Outline

1. To maintain consistency with the book, we will use $p$ in instead of $\pi$ for the parameter (population proportion) and $\hat{p}$ instead of $\hat{\pi}$ for the estimate.

2. The sampling distribution of $\hat{p}$. In all possible samples of size $n$:
   (a) $\hat{p}$ has mean $p$
   (b) $\hat{p}$ has standard deviation $\sqrt{\frac{p(1-p)}{n}}$
   (c) $\hat{p}$ has an approximately normal distribution (when $n$ is large and $p$ and $1-p$ are not too close to 0)

3. A 95% confidence interval for $p$ — first attempt

   $$\hat{p} \pm 1.96 \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

   (Use only if number of successes and number of failures are each at least 15).

   Example: 221 of 530 spun coins came up heads. Estimate for heads proportion is .417. Confidence interval is:

4. A better 95% confidence interval: the plus 4 interval. Add 2 successes and 2 failures before computing the above interval. (Use this interval if $n \geq 10$ and the confidence level is at least 90%).

   Example: 7 of 68 Mathematics 143 students write with their left hand. Confidence interval is

5. Hypothesis test of $H_0: p = p_0$.

   If $H_0$ is true, $\frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$ has an approximately standard normal distribution.

   Example: If students are asked to choose a letter, $S$ or $Q$, is each equally likely?
   $H_0$: $p = .5$
   $H_a$: $p \neq .5$
   42 of 68 students choose $S$. $P$-value is: