Instructions: work these problems before you view the answer key, which is available on Tuesday morning. Bring both to the exam on Thursday.

1. Suppose you work for a major car maker. They are designing cars to fit the majority of people (but obviously not everyone). They know that the population as a whole has a mean height of 62 inches with a population standard deviation of 9 inches.

   a) They have measured the height of their car and determined that the tallest person that could fit is one that is 78 inches tall. The shortest person who can still see over the steering wheel is 54 inches tall.

      i) Compute the z-scores that correspond to the shortest and tallest heights.

      ii) Compute the proportion of people who will fit in this car.

   b) Suppose that the car maker knows that the shortest person who will be able to use the car is 54 inches tall. How tall do they have to make the car in order to allow 60% of the total population to use the car? (note: the 40% of people who can't use the car includes both short and tall people).

   c) By adding a power booster seat, the car maker can make cars that can be used by people who are very short. That is, there is no lower limit to how short a person could be and still use this car. How tall do they have to make this car in order to allow 95% of the people to drive this car?

2. On a certain statistic, you are told that 30% of the people fall below a value of 34. 30% of the people fall above a value of 44. What is the mean and standard deviation of the original distribution? (hint: compute the z-scores of each X value and then use logic to deduce the mean and standard deviation).

3. Why does the binomial distribution approximate the normal distribution for large N?

4. Why does the distribution of sample means tend to be normally distributed, even if the original distribution is not normally distributed?
5. What is the difference between the standard deviation and the standard error?

6. The makers of a new fat substitute, Fatbegone™, have hired you to determine if replacing the lard in potato chips changes the taste. The makers know that on average, people eat 27 of the regular chips. You get 6 friends, and record how many chips made with Fatbegone they eat. Your experiment will measure the number of chips eaten by each person. From previous work with chip experiments, you know that the number of chips eaten has a population variance $\sigma^2$ of 64. Test the hypothesis that people eat more Fatbegone chips than regular chips.

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<thead>
<tr>
<th>Fatbegone Subject #</th>
<th>Fatbegone Chips Eaten</th>
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<tbody>
<tr>
<td>1</td>
<td>32</td>
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<tr>
<td>2</td>
<td>35</td>
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<td>3</td>
<td>23</td>
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<td>43</td>
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<td>32</td>
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a) What is the null and alternative hypotheses?

b) What is the criterion, and what will we compare to the criterion? Just put down words.

c) Using an $\alpha = 0.10$, test the hypothesis that people each more Fatbegone chips than regular chips.
   
   i) First list the critical $z$-value.

   ii) Compute your summary score.

   iii) Compare your summary score to the critical score and answer your question.
7. Joe is applying to graduate school. His GPA is 2.8. He calls up his dream school, East Scranton VoTech, to find out if he will get into the East Scranton VoTech grad school program based on his GPA. The guidance counselor tells him that the school admits people based on their GPA alone. The cutoff GPA varies from year to year. However, the guidance counselor says that through the years the cutoff GPA has proven to be normally distributed, with a mean $\mu$ of 3.0 and a standard deviation $\sigma$ of 0.5.

a) On the graph below, roughly sketch the distribution of cutoff GPA's. Don't worry about the y axis, but as a general guide use the fact that 67% of the area under the normal distribution lies within 1 sd of the mean.

b) On your graph, sketch in Joe's GPA as a single line denoting the decision criterion.

c) Compute the probability that Joe will get into grad school: $p(\text{cutoff GPA} \leq 2.8)$.

d) Compute the probability that Joe won't get into grad school.
e) What is the probability that the cutoff GPA will equal exactly 3.0? (careful)

f) What is the probability that the cutoff GPA will fall in the interval 2.7 to 3.6?

8. How does sample size affect $\alpha$, the probability of a Type-1 error?
   How does sample size affect $1-\beta$ the power of the experiment?

9. What are the two reasons the sample mean measured after a treatment could differ from the original population mean?

10. Does a 1-tailed test have more or less power than a 2-tailed test?

11. How does the type of test (one-tailed or two-tailed) affect $\alpha$, the probability of a type-1 error?