STAT 2507 EXAM REVIEW QUESTIONS

1. The probability of a student passing STAT 2507 is 0.80. The probability of a student passing the course if they study for at least 10 hours is 0.90. The probability they study for at least 10 hours is 0.60. What is the probability that a randomly select student...

(A) ...studies for at least 10 hours and passes the course?

(B) ... studies for less than 10 hours and passes the course?

(C) ... studies for at least 10 hours but fails the course?

(D) ... studies for at least 10 hours or passes the exam, or both?

(E) ... fails the course given they studied for at least 10 hours?

(F) ...they studied for at least 10 hours given that they passed the course?

Also, are the events of a student "passing the course" and "studying for at least 10 hours" independent? Are they mutually exclusive events?

2. Adam takes a random sample of 8 oranges and Eve takes a random sample of 12 apples. Adam's sample of oranges yields an average weight of 15 ounces with a standard deviation of 4 ounces. Eve's sample of apples yields an average weight of 12 ounces with a standard deviation of 2 ounces. Conduct a hypothesis test at the 5% level of significance to determine if there is a difference in the average weight of apples and oranges using (i) the p-value method, (ii) the critical value method, and (iii) the confidence interval method. You may assume the weights of apples and oranges both follow approximately normal distributions.

3. Let X represent the number of coffees your statistics professor drinks on a randomly chosen day. The probability distribution of X is described by the following probability table

x	1	2
$P(X = x)$	0.30	0.70

You may assume that the number of coffees consumed on one day are independent of the number of coffees consumed on other days.

(A) Consider a SRS of 3 days. What is the sampling distribution of the sample mean?

(B) Consider a SRS of 40 days. What is the approximate sampling distribution of the sample mean? Why?

(C) Approximate the probability that the average number of coffees your professor drinks in 40 days is more than 1.80.

4. The time until failure of iPod Nanos follows an exponential distribution with a mean of 20,000 hours.

(A) What is the probability that a randomly selected iPod Nano would fail within 10,000 hours of use?

(B) Consider a random sample of 12 iPod Nanos. What is the probability that at least 4 of them fail within 10,000 hours of use?

(C) Consider a random sample of 120 iPod Nanos. Approximate the probability that at least 40 of them fail within 10,000 hours of use?

5. Many colleges and universities hold a "blood drive" for organizations such as the Red Cross. To help with the planning of an upcoming blood drive, we want to estimate the proportion, *p*, of students and faculty who would be willing to donate a pint of blood. The Red Cross would like us to estimate *p* with 99% confidence such that the margin of error is no greater than 0.04. How large should the random sample be if…

(A) …the proportion has always been at most 0.24?

(B) …no other information is given?

6. Lightning strikes are the leading cause of forest fires during forest fire season. Therefore, in models applied to forest fire management, it is of particular interest to model lightning strike patterns within a region. Suppose a particular region has lightning strikes occurring according to a Poisson process with a rate of 120 per hour**.**

(A) What is the probability of more than 2 lightning strikes in a one minute period?

(B) What is the probability that the amount of time that passes between two consecutive lightning strikes is more than one minute?

7. An agricultural researcher plants 25 randomly selected plots with a new variety of corn. From these 25 plots, the average yield was 150 bushels per acre. The population standard deviation is known to be 20 bushels per acre.

(A) Give a 99% confidence interval for the population mean yield μ bushels per acre. Interpret your answer in terms of the question. What do you need to assume in order for your confidence interval to be valid?

(B) Suppose the researcher wanted to estimate the true average yield, to within 5 bushels per acre, with 99% confidence. How many plots of land should he use in order to achieve the desired margin of error?

8. The Ledd Pipe Company has received a large shipment of pipes, and a quality control inspector wants to estimate the average diameter of the pipes to see if they meet minimum standards. In particular, the average diameter of the pipes must not differ significantly from 2.52 mm. She takes a random sample of 15 pipes, and the sample produces an average diameter of 2.55 mm with a standard deviation of 0.07 mm. Assume that the diameters of the pipes are normally distributed. Is there enough evidence to conclude that the true average diameter differs from this amount? Use a 1% level of significance.

9. A particular model of HD LCD television has a warranty period of 12 months and it has a lifetime (before repairs are needed or before it has to be replaced) that is normally distributed with a mean of 26 months and a standard deviation of 8 months.

(A) What is the probability that this brand of television that you just purchased will not need repairs during the warranty period?

(B) What is the probability that this television will not need repairs during the first 24 months?

(C) If a one-year extended warranty was offered to you at the time of purchase (i.e., the warranty period is extended to 24 months) and you purchased it, what is the probability that you made a wise decision (assuming the cost of repairs or replacement exceeded the cost of the additional warranty)?

(D) If you did not purchase the extended warranty initially but could purchase it and did purchase it when your initial warranty expired, what is the probability that you made a wise decision (again assuming the cost of repairs or replacement exceeded the cost of the additional warranty)? Should this warranty cost more than if you had purchased it initially? Explain.

(E) What would the length of the initial warranty period have to be so that only 1 percent of the televisions would have to be repaired or replaced under warranty?

(F) If the warranty period remains at 12 months and if the mean lifetime can be changed by using better quality components, what would the mean lifetime have to change to so that only 1 percent of the televisions would have to be repaired or replaced under warranty?

(G) If the standard deviation in lifetimes can be changed by using better quality controls, what would the standard deviation in lifetimes have to change to so that only 1 percent of the televisions would have to be repaired or replaced under warranty?

(H) Suppose a gym buys 12 of these televisions for its entertainment area. Based on the information given at the beginning of the question, what is the probability that at least one of these televisions will need repairs under the warranty period?

(I) Suppose a gym buys 12 of these televisions for its entertainment area. Based on the information given at the beginning of the question, what is the probability that the average life of these televisions will exceed 30 months?

10. Chronic exposure to asbestos fiber is a well-known health hazard. The article "The Acute Effects of Chrysotile Asbestos Exposure on Lung Function" (*Environ. Research,* 1978: 360–372) reports results of a study based on a sample of construction workers who had been exposed to asbestos over a prolonged period. Among the data given in the article were the following values of pulmonary compliance ($cm^3/cm\ H_2O$) for each of 10 subjects 8 months after the exposure period (pulmonary compliance is a measure of lung elasticity, or how effectively the lungs are able to inhale and exhale):

167.9 180.8 184.8 189.8 201.9 207.2 227.7 232.4 239.8 258.6

(A) What assumption(s) do you require to perform any type of statistical inference with this data set?
(B) Compute the mean and variance for this data set.
(C) Compute an appropriate 95% confidence interval for the true average pulmonary compliance after such exposure. Interpret your interval in terms of the question.

11. Larry's Light Bulb Emporium claims that, on average, their light bulbs last more than 500 hours longer than light bulbs produced by their competitor Billy's Bright Bulbs. Two independent samples of fifteen 100W light bulbs from each company are used in the same model of lamp and the lifetime of each light bulb is measured. The average life of Larry's light bulbs is found to be 10,400 hours, with a standard deviation of 1,200 hours. Billy's light bulbs lasted a mean of 9,600 hours, with a standard deviation of 900 hours. You may assume that the time until failure of the light bulbs follows a normal distribution. Conduct an appropriate hypothesis test to test Larry's claim at the 5% level of significance. Conduct this test using (i) the p-value method and (ii) the rejection point method.

12. An airport gamma ray luggage scanner coupled with a neural net artificial intelligence program can detect a weapon in suitcases with a false positive rate of 4 percent and a false negative rate of 2 percent. If the scanner believes it has detected a weapon, it will set off an alarm. Assume a 0.001 probability that a suitcase contains a weapon.
(A) What is the probability that a randomly chosen suitcase will trigger the alarm?
(B) If a suitcase triggers the alarm, what is the probability that the suitcase contains a weapon?

13. Joe-Cool-Copiers sells and services the Ultra-Cool-500 photocopying machine. As part of its standard service contract, the company agrees to perform routine service on this particular brand of copier. For a random sample of 10 service calls, both the number of copiers serviced and the total service time (in minutes) were recorded. The results are in the table below.

Number of Copiers	**Service Time**
4	90
2	60
5	170
7	190
1	40
3	80
4	100
5	130
2	70
6	150

Fit the least square regression line predicting service time from number of copiers. Predict the service time for a business with 3 copiers.