|---|
| 15 | A die is thrown 264 times with the following results. Prove that the die is unbiased. | Apply | Learner to recall the procedure of Chi square-test for unbiasedness and calculate test statistic value compare it with the tabulated value to draw the inference. | CO 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| No appeared-on die | 1 | 2 | 3 | 4 | 5 | 6 |
| Frequency | 40 | 32 | 28 | 58 | 54 | 52 |

| | | | | |
|---|---|---|---|---|
| 16 | 200 digits were chosen at random from set of tables the frequency of the digits is Where d: digits and f: frequencies. Use chi square test to examine the correctness of the hypothesis that the digits are distributed in equal number in the table. | Apply | Learner to recall the procedure of Chi square-test for equal frequencies and calculate test statistic value compare it with the tabulated value to draw the inference. | CO 6 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| d | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| f | 18 | 19 | 23 | 21 | 16 | 25 | 22 | 20 | 21 | 15 |

| | | | | |
|---|---|---|---|---|
| 17 | The average breaking strength of the steel rods is specified to be 18.5 thousand pounds. sample of 14 rods were tested. The mean and S.D obtained were 17.85 and 1.955 respectively. Is the result of experiment significant? | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 18 | A group of 5 patients treated with medicine A weigh 42, 39, 48, 60 and 41 kgs. Second group of 7 patients from the same hospital treated with medicine B weigh 38, 42, 56, 64, 68, 69 and 62 kgs. Do you agree with the claim that medicine B increases the weigh significantly? | Apply | Learner to recall the procedure of testing of hypothesis and select the suitable test statistic formula and compare the calculated test statistic value with the tabulated value to draw the inference. | CO 6 |
| 19 | In one sample of 10 observations, the sum of the deviations of the sample values from sample mean was 120 and in the other sample of 12 observations it was 314. Examine whether the difference is significant at 5% level. | Apply | Learner to recall the procedure of F-test for equality of variances and calculate test statistic value compare it with the tabulated value to draw the inference. | CO 6 |
| 20 | The following random samples are measurements of the heat-producing capacity (in millions of calories per ton) of specimens of coal from two mines: Use the 0.05 level of significance to Examine whether it is reasonable to assume that the variances of the two populations are equal. | Apply | Learner to recall the procedure of F-test for equality of variances and calculate test statistic value compare it with the tabulated value to draw the inference. | CO 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Mine 1 | 8,260 | 8,130 | 8,350 | 8,070 | 8,340 | ... |
| Mine 2 | 7,950 | 1,890 | 7,900 | 8,140 | 7,920 | 7,840 |

PART-B

1) $n_1 = 400$, $\sigma = 10$

$\bar{x} = 40$, $\mu = 38$

NH $H_0$ : $\mu = 38$

AH $H_1$ : $\mu \neq 38$

LOS : $\alpha = 0.05$

Test statistic : $z = \dfrac{\bar{x} - \mu}{\left(\frac{\sigma}{\sqrt{n}}\right)} = \dfrac{40-38}{\left(\frac{10}{20}\right)} = 4.$

cal $|z|$ > tab $|z|$

$\therefore$ Reject $H_0$

The 95% confidence limits for $\mu$ are

$$\left[x \mp 1.96 \frac{\sigma}{\sqrt{n}}\right]$$

$$\Rightarrow \left[40 - 1.96\left(\frac{10}{20}\right), 40 + 1.96\left[\frac{10}{20}\right]\right] = (39.02, 40.98)$$

2] $n_1 = 1000$, $n_2 = 2000$

$\bar{x}_1 = 67.5$, $\bar{x}_2 = 68$

$\sigma = 2.5$

NH $H_0$ : ($\mu_1 = \mu_2$) The two samples are drawn from the same population.

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

$\alpha = 0.05$

Test statistic :

$$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma^2}{n_1} + \frac{\sigma^2}{n_2}}}$$

$$z = \frac{67.5 - 68}{\sqrt{\frac{2.5^2}{1000} + \frac{(2.5)^2}{2000}}}$$

$$z = ~~0.09069~~ - 5.16$$

$\therefore$ cal $|z|$ > tab $|z|$

$\therefore$ Reject $H_0$

3] $n = 50$, $\mu = 8.9$

$\bar{x} = 9.2$, $s = 1.6$

$\alpha = 0.05$

NH $H_0 = \mu = 8.9$

AH $H_1 = \mu \neq 8.9$

Test statistic:

$$Z = \frac{\bar{x} - \mu_0}{\left(\frac{s}{\sqrt{n}}\right)}$$

$$z = \frac{9.2 - 8.9}{\left[\frac{1.6}{7}\right]} = \frac{0.3}{0.22} = 1.36$$

cal $|z|$ < tab $|z| = 1.96$

$\therefore$ Accept $H_0$

4] $n = 40$, $\bar{x} = 76.7$, $\mu = 73.2$, $S = 8.6$

NH $H_0$: $\mu = 73.2$

AH $H_1$: $\mu > 73.2$

LOS : $\alpha = 0.05$

Test statistic:

$$t = \frac{76.7 - 73.2}{\left(\frac{8.6}{\sqrt{39}}\right)} = \frac{3.5}{1.37} = 2.55$$

$\therefore$ tab $|t|$ < cal $|t|$

$\therefore$ Reject $H_0$

5) $n = 100$, $\bar{x}_1 = 1190$, $\sigma_1 = 90$

$n_2 = 75$, $\bar{x}_2 = 1230$, $\sigma_2 = 120$

$\alpha = 0.05$

NH $H_0$ : $\mu_1 = \mu_2$

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

TS :

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$$= \frac{1190 - 1230}{\sqrt{\frac{8100}{100} + \frac{14400}{75}}} = -2.42$$

~~df~~ cal $|Z|$ > tab $|Z|$

∴ Reject $H_0$

6] $n_1 = 200$,

$P_1 = \frac{42}{200} = 0.21$, $Q_1 = 0.79$

$n_2 = 100$,

$P_2 = \frac{18}{100} = 0.18$, $Q_2 = 0.82$

NH $H_0$ : $P_1 - P_2 = 0.08$

AH $H_1$ : $P_1 - P_2 \neq 0.08$

$\alpha = 0.05$

TS :

$$Z = \frac{P_1 - P_2}{\sqrt{\frac{P_1 Q_1}{n_1} + \frac{P_2 Q_2}{n_2}}} = \frac{0.21 - 0.18}{\sqrt{\frac{0.16}{200} + \frac{0.14}{100}}} = \frac{0.03 \times 10}{0.96} = 0.31$$

∴ cal $|Z|$ < tab $|Z|$

∴ Accept $H_0$

7) $n_1 = 400$

$P_1 = \frac{48}{400} = 0.12$, $Q_1 = 0.88$

$n_2 = 500$

$P_2 = \frac{120}{500} = 0.24$, $Q_2 = 0.76$

NHH$_0$: $P_1 = P_2$

AHH$_1$: $P_1 \neq P_2$

$\alpha = 0.05$

TS:

$$Z = \frac{P_1 - P_2}{\sqrt{\frac{P_1 Q_1}{n_1} + \frac{P_2 Q_2}{n_2}}}$$

$$Z = \frac{0.12 - 0.24}{\sqrt{\frac{0.10}{400} + \frac{0.18}{500}}}$$

$$= \frac{-0.12 \times 10}{\sqrt{0.025 + 0.036}} = \frac{-1.2}{0.24} = -5$$

cal$|z|$ > tab$|z|$

$\therefore$ Reject H$_0$

8] $\bar{x}_1 = 55$, $\bar{x}_2 = 57$

$\sigma_1 = 10$, $\sigma_2 = 15$

$n_1 = 400$, $n_2 = 100$

NHH$_0$: $\mu_1 = \mu_2$

AHH$_1$: $\mu_1 \neq \mu_2$

$\alpha = 0.05$

TS:

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} = \frac{55 - 57}{\sqrt{\frac{100}{400} + \frac{225}{100}}} = \frac{-2}{1.58} = -1.26$$

cal$|Z|$ ≤ tab$|z|$

$\therefore$ Accept H$_0$

9) $n = 600$

$p = \frac{325}{600} = 0.54$

$P = 0.5, \ Q = 0.5$

NH $H_0$ : $P = 0.5$ [No Majority]

AH $H_1$ : $P > 0.5$ (Majority)

TS :

$$z = \frac{p - P}{\sqrt{\frac{PQ}{n}}} = \frac{0.54 - 0.5}{\sqrt{\frac{0.25}{600}}}$$

$$= \frac{0.04}{0.5} \times 2.44 \times 10$$

$$= 1.952$$

tab $|z| = 1.964$

cal $|z| \ngtr$ tab $|z|$

~~Accept $H_0$~~ $\therefore$ Reject $H_0$

10) $n = 26, \ \bar{x} = 990, \ \sigma = 20$

$\mu = 1000$

NH $H_0$ : $\mu = 1000$

AH $H_1$ : $\mu \neq 1000$

$\alpha = 0.05$

TS :

$$z = \frac{\bar{x} - \mu}{\left[\frac{s}{\sqrt{n}}\right]} = \frac{990 - 1000}{\left[\frac{20}{\sqrt{26}}\right]} = \frac{-10}{20} \times 5.09$$

$$= -2.545$$

$\therefore$ tab $|z|$ at $(25)_{0.05} \approx 2.06$

$\therefore$ cal $|z| >$ tab $|z|$

$\therefore$ Reject $H_0$

11) $n_1 = 10$

IQ's: 70, 120, 110, 101, 88, 83, 95, 98, 107, 100

$\mu = 100$, $\alpha = 0.05$, $\bar{x} = 97.2$

$$\sigma^2 = \frac{\sum (x_i - \bar{x})^2}{n} = \frac{739.84 + 519.84 + 163.84 + 14.44 + 84.64 + 201.64 + 4.84 + 0.64 + 96.04 + 7.84}{10}$$

$$= \frac{1833.6}{10} = 183.36$$

$\sigma = 13.54$

NH $H_0$ : $\mu = 100$

AH $H_1$ : $\mu \neq 100$

TS:

$$t = \frac{\bar{x} - \mu}{\left(\frac{\sigma}{\sqrt{n}}\right)} = \frac{97.2 - 100}{\left(\frac{13.54}{\sqrt{10}}\right)} = \frac{-2.8 \times 3.16}{13.54}$$

$= 0.65$

cal $|t|$ < tab $|t| \approx 2.26$

$\therefore$ Accept $H_0$

12] $n_1 = 10$, $\bar{x}_1 = 15$, $\sum (x_i - \bar{x})^2 = 90 = n_1 s_1^2$

$n_2 = 12$, $\bar{x}_2 = 14$, $\sum (x_i - \bar{x})^2 = 108 = n_2 s_2^2$

$$S^2 = \frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2} = \frac{90 + 108}{20} = \frac{198}{20} = 9.9$$

$s = 3.14$

NH $H_0$: $\mu_1 = \mu_2$

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

$\alpha = 0.05$

TS:

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

$$t = \frac{15 - 14}{3.14\sqrt{\frac{10 + 12}{120}}}$$

$$t = \frac{10.95}{3.14 \times 4.69} = 0.74$$

tab $|t| \approx 2.086$

$\therefore$ cal $|t|$ < tab $|t|$ $\therefore$ Accept $H_0$

13)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample① | 11 | 11 | 13 | 11 | 15 | 9 | 12 | 14 |
| Sample② | 9 | 11 | 10 | 13 | 9 | 8 | 10 | — |

$n_1 = 8, \quad n_2 = 7$

$\bar{x}_1 = 12, \quad \bar{x}_2 = 10$

$$s_1^2 = \frac{\sum (x_i - \bar{x})^2}{n} = \frac{1+1+1+1+9+9+0+4}{8} = 3.25$$

$$s_2^2 = \frac{1+1+0+9+1+4+0}{7} = 2.28$$

$$S = \frac{s_1^2 n_1 + s_2^2 n_2}{n_1+n_2-2} = \frac{8(3.25)+7(2.28)}{13} = 3.23$$

$S = 1.79$

$NH \; H_0 : \mu_1 = \mu_2$

$AH \; H_1 : \mu_1 \neq \mu_2$

$\alpha = 0.05$

TS :

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

$$= \frac{12-10}{1.79\sqrt{\frac{1}{8}+\frac{1}{7}}}$$

$t = 2.15$

Tab $|t| \approx 2.2$

Tab $|t| >$ cal $|t|$

$\therefore$ Accept $H_0$

14)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Method 1 | 20 | 16 | 27 | 23 | 22 | 26 | - |
| Method 2 | 27 | 33 | 42 | 35 | 32 | 34 | 38 |

$n_1 = 6, \ n_2 = 7$

$\bar{x}_1 = 22.33, \ \bar{x}_2 = 34.42$

$$S_1^2 = \frac{\Sigma (x_i - \bar{x})^2}{n-1}$$

$$S_1^2 = \frac{5.42 + 40.8 + 21.72 + 0.44 + 0.10 + 13.72}{5}$$

$S_1^2 = 16.44$

$$S_2^2 = \frac{54.92 + 1.90 + 57.38 + 0.32 + 5.90 + 0.18 + 12.98}{6}$$

$S_1^2 = 22.26$

$$F = \frac{S_2^2}{S_1^2} = \frac{22.26}{16.44} = 1.35$$

$df_1 = 7-1 = 6, \ df_2 = 6-1 = 5$

NH $H_0: \sigma_1^2 = \sigma_2^2$

AH $H_1: \sigma_1^2 \neq \sigma_2^2$

$\alpha = 0.05$

$F_{0.05}$ at $(6,5) = 4.95$

cal $|F| <$ tab $|F|$

$\therefore$ Accept $H_0$

15) $n = 264$

| No appeared - On die | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Frequency | 40 | 32 | 28 | 58 | 54 | 52 |

$E_i = 44$

| $O_i$ | $E_i$ | $O_i - E_i$ | $(O_i - E_i)^2$ | $(O_i - E_i)^2 / E_i$ |
|---|---|---|---|---|
| 40 | 44 | -4 | 16 | 0.36 |
| 32 | 44 | -12 | 144 | 3.27 |
| 28 | 44 | -16 | 256 | 5.81 |
| 58 | 44 | -14 | 196 | 4.45 |
| 54 | 44 | -10 | 100 | 2.27 |
| 52 | 44 | -8 | 64 | 1.45 |

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

$\chi^2 = 17.61$

NH $H_0$ : The die is ubiased

AH $H_1$ : The die is Biased

$\alpha = 0.05$

TS :

$\chi^2 = 17.61$

$Tab \, |\chi^2|_5 \approx 11.07$

$cal \, \chi^2 > Tab \, \chi^2$

$\therefore$ Reject $H_0$

16)

| d | $O_i$ | $E_i$ | $O_i - E_i$ | $(O_i - E_i)^2$ | $(O_i - E_i)^2 / E_i$ |
|---|---|---|---|---|---|
| 0 | 18 | 20 | -2 | 4 | 0.2 |
| 1 | 19 | 20 | -1 | 1 | 0.05 |
| 2 | 23 | 20 | 3 | 9 | 0.45 |
| 3 | 21 | 20 | 1 | 1 | 0.05 |
| 4 | 16 | 20 | -4 | 16 | 0.8 |
| 5 | 25 | 20 | 5 | 25 | 1.25 |
| 6 | 22 | 20 | 2 | 4 | 0.2 |
| 7 | 20 | 20 | 0 | 0 | 0 |
| 8 | 21 | 20 | 1 | 1 | 0.05 |
| 9 | 15 | 20 | -5 | 25 | 1.25 |

$$\chi^2 = \Sigma\left(\frac{(O_i - E_i)^2}{E_i}\right) = 4.35$$

NH $H_0$: The digits are distributed equally

AH $H_1$: Not distributed equally

$\alpha = 0.05$

Tab $\chi^2_{at\ 9} = 16.919$

$\therefore$ cal $|\chi^2| <$ Tab $|\chi^2|$

$\therefore$ Accept $H_0$

17] $\mu = 18.5$, $n = 14$,

$\sigma = 17.85$, $\bar{x} = 17.85$

NH $H_0$ : $\mu = 18.5$

AH $H_1$ : $\mu \neq 18.5$

$\alpha = 0.05$

TS :

$$t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}} = \frac{17.85 - 18.5}{\left[\frac{17.85}{\sqrt{14}}\right]} \approx -1.245$$

$df = n - 1 = 13$

tab $|t| \approx 2.160$

$\therefore$ cal $|t| <$ tab $|t|$

$\therefore$ Accept $H_0$

18] $n = 5$, $\bar{x}_1 = 46$

Weight $\Rightarrow$ 42, 39, 48, 60, 41

$n = 7$, $\bar{x}_2 = 56.14$

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

Weight $\Rightarrow$ 38, 42, 56, 64, 68, 69, 62

$$S_A^2 = \frac{16 + 49 + 4 + 196 + 25}{4} = 58$$

$$S_B^2 = \frac{327.98 + 200.98 + 0.02 + 61.46 + 142.98 + 167.30 + 34.98}{7}$$

$= 133.6$

$$S^2 = \frac{s_1^2 n_1 + s_2^2 n_2}{n_1 + n_2 - 2} = \frac{290 + 935.2}{10} = 122.52$$

$S = 11.06$

NH $H_0$ : $\mu_A = \mu_B$

AH $H_1$ : $\mu_B > \mu_A$

$\alpha = 0.05$

TS :

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} = \frac{46 - 56.14}{11.06\sqrt{\frac{12}{35}}}$$

$$= \frac{-10.14 \times 5.91}{11.06 \times 3.46} = \frac{-59.92}{38.26} = -1.56$$

$df = n_1 + n_2 - 2$

$= 12 - 2 = 10$

tab $|t| = 1.812$

∴ cal $|t|$ < tab $|t|$

∴ Accept $H_0$

19) $n_1 = 10$

$\Sigma(x_i - \bar{x})^2 = n_1 s_1^2 = 120$

$n_2 = 12$

$\Sigma(x_i - \bar{x})^2 = n_2 s_2^2 = 314$

$$S^2 = \frac{ns^2}{n-1}$$

$$S_1^2 = \frac{120}{9} = 13.33$$

$$S_2^2 = \frac{314}{11} = 28.54$$

NH $H_0$ : $\mu_1 = \mu_2$ $(\sigma_1^2 = \sigma_2^2)$

AH $H_1$ : $\mu_1 \neq \mu_2$ $(\sigma_1^2 \neq \sigma_2^2)$

$\alpha = 0.05$

TS:

$$F = \frac{S_2^2}{S_1^2} = \frac{28.54}{13.33} = 2.14$$

$F_{at\ 0.05}(11, 9) = \cancel{(3.1\ldots)}\ (3.07, 3.14)$

$\therefore$ cal $|F| <$ Tab $|F|$

$\therefore$ Accept $H_0$

20)

| | | | | | | |
|---|---|---|---|---|---|---|
| Mine1 | 8,260 | 8,130 | 8,350 | 8,070 | 8,340 | -- |
| Mine2 | 7,950 | 7,890 | 7,900 | 8,140 | 7,920 | 7,840 |

$n_1 = 5$, $n_2 = 6$

$\bar{x}_1 = 8230$

$\bar{x}_2 = 6940$

NH $H_0$ : $\sigma_1^2 = \sigma_2^2$

AH $H_1$ : $\sigma_1^2 \neq \sigma_2^2$

$\alpha = 0.05$

| $X_1$ | $X_2$ | $(X_1 - \bar{x}_1)$ | $(X_2 - \bar{x}_2)$ | $(X_1 - \bar{x}_1)^2$ | $(X_2 - \bar{x}_2)^2$ |
|---|---|---|---|---|---|
| 8860 | 7950 | 30 | 1010 | 900 | 1020100 |
| 8130 | 1890 | -100 | -5050 | 10000 | 25502500 |
| 8350 | 7900 | +120 | 960 | 14400 | 921600 |
| 8070 | 8140 | -160 | 1200 | 25600 | 1440000 |
| 8340 | 7920 | 110 | 980 | 12100 | 960400 |
| | 7840 | | 900 | | 810000 |

$$S_1^2 = \frac{63000}{4} = 3150$$

$$S_2^2 = \frac{30654600}{5} = 6130920$$

Test statistic :

$$F = \frac{S_2^2}{S_1^2} = \frac{6130920}{3150} = 1946.32$$

$\therefore$ Cal $|F|$ > Tab $|F|$

$\therefore$ Reject $H_0$