Stat 2300 International, Fall 2006 – Midterm

Friday, October 27, 2006

Your Name: _____

A Number: _____

The Midterm consists of 35 questions: 20 multiple-choice questions (with exactly 1 correct answer) and 15 text-based questions where you have to provide a verbal explanation or calculate one or multiple numerical values. Some of the questions require you to use Excel. For other question, you can decide yourself whether you want to use Excel, a calculator, or do the calculations by hand.

The exam is worth a total of **350 points**. The number of points for each question is indicated in parentheses at the beginning of each question. You have approximately **90 minutes** to complete the exam. Try to correctly answer as many questions as possible during this time period. **You are allowed to answer questions in any order.** Start with a question that seems the easiest for you. If you cannot answer a question within a short time, move to another question, and come back to the previously unanswered questions toward the end of the exam.

Mark your answers to the multiple choice questions and fill in the spaces for the text-based questions on the **answer sheets**. Do not write your answers on the pages with the questions. However, you can use those pages for personal comments and calculations. Make sure to write your name and your A number on the pages with the questions **and** on the answer sheets. You have to turn in the pages with the questions **and** the answer sheets.

For multiple choice questions, mark exactly one of the choices (representing options a, b, c, or d) with a solid dot. Only 1 answer is correct. If you mark more than 1 of the options, this will automatically be an incorrect answer (even if one of the options you have marked is correct). For the text-based questions, indicate the formula you are using, the numerical values you have to fill in, and the final result (e.g., $n*p = 10*0.2 = 2$). Just the (correct) final result will not provide you with the full points for this question. If you use Excel to calculate a result, indicate which feature you have used (e.g., Summary Statistics) and the result from within Excel. Please do not write outside the text boxes.

In case of any problems with Excel, please inform your local instructor as quickly as possible and try to answer the questions as far as possible. Return to these questions later on. In case Excel is unavailable for an extended time period, your exam score will be adjusted accordingly.

1. (8 Points) A list of all of the units in a population is called a

- **a.** census.
- **b.** frame.
- **c.** sample.
- **d.** variable.

2. (8 Points) Which percentile describes the third quartile Q3?

- **a.** 25^{th}
- **b.** 50^{th}
- **c.** 75^{th}
- **d.** 100^{th}

3. (8 Points) As the sample size _____ the variation of the sampling distribution of $\overline{X}$ _____.

- **a.** decreases, decreases
- **b.** increases, remains the same
- **c.** decreases, remains the same
- **d.** increases, decreases

4. (8 Points) When a confidence interval for a population proportion is constructed for a sample size $n = 100$ and the value of, $\hat{p} = .4$ the interval is based on

- **a.** the *z* distribution.
- **b.** the *t* distribution.
- **c.** the Binomial distribution.
- **d.** the Poisson distribution.

5. (8 Points) When we are choosing a random sample and we place chosen units back into the population, we are

- **a.** sampling with replacement.
- **b.** sampling without replacement.
- **c.** using a Systematic Sample.
- **d.** using a Voluntary Response Sample.

6. (8 Points) Two characteristics/assumptions of the Poisson distribution include

- **a.** probability of success remains constant from trial to trial and the random variable of interest is continuous.
- **b.** the event occurring in one interval is independent of the event occurring in any other nonoverlapping interval, and the random variable of interest is continuous.
- **c.** the event occurring in one interval is independent of the event occurring in any other nonoverlapping interval, and the random variable of interest is discrete.
- **d.** the event occurring in one interval is dependent on the event occurring in any other nonoverlapping interval, and the random variable of interest is discrete.

7. (8 Points) _____ occurs when some population units are excluded from the process of selecting the sample.

- **a.** Undercoverage.
- **b.** Nonresponse
- **c.** Random sampling
- **d.** Multistage cluster sampling

8. (8 Points) Which of these is correct?

- **a.** The median is resistant to extreme values.
- **b.** The mean is resistant to extreme values.
- **c.** There is exactly one mode in each data set.
- **d.** All of the above.

9. (8 Points) When solving for the sample size needed to compute a confidence interval for a population proportion, the _____ $p(1-p)$ is, the _____ n will be.

- **a.** larger, smaller.
- **b.** smaller, larger.
- **c.** larger, larger.
- **d.** cannot be answered without knowing the exact value of p.

10. (8 Points) If the mean, median and mode for a given population all equal 75, then we know that its distribution is

- **a.** normal.
- **b.** skewed to the right.
- **c.** symmetric.
- **d.** normal AND symmetric.

11. (8 Points) The set of all possible experimental outcomes is called a(n)

- **a.** sample space.
- **b.** event.
- **c.** experiment.
- **d.** probability.

12. (8 Points) If events A and B are mutually exclusive, then P(A|B) is always equal to

- **a.** One
- **b.** Zero
- **c.** P(A)
- **d.** P(B)

13. (8 Points) The expected value of a discrete random variable is:

- **a.** $\Sigma x\, p(x)$
- **b.** $n \cdot p \cdot q$
- **c.** $\Sigma(x - \mu_x)^2\, p(x)$
- **d.** σ / μ

14. (8 Points) The following formula: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ represents

- **a.** the conditional probability.
- **b.** independence.
- **c.** the multiplication rule.
- **d.** None of the above.

15. (8 Points) The variance of the binomial distribution is equal to

- **a.** p.
- **b.** $(n)(p)$.
- **c.** $p^x(1-p)^{n-x}$
- **d.** $(n)(p)(1-p)$

16. (8 Points) If a random variable x has a uniform distribution with a mean of 10 and the lowest value of x is 0, what is the largest value of x that can exist?

- **a.** 5
- **b.** 10
- **c.** 15
- **d.** 20

17. (8 Points) The price-to-earning ratio for firms in a given industry is distributed according to normal distribution. In this industry, a firm with a Z value equal to -1

- **a.** has an above average price-to-earning ratio.
- **b.** has a below average price-to-earnings ratio.
- **c.** has an average price-to-earnings ratio.
- **d.** may have an above average or below average price-to-earnings ratio.

18. (8 Points) As the number of degrees of freedom _____, the spread of the t distribution decreases and the t curve approaches the _____.

- **a.** increases, binomial curve.
- **b.** increases, standard normal curve.
- **c.** decreases, binomial curve.
- **d.** decreases, standard normal curve.

19. (8 Points) The area under the standard normal curve between $z = 0$ and $z = 1$ is _____ the area under the normal curve between $z = 1$ and $z = 2$.

- **a.** less than
- **b.** greater than
- **c.** equal to
- **d.** A, B, or C above depending on the value of the standard deviation

20. (8 Points) If the sampled population has mean 48 and standard deviation 4, then the mean and the standard deviation for the sampling distribution of $\bar{X}$ for $n = 16$ are

a. 4 and 1.
b. 12 and 4.
c. 48 and 4.
d. 48 and 1.

21. (12 Points) The MPG (mileage per gallon) for an American car is normally distributed with a mean of 20 and a standard deviation of .6. What is the probability that the MPG for a selected American car would be more than 21.5?

22. (12 Points) Assume the waiting time x at a traffic light is uniformly distributed between zero and five minutes. Find P($\{0 \le x \le 1\}$ or $\{4 \le x \le 5\}$)

23. (12 Points) Bill and Mary are married. The probability that Bill watches a certain television show is .4. The probability that Mary watches the show is .5. The probability that Bill watches the show, given that Mary does, is .2. Find the probability that Mary watches the show, given that Bill does.

24. (12 Points) The lifetimes of a particular brand of CD players are normally distributed with a mean of five years and a standard deviation of six months. Find the probability P($6 \le x \le 6.5$), where x denotes the lifetime in years.

25. (12 Points) Calculate the (i) mean, (ii) median, and (iii) mode of the following population of numbers:

7, 7, 3, 3, 7, 1, 7, 7, 3, 1

26. (12 Points) Calculate a 99% confidence interval for the population proportion p, given that $\hat{p} = .4$ and $n = 100$.

27. (12 Points) Consider the following population of five numbers: 15, 19, 20, 21, 25. Calculate the (i) range, (ii) variance, and (iii) standard deviation of this population.

28. (12 Points) A sprinkler system inside an office building has two types of activation devices, D1 and D2, which operate independently. When there is a fire, if either device operates correctly, the sprinkler system is turned on. In case of fire, the probability that D1 operates correctly is .95, and the probability that D2 operates correctly is .90. Find the probability that the sprinkler system will fail.

29. (12 Points) An insurance company will insure a $50,000 diamond for its full value against theft at a premium of $400 per year. Suppose that the probability that the diamond will be stolen is 0.005, and let x denote the insurance company's profit. Keep in mind that the premium has to be paid no matter whether the diamond gets stolen or not! Calculate the insurance company's expected profit.

30. (12 Points) Suppose that x has a binomial distribution with $n = 400$ and $p = .4$. Make a continuity correction and then use the normal approximation to the binomial to find the probability $P(x = 170)$.

31. (12 Points) Suppose that x has a Poisson distribution with a mean $\mu = 2.5$. Find $P(x = 0)$.

32. (12 Points) Suppose we randomly select a sample of size 144. The sampled population has a mean of 50 and a standard deviation of 1. What is the probability of obtaining a sample mean greater than 50.2?

33. (12 Points) The customer service department for a supermarket claims that 80 percent of all customer complaints are resolved to the satisfaction of the customer. A random sample of 12 customers who have filed complaints is selected. Assuming the claim is true, what is the probability that 11 of these 12 customers are satisfied?

34. (17 Points) Download the data set http://www.math.usu.edu/~symanzik/teaching/2006_stat2300/data/GasMiles.xls from the Web and use Excel to construct a 98% confidence interval for the average MPG for one particular car model of one manufacturer. You should assume that the numbers reported are based on a random sample of 49 cars of this car model.

35. (17 Points) Download the data set http://www.math.usu.edu/~symanzik/teaching/2006_stat2300/data/DrSalary.xls from the Web and use Excel to calculate the (i) mean, (ii) median, and (iii) population variance for the salary (in $1000) of all doctors in the only hospital in a small city, i.e., these data represent the entire population