

Unit 5 – Worksheet

1. A publisher of college textbooks claims that the average price of all hardbound college textbooks is Rs. 1,200. A student group believes that the actual mean is lower and wishes to test their belief. State the relevant null and alternate hypotheses.
2. The recipe for a bakery item is designed to result in a product that contains 8 grams of fat per serving. The quality control department samples the product periodically to ensure that the production process is working as designed. State the relevant null and alternate hypotheses.
3. Suppose that it is known that the population is normally distributed with standard deviation $\sigma = 25$ and suppose that the test of hypotheses $H_0: \mu = 120$ versus $H_a: \mu > 120$ will be performed with a sample of size 10. Construct the rejection region for the test for the choice $\alpha = 0.01$.
4. Suppose that it is known that the population is normally distributed with standard deviation $\sigma = 0.2$ and suppose that the test of hypotheses $H_0: \mu = 10$ versus $H_a: \mu \neq 10$ will be performed with a sample of size 5. Construct the rejection region for the test at 5% level of significance.
5. Compute the observed significance of each test.
 - (i) Testing $H_0: \mu = 54.7$ vs. $H_a: \mu < 54.7$, test statistic $z = -1.72$.
 - (ii) Testing $H_0: \mu = -45$ vs. $H_a: \mu > -45$, test statistic $z = 2.54$.
 - (iii) Testing $H_0: \mu = 195$ vs. $H_a: \mu \neq 195$, test statistic $z = -2.07$.
6. The total score in a professional basketball game is the sum of the scores of the two teams. An expert commentator claims that the average total score for NBA games is 202.5. A fan suspects that this is an overstatement and that the actual average is less than 202.5. He selects a random sample of 85 games and obtains a mean total score of 199.2 with standard deviation 19.63. State the null hypothesis and alternate hypothesis. Determine, at the 5% level of significance, whether there is sufficient evidence in the sample to reject the expert commentator's claim. (Use Z-test)
7. Mr. Peter has been teaching Algebra II from a particular textbook at an High School for many years. Over the years students in his Algebra II classes have consistently scored an average of 67 on the end of course exam (EOC). This year Mr. Peter used a new textbook in the hope that the average score on the EOC test would be higher. The average EOC test score of the 64 students who took Algebra II from Mr. Peter this year had mean 69.4 and sample standard deviation 6.1. State the null hypothesis and alternate hypothesis. Determine whether these data provide sufficient evidence, at the 1% level of significance, to conclude that the average EOC test score is higher with the new textbook. (Use Z-test)

8. For the surface water in a particular lake, local environmental scientists would like to maintain an average pH level at 7.4. Water samples are routinely collected to monitor the average pH level. If there is evidence of a shift in pH value, in either direction, then remedial action will be taken. On a particular day 30 water samples are taken and yield average pH reading of 7.7 with sample standard deviation 0.5. State the null hypothesis and alternate hypothesis. Determine, at the 1% level of significance and 5% level of significance, whether there is sufficient evidence in the sample to indicate that remedial action should be taken. (Use Z-test)

9. Make the decision in each test, based on the information provided.

(i) Testing $H_0: \mu = 82.9$ vs. $H_a: \mu < 82.9$ @ $\alpha = 0.05$, observed significance $p = 0.038$.

(iii) Testing $H_0: \mu = 31.4$ vs. $H_a: \mu > 31.4$ @ $\alpha = 0.05$, observed significance $p = 0.062$.

(ii) Testing $H_0: \mu = 213.5$ vs. $H_a: \mu \neq 213.5$ @ $\alpha = 0.01$, observed significance $p = 0.038$.

10. The average amount of time that visitors spent looking at a retail company's old home page on the world wide web was 23.6 seconds. The company commissions a new home page. On its first day in place the mean time spent at the new page by 7,628 visitors was 23.5 seconds with standard deviation 5.1 seconds. Test at the 5% level of significance whether the mean visit time for the new page is less than the former mean of 23.6 seconds, using the p-value approach.

11. In a recent year the fuel economy of all passenger vehicles was 19.8 mpg. A trade organization sampled 50 passenger vehicles for fuel economy and obtained a sample mean of 20.1 mpg with standard deviation 2.45 mpg. The sample mean 20.1 exceeds 19.8, but perhaps the increase is only a result of sampling error. Perform the test of hypotheses at the 1% level of significance using the p-value approach.

12. The mean increase in word family vocabulary among students in a one-year foreign language course is 576 word families. In order to estimate the effect of a new type of class scheduling, an instructor monitors the progress of 60 students; the sample mean increase in word family vocabulary of these students is 542 word families with sample standard deviation 18 word families. Test at the 5% level of significance and at 1% level of significance whether the mean increase with the new class scheduling is different from 576 word families, using the p-value approach.

13. Two random samples taken from two normal populations yielded the following information: $n_1 = 16, n_2 = 21, s_1^2 = 53, s_2^2 = 32$. Find the statistic F . Perform the test of hypotheses $H_0 = \sigma_1^2 = \sigma_2^2$ vs. $H_a = \sigma_1^2 > \sigma_2^2$ at the 5% level of significance. Given $F_{0.05,15,20} = 2.2$.

14. Two random samples taken from two normal populations yielded the following information: $n_1 = 10, n_2 = 13, s_1^2 = 12, s_2^2 = 23$. Find the statistic F . Perform the test of hypotheses $H_0 = \sigma_1^2 = \sigma_2^2$ vs. $H_a = \sigma_1^2 < \sigma_2^2$ at the 5% level of significance. Given $F_{0.95,9,12} = 0.3254$.

15. Two random samples taken from two normal populations yielded the following information: $n_1 = 9, n_2 = 31, s_1^2 = 123, s_2^2 = 543$. Find the statistic F . Perform the test of hypotheses $H_0 = \sigma_1^2 = \sigma_2^2$ vs. $H_a = \sigma_1^2 \neq \sigma_2^2$ at the 5% level of significance. Given $F_{0.975,8,30} = 0.26, F_{0.025,8,30} = 2.65$.

16. A laptop computer maker uses battery packs supplied by two companies, A and B. When both brands have the same average battery life between charges(LBC), the computer maker seems to receive more complaints about shorter LBC than expected for battery packs supplied by company B. The computer maker suspects that this could be caused by higher variance in LBC for brand B. To check that, ten new battery packs from each brand are selected, installed on the same models of laptops, and the laptops are allowed to run until the battery packs are completely discharged. The following are the observed LBCs in hours:

Brand A	3.2	3.4	2.8	3.0	3.0	3.0	2.8	2.9	3.0	3.0
Brand B	3.0	3.5	2.9	3.1	2.3	2.0	3.0	2.9	3.0	4.1

Test, at the 5% level of significance, whether the data provide sufficient evidence to conclude that the LBCs of Brand A have a larger variance than those of Brand B. Given $F_{0.05,9,9} = 3.18$.

17. A manufacturer of a blood-pressure measuring device for home use claim that its device is more consistent than that produced by a leading competitor. During a visit to a medical store a potential buyer tried both devices on himself repeatedly during a short period of time. The following are readings of systolic pressure.

Manufacturer	132	134	129	129	130	132
Competitor	129	132	129	138	-	-

Test at the 5% level of significance, whether the data provides sufficient evidence to conclude that the manufacturer's claim is true. Given $F_{0.95,5,3} = 0.1848$.

18. The annual salaries, in thousands of dollars of 8 men at a company are 55.5, 64.8, 68.2, 70.2, 52.4, 56.8, 60.6, 72.5, while those of 6 women are: 56.2, 48.8, 58.4, 50.9, 60.2, 54.5. Test at the 5% level of significance, that there in no difference in variance of salaries of men and women. Given $F_{0.025,7,5} = 6.85, F_{0.975,7,5} = 0.19$.

19. Based on field experiments, a new variety green gram is expected to given an yield of 12.0 quintals per hectare. The variety was tested on 10 randomly selected farmers fields. The yield (quintals/hectare) were recorded as 14.3,12.6,13.7,10.9,13.7,12.0,11.4,12.0,12.6,13.1. Do the results confirm the expectation? Use t-test. Given $t_{0.05}(9) = 2.26, t_{0.01}(9) = 3.25$.

20. In certain food experiment to compare two types of baby foods A and B, the following results of increase in weight (lbs) we observed in 8 children as follows.

Food A	49	53	51	52	47	50	52	53
Food B	52	55	52	53	50	54	54	53

Examine the significance of increase in weight of children due to food B.

Use t-test. Given $t_{0.05}(7) = 2.37, t_{0.01}(7) = 3.5$.

21. The numbers 24.4, 18.9, 12.8, 20.5, 19.1, 15.2, 21.7, 14.6 form a random sample of values of a normally distributed random variable. Find a 95% confidence interval for the mean of the population. Given $t_{0.05}(7) = 2.37$.

22. Suppose a random sample of size 16 has the standard deviation of 3. What values of \bar{x} will result in the rejection of the hypothesis: $\mu = 12$, at 1% level of significance? Given $t_{0.01}(15) = 2.95$.

23. A data sample is sorted into five categories with an assumed probability distribution.

Factor Levels	Assumed Distribution	Observed Frequency
1	0.3	23
2	0.3	30
3	0.2	19
4	0.2	18

Find the expected number e of observations for each level, if the sampled population has a probability distribution as assumed. Find the chi-square test statistic χ^2 . Test the goodness of fit at 5% and 1% level of significance. Given $\chi_{0.05}^2(3) = 7.815, \chi_{0.01}^2(3) = 11.345$.

24. A pair of dice is tossed 360 times and the frequency of each sum is indicated in the table below:

Sum	2	3	4	5	6	7	8	9	10	11	12
Frequency	8	24	35	37	44	65	51	42	26	14	14

Use chi-square test to check the fairness of the dice at 5% and 1% level of significance. Given $\chi_{0.05}^2(10) = 18.307, \chi_{0.01}^2(10) = 23.209$.

25. Over the years, the grades in a certain college professor's class are typically as follows: 10% As, 20% Bs, 50% Cs, 15% Ds and 5% Fs. The grades of her current class of 100 are 16 As, 28Bs, 46 Cs, 10 Ds and 0Fs. Test the hypothesis that the current class is typical by a chi-squared test at 5% and 1% significance level. Given $\chi_{0.05}^2(4) = 9.488, \chi_{0.01}^2(4) = 13.277$.