Statistics 151 Midterm #2 – November 15, 2006

This exam has 6 problems and is worth 50 points. **Instructor:** Michael Kozdron

You must answer all of the questions in the exam booklet provided.

You have 50 minutes to complete this exam. Please read all instructions carefully, and check your answers. Show all work neatly and in order, and clearly indicate your final answers. Answers must be justified whenever possible in order to earn full credit. ***Unless otherwise specified, no credit will be given for unsupported answers, even if your final answer is correct.*** *Points will be deducted for incoherent, incorrect, and/or irrelevant statements.*

This exam is closed-book, except that one $8\frac{1}{2} \times 11$ *double-sided page of notes is permitted. A copy of Table E and Table F will be provided, and calculators are allowed. Other than these exceptions, no other aids are allowed.*

1. (*8 points*) Farmer Michael believes that his hens lay eggs whose weights are approximately normally distributed. A random sample of 6 eggs yields the following weights (in grams)

$$55, 61, 61, 64, 65, 66.$$

Construct an approximate 95% confidence interval for the true weight of eggs laid by Farmer Michael's hens. *You may leave your expression in either the form*

$$\square \pm \square \cdot \frac{\square}{\sqrt{\square}} \quad \textit{or} \quad \left(\square - \square \cdot \frac{\square}{\sqrt{\square}}, \square + \square \cdot \frac{\square}{\sqrt{\square}} \right).$$

2. (*16 points*) Statistics Canada recently conducted the Canadian Community Health Survey (CCHS) and found that overweight rates among children and adults have increased substantially during the past 25 years. The CCHS directly measured the height and weight of respondents, and found that 68.1% of adult respondents from Saskatchewan were overweight. The CCHS also found that $(0.630, 0.733)$ is a 95% confidence interval for the true proportion of adult Saskatchewan residents who are overweight.

(a) (*8 points*) How many adult respondents from Saskatchewan were included in the CCHS?

(b) (*4 points*) If there were 85 children respondents from Saskatchewan, and 51 of them were overweight, construct a 95% confidence interval for the true proportion of children Saskatchewan residents who are overweight?

(c) (*4 points*) Is there evidence (at the 95% confidence level) to suggest that adults and children in Saskatchewan have *different* overweight rates? Explain.

3. (*8 points*) There are an estimated 1.4 million Canadians who suffer from a disease which leads to bone fragility and increased risk of fractures, especially the hip, spine and wrist. In order to determine if a patient has normal bone structure, a test is done to measure her *bone mineral density (BMD)*, and is said to have *osteoporosis* if the value of her BMD test "is 2.5 standard deviations or more below the young adult mean." It has been found that young adult BMD values are normally distributed with mean 0.85 g/cm^2 and standard deviation 0.11 g/cm^2. Suppose that 4 women are selected at random.

(a) (*4 points*) What is the probability that all 4 of them have BMD values 0.74 g/cm^2 or less?

(b) (*4 points*) What is the probability that the average of their four BMD values is 0.74 g/cm^2 or less?

(continued)

4. (*6 points*) Suppose that two researchers, Michael and Jessica, study a simple random sample of subjects from a population, and they find that the sample proportion is equal to 0.8. Each uses this sample proportion to construct a (z-based) confidence interval; Michael comes up with $(0.75, 0.89)$, while Jessica finds $(0.73, 0.87)$. Indicate whose interval *must* be wrong, and explain your choice.

5. (*8 points*) We hear that listening to Mozart improves students' performance on tests. Perhaps pleasant odors have a similar effect and also increase students' performance on tests. To evaluate this hypothesis, a researcher gives 21 subjects simple multiple choice tests to work while wearing masks. The mask is either unscented or carries a pleasant floral scent. Each subject works two separate tests, and wears a different mask for each test. The decision about which mask to wear for the first test is random. The researcher decides to analyze this data by subtracting the scented score from the unscented score for each student, and then analyze the differences in scores for all students. In this way, the researcher will draw inference about the true difference between scented and unscented scores for the population of students.

Suppose that the researcher will conduct an hypothesis test. Carefully define the population parameter of interest, and give appropriate hypotheses H_0 and H_1 for the researcher's hypothesis test.

6. (*4 points*) Based on a simple random sample from a population with mean μ, one obtains $(33, 45)$ as a 95% confidence interval for μ. Select *alll* statements which are correct; there could be more than one. Clearly indicate your answer(s) (numeral(s) only) in your exam booklet. You do *not* need to justify your answers.

(i) The probability that the sample mean falls between 33 and 45 is 0.95.

(ii) If a million independent random samples were taken from the population and a 95% confidence interval for μ calculated using each sample, then the proportion of intervals covering μ would be close to 0.95.

(iii) The probability that the sample mean for a future sample falls between 33 and 45 is 0.95.

(iv) The probability that μ falls between 33 and 45 is 0.95.