

Name: _____

STATISTICS 217, SPRING 2005

EXAM 2; March 31, 2005; 100 points

v. 1

Instructions: Write legibly. Closed book. Calculator allowed. Double-sided exam.

Multiple Choice Questions (4 pts each). Circle the SINGLE best answer for each question.

- In a jar, there are ten marbles, of which five are blue and five are red. Three marbles are drawn at random, one after another and with replacement. Let X denote the number of selected marbles that are blue.
 - X does not have a binomial distribution because the probability of success changes from observation to observation.
 - X does not have a binomial distribution because the observations are not all independent.
 - X does not have a binomial distribution because the number of observations is not fixed.
 - X does not have a binomial distribution because each observation has more than two possible outcomes.
 - X does have a binomial distribution.
- A Gallup Poll recently surveyed 1700 American teenagers and reported that two-thirds of the teenagers have a television in their bedroom. The reported value of “two-thirds” is a
 - sample proportion.
 - population proportion.
 - count of successes.
 - sample size.
- The National Institute of Mental Health reports that an adult American has a 20% chance of suffering from a psychiatric disorder. Let X be the number of adults in a simple random sample of 500 that have a psychiatric disorder. The approximate distribution of X is
 - $X \sim N(0, 1)$
 - $X \sim N(500, 0.2)$
 - $X \sim BIN(500, 0.2)$
 - $X \sim BIN(100, 0.2)$
- Suppose we want to test for an association between two categorical variables using an $r \times c$ two-way table. If an association exists, one will likely see
 - a large value of X^2 from an approximate chi-square distribution with $(r - 1) \times (c - 1)$ degrees of freedom.
 - a small to moderate value of X^2 from an approximate chi-square distribution with $r \times c$ degrees of freedom.
 - a small to moderate value of X^2 from an approximate chi-square distribution with $(r - 1) \times (c - 1)$ degrees of freedom.
 - a large value of X^2 from an approximate chi-square distribution with $r \times c$ degrees of freedom.

Use the following scenario to answer questions 5, 6, and 7.

An Associated Press article on potential violent behavior reported the results of a simple random sample of 750 full-time workers. Of those sampled, 125 indicated that they were so angered by a coworker that he or she felt like hitting the person. Use the data to test if the true proportion of full-time workers so angered by a colleague that they wanted to hit him or her exceeds 15%.

5. What are the appropriate hypotheses to test?
- A. $H_0 : p = 0.1667$ vs. $H_a : p > 0.1667$
 - B. $H_0 : p = 0.15$ vs. $H_a : p > 0.15$
 - C. $H_0 : p = 15\%$ vs. $H_a : p > 15\%$
 - D. $H_0 : p = 16.67\%$ vs. $H_a : p \neq 16.67\%$
6. What does the number 125 represent?
- A. The sample size
 - B. The sample proportion
 - C. The population proportion
 - D. The number of successes
7. What is the parameter of interest?
- A. The true proportion of full-time workers who were so angered by a colleague that he or she felt like hitting the person.
 - B. The proportion of the 750 full-time workers who were so angered by a colleague that he or she felt like hitting the person.
 - C. The number of full-time workers who were so angered by a colleague that he or she felt like hitting the person.
 - D. The number of people who invoke violent behavior on another person.

Choose the Correct Statistical Test: Write the letter (A. through D.) corresponding to the correct statistical test in the blank provided for each description. (4 pts each)

A. one proportion B. two proportions C. chi-square D. none of the above

_____ There were 21,870 male physicians, age 40-84, who participated in the Physicians Health Study. Each physician was categorized by "Smoking Status" (never smoked, smoked in the past, or currently smokes) and "Alcohol Consumption" (<1, 1, 2-4, 5-6, or >6 drinks per week). Is there an association between smoking status and alcohol consumption?

_____ Can duct tape fix anything? Many people were skeptical when researchers announced that duct tape may be a more effective and less painful alternative to liquid nitrogen, which doctors routinely use to freeze warts. In a study, patients were randomly assigned to either the duct tape treatment or the more traditional freezing treatment. The proportion of warts successfully removed was recorded for each treatment.

SHOW YOUR WORK: Problems and Discussion

Instructions: SHOW ALL WORK to receive full credit. Perform all calculations to 4 decimal places.

8. **Pets and Pesticides** Researchers at the National Cancer Institute released the results of a study that examined the effect of weed-killing herbicides on house pets. Dogs, some of whom were from homes where the herbicide was used on a regular basis, were examined for the presence of malignant lymphoma. Test the researchers claim that the proportion of exposed dogs that develop lymphoma exceeds that for unexposed dogs. Assume the necessary assumptions have been met.

Group	n	Number with Lymphoma
1 - Exposed	827	473
2 - Unexposed	130	19

- (a) State the hypotheses to be tested. (4 pts)
- (b) Calculate the test statistic for testing H_o versus H_a . (4 pts)
- (c) What is the distribution of the test statistic, assuming H_o is true? (3 pts)
- (d) Compute the p-value for this test. (3 pts)
- (e) Compare the p-value to $\alpha = 0.05$. What is your decision regarding H_o ? (2 pts)
- (f) State your conclusion in terms of the problem. (4 pts)

9. **Doctor-Assisted Suicide** The Society for the Right to Die and the American Medical Association quoted very different figures regarding the proportion of primary-care physicians who have participated in some form of doctor-assisted suicide for terminally ill patients. Suppose that a survey of physicians is to be designed to estimate this proportion to within 0.05 with 95% confidence. How many primary-care physicians should be included in the sample? (6 pts)

10. **Credit Card Debt** The credit card industry asserts that 50% of college students carry a credit card balance from month to month. However, in a random sample of 310 credit-card-carrying college students, 217 carried a balance each month. Assume the necessary assumptions have been met.

(a) Construct a 95% confidence interval for the true proportion of credit-card-carrying college students who carry a balance each month. (6 pts)

(b) Give the interpretation of the 95% confidence interval in terms of the problem. (5 pts)

11. **Drugs** To compare the effectiveness of four drugs in relieving post-operative pain, an experiment was done by randomly assigning 195 surgical patients to one of the four drugs under study. Recorded here are the number of patients assigned to each drug as well as the number of patients who were free of pain for a period of at least five hours.

	Free of Pain	Not Free of Pain	Total
Drug 1	23	29	52
Drug 2	30	18	48
Drug 3	22	28	50
Drug 4	25	20	45
Total	100	95	195

(a) Compute the conditional distribution of the drug treatment variable for the free-of-pain patients. Give answers as fractions. (4 pts)

Drug 1	Drug 2	Drug 3	Drug 4

- (b) A chi-square test was conducted on the post-operative pain data. Assume the necessary assumptions have been met. Note some of the Minitab output has been purposely deleted and you will be asked to calculate the omitted values in the questions below.

	Free of Pain	Not Free of Pain	Total
Drug 1	23 26.67	29 -----	52
Drug 2	30 24.62	18 23.38	48
Drug 3	22 25.64	28 24.36	50
Drug 4	25 23.08	20 21.92	45
Total	100	95	195

$$\begin{aligned} \text{Chi-Sq} = & 0.504 + 0.531 + \\ & 1.178 + 1.240 + \\ & 0.517 + 0.544 + \\ & \text{-----} + 0.169 = 4.843 \\ \text{DF} = \text{--}, & \text{P-Value} = 0.184 \end{aligned}$$

- i. State the hypotheses being tested by the p-value = 0.184. (4 pts)

- ii. Calculate the expected count for the “Drug 1” and “Not Free of Pain” cell (show your work). (3 pts)

- iii. Calculate the contribution to the X^2 statistic for the “Drug 4” and “Free of Pain” cell (show your work). (3 pts)

- iv. What is the distribution of the test statistic, assuming H_o is true? (3 pts)

- v. State your decision regarding the H_o at the 0.05 significance level. (2 pts)

- vi. State your conclusion in terms of the problem. (4 pts)

- vii. What type of association is occurring in this problem? Circle the SINGLE best answer. (4 pts)
 - A. Based on the data given, Drug 2 is more likely to relieve pain than what would be expected if there was no association between drug and pain relief.
 - B. Based on the data given, Drug 4 is less likely to relieve pain than what would be expected if there was no association between drug and pain relief.
 - C. Based on the data given, Drugs 1 and 3 are less likely to relieve pain than what would be expected if there was no association between drug and pain relief.
 - D. Based on the data given, there is no association between the drug and pain relief.