## Lesson 11

index Reading**:** ***An Introduction to Statistical Methods and Data Analysis*,** Chapters 7.3, 10.3 and 10.5**.**

## Sample Homework Problem:

1. Problem 7.25 (7.32 in 5th ed) a, c (skip b) (Note that the p-value in the Minitab output corresponds to the p-value of a two-tailed test. (You need to make appropriate adjustment to find the p-value for the one-tailed test.)
2. Problem 10.78 (10.78 in 5th ed)

**Partial Solutions:**

1. **Problem 7.32**.

We provide solution first to c and then to a.

**c**) Both samples are normally distributed. Therefore, the required conditions have been met for the inferences and we may use F-test to compare the variances of the two portfolio in a.

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* + 1. To formally test, we want to conduct the following hypothesis test, Ho: σ²1 = σ²2, Ha: σ²1 < σ²2 (one-sided left-tailed test). Use α = 0.05.

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| Homogeneity of Variance Response Returns  Factors Portfolio  ConfLvl **95.0000**  Bonferroni confidence intervals for standard deviations    Lower Sigma Upper N Factor Levels  2.35242 **3.59629** 7.2417 10 Portfolio 1  3.89800 **5.95912** 11.9996 10 Portfolio 2    F-Test (normal distribution)  Test Statistic: **2.746**  P-Value : **0.148**  Levene's Test (any continuous distribution)  Test Statistic: 3.512  P-Value : 0.077 |

Using results from part c, we know that the data from both populations may come from normal distribution and it is correct to make inference based on the F-Test. In this case we cannot reject Ho (F = 0.364; p = 0.074) at α = 0.05 level. P-value for one-sided test is (p-value for two-sided test / 2) = 0.148/2 = 0.074. Therefore, we conclude there is not enough evidence to suggest that portfolio2 has a higher risk than portfolio1.

Note that for this problem, the hypothesis is one-sided whereas Minitab output is for a two tailed test. We thus need to make adjustment to obtain the p-value of the one tailed test.

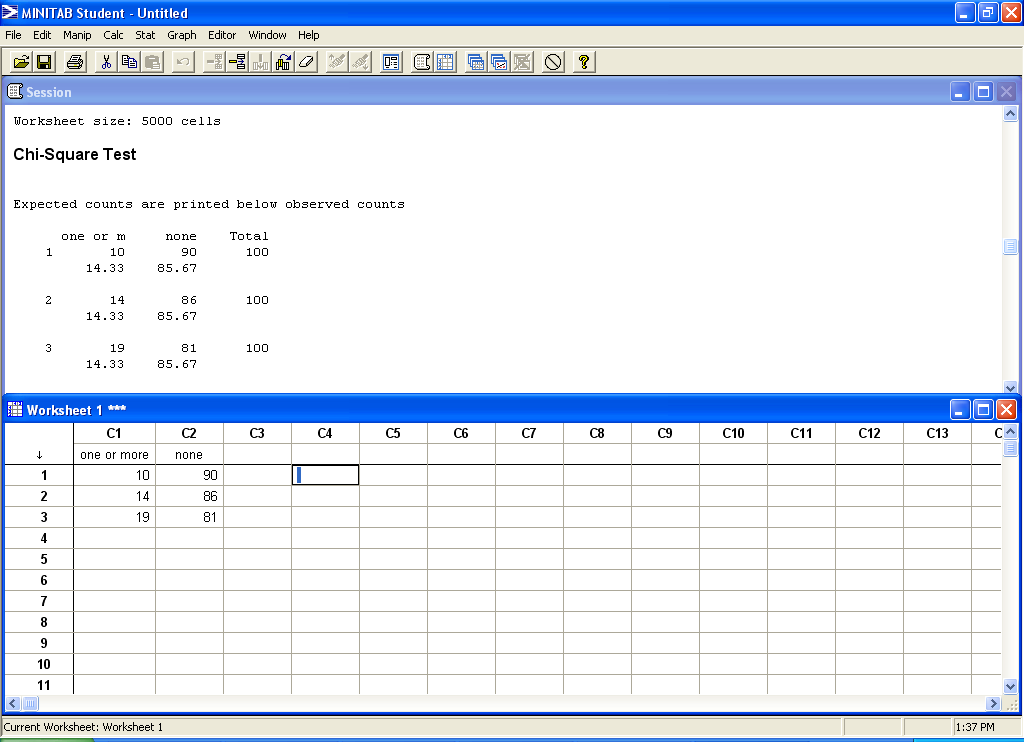
1. **Problem 10.78**
2. The percentage of rats with one or more tumors for each of three treatment groups are Control 10/100 = 10%, Low Dose 14/100 = 14%, High Dose 19/100 = 19%.
3. Set up the hypotheses:

Ho: Number of tumor and rat group are independent.

Ha: Number of tumor and rat group are dependent.

α = 0.05.

How to enter data into Minitab:



Output from Minitab:

|  |
| --- |
| Expected counts are printed below observed counts  one or m none Total  1 10 90 100  14.33 85.67  2 14 86 100  14.33 85.67  3 19 81 100  14.33 85.67  Total 43 257 300  Chi-Sq = 1.310 + 0.219 +  0.008 + 0.001 +  1.519 + 0.254 = 3.312  DF = 2, P-Value = 0.191 |

Test statistic is χ² = ∑ [ (nij – Eij)²/Eij ] = 3.312 with df = (r – 1)(c - 1) = 2\*1 = 2, and P-value = 0.191. Since the *p*-value = 0.191 > 0.05 = α, we fail to reject the null hypothesis. Therefore, there is no sufficient evidence of a difference in the proportion of rats having one or more tumors for the three rat groups, i.e. the population proportions for each group are identical.

1. There does not seem to be a drug-related problem regarding tumors for this drug product since we failed to reject the null hypothesis in part (b).

**Practice Homework:** (Please do not submit these problems): 7.23 (7.27 in 5th ed), 10.23(a)(c) (10.31, 10.32 in 5th ed are similar), 10.42 (10.60 in 5th ed), and 10.67 (10.67 in 5th ed).

**Submit the following Homework Problems to “Dropbox for HW 11”**

1. A study was conducted to compare the variability in strengths of 1-inch square sections of a synthetic fibre produced under two different procedures. A random sample of 9 squares from each process was obtained and tested.

1. Plot the data for each sample separately.
2. Is the assumption of normality warranted?
3. If permissible from part(b), use the following data to test the research hypothesis that the population variances corresponding to the two procedures are different. Use α = 0.10.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Procedure 1 | 74 | 90 | 103 | 86 | 75 | 102 | 97 | 85 | 69 |
| Procedure 2 | 59 | 66 | 73 | 68 | 70 | 71 | 82 | 69 | 74 |

(Part (a) refers to plotting the data so that one can answer part (b). For part (c), use Minitab to perform the appropriate test and draw a conclusion using the p-value from the relevant output.)

2. Problem 6.43 (6.39 in 5th ed) (a) (b) (Note: You first check whether you may use 2-sample t-test. Then use Minitab to perform the Test of Equal Variances to check whether you should use the pooled or non-pooled 2 sample t-test. Finally, use Minitab to perform the 2-sample t test to answer the question.)

3. A law student believes that the proportion of registered Republicans in favor of additional tax incentives is greater than the proportion of registered Democrats in favor of such incentives. The student acquired independent random samples of 200 Republicans and 200 Democrats and found 109 Republicans and 86 Democrats in favor of additional tax incentives. Use these data to test H0: π1 – π2 ≤ 0 versus Ha: π1 – π2 > 0. Give the level of significance for your test. (10.26 in 5th ed) (Use Minitab)

4. Problem 10.65 (10.65 in 5th ed) (Use Minitab, refer to Sample Problem 2 to see how to input data into Minitab)

5. For Problem 10.65, provide a hand computation to the chi-square Statistics and its degrees of freedom.

6. Problem 10.80 (10.80 in 5th ed) (Please note that the first cell on the upper left corner explains that the second entry of each cell is the expected cell numbers. The output is given in p.568 of the textbook. The purpose of this problem is to familiarize you with SAS output )

7. Learning at home: M. Stuart et al. studied various aspects of grade-school children and their mothers. One of the questions dealt with the children’s knowledge of nursery rhymes. The following data were obtained:

. Nursery Rhyme knowledge

|  |  |  |  |
| --- | --- | --- | --- |
| Social status | A few | Some | Lots |
| Middle class | 7( ) | 13( ) | 16( ) |
| Working | 8( ) | 11( ) | 18( ) |

Hand compute the expected counts at each cell and then use Minitab to find out the chi-square statistic and the p-value of the test. Check whether one can use the chi-square test of independence and conduct the test at α = 0.05