INSTITUTE OF AERONAUTICAL ENGINEERING

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COMPUTER SCIENCE AND ENGINEERING

COURSE HANDOUT

Course Name	**PROBABILITY AND STATISTICS**
Course Code	AHS010
Programme	B.Tech
Semester	II
Course Coordinator	Mr. J Suresh Goud
Course Faculty	Ms. P Srilatha
Lecture Number	44
Topics Covered	Test of hypothesis for difference of means-1
Course Learning Outcome's	Apply testing of hypothesis to predict the significance difference in the sample means.

Test of Hypothesis for Difference of Means:

Let $\overline{x_1}$ be the mean of the sample size n_1 from the population with mean μ_1 and S.D σ_1 and $\overline{x_2}$ be the mean of the sample size n_2 from the population with mean μ_2 and S.D σ_2.

$$Z = \frac{\left(\overline{x_1} - \overline{x_2}\right)}{\sqrt{\left(\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}\right)}}$$

Note: If σ is unknown then we can use S

$$Z = \frac{\left(\bar{x}_1 - \bar{x}_2\right)}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

If Samples are drawn from the same population i.e., $\sigma_1 = \sigma_2 = \sigma$

$$Z = \frac{\left(\bar{x}_1 - \bar{x}_2\right)}{\sqrt{\left(\frac{\sigma^2}{n_1} + \frac{\sigma^2}{n_2}\right)}}$$

Problems:

1. The means of two large samples of size 1000 and 2000 numbers are 67.5 and 68. Can the samples be regarded as drawn from the same population of standard deviation is 2.5 at 5%level of significance.
   Solution:

   Given

   $n_1 = 1000, \quad n_2 = 2000$

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

   $\sigma = 2.5, \quad \alpha = 5\%$

   Step 1: Null Hypothesis: $\bar{x}_1 = \bar{x}_2$

   Step 2: Alternative Hypothesis: $\bar{x}_1 \neq \bar{x}_2$

   Step 3: Level of Significance:

   $z_\alpha = 1.96 \quad at \quad \alpha = 0.05$

Step4: Test Statistics:

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

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

$$= -5.16$$

$$|Z| = 5.16$$

Step 5: Conclusion

$$|Z| > Z_\alpha$$

$\therefore$ We reject Null Hypothesis

2. A researcher wants to know the intelligence of students in a school. He selected two groups of students. In the first group there 150 students having mean IQ of 75 with a standard deviation of 15 in the second group there are 250 students having mean IQ of 70 with standard deviation of 20.

Solution:

Given

$$n_1 = 150, \quad n_2 = 250$$

$$\bar{x}_1 = 75, \quad \bar{x}_2 = 70$$

$$\sigma_1 = 15, \quad \sigma_2 = 20$$

$$\alpha = 5\%$$

Step 1: Null Hypothesis: $\bar{x}_1 = \bar{x}_2$

Step 2: Alternative Hypothesis: $\bar{x}_1 \neq \bar{x}_2$

Step 3: Level of Significance:

$$z_\alpha = 1.96 \quad at \quad \alpha = 0.05$$

Step4: Test Statistics:

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

$$= \frac{75 - 70}{\sqrt{\frac{225}{150} + \frac{400}{250}}}$$

$$= 2.711$$

$$|Z| = 2.711$$

Step 5: Conclusion

$$|Z| > Z_{\alpha}$$

$\therefore$ We reject Null Hypothesis

Exercise:

1. Two types of new cars produced in U.S.A. are tested for petrol mileage, one sample is consisting of 42 cars averaged 15 kmpl while the other sample consisting of 80 cars averaged 11.5 kmpl with population variances 2.0 and 1.5 respectively. Test whether there is any significance difference ijn the petrol consumption of these two types of cars. (Use level of significance 0.01)

2. The research investigator is interested in studying whether there is a significance difference in the salaries of MBA grades in two metropolitan cities. A random sample od size 100 from Mumbai yields on average income of Rs. 20,150. Another random sample of 60 from Chennai results in an average income of Rs. 20,250. If the variances of both the population are given as Rs. 40,000 and Rs. 32,400 respectively.