1. (12 pts) A chimpanzee named Sarah, who had been raised in captivity since age one, was the subject in a study of whether chimpanzees can solve problems. Sarah was shown 30-second videotapes of a human actor struggling with one of several problems (for example, not able to reach bananas hanging from the ceiling, a record player not playing). Then Sarah was shown two photographs, one that depicted a solution to the problem (like stepping onto a box, plugging in the record player) and one that did not match that scenario. Researchers watched as Sarah selected one of the photos, and they kept track of whether Sarah chose the correct photo depicting a solution to the problem. They found that Sarah chose the correct photo in 7 of 8 scenarios that she was presented.

a) (4 pts) Describe how you could use a coin to conduct a simulation analysis for testing whether Sarah genuinely does tend to choose the correct photo more than would be expected by random chance. Be sure to indicate how many times you would toss the coin and what variable you would keep track of.

The graph below depicts the results of using the Coin Tossing applet to simulate Sarah’s choices 1000 times:

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<table>
<thead>
<tr>
<th>Number of heads</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>24</td>
</tr>
</tbody>
</table>
```

(Notice that the numbers at the top of the graphs give counts of dots at each number. The number above 0 is hard to read: 4 dots are at the value 0.)

b) (2 pts) Use this graph to determine the approximate p-value.

c) (3 pts) Describe what this p-value means. [Hint: The p-value is the probability of what, assuming what?]

d) (3 pts) What would you conclude from this simulation analysis about whether Sarah is able to do better than guessing? Explain the reasoning process behind your conclusion.

2. (15 pts) A statistics student wanted to investigate whether her dog Muffin was more likely to chase one ball or the other when a blue ball and a red ball were thrown at the same time. In 96 throws, Muffin chased the blue ball 52 times and the red ball 44 times.

a) (2 pts) For what proportion of throws did Muffin chase the blue ball? Also indicate the appropriate symbol for denoting this proportion.
b) (2 pts) State (in symbols) the appropriate null and alternative hypotheses for testing the student’s question.

c) (2 pts) Describe (in words) the parameter of interest in this study.

d) (2 pts) Check whether the technical conditions for applying a one-proportion \( z \)-test are satisfied.

e) (4 pts) Calculate the test statistic and \( p \)-value.

f) (1 pt) What test decision would you make at the \( \alpha = .05 \) significance level?

g) (2 pts) Summarize your conclusion.

3. (8 pts) Suppose that the duration of human pregnancies (from conception to birth) follows a normal distribution with mean \( \mu = 266 \) days and standard deviation \( \sigma = 16 \) days.

a) (2 pts) Between what two values do about 95% of human pregnancy durations fall?

b) (3 pts) What proportion of human pregnancies last for more than 300 days (about ten months)?

c) (3 pts) Only 8% of human pregnancies last for fewer than how many days?

4. (9 pts) In the mid-1980s, sociologist Shere Hite undertook a study of American women’s attitudes toward relationships, love, and sex by distributing 100,000 questionnaires in women’s groups. One of the questions was: Do you give more emotional support to your husband or boyfriend than you receive from him? A total of 4500 women returned the questionnaire.

An ABC News/Washington Post poll conducted at about the same time surveyed a random sample of 767 women, asking them the same question about emotional support.

a) (2 pts) Which survey would you expect to obtain a more representative sample of the population? Explain briefly.

Of the 4500 women who returned the Hite questionnaire, 96% said that they gave more emotional support than they received from their husbands or boyfriends. Of the 767 women interviewed in the ABC News/Washington Post poll, 44% claimed to give more emotional support than they receive.

b) (3 pts) Using only the poll corresponding to your answer to b), determine a 99% confidence interval for the relevant population parameter.

Based on the ABC News/Washington Post poll, a 99% confidence interval is:

c) (2 pts) Write a sentence interpreting what your confidence interval reveals.
d) (2 pts) If you were to calculate the margin-of-error for both surveys (do not bother to actually do this calculation), which survey would have the smaller margin-of-error? Explain briefly.

5. (6 pts) Suppose that you want to estimate the proportion of full-time Cal Poly students who have at least one class on Fridays this quarter to within ±.06 with 95% confidence.

a) (1 pt) Identify the observational units in this study.

b) (1 pt) Identify the variable in this study. Is it categorical or quantitative?

c) (1 pt) Identify the population in this study.

d) (3 pts) Determine the sample size needed to achieve your goal. [Hints: Re-read the first sentence of this question to remember what the goal is. Plug in any reasonable guess/estimate for what the proportion will turn out to be, and clearly state what your guess/estimate is.]