

Sampling Distribution Examples

Sections 15.4, 15.5

Lecture 27

Robb T. Koether

Hampden-Sydney College

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Outline

- 1 The Sampling Distribution of \bar{x}
- 2 Discrete Example
- 3 Continuous Example
- 4 Assignment

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The Sampling Distribution of \bar{x}

Fact

Let \bar{x} be the mean of a simple random sample taken from a large population that has mean μ and standard deviation σ . Then the sampling distribution of \bar{x}

- *has mean μ , and*
- *has standard deviation σ/\sqrt{n} .*

The Sampling Distribution of \bar{x}

- This tells us three important things about \bar{x} .
 - \bar{x} on average neither overestimates μ nor underestimates μ . That is, \bar{x} is an **unbiased estimator** of μ .
 - The variability of \bar{x} is less than the variability in the population.
 - The variability of \bar{x} is less for large samples than it is for small samples.

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Discrete Example

Example (Discrete Example)

- Let the population be $\{6, 12, 18\}$.
- Take simple random samples of size 2, *with replacement*.
- The possible sample means are 6, 9, 12, 15, and 18.
- The sampling distribution of \bar{x} is

\bar{x}	6	9	12	15	18
$P(\bar{x})$	1/9	2/9	3/9	2/9	1/9

Discrete Example

Example (Discrete Example)

- Now take simple random samples of size 3, *with replacement*.
- The possible sample means are 6, 8, 10, 12, 14, 16, and 18.
- The sampling distribution of \bar{x} is

\bar{x}	6	8	10	12	14	16	18
$P(\bar{x})$	$\frac{1}{27}$	$\frac{3}{27}$	$\frac{6}{27}$	$\frac{7}{27}$	$\frac{6}{27}$	$\frac{3}{27}$	$\frac{1}{27}$

Discrete Example

Example (Discrete Example)

- Now take simple random samples of size 4, *with replacement*.
- The possible sample means are 6, 7.5, 9, 10.5, 12, 13.5, 15, 16.5 and 18.
- The sampling distribution of \bar{x} is

\bar{x}	6	7.5	9	10.5	12	13.5	15	16.5	18
$P(\bar{x})$	$\frac{1}{81}$	$\frac{4}{81}$	$\frac{10}{81}$	$\frac{16}{81}$	$\frac{19}{81}$	$\frac{16}{81}$	$\frac{10}{81}$	$\frac{4}{81}$	$\frac{1}{81}$

Discrete Example

Example (Discrete Example)

- Now take simple random samples of size 6, *with replacement*.
- The possible sample means are 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18.
- The sampling distribution of \bar{x} is

\bar{x}	6	7	8	9	10	11	12	13	14	15	16	17	18
$P(\bar{x})$	$\frac{1}{729}$	$\frac{6}{729}$	$\frac{21}{729}$	$\frac{50}{729}$	$\frac{90}{729}$	$\frac{126}{729}$	$\frac{141}{729}$	$\frac{126}{729}$	$\frac{90}{729}$	$\frac{50}{729}$	$\frac{21}{729}$	$\frac{6}{729}$	$\frac{1}{729}$

Outline

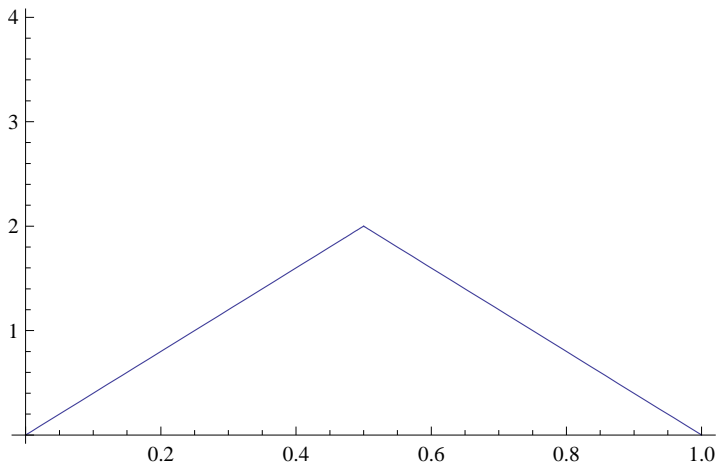
- 1 The Sampling Distribution of \bar{x}
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Continuous Example

Example (Continuous Example)

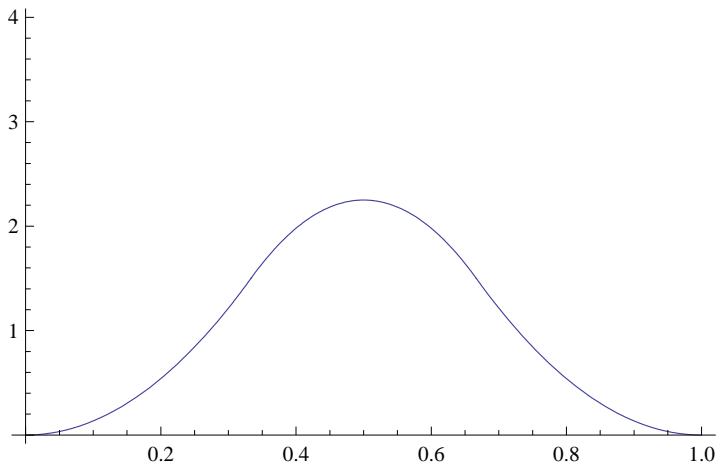
- Let the population be all real numbers from 0 to 1 (e.g., the `rand` key).
- Take simple random samples of size 2, then 3, 4, and 6, *with replacement*.
- The following slides will show the density curves of the sampling distribution of \bar{x} .

Continuous Example



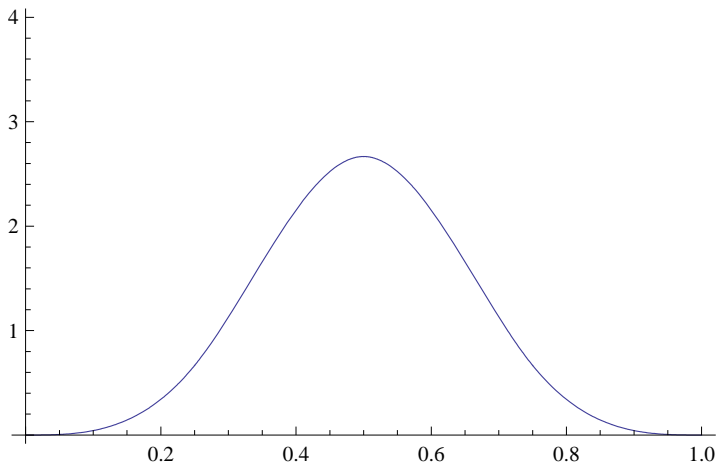
Sample size = 2

Continuous Example



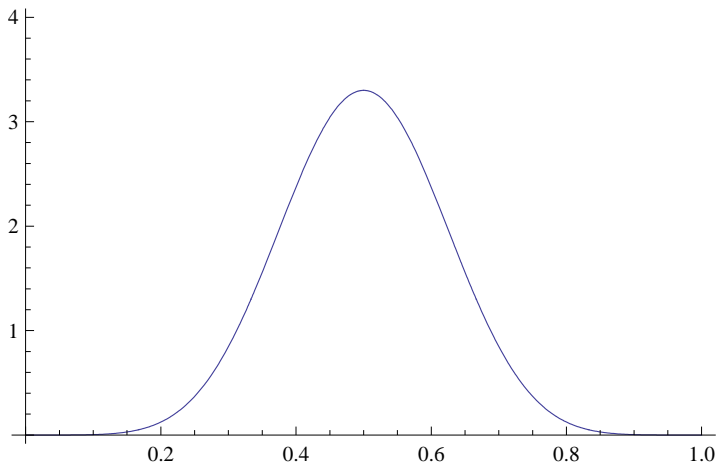
Sample size = 3

Continuous Example



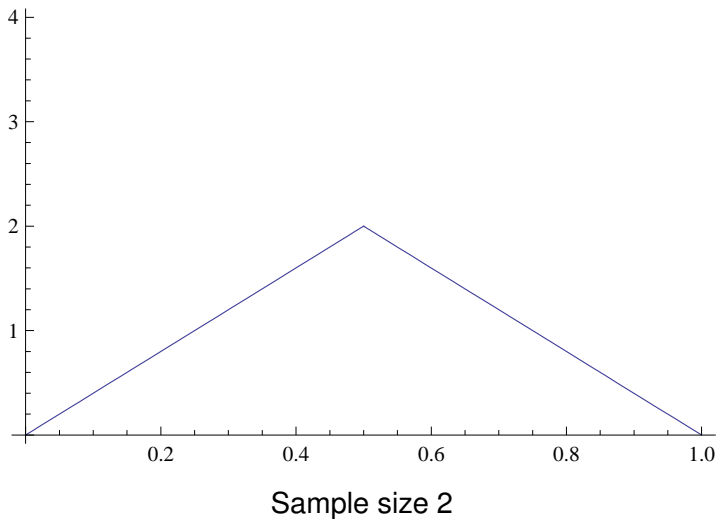
Sample size = 4

Continuous Example

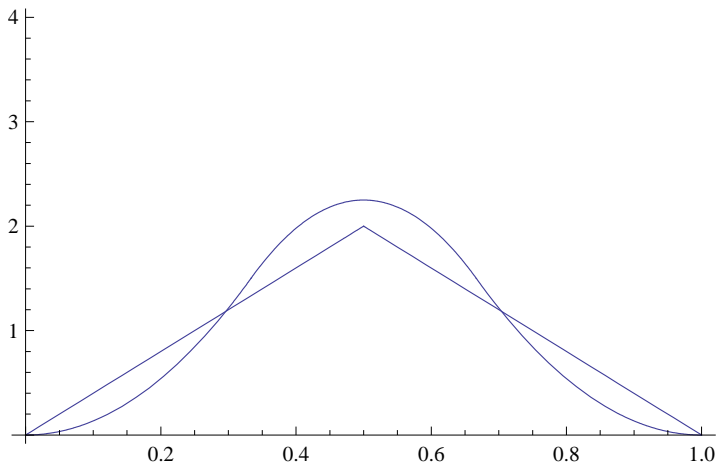


Sample size = 6

Continuous Example

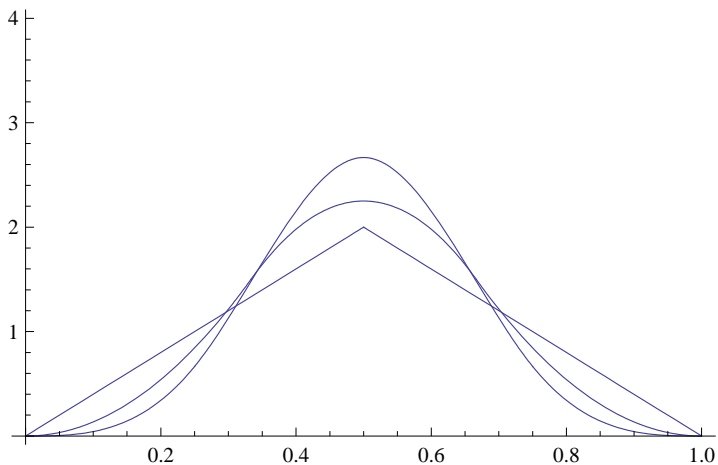


Continuous Example



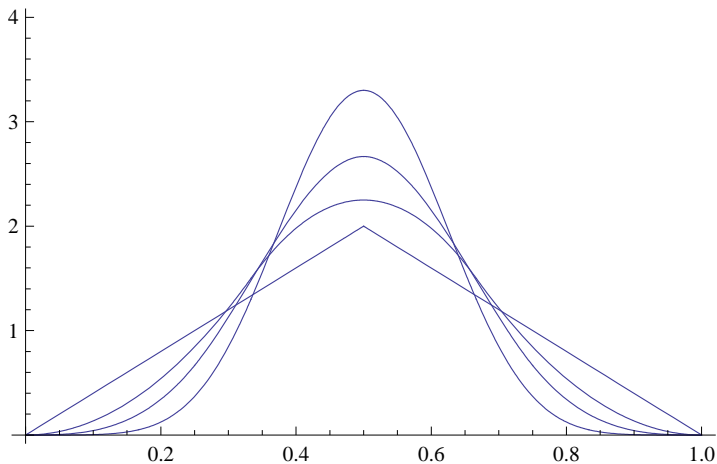
Sample sizes 2 and 3

Continuous Example



Sample sizes 2, 3, and 4

Continuous Example



Sample sizes 2, 3, 4, and 6

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Assignment

Assignment

- Read Sections 15.4, 15.5.
- Apply Your Knowledge: 6, 8, 9, 10, 12.
- Check Your Skills: 20, 21, 22, 23.
- Exercises 28, 29, 30, 31.