Math 121   **Test #1**   **Fall 2011**
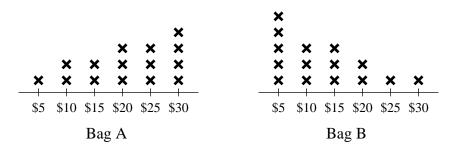
1. (17 pts) There are two bags: Bag A and Bag B. Each bag contains 15 vouchers worth various amounts from $5 to $30. The distributions in the two bags are shown in the following diagrams.

Bag A

Bag B

We are handed one of the bags, but we do not know which one it is. The two bags are identical in appearance. We will draw one voucher at random from the bag we are holding and, based on its value, we will decide which bag we believe to be. The two hypotheses are

$$H_0: \quad \text{We are holding Bag A.}$$
$$H_1: \quad \text{We are holding Bag B.}$$

(a) (3 pts) What is the direction of extreme?

(b) (8 pts) Our decision rule is to accept H_0 unless the value of the selected voucher is $10 or less. Find the values of α and β.

(c) (3 pts) What is the p-value of 15?

(d) (3 pts) If the value of the selected voucher is 15, would that datum be statistically significant?

2. (25 pts) The following article, titled "Study puts SpongeBob in hot water over kids[1]," is taken from the Richmond Times-Dispatch from September 12, 2011.

   CHICAGO – The cartoon character SpongeBob SquarePants is in hot water from a study suggesting that watching just nine minutes of that program can cause short-term attention and learning problems in 4-year-olds.

   The problems were seen in a study of 60 children randomly assigned to either watch "SpongeBob" or the slower-paced PBS cartoon "Caillou," or assigned to draw pictures. Immediately after these nine-minute assignments, the kids took mental function tests; those who had watched "SpongeBob" did measurably worse than the others.

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[1] http://www2.timesdispatch.com/news/2011/sep/12/tdmain08-study-puts-spongebob-in-hot-water-over-ki-ar-1302023/

Previous research has linked TV watching with long-term attention problems in children, but the new study suggests more immediate problems can occur after very little exposure, study authors said.

Kids' cartoon shows typically feature about 22 minutes of action, so watching a full program "could be more detrimental," the researchers speculated. But they said more evidence is needed.

The results should be interpreted cautiously because of the study's small size, but the data seem robust and bolster the idea that media exposure is a public health issue, said Dr. Dimitri Christakis. He is a child development specialist at Seattle Children's Hospital who wrote an editorial accompanying the study published online Monday today in the journal Pediatrics.

Christakis said parents need to realize that fast-paced programming may not be appropriate for very young children. "What kids watch matters, it's not just how much they watch," he said.

University of Virginia psychology professor Angeline Lillard, the lead author, said Nickelodeon's "SpongeBob" shouldn't be singled out. She found similar problems in kids who watched other fast-paced cartoons programming.

She said parents should realize that young children are compromised in their ability to learn and use self-control immediately after watching such shows.

(a) (8 pts) State reasonable null and alternative hypotheses for this situation.

(b) (4 pts) Which hypothesis was accepted? Underline the statement in the article that supports your answer.

(c) (5 pts) Describe the sample.

(d) (3 pts) The children were *randomly* assigned to three different groups. Name one type of bias that this random design was intended to avoid.

(e) (5 pts) Explain why three groups were used (watching SpongeBob, watching Caillou, and drawing pictures) instead of just having all the children watch SpongeBob?

3. (15 pts) Continuing with the article in the previous problem,

(a) (4 pts) Describe one explanatory variable in this study.

(b) (4 pts) Describe one response variable in this study.

(c) (3 pts) Is your explanatory variable qualitative or is it quantitative?

(d) (4 pts) Is this study observational or is it experimental? Explain.

4. (10 pts) The following article, titled "Study links child abuse, recession[2]," is taken from the Richmond Times-Dispatch from September 19, 2011.

> CHICAGO – An increase in child abuse, mostly against infants, is linked with the recent recession in new research that raises fresh concerns about the impact of the nation's economic woes.
>
> The results are in a study of 422 abused children from mostly lower-income families, known to face greater risks for being abused, and the research involved just 74 counties in four states. But lead author Rachel Berger of Children's Hospital of Pittsburgh said the results confirm anecdotal reports from pediatricians who've seen increasing numbers of shaken baby cases and other forms of brain-injuring abuse.
>
> Berger decided to study this type of injury, known as abusive head trauma, after noticing an increase at her own hospital from late 2007 through June 2009. Her hospital averaged 30 cases per year during those recession years versus 17 yearly before 2007.
>
> Though this abuse is still uncommon, the number of cases in the counties studied increased sharply, rising from about 9 cases per 100,000 children in pre-recession years, to almost 15 per 100,000 kids during the recession – a 65 percent increase.
>
> Children studied were younger than 5, and most were infants. Most suffered brain damage and 69 died, though the death rate didn't rise during the recession.

(a) (5 pts) Describe a possible confounding variable in this study? There are many possible answers. Use your good judgment.

(b) (5 pts) The study says that there was a 65 percent increase in abuse cases in the 74 counties that were studied. Is this figure a statistic or is it a parameter? Explain.

5. (20 pts) Suppose that we want to study adolescent behavior in a middle school. There are 500 students in the school. We will take a sample of 50 students.

(a) (8 pts) Using a seed of 22, give the labels of the first 5 students selected in a simple random sample.

(b) (4 pts) Of the 500 students in the school, 150 are sixth graders, 150 are seventh graders, and 200 are eighth graders. If we intentionally select at random 15 sixth graders, 15 seventh graders, and 20 eighth graders, what sampling method would we be using?

(c) (4 pts) If, instead, we randomly select two classes, each with 25 students, and study those 50 students, what sampling method would we be using?

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[2] http://www2.timesdispatch.com/news/2011/sep/19/tdmain03-study-links-child-abuse-recession-ar-1319584/

(d) (4 pts) If we let 50 students volunteer for the study, which of the following types of bias would likely be present in our sample? Select one or more and explain your reasoning.

   (i) Selection bias.

   (ii) Response bias.

   (iii) Nonresponse bias.

   (iv) Experimenter bias.

6. (13 pts) The following data represent the daily high temperatures in Farmville for the first 21 days of this month.

$$
\begin{array}{ccccccc}
87 & 84 & 87 & 89 & 84 & 77 & 80 \\
87 & 84 & 87 & 86 & 84 & 87 & 89 \\
84 & 64 & 64 & 66 & 73 & 75 & 77 \\
\end{array}
$$

(a) (8 pts) Create a stem-and-leaf display *with split stems* of these data.

(b) (5 pts) Using appropriate statistical terminology, describe the shape of the distribution.