Midterm Review

Fall 2011
Basics

- Time and place (usual): 331 SMI 11:00 AM - 12:15 PM
- Bring a Calculator. NO laptop, NO cell phones (NO other electronic devices).
- Coverage: Everything through Chapter 6 including the notes on simulation experiments.
- Closed notes, closed book.
- Formula sheet $8\frac{1}{2} \times 11$ sheet (both sides).
- Other Questions?
Practice Problems

- Look at the HW Problems
- Look at the HW Solutions - gives ideal for getting partial credit.
- Examples covered in lecture notes.
- Examples in your textbook - e.g. p.103 Example 3.44. Gives a good practice problem for the Binomial distribution.
Tables to Know

- Standard Normal Distribution - Table 3 (p.675-676).
- t Distribution - Table 4 (p. 677).
Warning!

- I highlight some of the main topics below.
- Of course you are responsible for everything covered in lecture and HW assignments.
Populations and Samples

- What is the target population
- Is the sample truly a random sample from the population
- Is the sample representative
Exploratory data analysis

- Distinguish categorical/numerical data,
- Display distributions, describe their shape,
- Boxplots: determine $Q_1$, median, $Q_3$, detect outliers,
- Calculate the mean and standard deviation (don’t forget to $\sqrt{var}$ !)
Discrete Random Variables

- Formula for the mean and variance.
- Be able to compute questions given a probability table.
Consider a random variable $X$ defined by the following distribution

<table>
<thead>
<tr>
<th>$k$</th>
<th>0</th>
<th>1</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P(X = k)$</td>
<td>0.1</td>
<td>0.5</td>
<td>0.1</td>
<td>0.3</td>
</tr>
</tbody>
</table>

1. Compute $P(X \geq 5)$
2. Compute $P(0.5 \leq X \leq 6)$
3. Compute $E(X)$, $Var(X)$, and $SD(X)$
Given the description of a random variable $Y$, determine whether it has a binomial distribution or not. If information is available, give $n$ and $p$.

- The BInS assumption p.104-105 (See p.110 Example 3.50)
- Know the mean and variance formulas for the Binomial.
- Carry out probability calculations with $B$.
- Know how to approximate $B$ with $N$ (possibility of the continuity correction).
Normal distribution

- Carry out probability calculations: $\mathbb{P}\{ Y \leq a \} = ?$, $\mathbb{P}\{ Y \geq a \} = ?$, $\mathbb{P}\{ a \leq Y \leq b \} = ?$,
- and quantile calculations: $\mathbb{P}\{ Y \leq ? \} = p$, $\mathbb{P}\{ Y \geq ? \} = p$.
- Use the transformation $Z = \frac{Y - \mu}{\sigma}$
Sampling Distribution of $\hat{p}$

- Know the expected value and variance.
- Also, see related questions from HW
Sampling Distribution of $\bar{Y}$

- If $Y_1, \ldots, Y_n$ have mean $\mu$ and standard deviation $\sigma$, then $\bar{Y}$ has mean $\mu$, standard deviation $\sigma/\sqrt{n}$.
- $\bar{Y} \sim N$ if $Y_1, \ldots, Y_n \sim N$.
- In any case, $\bar{Y}$ still $\sim N$ when $n$ is large.
Confidence Intervals - one sample

- Construct and interpret a confidence interval for a population mean.
- Construct and interpret a confidence interval for a population proportion.
- Determine a sample size necessary to achieve a given precision.
- Remember interpret.
Confidence Interval for a Population Mean

\[ \bar{y} \pm t \text{SE}_{\bar{y}}, \]

\[ \text{SE}_{\bar{y}} = \frac{s}{\sqrt{n}} \]
Conclusion
We are 95% confident that the average daily milk yield of a cow in the herd the cows were sampled from is between 30.6 and 41.8 lbs.
Confidence intervals for proportions

\[ \hat{p} = \frac{y + 2}{n + 4} \quad \text{and} \quad \text{SE}_{\hat{p}} = \sqrt{\frac{\hat{p}(1 - \hat{p})}{n + 4}} \]

A 95% confidence interval for \( p \) is

\[ \hat{p} \pm 1.96 \text{SE}_{\hat{p}} \]