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1. With a perfectly balanced roulette wheel, in the long run, red numbers should turn up 18 times out of 38. To test its wheel, one casino records the results of 3800 plays, finding 1890 red numbers. Is that too many reds, or could it be chance? What is the null hypothesis? The alternative hypothesis? Compute z, and p, and comment on whether this is too many reds.

2. One kind of plant has only blue flowers and white flowers. According to a genetic model, the offsprings of a certain cross have a 75% chance to be blue-flowering, and a 25% chance to be white-flowering, independently of one another. Two hundred seeds of such a cross are raised, and 142 turn out to be blue-flowering. Are the data consistent with the model? What is the null hypothesis? The alternative hypothesis?

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3. National data show that on average, college freshmen spend 7.5 hours a week going to parties. One administrator does not believe that these figures apply at her college, which has nearly 3000 freshmen. She takes a simple random sample of 100 freshmen, and interviews them. On average, they report 6.6 hours a week going to parties, and the SD is 9 hours. Is the difference between 6.6 and 7.5 real? Begin your answer by formulating the null and alternative hypotheses.

4. Short-answer questions:
(a) True or false, and explain briefly.
i. A difference which is highly significant can still be due to chance.
ii. A statistically significant number is big and important.
iii. A p-value of 4.7% means something quite different from a p-value of 5.2%.

(b) Which of the following questions does a test of significance deal with?
i. Is the difference due to chance?
ii. Is the difference important?
iii. What does the difference prove?
iv. Was the experiment properly designed?

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(c) Two investigators are testing the same null hypothesis about box X, that its average equals 50. They agree on the alternative hypothesis: that the average differs from 50. They also agree to use a two-tailed z-test. The first investigator takes 100 tickets at random from the box, with replacement. The second investigator takes 900 tickets at random, also with replacement. Both investigators get the same SD of 10. True or false: the investigator whose average is further from 50 will get the smaller p-value. Explain briefly.

(d) Suppose that courts have held that there is a *prima facie* case of discrimination against a firm when the percentage of whites among the employees of the firm is lower than the percentage of whites in the surrounding geographical region, provided the difference is "statistically significant" by the z-test. Suppose that in one city, 10% of the people are white. Suppose too that every firm in the city hires employees by a process which, as far as race is concerned, is equivalent to simple random sampling. Would any of these firms ever be found guilty of discrimination by the z-test? Explain briefly.

5. You wish to determine whether your textbook is beneficial or detrimental to students learning statistics. On a national statistics exam, μ=68.5 for students who have used other textbooks. A random sample of students who have used this book has the following scores:

64 69 92 77 71 99 82 74 69 88

(a) What are Ho and Ha for this study? Is a one-tailed or two-tailed t-test appropriate for this study? (b) Compute t_{obt}. (c) With α=0.05, what is t_{crit}? (d) What do you conclude about the use of this book?

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6. A researcher predicts that smoking cigarettes decreases a person's sense of smell. On a standard test of olfactory sensitivity, the μ for nonsmokers is 18.4. By giving this test to a random sample of people who smoke a pack a day, the researcher obtains the following scores:

16 14 19 17 16 18 17 15 18 19 12 14

(a) What are Ho and Ha for this study? (b) Is a one-tailed or two-tailed test appropriate? Why? (c) Compute t_{obt}. (d) With α=0.05, what is t_{crit}? (d) What should the researcher conclude about this relationship?

7. While reading a published research report, you encounter the following statements. For each, identify the N, the procedure performed (what kind of test, what criterion) and the outcome, and the relationship, and the type of error possibly being made (Type I vs. Type II). (a) "When we examined the perceptual skills data, the mean of 55 for the sample of adolescents differed significantly from the population mean of 70 for adults, $t(45) = 3.76$, $p < 0.01$." (b) "Men's salaries in fast-food restaurants were not significantly greater than women's salaries ($t(25) = 1.65$, $p > 0.05$)."

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8. Suppose that in order to test the hypothesis that a coin is fair, you use the following decision rule: (1) you accept the null hypothesis that the coin is fair if, in a single sample of 100 tosses, the number of heads you see is between 40 and 60 heads; (2) otherwise, you reject the null hypothesis that the coin is fair. (a) What is the probability of rejecting the hypothesis when it is actually correct? (b) What is the α corresponding to this decision rule?

9. Further consider the decision rule in problem 8. (a) sketch the binomial distribution of number of heads in 100 tosses for p=0.5 and p=0.7 (just one sketch!). Indicate α and β in this sketch. (b) What is the probability of accepting the null hypothesis, when actually the coin is unfair with p(heads) = 0.7? If the actual probability of getting a head is p=0.7, what is the power of the test described in problem 8 for detecting that this coin is not fair?

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10. Design a decision rule to test the hypothesis that a coin is fair if a sample of 64 tosses of the coin is taken, and if a level of significance of (a) 0.05, and (b) 0.01 is used.