MATH 333A: Probability & Statistics. **Final Examination** **(Spring 2008)**

May 14, 2008 **NJIT**

Name:	**SSN:**	**Section #**

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➔ **Must show all steps for each problem to receive full credit.**

I pledge my honor that I have abided by the Honor System. ______________________
(Signature)

	Score
#1	
# 2	
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Total	

1. The number of accidents on I-80 in New Jersey has a Poisson distribution with a mean of 1.2 accidents per day. You may assume that the number of accidents on different days are mutually independent.(3 pts each)

   a. What is the probability that there are no accidents in one day?
   b. If the accident records are reviewed for a period of 5 days, what is the probability that none of these 5 days has any accidents?
   c. For the same 5 days, what is the probability that each of the 5 days have some accidents?

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2. Customers who purchase a certain make of car from dealer XYZ can order an engine in any of three sizes - small, medium, and large. Of all the cars sold, 45% have the small engine, 35% have the medium engine, and 20% have the large engine. Of cars with the small engine, 10% fail an emission test within 2 years of purchase, while 15% of those with medium engine and 20% of those with the large engine fail an emission test within 2 years of purchase. (5 pts each)

   a. What is the probability that a randomly chosen car will fail an emission test within 2 years?
   b. A record of failed emission tests is chosen at random. What is the probability that it is for a car with a small engine?
   c. What is the probability that if a random record is chosen from all cars that pass an emission test within 2 years, it corresponds to a car with a large engine?

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3. A tire manufacturer wishes to compare the tread wear of tires made of a new material with that of tires made of old conventional material. One tire of each material is placed on the front wheels of the front-wheel-drive vehicles. Each of the 10 cars in the sample is driven for 40,000 miles and the depth of the tread left is measured. The resulting data are shown below: (5 pts each)

	Car									
Material	1	2	3	4	5	6	7	8	9	10
New	4.35	5.00	4.21	5.03	5.71	4.61	4.70	6.03	3.80	4.70
Old	4.19	4.62	4.04	4.72	5.52	4.26	4.27	6.24	3.46	4.50

A chemical engineer claims that the true mean of the tread left after 40,000 miles for the new material exceeds that for the old material. It is reasonable to assume that the treads left follow a Normal distribution.

a. Formulate your hypotheses and explain why you chose them.
b. Does the above data support the chemist's claim at $\alpha = 0.05$?
c. Compute the P-value for your test in Part (b).

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4. In an experiment to measure the rate of absorption of pesticides through skin, a dosage of 500 micrograms of uniconazole was applied to the skin of a sample of 4 rats. After 10 hours, the amounts absorbed were 0.5, 2.0, 1.4, and 1.1. You may assume that the amount absorbed follows a Normal distribution. (5 pts each)

a. Find a 90% confidence interval (CI) for the population mean.
b. Find a 95% confidence interval for the population standard deviation.
c. What is the minimum sample size needed to ensure that the error of estimation (i.e., the half-width of the CI) in Part (a) is no more than 0.20?

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5. A materials engineer is interested in determining the proportion of steel alloy failures that are due to stress corrosion cracking. She takes a sample of 200 failures and finds that 30 of them were caused by stress corrosion cracking. (5 pts each)

a. Find a 98% confidence interval for the proportion of failures caused by stress corrosion cracking.
b. Is there evidence to support the claim that the proportion of failures due to stress corrosion cracking is different from 10% at $\alpha = 0.02$? Include a statement of your hypotheses and the rejection region.
c. What is the P-value of your test in Part (b)?

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6. A grinding machine produces roller bearings whose diameter follows a Normal distribution with a mean of 3.16 mm and a standard deviation of 0.03 mm. If the diameter is between 3.12 mm and 3.20 mm, then the bearings meet the specification; otherwise they are scrapped. (5 pts each)

   a. What is the proportion of bearings that meet the specifications?
   b. If a lot of 400 bearings is made, what is the probability that the number of bearings in this lot that meet the specifications is greater than 300?
   c. If a Quality Improvement project can reduce the standard deviation of bearings to 0.02 mm, what will be the proportion of bearings that meet the specifications?

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7. An energy conservation group claims that the mean residential electricity consumption in Boston is greater than 1300 kwh/household. To test this claim, a random sample of 200 households is selected. The resulting sample mean is 1325 kwh and the sample standard deviation is 185 kwh. (4 pts each)

   a. State your hypotheses and explain your reasons for this formulation.
   b. Is there evidence to support the claim at $\alpha = 0.05$?
   c. Find the P-value of the test in Part (b).
   d. What is β, the Type II Error, if the true population mean is 1320?

END