Sampling Distribution for Proportions
Section 22.1
Lecture 40

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Outline

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Proportions

- For a given characteristic, we may divide a population into two groups: those who have the characteristic and those who do not.
- For example, in the population of registered voters, the characteristic may be “intend to vote for Donald Trump.”
- We are interested in estimating the proportion of the population that has the characteristic.
- We use p to denote the population proportion (a parameter).

Proportions

- Obviously, the best way to estimate the population is to collect a sample and find the sample proportion.
- We use $\hat{p}$ to denote the sample proportion (a statistic).

Proportions

- To use $\hat{p}$ in statistical procedures, we need to know its sampling distribution.
- We need to know, over all possible values of $\hat{p}$,
  - The mean of $\hat{p}$
  - The standard deviation of $\hat{p}$
  - The shape of the distribution

Outline

Sampling Distribution of $\hat{p}$

Example

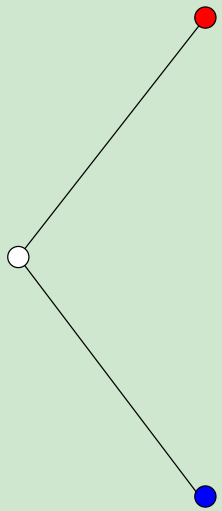
- Suppose that a large population is 40% in favor of Trump and 60% opposed.
- That is, $p = 0.40$.
- What are the possible sample proportions $\hat{p}$ if we draw samples of size $n = 4$?

Sampling Distribution of $\hat{p}$

Example

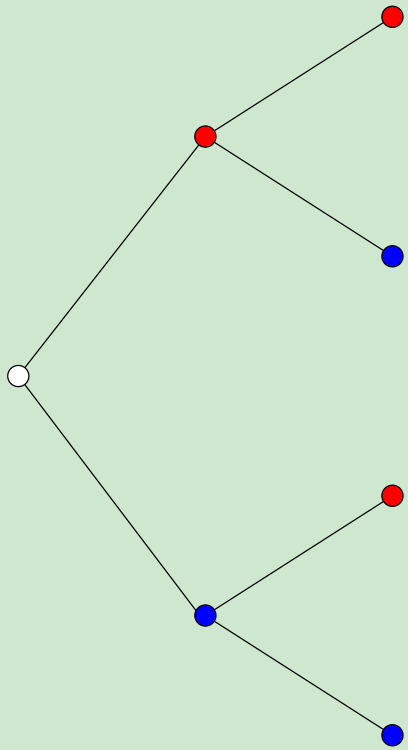
Sampling Distribution of $\hat{p}$

Example



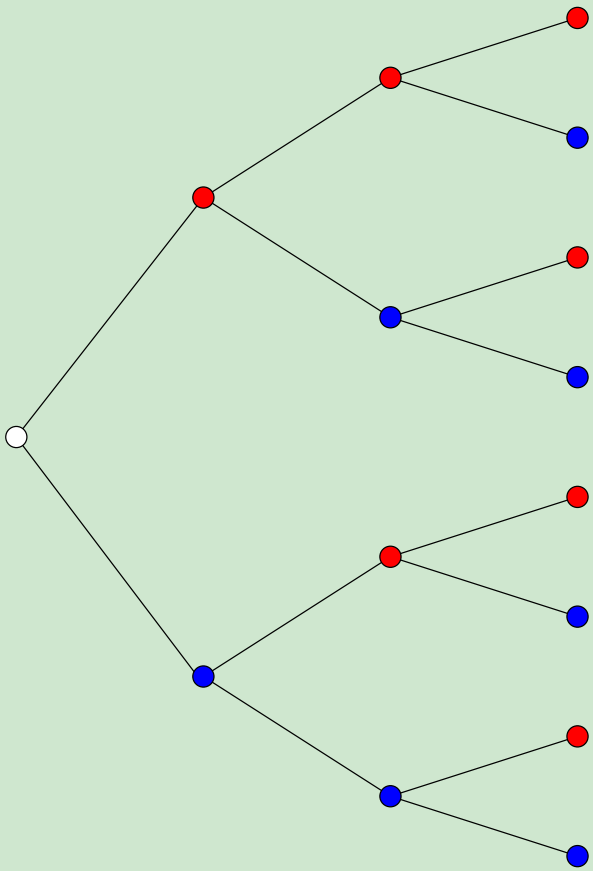
Sampling Distribution of $\hat{p}$

Example



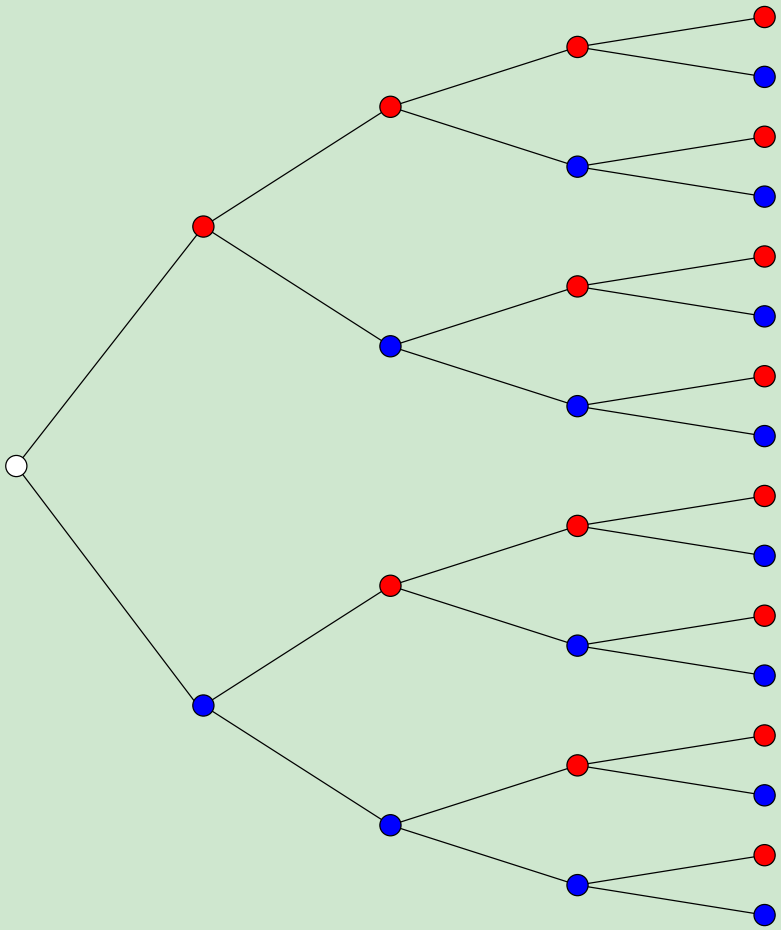
Sampling Distribution of $\hat{p}$

Example



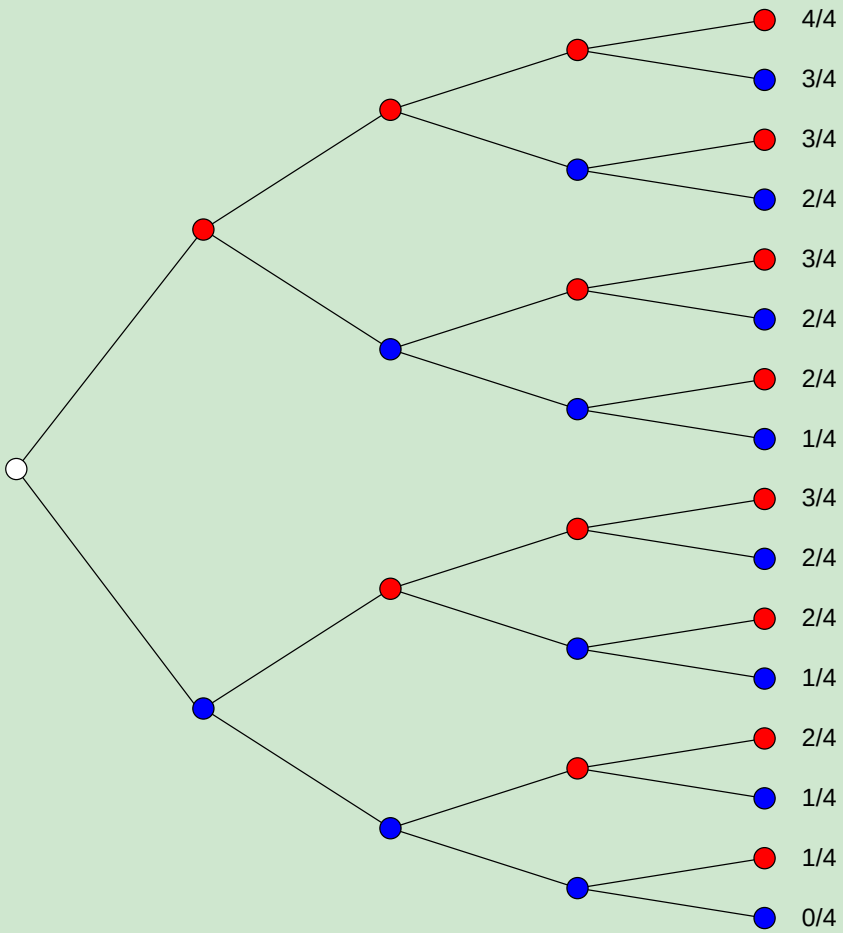
Sampling Distribution of $\hat{p}$

Example



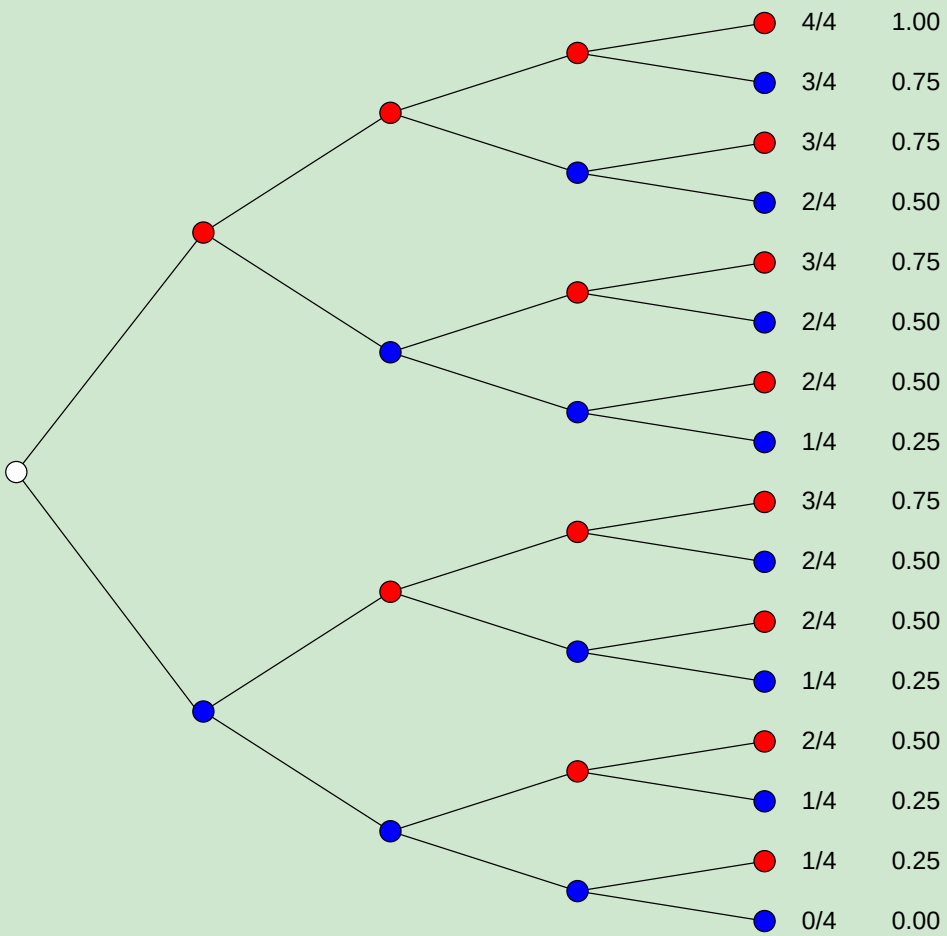
Sampling Distribution of $\hat{p}$

Example



Sampling Distribution of $\hat{p}$

Example



Sampling Distribution of $\hat{p}$

- The sampling distribution is

$\hat{p}$	0.00	0.25	0.50	0.75	1.00
$P(\hat{p})$	0.1296	0.3456	0.3456	0.1536	0.0256

- It turns out that the mean of this distribution is $\mu_{\hat{p}} = 0.40$.
- The variance is $\sigma^2_{\hat{p}} = 0.06$.
- The standard deviation is $\sigma_{\hat{p}} = \sqrt{0.06} = 0.2449$.

Sampling Distribution of $\hat{p}$

- The mean of $\hat{p}$ is p.
- The standard deviation of $\hat{p}$ is

$$\sqrt{\frac{p(1-p)}{n}}.$$

- If the sample size is large enough, then $\hat{p}$ has a normal distribution.

Experiment

- Suppose we have a population of 100 individuals, 40 of whom support Trump and 60 of whom do not support Trump.
- Label the Trump supporters 1 - 40.
- Label the Trump nonsupporters 51 - 100.
- Use the TI-83 to select a random sample of 4 people and find the sample proportion.

Experiment

- Suppose we have a population of 100 individuals, 40 of whom support Trump and 60 of whom do not support Trump.
- Label the Trump supporters 1 - 40.
- Label the Trump nonsupporters 51 - 100.
- Use the TI-83 to select a random sample of 4 people and find the sample proportion.
- Do it repeatedly

Outline

Assignment

Assignment

- Read Section 22.1, 22.2.
- Apply Your Knowledge: 1, 2, 3, 4.
- Check Your Skills: 15, 16, 17, 18.
- Exercises 26, 27, 30, 31, 33.