

Due at the beginning of class, Monday December 2.

Instructions. In this test, you will write three essays, each of about 150 words. You may use any published source you like. However, you must work alone and not talk with other students or view their written work. If you have questions, you may email them to me before 5:00 PM, Wednesday, November 27. I will post answers on the course web site on Wednesday evening.

This test is intended to give you an opportunity to consolidate what you have learned and experienced regarding three major conceptual ideas in statistical reasoning: 1) hypothesis testing, 2) sampling (to determine population proportions) and 3) correlation. The essays give you an opportunity to demonstrate that you have learned the appropriate vocabulary and conceptual links and that you can relate these ideas to real situations.

For each essay, you will have a list of terms and concepts. You must incorporate the terms and concepts in the essay in such a way as to demonstrate an understanding of them. I will also give you one or more examples, and you should use one of the examples to illustrate. Address your essay to a future student of this course, who is encountering the ideas for the first time.

I. Hypothesis Testing.

- **Text.** Chapter 9, especially pages 360–365.
- **Vocabulary.** Null hypothesis, alternative hypothesis, reject the null hypothesis, statistical significance, P -value (probability of data at least as extreme, assuming the null hypothesis).
- **Concepts.** The null hypothesis is a set of assumptions about the factors that influence our data. We reject the null hypothesis when the data that we have obtained would be unlikely if the null hypothesis were true. The statistician quantifies how unlikely, and decides a level at which to reject.
- **Illustrations.** We encountered the ideas involved in hypothesis testing in projects that we conducted. Use one of the following:
 - In one assignment we asked whether we had any evidence that the class was biased in choosing between T and H as the first symbol in an assignment where students were asked to submit a sequence T s and H s. We noted that the class began with one letter much more often than the other. We determined how likely it would be for an imbalance at least as large as that which we observed to occur *if the members of the class had no preference whatsoever* (null hypothesis), and we found this probability to be fairly small. (This led us to doubt the null hypothesis.)
 - In another assignment, each of you conducted tests to determine if subjects were capable of distinguishing between different brands of a product. We calculated that there is a 1-in-70 (or approximately, 0.014) chance for a subject to correctly sort 8 samples (consisting of 4 samples of each of two brands) *if* the subject actually has no ability to distinguish. Similarly, we calculated that there is a 1-in-252 (or approximately, 0.004) chance of a subject sorting 10 samples (evenly divided between two brands) correctly.*

* Your book says that a hypothesis must concern a population parameter. This allows much more generality than it might at first appear. For example, when we use the ideas of

II. Determining Population Proportions.

- **Text.** Chapter 8, especially pages 333–335 and pages 347–350.
- **Vocabulary.** Population proportion, sample proportion, distribution of sample proportions (p. 335), margin of error, level of confidence.
- **Concepts.** “Population proportion” refers to the fraction of a population with some characteristic. One estimates population proportion from sample proportion, recognizing that samples seldom have exactly the same proportion as the population from which they are drawn, but also recognizing that the sample proportions will be close. The range in which sample proportions are likely to fall depends upon the sample size. This is described by the sampling distribution. From the sampling distribution, we can compute margin of error and level of confidence. Level of confidence really means how often we expect our sample proportion to differ from the population proportion by no more than the margin of error, if we select random samples of the same size over and over.
- **Illustrations.**
 - Any newspaper report of a poll of voter preference would be a decent example. When news organizations report the results of polls or surveys they often say that there is a margin of error of a certain size or per cent. A very careful reporter will add that the margin of error has an associated level of confidence, but some reporters omit mentioning this. (Often when a level of confidence is not stated, a level of 95% is assumed.)
 - Page 337, problem 20.

III. Correlation.

- **Text.** Chapter 7, especially pages 274–285.
- **Vocabulary.** Scatter diagram, correlation, positive/negative correlation, strength of correlation, r -value.
- **Concepts.** A correlation between two quantitative variables exists the values of one variable enable us to predict the values of the other. Correlations are often apparent to the eye when data is displayed in a scatter diagram. When both variables rise together, we say there is a positive correlation; when one rises as the other falls, we have a negative correlation. When data points are scattered widely, the correlation is weak. When all data points lie very close to a line, the correlation is strong. For any given data set, statisticians compute an r -value, which is a measure of the strength of the correlation. An r -value close to 1 indicates a strong positive correlation; r -values close to -1 are seldom seen in random data sets, especially when the data set contains many points. Statisticians can calculate the probability that a random data set (of a given size) will have an r -value exceeding a specified value. This is the basis for evaluating the statistical significance of a given r -value.
- **Illustrations.** *See attached sheet.*

hypothesis testing determine a subject’s ability to distinguish between brands, the population that is involved might not be obvious. Actually, we may think of all the occasions on which the subject might attempt to make a distinction as a population. To say that the subject has ability simply means that the proportion of occasions on which he is correct is very high.