NAME: SOLUTIONS

Math 124 FALL 2004: Section 7 TTh 9:35-10:50 AM
Midterm 2 **Date: Apr 28, 2005**

Instructions: Answer questions 1-4. There is a bonus question, but you can get a perfect score without attempting it. Show as much work as you feel reasonable. You have 75 minutes. To allow others to fully concentrate at the end please do not leave in the last 5 minutes. You should submit your page of notes with your test paper.

Question 1. (*25 points*)

Define each of these terms in the context of sample surveys. Where appropriate explain the possible effect (of the term) on conclusions drawn from a survey.

(a.) *Population* and *Sample*

5pts

population – a group of objects/units/people which you want to learn about

sample – a subset of the population for which you measure or record the variable (or variables) that you are interested in.

(b.) *Simple Random Sample*

5pts

A method of random sampling where every individual in the population has an equally likely chance of being chosen for the sample. The hope would be that SRS is more likely to give you an unbiased sample.

(c.) *Stratified Random Sample*

5pts

The population is divided into groups called "strata" based on some variable eg age, gender, state of residence. Within each strata a SRS is taken. This is done to ensure that the sample is representative of the population

(d.) *Voluntary Response*

A survey where only respondents who wish to respond with answers. More specifically we say that the respondants self-select themselves to answer. Examples include things like magazine surveys, web polls etc. Data from voluntary response surveys is highly suspect and not likely to generalize to the population.

5 pts

(e.) *Question Wording*

How a question is worded can have significant effect on how a question is answered. For instance ambiguous wording could cause people with same underlying opinion to answer differently. Using complicated terms might make it hard for a respondant to understand. Also there is potential to ask leading questions.

5 pts

Question 2. (*25 points*)

An education researcher at SFSU wants to investigate study habits of Freshmen students at SFSU. She gathers a list of all the Freshmen students at SFSU. Her research unit has the time and resources to deal with responses from as many as 250 students.

(a). What is the population in this study? What is the sample?

Population - Freshmen students at SFSU

sample - 250 Freshmen students chosen for the study

4 pts

(b). Suggest a method she could use to select Freshmen students for her study. Explain why you recommend this method.

she could use a SRS, specifically she could use a random number table or a computer to get random numbers and have these random numbers correspond to students on the list chosen for the sample. Her aim is to get a representative sample-

7 pts

Even better yet she should carry out SRS within strata. Eg where they live (dorm, at home, with other students, etc) Major or Classes taken ....

(c). What issues should the researcher consider when creating this questionnaire?

7pts

one primary issue she should consider is how the questionaire is worded. Every question should be written in simple, clear unambiguous language so that it is clear what is being asked. Also each question should be as neutral as possible ie not suggesting one specific answer over another. Also, she should ensure that the questionaire is not over tedious so that respondents will not restrict responding due to length.

(d). The researcher has two different options on how she can carry out the study: face to face personal interviews or self-administered questionnaires which can be mailed back. Discuss potential advantages and disadvantages for each of these methods.

7pts

Method	Advantages	Disadvantages
Face to Face	- possibility of getting fuller answers	- bias due to behavior of questioner - cost/time - no anonymity
Self Administered Questionaires	- quicker, easier for respondents - possibly more truthful	- Possibly high level of non response - respondent can't get clarification.

Question 3. (*25 points*)

The life time of a particular brand of automobile tire is known to be normally distributed with mean 35000 miles and standard deviation 5250 miles. Suppose the manufacturer offers a warranty that guarantees free replacement if a tire does not last at least 20000 miles.

(a.) What is the probability that a tire lasts between 25000 and 42000 miles?

Let $X \equiv$ "Life time of a tire" X is distributed $N(35000, 5250)$

9pts

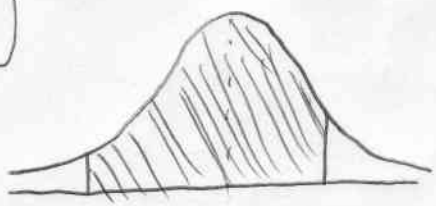
$$P(25000 < X < 42000) = P\left(\frac{25000-35000}{5250} < \frac{X-35000}{5250} < \frac{42000-35000}{5250}\right)$$

$$= P(-1.90 < Z < 1.33)$$

$$= P(Z < 1.33) - P(Z < -1.90)$$

$$= .9082 - .0287$$

$$= .8795$$

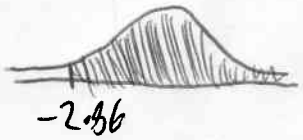


(b.) What is the probability that a tire will not need warranty replacement?

8pts

"won't need warranty replacement" $\equiv X > 20000$

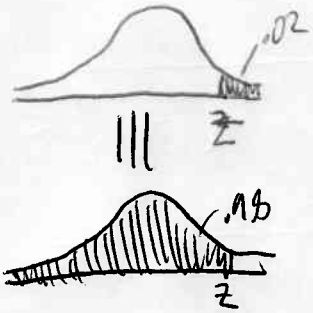
$$P(X>20000) = P\left(\frac{X-35000}{5250} > \frac{20000-35000}{5250}\right)$$



$$= P(Z > -2.86)$$
$$= 1 - P(Z < -2.86)$$
$$= 1 - .0021 = \underline{.9979}$$

(c.) Above how many miles will the top 2% of tires of this brand last?

8pts



Want x for which $P(X>x) = .02$

looking in table for .98 closest entry is .9798 which corresponds to $z = 2.05$

so $x = \sigma z + \mu$

$= (5250)(2.05) + 35000$

$= \underline{45762.5}$ miles

Question 4. (*25 points*)

Suppose that bolts are produced in a factory. The probability of a bolt being defective (outside acceptable specifications) is .01. Each bolt is produced independently of all other bolts.

(a.) What is the probability that there is one or more defective bolts in a batch of size 10?

9pts

Let $X \equiv$ "number of defective bolts in batch of n bolts"

when $n=10$ X has binomial distribution $B(10, .01)$

one or more $\equiv X \geq 1$

$$P(X \geq 1) = 1 - P(X=0)$$

$$= 1 - \binom{10}{0}^{4} .01^0 .99^{10} = 1 - .9044$$

$$= \underline{0.0956} \text{ (4dp)}$$

(b.) Suppose that there are instead 2000 bolts in a batch. What is the mean number of defective bolts in a batch of this size? What is the standard deviation?

8 pts

when $n=2000$ $np=2000(.01)=20>10$ $n(1-p)=2000(.99)=1980>10$

X has approx Normal distribution with

$\mu_X = np = 2000(.01) = \underline{20}$

$\sigma_X = \sqrt{np(1-p)} = \sqrt{2000(.01)(.99)} = \underline{4.4497}$ (4dp)

(c.) What is the probability of having more than 30 defective bolts in a batch of 2000?

8 pts

$$P(X>30) \approx P\left(\frac{X-20}{4.4497} > \frac{30-20}{4.4497}\right)$$

$$= P(Z > 2.25)$$

$$= 1 - P(Z < 2.25)$$

$$= 1 - .9878$$

$$= \underline{.0122}$$