

MATH 333: Probability & Statistics. **Final Examination** (Spring 2005)

May 11, 2005 (A) NJIT

Name:	SSN:	Section #
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→ **Must show all work to receive full credit.**

I pledge my honor that I have abided by the Honor System. _____
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1. Suppose that 0.10% of all computers of a certain type experience CPU failure during the warranty period. A random sample of 10,000 computers is selected.
 - a. What are expected value and standard deviation of the number of computers in the sample that experience CPU failure? (4 pts)
 - b. What is the probability that more than 4 sampled computers experience CPU failure? (4 pts)
 - c. What is the probability that no computers in the sample experience CPU failure? (2 pts)

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2. Suppose that in a large population, 1 in 500 adults is afflicted with a disease for which a diagnostic test has been developed. The test is such that when an adult has the disease, a positive result occurs 99% of the time. On the other hand, when an adult does not have the disease, a positive result occurs 2% of the time. An adult is chosen at random for testing.
- What is the probability that the test result for this adult is positive? (4 pts)
 - If the test result is positive, what is the probability that this adult has the disease? (4 pts)
 - If the test result is negative, what is the probability that this adult does not have the disease? (4 pts)

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3. Let X = the time between calls to a service center. It is known that X follows an exponential distribution with a mean of 10 minutes.
- (a) What is the probability that X is greater than 30 minutes? (3 pts)
 - (b) Find the 90th percentile of X [Hint: $P(X \leq 90^{\text{th}} \text{ percentile of } X) = 0.9$]. (3 pts)
 - (c) What is the median time between calls to the service center? (3 pts)

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4. A chemical supply company currently has in stock 100 pounds of a certain chemical. It sells the chemical to customers in 5 pound bags. Let X = the number of bags ordered by a randomly chosen customer, where X has the following probability mass function (pmf):

x	1	2	3	4
$f(x)$.2	.3	.3	.2

- Compute $E(X)$. (3 pts)
- Compute $V(X)$. (3 pts)
- Let Y = the number of pounds of chemical left after the first customer's order is shipped. Find $E(Y)$ [Hint: The number of pounds left is a linear function of X]. (3 pts)
- Find $V(Y)$. (3 pts)

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5. The strength of steel grade is normally distributed with mean of 43 and standard deviation of 4. Find the probability that the strength is:
- (a) Greater than 43? (3 pts)
 - (b) Less than 40? (3 pts)
 - (c) Less than or equal to 40? (3 pts)
 - (d) Between 40 and 43? (3 pts)

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6. A random sample of 10 breakdown voltages yielded a sample mean of 32.1 V and a sample standard deviation of 3.0 V. You may assume that breakdown voltage is normally distributed.
- (a) Compute a 95% confidence interval (C.I.) for the population mean. (4 pts)
 - (b) Find a 90% C.I. for the population standard deviation. (4 pts)
 - (c) What is the minimum sample size required to ensure that the width of the 95% C.I. for the population mean is no more than 2 V? (4 pts)

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7. The New Jersey Department of Motor Vehicles reported that 70% of all vehicles undergoing emissions test passed the test on the first try. Essex county claims that it has a higher rate of vehicles passing emissions test on the first try than the state-wide average. In order to test this claim, a random sample of emission test results of 200 vehicles from Essex county was examined and it was found that 160 vehicles passed the test on the first try.
- (a) Formulate your hypotheses and explain why you chose those hypotheses. (5 pts)
 - (b) Does the sample data support Essex county claim when the significance level is $\alpha = .05$? (5 pts)

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8. The results of a Wagner turbidity test performed on 15 samples were (in microamperes):
26.7, 25.8, 24.0, 24.9, 26.4, 25.9, 24.4, 21.7, 24.1, 25.9, 27.3, 26.9, 27.3, 24.8, 23.6
You may assume that turbidity follows a normal distribution.

- (a) Find a 95% confidence interval on the population mean. (6 pts)
- (b) Find a 90% confidence interval on the population variance. (5 pts)

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9. The drying time of paint follows a normal distribution with a mean of 75 minutes and standard deviation of 5 minutes. A chemist has proposed a new mix of the paint designed to decrease the drying time. A sample of 25 test specimens of the new mix of the paint was chosen and the sample average drying time was found to be 72.3 minutes.
- Formulate your hypotheses and explain why you chose those hypotheses. (4 pts)
 - Does the sample data support the chemist's claim when the significance level is $\alpha = .01$? (4 pts)
 - What is the P-value for the test in part (b)? (4 pts)

END