MATH 333, Final Exam, Fall 2000

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

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I pledge my honor that I have abided by the Honor System. _____

1. The proportion of voters selecting Vice-President Al Gore as the next President of the U.S. is subject to dispute in Florida. Instead of conducting a recount of all the votes in the state, a statistician suggests taking a sample of the votes and using the sample data to test the hypothesis that Gore received a majority (*i.e.*, testing that the proportion of votes for Gore is more than 0.50). A random sample of 2500 votes was recounted by hand. Of these, 1320 were for Gore.

a. (10 pts) Does the sample data strongly suggest that Gore received a majority of the votes in Florida? State and test the relevant hypotheses using significance level 0.005.

b. (5 pts) How many votes would need to be sampled for the hand recount in order to ensure that the proportion in the sample differed from the true proportion by less than one percentage point (0.01) with reliability 99%?

2. (10 pts) A shipment of 20 personal computers has 14 intact, four damaged but operative, and two inoperative. If five personal computers are selected at random without replacement from the shipment, what is the probability that four or more are intact?

3. The distribution of a company's projected annual profits, x, in thousands of dollars is as follows : (a negative profit is a considered a loss)

X	-100	0	100	150	200
$P(X=x)$	0.10	0.20	0.30	0.25	?

a. (5 pts) What is the probability that the company makes a profit ?

b. (5 pts) What is the expected annual profit ?

4. Assume that the lifetime of an electrical switch purchased from RutgersCO follows an exponential distribution with a mean of 4 years.

a. (5 pts) What is the chance that a randomly chosen switch will last at least 5 years?

b. (5 pts) Twenty switches are randomly chosen and installed in Cullimore Hall. What is the chance that nineteen or more of them will last at least 5 years?

c. (5 pts) Sixty-four switches are selected and their lifetimes assessed using accelerated testing methods. What is the approximate probability that the sample average lifetime for these 64 switches is greater than 5 years?

5. (10 pts) A fire insurance company has high-risk, medium risk, and low-risk clients, who have, respectively, probabilities 0.02, 0.01, and 0.0025 of filing claims within a given year. The proportions of the numbers of clients in the three categories are 0.10, 0.20, and 0.70, respectively. What proportion of the claims filed each year come from high-risk clients?

6. An environmental engineer monitored sound level in a building every 15 seconds to determine whether noise levels were within EPA standards. The values below represent the noise levels, recorded in dBa units, for 12 fifteen-second intervals.

66 56 70 72 67 68 70 71 74 69 72 70

a. (6 pts) Compute the sample mean and median of the noise levels.

b. (8 pts) The EPA standards indicate that average noise level should be at most 66 dBa. Company employees in the building complained that the average noise level exceeds the EPA standards. Results from a StataQuest analysis of the data are given below. (Note that StataQuest gives results for a two-sided test of hypothesis.)

Ho: mean = 66
t = 2.07 with 11 d.f.
Pr > |t| = 0.0624
95% CI = (65.8305,71.6695)

Do the data support their complaint? State and test the relevant hypotheses using significance level 0.05.

c. (8 pts) Suppose the actual noise level in the building is 68.38 dBA. What is the probability that the test used in (b) will fail to detect that the noise level exceeds the EPA standards?

7. A triathlon consists of three events, swimming, biking, and running. Triathletes are known to be quite obsessive about monitoring their workouts. In one training group, the following data were recorded on maximum heart rate (HR) achieved during each of the three events for male and female athletes.

	n		HR-Swim	HR-Bike	HR-Run	B-S
Male	14	$\bar{X}$	162	171	181	9
		s	10.3	9.4	11.4	2.1
Female	10	$\bar{X}$	154	169	178	15
		s	7.8	8.0	15	3.4

a. (8 pts) Give the *p*-value for testing whether there a difference between maximum heart rates achieved while swimming for men versus women.

b. (4 pts) What assumption(s) must you make for the test in part (a) to be appropriate?

c. (7 pts) The column headed B-S in the above table gives summary statistics on the differences in maximum heart rate achieved during biking relative to swimming for the same athlete. Use the data to construct a 95% lower confidence bound on the average difference in maximum heart rate achieved while biking relative to that achieved while swimming for the female athletes.

Extra Formula:

1. Small sample (1-α) x 100% confidence interval for $\mu_1 - \mu_2$: $(\bar{X}_1 - \bar{X}_2) \pm t_{\alpha/2,\nu}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$, where

$$\nu = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(s_1^2/n_1\right)^2}{n_1 - 1} + \frac{\left(s_2^2/n_2\right)^2}{n_2 - 1}}$$