STA 5172 Midterm 1

February 21, 2013

Name:

FSUID:

Please sign the following pledge and read all instructions carefully before starting the exam.

Pledge: I have neither given nor received any unauthorized aid in completing this exam, and I have conducted myself within the guidelines of the University Honor Code.

Signature: ______________________________

INSTRUCTIONS:

- This is an open-book, open-notes exam. You can refer to your notes, the text, or any other books. You may use a calculator. qnorm and pnorm stands for standard normal quantile and standard normal cdf respectively.
- Total time is 75 minutes (9:30 A.M to 10:45 A.M.)
- **Show all work**, clearly and in order, if you want to receive full credit. When you use your calculator, explain all relevant mathematics. I reserve the right to take off points if I cannot see how you arrived at your answer (even if your final answer is correct).
- Circle or otherwise indicate your final answers.
- **Answer all the questions in the space provided. You may attach additional sheets if necessary.**
- This test has 4 problems and is worth 80 points. It is your responsibility to make sure that you have all of the problems.
- **Good luck!**

Prob. No.	Max Points	Earned Pts.
1	20	
2	15	
3	20	
4	25	

TOTAL: ___________

Question 1. (20 pts.) A rare genetic disease is discovered. Although only one in a million people carry it, you consider getting screened. You are told that the genetic test is extremely good; it is 100% sensitive (it is always correct if you have the disease) and 99.99% specific (it gives a false positive result only 0.01% of the time).

a) Calculate using the law of total probability, the probability of a positive test.

b) Having recently learned Bayes' theorem, you decide not to take the test. Why? (Calculate the probability of being healthy given positive test to justify your answer).

Question 2. (15 pts.) Suppose a dietician knows that the average energy intake for healthy adults follows a normal distribution with a mean of 2000 Calories but does not know the standard deviation σ. If she finds 70% of her clients have a daily energy intake between 1800 and 2200 Calories, what is the value of σ? (Given $pnorm(-x) = 1 - pnorm(x), qnorm(0.85) = 1.036$)

Question 3. (20 pts.) A new drug is proposed for people with high intraocular pressure (IOP), to prevent the development of glaucoma. A pilot study is conducted with the drug among 10 patients. Their mean IOP decreases by 5 mm Hg after 1 month of using the drug. The investigator proposes to study 100 participants in the main study. Is this a sufficient sample size for the study to obtain a power of 80% to have the same amount of IOP deduction based on a 5% level of significance? If not, obtain the minimum sample size needed to obtain a power of 80% based on a 5% level of significance. (Assume IOP is normally distributed with a standard deviation of 10 mm Hg , $qnorm(0.8) = Z_{0.8} = 0.8416, qnorm(0.95) = Z_{0.95} = 1.645$)

Question 4. (25 pts.) The operations manager of Medtronics (a reputed medical device company) would like to estimate the mean amount of time a worker takes to assemble a new medical device. Assume that the standard deviation of this assembly time is 3.6 minutes. (Assume assembly time is normally distributed, $qnorm(0.95) = 1.645$)

a) After observing 120 workers assembling similar devices, the manager noticed that their average time was 16.2 minutes. Construct a 90% confidence interval for the mean assembly time.

b) Calculate the length of a 90 % confidence interval for a given number of workers n.

c) How many workers (n) should be involved in this study in order to have the mean assembly time within an interval of length 15 seconds with 90% confidence?