

## Practice Midterm Exam; Stat 431

**Instructions:** Closed Book. The “Facts and Formulas” sheets will be included with the exam. Calculators are allowed for numerical calculations. On the regular exam you will be asked to write answers on the test pages along with your work. (Space, and additional pages if necessary, will be allowed for this.) When performing hypothesis tests, clearly state the null and alternative hypotheses and show the critical value and/or P-value (from the table) where appropriate. Normal and t tables will be provided.

**Time** = 90 minutes.

(24) **1.** In any bottling process a manufacturer will lose money if the bottles contain either more or less than is claimed on the label. Suppose a quality manager for a ketchup company is interested in testing whether the mean number of ounces per family size bottle differs from the labeled amount of 24 ounces. The manager samples 90 bottles, measures the weight of their contents, and finds that  $\bar{x} = 23.96$  and  $s = .32$ .

i) Does the sample evidence indicate that the ketchup dispensing machine needs adjustment? State null and alternative hypotheses and test at  $\alpha = .05$ .

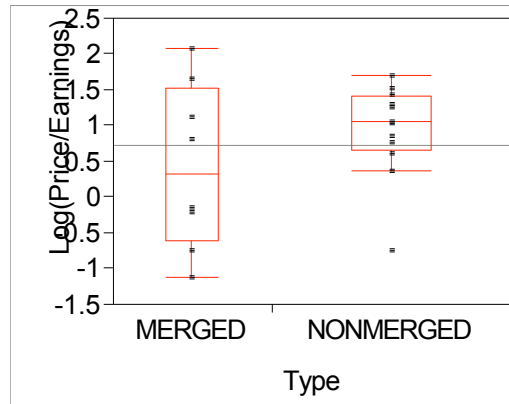
ii) Find a 99% confidence interval for the mean number of ounces of ketchup being dispensed.

iii) Bottles having net weight less than 23.76 ounces are more than 1% underweight, and hence can be cited by the FDA as being mislabeled. **Using the data provided**, give the best available estimate of the proportion of ketchup bottles that will fail to meet the FDA standard of weighing at least 23.76 ounces.

(25) **2.** Wansley, Roenfeldt, and Cooley (1983) compared the profiles of a sample of 8 firms that merged during 1975-1976 with those of a separate sample of 12 firms that did not merge. They wished to compare the logarithms of the firms’ price-to-earnings ratios. Selected JMP plots and tables for the Log(Price/Earnings) are given below.

(These firms may be considered a random sample of all firms during the 70s. In answering questions i) - iv) below you may assume the relevant populations are satisfactorily normal.)

### Oneway Analysis of Log(Price/Earnings) By Type



#### Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean
MERGED	8	0.441	1.158	0.409
NONMERGED	12	0.942	0.655	0.189

- i) Give a 95% confidence interval for the mean Log(Price/Earnings) of all Merged Firms.
- ii) Construct a similar 95% confidence interval for the mean Log(Price/Earnings) of all Nonmerged Firms.
- iii) Consider testing

$$H_0: \mu_{\text{Merged}} = \mu_{\text{Nonmerged}} \text{ versus } H_a: \mu_{\text{Merged}} \neq \mu_{\text{Nonmerged}}$$

Does a test at  $\alpha = .05$  reject  $H_0$  or fail to reject  $H_0$ ? Show your work or explain your reasoning. (Here  $\mu_{\text{Merged}}$  denotes the population mean of the value of Log(Price/Earnings) for the population of all Merged Firms, and similarly for  $\mu_{\text{Nonmerged}}$ .)

- iv) Give the approximate P-value for the test in part iii). (Make the best statement you can based on the t-tables in the text.)

(12) **3.** A randomized experiment was performed to test the food value of a new variety of high-lysine corn. 20 sibling-pairs of one-day-old chicks were chosen for the experiment. (The two members of each pair come from the same “mother” and “father” chickens.)

One member of each pair was fed a diet based on the new corn; the other member of the pair was fed a similar diet based on normal corn. The data are the weight gains in grams after 21 days. Here are the summary data for the chicks fed the Control (=normal) and Experimental diets, and for the difference in weights between the control and experimental chick in each sibling pair:

	N	Mean	StDev
Control	20	362.8	50.85
Experimental	20	392.9	42.73
Difference	20	omitted	46.59

- i) Use this data to construct the most appropriate test at level  $\alpha = .01$  to discover

whether there is a difference in the nutritive value of these two varieties of corn.  
(Note: the histograms for the data reveal that it conforms reasonably well to the usual assumption of normality.)

ii) Report the P-value for the test in i) as accurately as possible using the tables provided.

(22) 4. Prior to a TV advertising campaign, the producers of Nike athletic shoes find that 29 among a random sample of 200 people were aware of their new leisure shoe line.

- a) Give a 95% confidence interval for the proportion of people showing brand awareness.
- b) How many more people should they sample in order to reduce the margin of error of the above interval by one-half?
- c) An intensive TV advertising campaign was launched. A second random sample of 300 people is taken after the campaign. 96 among these 300 people are aware of the new line.
  - a. Construct a 99% confidence interval for the difference in the proportion of people showing brand awareness before and after the ad campaign.
  - b. Is the data significant at the  $\alpha = 0.05$  level to show the effectiveness of the TV advertising campaign? Set up the appropriate hypotheses and carry out the test. Did you use a one-sided test or a two sided one? Why?
  - c. Find the P-value of this test.

(7) 5. I recently received a telephone call. The caller gave me the following facts:

- He graduated from Wharton 18 years ago.
- He had recently taken over as a VP in the commercial loan dep't of a major bank.
- The bank had done a survey to discover the real, total costs to the borrower and to the bank inherent in creating a certain type of commercial loan.
- The costs are a lot higher than anyone suspects.
- The survey involved looking carefully at the records for 100 loans.
- This survey provided an estimate with 95% confidence to within  $\pm \$215$ .
- His boss wants a more accurate survey. To be specific his boss wants an estimate with 98% confidence that is within  $\pm \$100$ .
- His boss would like to budget now for the additional time and expense of carefully examining the additional loan records needed to get such an estimate.

Approximately how many additional loan records will need to be examined in order to get the desired confidence interval?

[PS. I wanted to get some additional information from him, such as a look at the data to check normality and to see whether the preceding interval was properly calculated. He wouldn't give me that information. ("It's privileged.") However, the information that he did give me is enough to get a satisfactory answer to his question, on the assumption that the sample of 100 loans was properly taken and used.]

Show enough of your work so as to make clear your method of solution.

(5) 6. This problem refers to the situation in problem 1. You should use the data provided in that problem to help answer this one.

The ketchup producer in problem 1 installs an accurate bottle weighing machine at the end of the production line. This machine weighs every bottle produced and discards into the trash every bottle whose net weight is less than 23.76 ounces (the FDA standard). For those substandard bottles both the glass container and the ketchup it contains are trashed.

Ketchup costs the producer 1¢ per ounce and empty bottles cost 5¢ each. Filled bottles that pass the weight test can be sold for 50¢ each. Using the available data, what is the best estimate for the profit the manufacturer will make on each 1000 bottles produced?

{Note: This problem is different from any we've done in class. It involves some principles you should be carrying forward from Stat 430, or equivalent. This illustrates that you may expect to see something on the actual exam that goes beyond what we've explicitly covered in class. Of course, the actual exam won't contain this problem – or one just like it.}