55. Suppose a farmer is interested in testing two fertilizers to see which is more effective. He uses the two fertilizers and gets the following results.

Fertilizer	Mean Growth	Standard Deviation	Size of Sample
A	7 inches	.5 inch	100
B	6 inches	.2 inch	125

Test, at the 10 percent level of significance, the hypothesis that the mean difference in growth between the two fertilizers is not significant.

56. A production manager is interested in the number of defects in batches derived from different production processes. He examines a random sample drawn from each process and records the following data.

Process	Mean Defects	Standard Deviation	Size of Sample
A	221	25	90
B	300	80	110

Test, at the 1 percent level of significance, the hypothesis that the mean difference in number of defects between the two production processes is not significant.

57. Suppose an attorney specializing in wage discrimination cases is interested in determining whether the earnings of men and women are significantly different. He collects the following data on earnings for a random sample of first-year accountants.

Sex	Mean Earnings	Standard Deviation	Size of Sample
Female	$39,217	$12,210	125
Male	$43,121	$17,020	100

Test, at the 5 percent level of significance, the hypothesis that the mean earnings of male and female first-year accountants do not differ significantly.

58. Suppose a political scientist is interested in whether wealth is a determining factor in the individual's propensity to vote. A random sample of 500 people who earned $100,000 or more showed that 390 voted, whereas a random sample of 400 people who earned less than $25,000 showed that 280 voted. Test, at the 10 percent level of signifi-

cance, the null hypothesis that the two population voting rates are equal against the alternative hypothesis that the voting rate is higher for people earning $100,000 or more.

59. A mutual fund manager claims that the returns of stocks in her fund have a variance of no more than .50. A random sample of 25 stocks in her fund has a sample variance of .72. Assuming that the distribution is normal, test the fund manager's claim at the 5 percent level of significance.

60. Bob claims that the variance of the score for the people who took the SAT review course he offers is 100. Fred believes that Bob's students have a variance larger than 100. A random sample of 10 of Bob's students has a variance of 162. Test Fred's claim at the 10 percent level of significance.

61. A political science professor believes students majoring in political science are more likely to vote in elections than students majoring in other disciplines. He collects the following information from two random samples of students.

Major	Proportion Voting	Number of Students
Political science	.65	120
Other	.62	113

Test, at the 5 percent level of significance, this professor's hypothesis against a two-sided alternative that the population proportions are equal.

62. An education professor is interested in whether there is any difference between the proportion of students who have taken a review course that pass the bar exam and the proportion of those who have not taken a review course that pass the exam. She collects the following information from a random sample of students.

	Proportion Passing	Number of Students
Review course	.55	300
No review course	.49	400

Test the hypothesis that the population proportions are equal at the 10 percent level of significance in terms of a two-tailed test.

63. Use the information given in question 62, but this time test the hypothesis that the proportion of students passing the exam is greater for those who take the course than for those who do not.

64. The IRS is interested in knowing whether people who have an accountant prepare their tax returns have fewer errors than people who prepare their own returns. A random sample of 500 people who had their returns professionally prepared reveals that 125 had errors. A random sample of 450 returns of people who prepared their own returns reveals that 128 had errors. Test, at the 1 percent level of significance, the hypothesis that there is no difference between the number of errors for returns prepared by an accountant and the number of errors for returns prepared by the individual.

65. Use the information given in question 64 to test, at the 1 percent level of significance, the hypothesis that the number of errors is greater for individuals who prepare their own returns than for people who have their returns professionally prepared.

66. A muffler manufacturer claims that the variance of its product is no more than 200. A random sample of 25 mufflers has a sample variance of 391. Assuming a normal distribution, test the manufacturer's claim at the 10 percent level of significance.

67. An SAT review course claims that the variance of test scores of its graduates is less than 150. A random sample of 30 students who took the course is found to have a variance of 225. Assuming a normal distribution, test the review course's claim at the 10 percent level of significance.

68. From past experience, a teacher finds that the variance of midterm test scores is 76. A random sample of 21 midterms in her course has a sample variance of 110. Assuming that the population is distributed normally, test whether the sample variance is different from the population variance at a 5 percent level of significance.

69. Refer to question 41 to find the power of a 10 percent level test when the true population mean mileage is 36 miles per gallon.

70. Referring to question 43, find the power of a 5 percent level test when the true population mean time for headache relief is 35 minutes.

71. Assume that you're taking a part-time job in a zoo. You are called upon to inspect a new cage built to contain a ferocious lion. Do you set up the null hypothesis that the cage is safe or that the cage is dangerous?

Use the following information to answer questions 72 to 78. A college professor gives a test that has 10 true-false questions. Two students take the test. Student A, who does not know anything about the subject, answers the questions by tossing a coin. The college professor sets up the following hypothesis, where p represents the probability that a student gets an answer right.

H_0: The students do not know anything ($p = .5$).
H_1: The students know the subject ($p > .5$).

72. What is the consequence of a Type I error in this question?

73. What is the chance of student A getting exactly 6 correct answers when the null hypothesis is true?

74. If the professor decides to reject the null hypothesis (that means passing the student) when the students get 8 or more correct answers, what is the probability of a Type I error?

75. If the professor wants to raise the standard for passing the test to 9 or more correct answers, what is the probability of a Type I error?

76. Student B studies one night before the test, so he knows about 60 percent of the material. What is the probability that this student can pass the test when the standard for passing is 8 correct answers?

77. Plot the OC curve, assuming $p = .5, .6, .7, .8, .9, 1$.

78. Plot the power curve, assuming $p = .5, .6, .7, .8, .9, 1$.

79. A poll was done to predict the outcome of the upcoming election. Of the 900 potential voters who responded, 500 plan to vote for the incumbent. If a candidate needs 50 percent of the votes to win the election, can you reject the hypothesis that the incumbent will win? Do a 5 percent level of significance test.

80. On a given trading day, a financial economist randomly examines the stock prices of 500 companies and discovers that 205 went up and 295 went down. On this evidence, can he argue that more than 50 percent of all the stocks went down in price? Do a 10 percent level of significance test.

81. The head of the accounting department randomly examined some accounting entries and was upset with the high proportion of incorrect invoices. He instituted a new system to keep the proportion of bad invoices below 0.1 percent. A year later, 10,000 invoices were randomly examined and 6 were found to be incorrect. Can this manager reject the null hypothesis that the proportion of bad invoices is 0.1 percent? Do a 5 percent level of significance test.

82. You are working for a consumer rights organization. You are interested in knowing whether the milk contained in 16-ounce (1-pint) bottles really weighs 16 ounces. You do not want to accuse the packer of cheating its customers unless you obtain convincing evidence. You collect 60 bottles of milk. The average weight is 15.32, and the standard deviation is 1 ounce. Test at a 5 percent significance level.

83. You are working for a VCR manufacturer. There are three shifts in the plant: morning shift, evening shift, and midnight shift. The manager suspects that the midnight shift's productivity is lower than 70 units. He wants to shut down the midnight shift without causing any labor–management tension. That means he will take that action only when he has enough evidence. Your responsibility is to test whether the productivity of the midnight shift is really lower than 70 units. You obtain the production for 100 nights and compute the mean as 68 and the standard deviation as 15. Test at a 5 percent significance level. Propose your suggestion to the manager.

84. A college wants to increase its dormitory facilities to house 60 percent of the students enrolled. In order to make sure that more than 60 percent of the students want to live in the dormitory, the school randomly surveys 400 students and finds that 255 students intend to live in the dormitory. Can the school reject the null hypothesis of $p = 60$ percent? Test at a 5 percent significance level.

85. A cola company wants to change its formula for producing cola, but first it wants to make sure that more than 70 percent of its customers will like the new cola better than the old. Two thousand people taste-tested the cola, and 1,422 liked the new product better. Can the company reject the null hypothesis that only 70 percent of its customers will like the new cola more? Do a 5 percent test.

86. In order to control the job turnover ratio, the personnel department did a survey and found that out of the 500 employees who were hired in the last year, only 234 stayed. Does that provide enough evidence to support the hypothesis that the retention ratio is lower than 50 percent? Do a 5 percent test.

87. An insurance company wants to study the chances that a teen-aged driver who owns a sports car will have an auto accident. Two thousand teen-aged policyholders who own sports cars were sampled in the last year. Fifteen of them got into an accident and filed a claim for damages. Can the researcher reject the null hypothesis that less than 1 percent of the policyholders got into accidents last year? Do a 5 percent test.

88. A food company claims that its new product, low-fat yogurt, is 99 percent fat-free. The management wants to keep the proportion of bad (not 99 percent fat-free) products below 2 percent. Inspectors check 500 cups of yogurt every month. In September, 20 cups of yogurt were discovered to be bad. Can you reject the null hypothesis that less than 2 percent of the product is bad? Do a 5 percent test.

89. A questionnaire was sent to 500 of a dry cleaner's customers to solicit their opinions about service received. Twenty-three customers were found to be unhappy with the service. On this evidence, can you reject the null hypothesis that more than 10 percent of the customers are unhappy? Do a 5 percent test.

90. The dean of the school of business wants the proportion of A grades given out by his faculty members to be around 10 percent. He randomly surveys 2,000 students in 50 classes and finds that of the 2,000 grades given, 198 were A. Can he reject the null hypothesis that the proportion of A grades is about 10 percent? Do a 10 percent test.

91. The placement office in a college wants to know whether experience with personal computers is important in obtaining a job. The placement director randomly selects 600 job openings and finds that 313 jobs require computer experience. On this evidence, can he support the hypothesis that more than half of the jobs in the market today require computer experience? Do a 5 percent test.

92. The head accountant in a large corporation conducted a survey last year to study the proportion of incorrect invoices. Of the 2,000 invoices sampled, 25 were incorrect. To lower the proportion, he instituted a new system. A year later, he wants to know whether the new system worked. He collects 3,000 invoices and obtains 30 incorrect invoices. Can he argue that his new system has successfully lowered the proportion of incorrect invoices? Do a 5 percent test.

93. A new medicine was invented to treat hayfever, but the new drug was found to have unpleasant side effects. An experiment on 5,000 women and 4,000 men showed that 100 women and 60 men suffered side effects after they took the medicine. Does the evidence support the hypothesis that the drug causes side effects in more women than men? Test at the 5 percent level.

94. A company believed its new toothpaste to have an effect in controlling tooth decay among children. It randomly selected a group of 400 children and gave them the new toothpaste. Another 300 children were randomly selected also and given another brand of toothpaste. It was found that 30 children using the new toothpaste and 25 children using the other brand suffered tooth decay. Can the manufacturer legitimately argue that the new toothpaste is more effective in controlling tooth decay? Do a 5 percent test.

95. The PPP cola company wants to determine what age groups like its product. It surveyed 500 teen-agers and 600 middle-aged people and found that 300 teen-agers and 350 middle-aged people liked PPP cola. Can the company conclude that PPP cola is more popular among teen-agers than among middle-aged people? Do a 5 percent test.

96. Wood *et al.* (1979) studied the impact of comprehensive planning on the financial performance of banks. They used 4 random samples to perform their study. The sample size n, average annual percent return on owner's equity $\bar{x}$, and sample standard deviation s are presented in the table.

 a. Use the data in this table to construct a 90 percent confidence interval for the difference between the mean of the "comprehensive formal planners" group and that of the "no formal planning system" group.

 b. Perform a hypothesis test at $\alpha = 10$ percent.

Average Annual Percent Return on Net Income

Classification	n	$\bar{x}$, %	s
Comprehensive formal planners	26	11.928	3.865
Partial formal planners	6	9.972	7.470
No formal planning system	9	4.936	4.466
Control group	20	2.098	10.834

Source: D. R. Wood and R. L. LaForge (1979), "The Impact of Comprehensive Planning on Financial Performance," *Academy of Management Journal* 22, 516–526. Reprinted by permission of the publisher.

97. Professor Preston *et al.* (1978) studied the effectiveness of bank premiums (stoneware, calculators) given as an inducement to open bank accounts.[11] They randomly selected a sample of 200 accounts each for "premium offered" and "no premium offered." They found that 79 percent of the accounts opened when a premium was offered and 89 percent of accounts opened when a premium was not offered were retained over a 6-month period. Use these data to test whether $P_x = 79$ percent is statistically different from $P_y = 89$ percent. Do a 5 percent test.

98. Use the data in the table to answer the following questions by using MINITAB.

Current Ratios for GM and Ford

Year	Ford	GM
81	1.02	1.09
82	.84	1.13
83	1.05	1.40
84	1.11	1.36
85	1.10	1.09
86	1.18	1.17
87	1.24	1.56
88	1.00	1.00
89	.97	1.72
90	.93	1.37

[11] R. H. Preston, F. R. Dwyer, and W. Rudelius (1978), "The Effectiveness of Bank Premiums," *Journal of Marketing* 42, 3, 39–101.