E 370 – Spring 2003-04
Exam Three—Practical. Version 1 – white
Statement of Academic Integrity:

"I swear that I have neither given nor received assistance on this exam and that I will not discuss this exam until all sections have completed it, that is until 14:00 hours on Friday, March 26, 2004."

I have read and agree with the above statement.
Signature:_____

Name: (please print)_____

Team Number_____

Instructions

1. Write your name on every page of your exam.
2. Answer the questions in the spaces provided on the exam.
3. You will have exactly 50 minutes to complete this exam.
4. The value of each question is given by each question. Budget your time accordingly.
5. Absolutely ALL cell phones must be turned off and out of reach.
6. You must show your work and explanation to receive full credit. You must write any EXCEL functions you choose to use, with arguments, as well as the numerical output. For example, = PERCENTILE(A1:A100,20) = 47. Include 4 decimal places in your answer where applicable.
7. You may only use EXCEL for this exam. No other calculators or electronic devices of any kind may be on your desk.
8. Only the exam, pencils, erasers, and the tool cards may be on your desk. Put all the rest of your belongings along the wall or at the front of the room.
9. Remember, a student is to avoid even the appearance of cheating. Keep your eyes on your exam or on your computer screen. Any questionable behavior on your part is sufficient reason for your coach to confiscate your exam and ask you to leave the room.
10. You may only leave your seat to leave the room. Once you leave your seat, you must turn in your exam.
11. When you are finished, you may turn in all pages of the exam and leave the room as soon as you are able to without disturbing your classmates.
12. Stay calm and do your best.

1. The fuel economy of cars in the US is usually measured as a number of miles that a car can be driven on 1 gallon of gas (mpg). Industry testing has shown the fuel economy of the 2003 "StatRunner" to be normally distributed with a mean of 22 mpg and standard deviation of 2 mpg. Use this information to answer the following questions. (Total 22 points)

   A. What is the probability that a randomly selected "StatRunner" will show a fuel economy better than 25 mpg in a test drive? (5 points)

   4 points – formula, 1 point – outcome
   =1-NORM.DIST(25,22,2,1) = 0.06681

   B. The company claims that its cars are fuel efficient compared to other similar vehicles. To prove this they demonstrate that 75% of their cars show a fuel economy of at least how many miles per gallon? (5 points)

   4 points – formula, 1 point – outcome Attention: if "1-Norminv" is used deduct 5 points
   = NORM.INV(1-0.75,22,2) = 20.651 mpg

   C. Now suppose that a "StatRunner" dealer had determined the standard deviation provided to you at the beginning of this question from a sample of 100 cars. What is the probability that a randomly selected "StatRunner" will show a fuel economy of more than 24 mpg in a test drive? Explain your answer by completing the sentence below. Show all the steps. (12 points) (**Hint**: you might want to standardize the variable.)

   I will use the _____T distribution_____ distribution to answer this question because __we know sample standard deviation, not the population one _____.

   4 points – 3 for the formula, 1 for the actual number.
   t=(x-μ)/s=1

   5 points – 4 for the formula, 1 for the actual number.
   =1-t.dist(1,99,1)=.1599

2. Use the information in the following table to answer parts A through F. (44 points)

Random Variable	Distribution	Parameters
Let X represent the sulphur content of a shipment of coal	Uniformly distributed between 1% and 3%	E(X) = 2% V(X) = 0.33%
Let Y represent the daily demand for beef in a fast food restaurant.	Normally distributed	E(Y) = 680 lbs. V(Y) = 6400

A. What is the probability that Y is between 600 and 700 pounds? (5 points)

5 points – 4 for the formulae, 1 for the actual number

=NORM.DIST(700,680,80,1)-NORM.DIST(600,680,80,1)= 0.44

B. A statistician is interested in discovering **the distribution of sample means of X** for n=10. Briefly describe how the statistician would achieve this goal. (7 points)

Select a very large number of samples with 10 prices in each sample and calculate sample means. Then either run descriptive statistics on sample means or graph the sample means to estimate the mean and standard deviation. **(Points: 3 points for large number of samples, 4 points for graphing/descriptive stats/any other calculation of mean and standard deviation)**

C. Assuming that the process you described in part B has been followed for both X and Y, what is the distribution of $\overline{X}$ and $\overline{Y}$? You need to describe TWO different distributions here. (11 points)

$\overline{X} \sim some\ dist?(2, \sqrt{0.33/10}(= 0.182))$

$\overline{Y} \sim N(680, \sqrt{6400/10} = 25.3)$

Here 2 points are given for each of the parameters of the distribution, 1 point given if the student writes that the form of the distribution of Xbar cannot be identified, 2 points for identifying Normal for Ybar.

D. How would your results differ from part C if you worked with samples of size 50 instead? Be very specific. (11 points)

The distributions will be Normal in both cases, the means will be the same as above, but the standard errors will be smaller due to larger sample size.

$\overline{X} \sim N(2, \sqrt{0.33/50}(= 0.08124))$

$\overline{Y} \sim N(680, \sqrt{6400/50}(= 11.31))$

Here 2 points are given for each of the parameters of the distribution, 1 point for identifying the Normal for each sample mean(2 means-2 points total) 1 for not referring to CLT or stating that distribution of Xbar is approximately normal.

E. Using the information from C, where n=10, calculate the probability that $\overline{Y}$ is between 600 and 700 pounds. (5 points) **Same points as in A.**

=NORM.DIST(700,680,80/SQRT(10),1)-NORM.DIST(600,680,80/SQRT(10),1)

= 0.785

F. Compare the results you obtained from A and E. Are they different? Explain why or why not in no more than two sentences. (5 points)

The probability in E is higher because in E we have a **sampling distribution of sample means (2.5 points)** with a significantly **smaller standard deviation (standard error)** (2.5 points) than in A.

3. Cheap blank DVD discs are subject to a high defective rate. CheapoLaser makes such discs and claims that each blank DVD disc they sell has a probability of 1/300 to be defective. (34 points total)

A. If a retailer decides to buy 3000 CheapoLaser discs, how many of them should he expect to be defective? What would be the standard deviation of the number of defective discs? Briefly describe the shape of this distribution. (10 points)

This distribution is __Right-skewed binomial because the probability of success is significantly smaller than .5. Though a large number of observations may cause this distribution to become symmetric_____ . **(2 points for identifying right skewness and 1 point for the reason, 1 point for binomial should be taken off iff the wrong (non-binomial) formulae are used for expected value and standard deviation. If the symmetry claim is made – 2 points for the claim, 1 point for the reason)**.

E(Defective)=3000*1/300=10 **(3 points – 2-formula, 1-number)**
St.Dev.=Sqrt(3000*.1/300*.299/300)= 3.157 **(3 points – 2-formula, 1-number)**

B. For a 100-pk CheapoLaser blank DVD spindle, what's the probability that there are no fewer than 3 defective discs? (5 points) **4 for the formula, 1 for the actual number**
=1- BINOM.DIST(2,100,1/300,1) = 0.00471

C. Jonty bought a 100pk CheapoLaser blank DVD spindle and happily found none of them defective. What's the probability of this event? (5 points) **4 for the formula, 1 for the actual number**
=BINOMDIST(0,100,1/300,1)=.716 or =BINOMDIST(0,100,1/300,0)=.716

D. CirCity, a dealer of CheapoLaser, has just got 500 spindles of 100pk CheapoLaser blank DVD from today's truck. What's the probability that less than 150 of these spindles have defective discs? (**Hint:** your answer to previous question may help here) (5 points) **4 for the formula, 1 for the actual number**
P (at least 1 defective) =1-.716=.284
= BINOM.DIST (149,500,1-.716,1)= 0.77246

E. Using the normal approximation, recalculate the probability that less than 150 of the 500 spindles of 100pk CheapoLaser blank DVD have defective discs. (9 points)

$\mu = n\,\pi = 500 * 0.284 = 142$ $\sigma^2 = n\,\pi\,(1-\pi) = 500 * 0.284 * (1-0.284) = 101.672$
2 points each – 1 for the formula, 1 for the outcome
5 points for approximation – 4 for the formula, 1 for the outcome.
=NORM.DIST (149.5,142,SQRT(101.672),1) = 0.7715