

## Stat 1 Practice Midterm Solutions

1. Read the following news report and answer the questions that follow.

### **Self-hypnosis shown to help children with stomachaches Philadelphia Inquirer: Personal Health 10/19/2009**

Doctors call it “functional abdominal pain” - those chronic tummy aches that make kids miserable, but have no detectable physical cause.

A new study suggests that such children can be taught to use their minds to feel better, since stress and anxiety may be the key to their pain.

Researchers at the University of North Carolina at Chapel Hill and Duke University Medical Center studied 34 children, ages 6 to 15. All of them received standard medical care, such as drugs to relieve constipation, diarrhea, or acid reflux, if present. But half of them also took home CDs with eight weeks of guided-imagery therapy, sometimes called self-hypnosis.

The recordings, used five days a week, helped the children imagine “floating comfortably on a big, puffy cloud” or “light and warmth spreading throughout the belly and making a protective barrier.”

About 73 percent who used guided imagery said their abdominal pain was reduced by at least half, compared with only 27 percent in the medical therapy-only group. When this group later added guided imagery sessions, 60 percent reported significant relief. Overall, about 62 percent said the pain relief lasted for six months.

The study appears in the November issue of *Pediatrics*. - Marie McCullough

- a) This study is (choose one)

- i) a randomized experiment.    ii) an experiment, but without randomization.
- iii) an observational study.    iv) a survey based on a simple random sample.

This is an **experiment** because the treatment (guided imagery or no guided imagery) is imposed on the subjects. It isn't entirely clear from the article whether or not randomization was used, so either i or ii could be correct. I'll make sure there is no ambiguity on the actual midterm.

- b) What are the explanatory and response variables in this study?

The explanatory variable is whether or not a child used guided imagery, and the response variable is whether or not the child said their pain was reduced by at least half.

- c) The difference is “statistically significant.” Which of the following is the best explanation for what this means?

- i) If the guided imagery had no effect, it would be very unlikely to see proportions as different as 0.73 and 0.27 in the two groups.
- ii) If the guided imagery had no effect, it would be very unlikely not to see proportions as different as 0.73 and 0.27 in the two groups.
- iii) If the guided imagery has an effect, it would be very unlikely to see proportions as different as 0.73 and 0.27 in the two groups.
- iv) If the guided imagery has an effect, it would be very unlikely not to see proportions as different as 0.73 and 0.27 in the two groups.

- d) Assuming there were 17 children in each group (half of 34), find the margin of error for 95% confidence and report 95% confidence intervals for the two percentages reported.

The quick margin of error for proportions is  $1/\sqrt{n}$ , so with  $n = 17$  the margin of error is  $1/\sqrt{17} \approx 0.24$ . The confidence interval for the guided imagery group is then  $0.73 \pm 0.24$  or  $(0.49, 0.97)$ . In the control group the confidence interval is  $0.27 \pm 0.24$  or  $(0.03, 0.51)$ . These intervals overlap only slightly, suggesting that the two proportions are estimating different rates of pain relief for the two treatments.

- e) Assuming 17 children in each group, comment on the plausibility of the reported percentages (73% and 27%).

If the sample sizes were both 17, it wouldn't be possible to get these proportions (73% of 17 is 12.4 and 27% of 17 is 4.6).

2. A movie buff named Larry brashly claims that he has seen at least 1000 movies. You want him to convince you, based on an 800-page movie guide that you and Larry agree is certain to list every movie he has seen. You select 20 pages at random and have Larry count the number of movies he has seen on these pages.

- a) This study is an example of (choose one)
- i) a randomized experiment.    ii) an experiment, but without randomization.
  - iii) an observational study.    iv) a survey based on a simple random sample.

- b) Suppose Larry checks 20 pages and finds a total of 30 movies he has seen. What is the estimated mean number of movies Larry has seen per page of the guide? What is the estimated total number of movies Larry has seen?

Larry estimates he has seen 1.5 movies per page on average, or  $(1.5)(800) = 1200$  movies.

3. Does coaching raise SAT scores? Because many students score higher on a second try even without coaching, a study looked at an SRS of 4200 students who took the SAT twice. Of these, 500 had taken coaching courses between their two attempts at the SAT. The study compared the average increase in scores (out of the total possible score of 1600) for students who were coached with the average increase for students who were not coached.

- a) This study compares two groups, but it is not an experiment because
- i) there is no explanatory variable.
  - ii) there is no response variable.
  - iii) random selection was not used to produce the data.
  - iv) each student chose whether or not to take a coaching course.
- b) The report of the SAT study says, With 95% confidence, we can say that students who are coached raise their average SAT scores by between 19 and 38 points more than students who are not coached. By 95% confidence we mean
- i) 95% of all students will increase their score by between 19 and 38 points if they are coached.
  - ii) we are certain that the average increase is between 19 and 38 points.
  - iii) we got the 19 to 38 point range by using a method that would give a correct answer in 95% of all samples.
  - iv) 95% of the coached students in the study raised their scores by between 19 and 38 points.

- c) If we wanted a 99% confidence interval, the range of points would be
- i) wider, because higher confidence requires a larger margin of error.
  - ii) narrower, because higher confidence requires a smaller margin of error.
  - iii) wider, because higher confidence requires a smaller margin of error.
  - iv) narrower, because higher confidence requires a larger margin of error .
  - v) the same, because sampling variability depends only on sample size.
- d) The SAT study doesn't show that coaching causes a greater increase in SAT scores. One plausible explanation for the study finding is
- i) more students were not coached than were coached.
  - ii) 4200 students is too few to draw a conclusion.
  - iii) students who chose coaching were different (in particular, they were richer) than students who had no coaching.
  - iv) there was no random selection.
4. The stock market did well during the 1990s. Here are the percent total returns (change in price plus dividends paid) for the Standard & Poors 500 stock index for the years 1989 – 1998:

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Return	31.7	3.1	30.5	7.6	10.1	1.3	37.6	23.0	33.4	28.6

- a) What was the median annual return during this period?
- To find the median, we need to put the ten values in order:  
 1.3, 3.1, 7.6, 10.1, 23.0, 28.6, 30.5, 31.7, 33.4, 37.6  
 The median value is the average of the 5th and 6th values:  $(23.0 + 28.6)/2 = 25.8$ .
- b) Find the interquartile range (IQR) of the annual returns during this period.
- The first quartile is 7.6 and the third quartile is 31.7, so the IQR is  $31.7 - 7.6 = 24.1$ .
5. The telephone company says that 62% of all residential phone numbers in Los Angeles are unlisted. A telephone survey contacts a random sample of 1000 Los Angeles telephone numbers, of which 58% are unlisted. In this setting,
- i) 62% is a parameter and 58% is a statistic.    ii) 58% is a parameter and 62% is a statistic.
  - iii) 62% and 58% are both parameters.            iv) 58% and 62% are both statistics.
6. Most fixed-rate home mortgages are structured so that the borrower makes a constant payment every month for the duration of the loan. Suppose someone took out a 20 year mortgage in 1987 and made payments of \$1000 every month until Feb. 2007. Explain how the value of the payment is changing (if at all) in constant dollars. Specifically, find the value of the final \$1000 payment in 1987 dollars. The CPI in 1987 was 113.6 and the value for February 2007 was 203.5.

Due to inflation, the mortgage payments are decreasing in value over time. 2007 dollars are worth  $113.6/203.5 \approx 0.558$  1987 dollars, so \$1000 in 2007 was worth only \$558 in 1987 dollars.

7. My nephew, Nicholas Corey Everson, was born March 11, 2005 and weighed 133 oz. The distribution of birth weights (for both male and female babies) is approximately Normal with mean and standard deviation of about 115 oz. and 20 oz. respectively. Assume this is exactly correct.

- a) Sketch the distribution and mark the mean and the values one and two standard deviations from the mean.
- b) What proportion of babies weigh at least 135 oz. at birth?

135 is one standard deviation above the mean, so about 16% of babies are born weighing this much or more. Using Table B the value would be 15.87%.

- c) Below what value are the lowest 2.5% of birth weights?

About 95% of draws from a Normal distribution are within two standard deviation of the mean. So the lowest 2.5% will be less than  $115 - 2(20) = 75\text{oz.}$

- d) About what percent of babies are born weighing as much or more than Nicholas?

The standard score for 133 is  $z = (133 - 115)/20 = 0.9$ . The value in percentile for 0.9 in table B is 81.59, meaning about 81.59% of babies are born weighing 133oz or less. That leaves 18.41% who are born weighing this much or more.

- e) About what percent of babies are born weighing between 95 oz and 133 oz?

The standard score for 95oz is  $z = (95 - 115)/20 = -1$ , so about 15.87% of babies weigh 95oz or less. From part d, we know 81.59% weigh less than 133oz, so about  $81.59 - 15.87 = 65.72\%$  weigh between 95oz and 133oz.

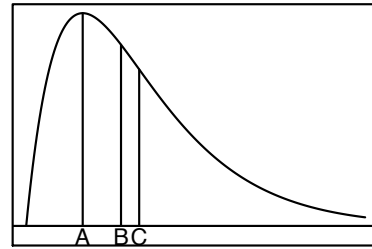
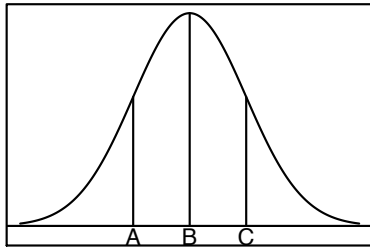
8. If we take a simple random sample of size  $n = 500$  from a population of size 5,000,000, the variability of our estimate will be

- i) less than the bias.
- ii) much less than the variability for a sample of size  $n = 500$  from a population of size 50,000,000.
- iii)** approximately the same as the variability for a sample of size  $n = 500$  from a population of size 50,000,000.
- iv) much greater than the variability for a sample of size  $n = 500$  from a population of size 50,000,000.
- v) plus or minus 1%.

9. You might try to measure how rich a person is by looking at the car they drive. In fact, driving a fancy car has little to do with income (most luxury cars are leased). In statistical terms, measuring income by car model is

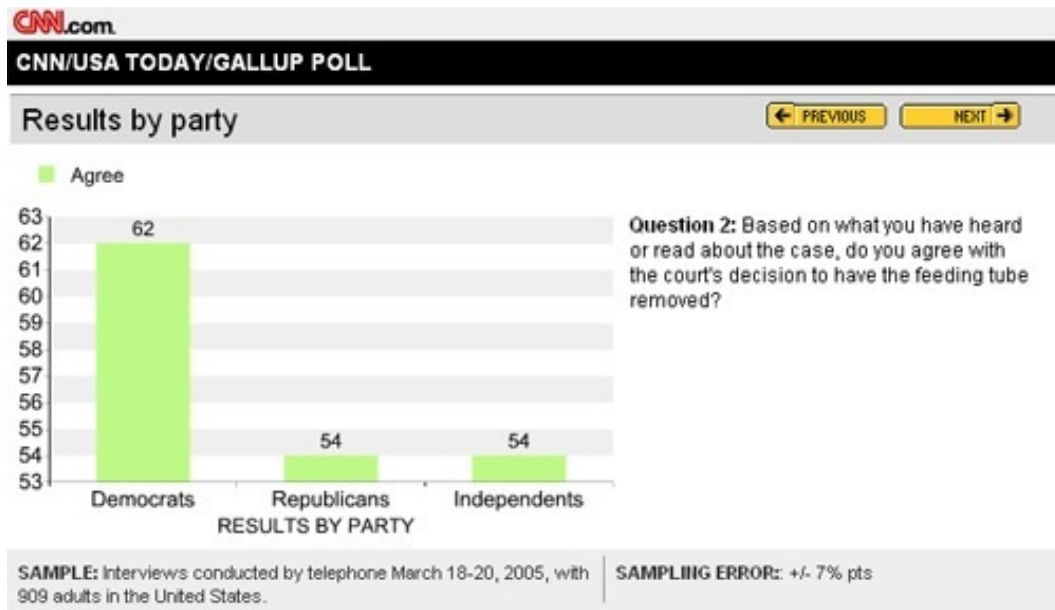
- (i) not reliable.    **(ii) not valid.**    (iii) biased.    (iv) not precise.

10. For each density function below, identify the point (A, B or C) that corresponds to the mean and the point that corresponds to the median.



The first density is symmetric about B, so the mean and median are both at B. The second density is skewed right, so we know the mean is larger than the median. The median divides the area in half, so the median is at B and the mean is at C.

11. The following graph appeared at CNN.com on March 21, 2005 as a summary of a survey question about the Terri Shiavo case:



Explain briefly why this graph is misleading.

The range is compressed so that the differences are exaggerated. In fact all three proportions are over 50%, but it looks like the value for Democrats is much larger.

12. Select all of the following values can that you can find from this graph and caption.
- The total number of people surveyed who agreed.
  - The proportion of people surveyed who agreed.
  - The proportion of people surveyed who were Republicans.
  - The proportion of Republicans surveyed who agreed.**
  - The number of Republicans surveyed who agreed.
  - The proportion of those who agreed who were Republicans.