## ECO 173: Applied Statistics

## Sample Midterm 2 Exam

This sample exam does not cover all the materials you are responsible to know for your midterm 2 exam. This sample is designed to give you an idea of the question pattern and the level of difficulty you are likely to face in the exam. You are advised to peruse the textbook chapters, class notes, slides and worksheets to be fully prepared for this exam.

For the following hypothesis test problems apply the given steps to conduct a comprehensive hypothesis test. You are expected to memorize these steps, and apply them in the exact order in your exam.

Step 1: State the theory/question you are about to test.
Step 2: State the test design (i) Null and Alternative Hypothesis (ii) Right, Left or Two tailed test (iii) Distribution of the sampling distribution of sample mean

## Step 3: Compute the test statistic

Step 4: Find the critical values of the rejection region. Include sketch of the standardized sampling distribution to show the rejection regions.

Step 5: State your decision. Interpret your decision with respect to the theory stated in Step 1.

Hypothesis test for population mean when population standard deviation is unknown:

Problem 1: A consumer group, concerned about the mean fat content of a certain grade of steakburger submits to an independent laboratory a random sample of 12 steakburgers for analysis. The percentage of fat in each steakburger is as follows:

## $\begin{array}{lllllllllll}21 & 18 & 19 & 16 & 18 & 24 & 22 & 19 & 24 & 14 & 18 \\ 15\end{array}$

The manufacturer claims that the mean fat content of this grade of steakburger is less than 20\%. Assuming percentage fat content is normally distributed, carry out an appropriate hypothesis test in order to advise the consumer group as to the validity of the manufacturer's claim. Choose a 5\% significance level.

Problem 2: The high school athletic director is asked if football players are doing well academically as the other student athletes. We know from a previous study that the average GPA for the student athletes is 3.10 . After an initiative to help improve the GPA of student athletes, the athletic director randomly samples 20 football players and finds that the average GPA of the sample is 3.18 with a sample standard deviation of 0.54 . Is there a significant improvement? Use a 0.05 significance level.

Problem 3: A random sample of 14 cows was selected from a large dairy herd at Brookfield Farm. The milk yield in one week was recorded, in kilograms, for each cow. The results are given below.

## $\begin{array}{lllllll}169.6 & 142.0 & 103.3 & 111.6 & 123.4 & 143.5 & 155.1\end{array}$ $\begin{array}{lllllll}101.7 & 170.7 & 113.2 & 130.9 & 146.1 & 169.3 & 155.5\end{array}$

Stating clearly any distributional assumptions that you make, investigate the claim that the mean weekly milk yield for the herd is greater than 120 kg .

## Hypothesis test for population variance

Problem 4: A user of a certain gauge of steel wire suspects that the standard deviation of its breaking strength, in newtons ( N ), is different from the value of 0.75 as specified by the manufacturer.

Consequently, the user tests the breaking strength of each of a random sample of nine lengths of wire and obtains the following results.

## $\begin{array}{lllllllll}72.1 & 74.5 & 72.8 & 75.0 & 73.4 & 75.4 & 76.1 & 73.5 & 74.1\end{array}$

(a) Assuming breaking strength to be normally distributed, test, at the $10 \%$ level of significance, the manufacturer's specification, (i.e. are the manufacturer's specifications supported by sample evidence or is sample evidence registering a difference in the standard deviation?)
(b) Estimate the true population standard deviation at $90 \%$ confidence level.

Problem 5: The makers of Flippin' Out Pancake Mix claim that one cup of their mix contains 11 grams of sugar. However, the mix is not uniform, so the amount of sugar varies from cup to cup. One cup of mix was taken from each of 24 randomly selected boxes. The sample variance of the sugar measurements from these 24 cups was 1.47 grams. Assume that the distribution of sugar content is approximately normal.
(a) Construct the $95 \%$ confidence interval for population variance.
(b) Test at $2.5 \%$ significance level whether the variance of the particle diameter of all particles in 220 -rated sandpaper is greater than 2.0 micrometers.

## Hypothesis Test for Population Proportion

Problem 6: An e-commerce research company claims that $60 \%$ or more graduate students have bought merchandise online. A consumer group is suspicious of the claim and thinks that the proportion is lower than $60 \%$. A random sample of 80 graduate students shows that only 22 students have ever done so. Is there enough evidence to show the true proportion is lower than $60 \%$ ? Conduct an appropriate hypothesis test.

Problem 7: The CEO of a large electric utility claims that 80 percent of his 1,000,000 customers are very satisfied with the service they receive. To test this claim, the local newspaper surveyed 100 customers, using simple random sampling. Among the sampled customers, 73 percent say they are very satisified. Based on these
findings, can we reject the CEO's hypothesis that $80 \%$ of the customers are very satisfied? Use a 0.05 level of significance. Conduct a two-tailed test.

Problem 8: A local law enforcement agency claimed that fewer than $50 \%$ of store owners actually turn shoplifters over to police. A random sample of 40 store owners indicated that only 24 of them turn shoplifters over to police. Test the law enforcement agency's claim.

Hypothesis test for difference in two population means (Independent Samples)

Problem 9: A random sample of 48 men with new CPA certifications showed a mean starting salary of \$80,168 and a standard deviation of $\$ 8000$. At the same time, a random sample of 39 women with new CPA certifications showed a mean starting salary of $\$ 70,754$ and a standard deviation of $\$ 6000$.
(a) Test if men are paid more than women at $1 \%$ significance level.
(b) Construct a $95 \%$ confidence interval for the difference in the mean salaries of men and women.

Problem 10: We want to compare the average weights of Hilsha fish in two river basins: (1) Padma and (2) Meghna River. Based on the health of the two rivers, we believe that the Hilsha in the Padma will be larger, on average, and would like to test for this effect. We randomly sample 100 Hilsha fish in each basin. The mean weight of the Padma Hilsha is 800 grams with a standard deviation of 400 grams. The mean weight of the Meghna Hilsha is 700 grams with a standard deviation of 300 grams. At $5 \%$ level of significance, does the data provide sufficient evidence that the Hilsha in the Padma will be larger on average?

Problem 11: A men's softball league is experimenting with a yellow baseball that is easier to see during night games. One way to judge the effectiveness is to count the number of errors. In a preliminary experiment, the yellow baseball was used in 10 games and the traditional white baseball was used in another 10 games. The number of errors in each game was recorded. The sample statistics of these errors are given below. Can we infer that there are fewer errors on average when the yellow ball is used?

Yellow Ball: mean $=5.1$; standard deviation $=2.42$
White Ball: mean $=7.3$; standard deviation $=2.41$

