1. Diagnostic tests of medical conditions have several results. The rest result can be positive or negative. A positive test (+) indicates the patient has the condition. A negative test (-) indicates the patient does not have the condition. Remember, a positive test does not prove the patient has the condition. Additional medical work may be required. Consider a random sample of 219 patients, some of whom have a medical condition and some of whom do not. Results of a new diagnostic test for the condition are shown.

	Condition Present	Condition Absent	Row Total
Test Result +	124	16	140
Test Result -	16	63	79
Column Total	140	79	219

Assume that the sample is representative of the entire population. For a person selected at random, find

a) *P*(condition absent and test result +). (3)

b) *P*(condition absent | test result -). (3)

2. Four cards are to be randomly selected from a standard deck of cards.

a. How many different hands of four cards are possible if a heart is drawn and the remaining three are not hearts? (4)

b. How many different hands of four cards are possible if a heart is drawn and the remaining three are not queens? (4)

3. An aircraft seam requires 10 rivets. The seam will have to be reworked if any of these rivets is defective. Suppose rivets are defective independently of one another, each with the same probability. If 15% of all seams need reworking, what is the probability that a rivet is defective? (4)

4. Suppose that a sample of n= 1,600 tires of the same type are obtained from an ongoing production process in which 8% of all such tires produced are defective. What is the **approximate** probability that in such a sample 150 or fewer tires will be defective? (4)

5. A shipment of vases is received. It is known that the probaility a vase breaks during shipment is 0.02. The vases are examined one by one. What is the probaility that at most 7 vases are examined before 6 non- broken ones are found? (4)

6. Suppose that at a certain automobile plant the number of work stoppages per day due to equipment problems during the production process has a Poisson distribution with λ=2.

a) How many work stoppages are expected in any one day? (3)

b) What is the probability of having between 8 and 11 (exclusive) work stoppages due to equipment problems in a work week (5 days)? (4)

7. The qualified applicant pool for three management trainee positions consists of five women and eight men. If the applicants are equally qualified and the trainee positions are selected by drawing the names at random so that all groups of three are equally likely, what is the probability that the trainee class

a) will consist entirely of men? (4)

b) the first woman will not be picked before the third draw? (4)

8. An average light bulb manufactured by the Acme Corporation lasts 310 hours with a standard deviation of 60 hours. Assuming that bulb life is normally distributed,

a) What is the probability that a lightbulb will last at least 10 days? (3)

b) A box of 5 lighbulbs will be tested. What is the probability that at most 4 of them will last at least 10 ten days? (4)

c) What is the probability that a sample of 10 of these light bulbs will last an average of at least 360 hours? (3)

9. A manufacturer claims that its drug test will detect steroid use (that is, show positive for an athlete who uses steroids) 95% of the time. What the company does not tell you is that 15% of all steroid-free individuals also test positive (**the false positive** rate). 8% of the rugby team members use steroids. Your friend on the rugby team has just tested positive. What is the probability that he uses steroids? (6)

10. Among the John Abbott grads, 90% want to continue their schooling in Montreal and the remaining 10% want to study outside Montreal. Consider randomly selecting 80 students.

a) What are the mean and variance among the 80 that will continue thier schooling in Montreal? (4)

b) What is the probability that the number that will continue their schooling in Montreal is more than one standard deviation away from the mean value? (4)

11. a) What is the rejection region for a two-tailed test about the population mean when the sample size is large and the level of significance is 0.02? (3)

b) Let μ denote the mean height of babies born in the Congo. The average height of babies born in Canada is 21 inches. You want to test if babies born in the Congo are the same height, on average, as those born in Canada, $H_0 : \mu = 21 \; vs \; H_a : \mu \neq 21$. What is the p value of the test if the test statistic z*=-1.26? (3)

c) Lorraine was in a hurry when she computed a confidence interval for μ. Since σ was not known, she used a Student's t distribution. However, she accidentally used degrees of freedom n+1 instead of n-1. Will her confidence interval be longer or shorter than one found using the correct degrees of freedom n-1? (3)

12. Suppose that out of 14,881 convicts who escaped from U.S. prisons, only 7067 were recaptured. Let *p* represent the proportion of all escaped convicts who will eventually be recaptured.

a) Find a 99% confidence interval for *p*. (3)

b) Test the claim that the true proportion of convicts that are recaptured is less than 50%. (4)

13. The BMI (Body Mass Index) is a measure of body fat based on height and weight. A sociologist studying the relationship between income and health collected the following BMI values from high income and low income men:

High Income	20	22.5	23.5	24	24.5	25	30.5	32
Low Income	20	23	24.5	25.5	29	29	35	36

a) Test if the distribution of BMI values of high and low income men have the same variance. Use the classical approach and $\alpha = 0.10$. (4+2)

b) According to the result found in part (a), use the appropriate test and the **p-value** approach to test if the mean BMI of high income men is smaller compared to low income men. Use $\alpha = 0.05$. (4)

14. A new casino game involves rolling 3 dice.

a) Let x be the number of sixes observed in three rolls of a die. Assuming the die is fair, find the probability of observing 0, 1, 2 and 3 sixes. (Note that x has a binomial distribution.) (4)

x	$p(x)$
0	
1	
2	
3	

b) The winnings are directly proportional to the total number of sixes rolled. Suppose a gambler plays the game 100 times, with the following observed counts: (5)

Number of Sixes	Observed Number of Rolls
0	47
1	35
2	15
3	3

The casino becomes suspicious of the gambler and wishes to determine whether the die is in fact fair.

Null Hypothesis: p_1 = P(roll 0 sixes) = ____; p_2 = P(roll 1 six) ____;
p_3 = P(roll 2 sixes) = ___; p_4 = P(roll 3 sixes) = _____.

Alternate Hypothesis: ____

The gambler plays 100 times. Test at the $\alpha = 0.05$. level of significance whether or not the die is fair.