1. (17 pts) The National Cancer Institute conducted a randomized, double-blind experiment to compare two drugs: tamoxifen (T) and raloxifene (R), for preventing various types of cancer. The researchers found that 36 of 4732 women in the T group developed uterine cancer, compared to 23 of 4712 women in the R group. These data are summarized in the table below:

<table>
<thead>
<tr>
<th></th>
<th>Tamoxifen</th>
<th>Raloxifene</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed uterine cancer</td>
<td>36</td>
<td>23</td>
<td>59</td>
</tr>
<tr>
<td>Did not develop uterine cancer</td>
<td>4696</td>
<td>4689</td>
<td>9385</td>
</tr>
<tr>
<td>Total</td>
<td>4732</td>
<td>4712</td>
<td>9444</td>
</tr>
</tbody>
</table>

a) (1 pt) Identify the response variable in this study.

b) (2 pts) Calculate the $z$-test statistic for testing whether these data provide strong evidence that the two drugs differ with regard to the development of uterine cancer.

c) (2 pts) Based on the value of this test statistic, do you suspect that the difference between the groups is statistically significant at the .05 significance level? Explain briefly, but do not calculate the p-value.

d) (1 pt) Calculate the relative risk of developing uterine cancer between the T group and the R group.

e) (3 pts) Determine a 95% confidence interval for the population relative risk.

f) (2 pts) Interpret what this confidence interval says (i.e., you’re 95% confident of what?).

g) (1 pt) If the study had involved fewer people, how would the confidence interval have changed? (Circle your answer; do not bother to explain.)

   Narrower  Same width  Wider

h) (1 pt) If you had used a 90% confidence level, how would the confidence interval have changed? (Circle your answer; do not bother to explain or calculate.)

   Narrower  Same width  Wider

2. (11 pts) A national survey conducted on October 1-5, 2009 asked pet owners whether they would perform CPR on their pet in the event of a medical emergency. The survey found that 63% of dog owners and 53% of cat owners responded that would perform CPR on their pet.

a) (2 pts) Could this study have used random sampling or random assignment? Choose the appropriate one of these, and briefly explain.

b) (2 pts) Are .63 and .53 parameters or statistics? Also state appropriate symbols to use for these values.
c) (2 pts) State (in symbols only) the appropriate hypotheses for testing whether dog owners and cat owners differ with regard to willingness to perform CPR on their pets.

d) (2 pts) What further information about the survey results do you need in order to carry out a test of these hypotheses?

e) (3 pts) A 95% confidence interval turns out to be: (-0.161, -0.039). Explain what this interval says, being sure to make clear what the parameter being estimated is.

3. (12 pts) Professional baseball teams have one coach at first base and one coach at third base, with third base regarded as the more important and prestigious position. An article in the August 11, 2010 New York Times raised a concern that minority coaches are under-represented at third base compared to first base. The article cited the following data:

- 27 of 60 base coaches in Major League Baseball (MLB) are members of minority groups
- 7 of the 30 third-base coaches in are members of minority groups.
- 20 of the 30 first-base coaches in are members of minority groups.

a) (2 pts) Is this an observational study or an experiment? Explain briefly.

b) (5 pts) Show how to calculate the exact p-value for investigating the article’s suspicion from these data.

c) (3 pts) The p-value turns out to equal .0008 (to four decimal places). Explain (in detail) what this p-value is the probability of, as if to someone interested in the New York Times article who has not taken a statistics class.

d) (2 pts) Summarize the conclusion that you would draw from the p-value.

4. (10 pts) The Gallup organization released a report on October 20, 2014 that studied the daily lives and well-being of American adults. Based on a random sample, the report compared survey responses between adults with children under age 18 living in the home and those without such children living in the home. The following table was provided in the report:

<table>
<thead>
<tr>
<th></th>
<th>All adults</th>
<th>Adults with children under 18 in household</th>
<th>Adults with no children under 18 in household</th>
<th>Difference (percentage points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% who smiled or laughed a lot on previous day</td>
<td>81.2</td>
<td>84.1</td>
<td>79.6</td>
<td>4.5</td>
</tr>
<tr>
<td>Number who were surveyed</td>
<td>131,159</td>
<td>36,043</td>
<td>95,116</td>
<td></td>
</tr>
</tbody>
</table>

a) (2 pts) Does this study involve random sampling, random assignment, both, or neither? (Circle your answer; do not bother to explain.)

random sampling  random assignment  both  neither
b) (2 pts) State the appropriate null and alternative hypotheses for testing whether the two groups of adults differ with regard to the proportion who smiled or laughed a lot on the previous day.

c) (2 pts) Show how to calculate the value of the z-test statistic for testing these hypotheses. (Do not bother to complete the calculation, but show the numbers plugged in.)

The test statistic turns out to be $z = 18.5$.

d) (2 pts) Write a sentence interpreting the value of this z-test statistic.

e) (2 pts) Would you reject the null hypothesis at the .01 significance level? Explain how your answer follows from the value of the z-test statistic.

5. (7 pts) This is a continuation of the previous question.

a) (2 pts) A 99% confidence interval based on the sample data turns out to be (.039, .051). Interpret what this interval says.

b) (2 pts) Is this confidence interval consistent with your test decision (from the previous question)? Explain how you know.

c) (1 pt) Give a very brief explanation for why this confidence interval is very narrow.

d) (2 pts) Suppose that someone reads about this study and says that having children in the household causes a very large increase in the likelihood of smiling or laughing a lot. Would you agree with this conclusion? Explain why or why not.

6. (6 pts) Three questions are given below. Circle the letters EXP next to any question that can reasonably be investigated with a randomized experiment. Also circle the letters CAT for any question that has a response variable that is categorical.

- Does using an underhand shooting method for a free throw in basketball increase the probability of successfully making the shot, as opposed to using the conventional overhand shooting method? EXP CAT
- Is the proportion of teenagers in England who have read at least one Harry Potter book greater than the proportion of teenagers in the U.S. who have read at least one Harry Potter book? EXP CAT
- Do cows tend to produce more milk, on average, if their handlers give them a name and speak to them using that name? EXP CAT