Sampling and Representativeness

Department of Government
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- Purposive
- Comparative
- Representative
  - Unrepresentative

Discuss in Pairs!

What does it mean for a "sample" (set of cases) to be representative of a population?

Different conceptualizations

- **Design-based**: A sample is representative because of how it was drawn (e.g., randomly)
- **Model-based**: A sample is representative because it resembles in the population with respect to certain variables (e.g., same proportion of women in sample and population, etc.)
- **Expert judgement**: A sample is representative as judged by an expert who deems it "fit for purpose"

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- **Simple random sampling**
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Inference from Sample to Population

- We want to know pop. parameter θ
- We only observe sample estimate $\hat{\theta}$
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- We only observe sample estimate $\hat{\theta}$
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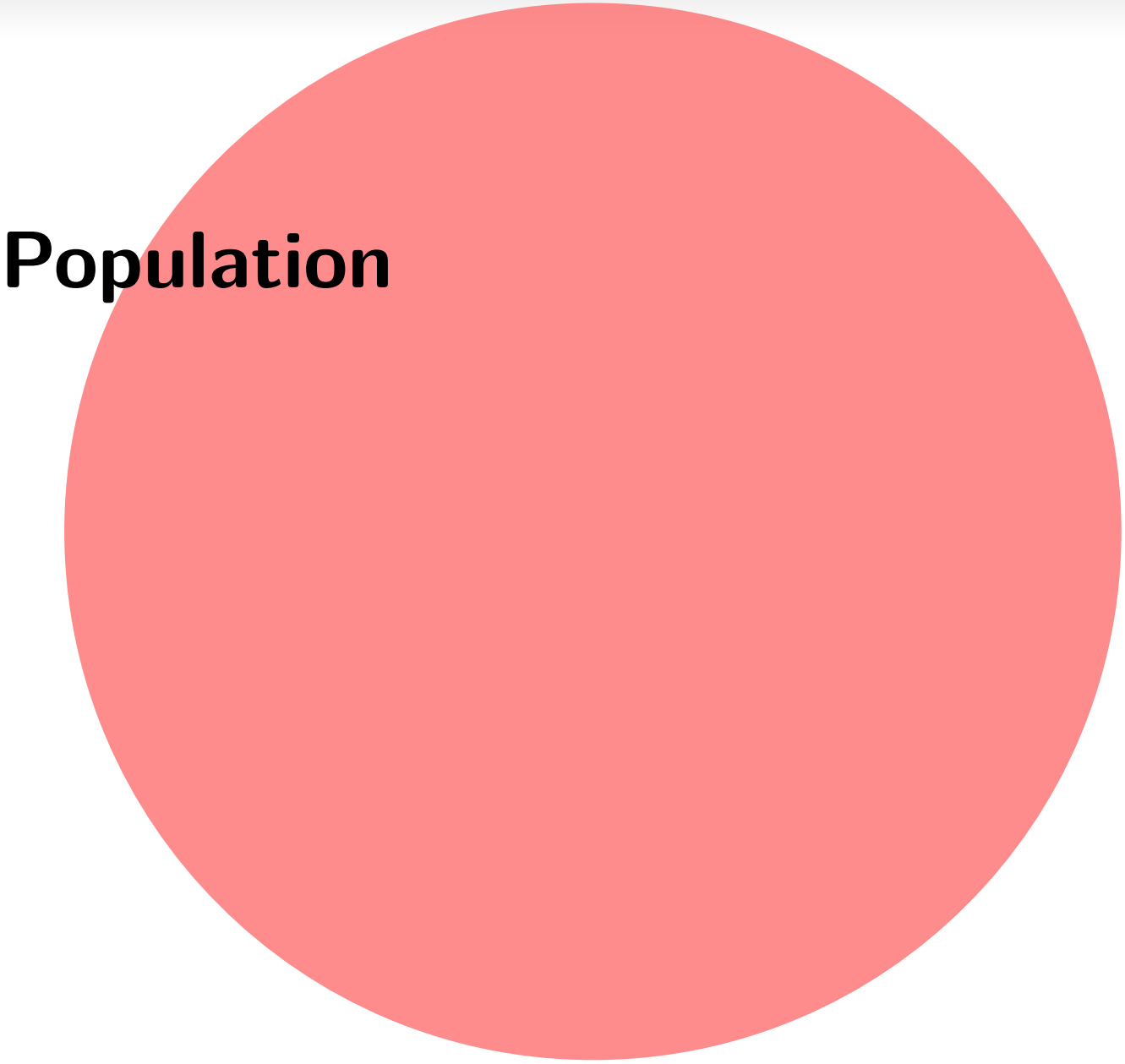
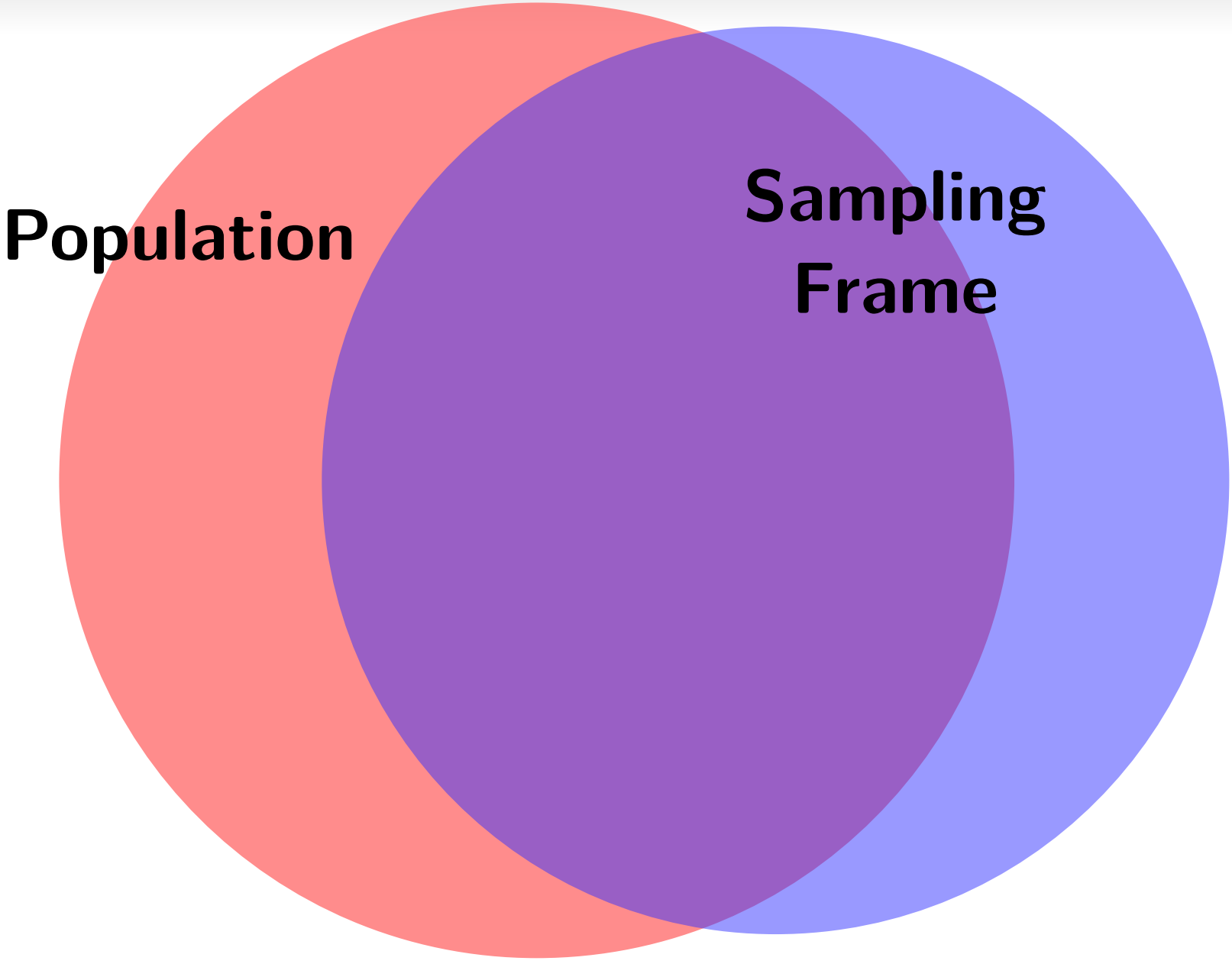
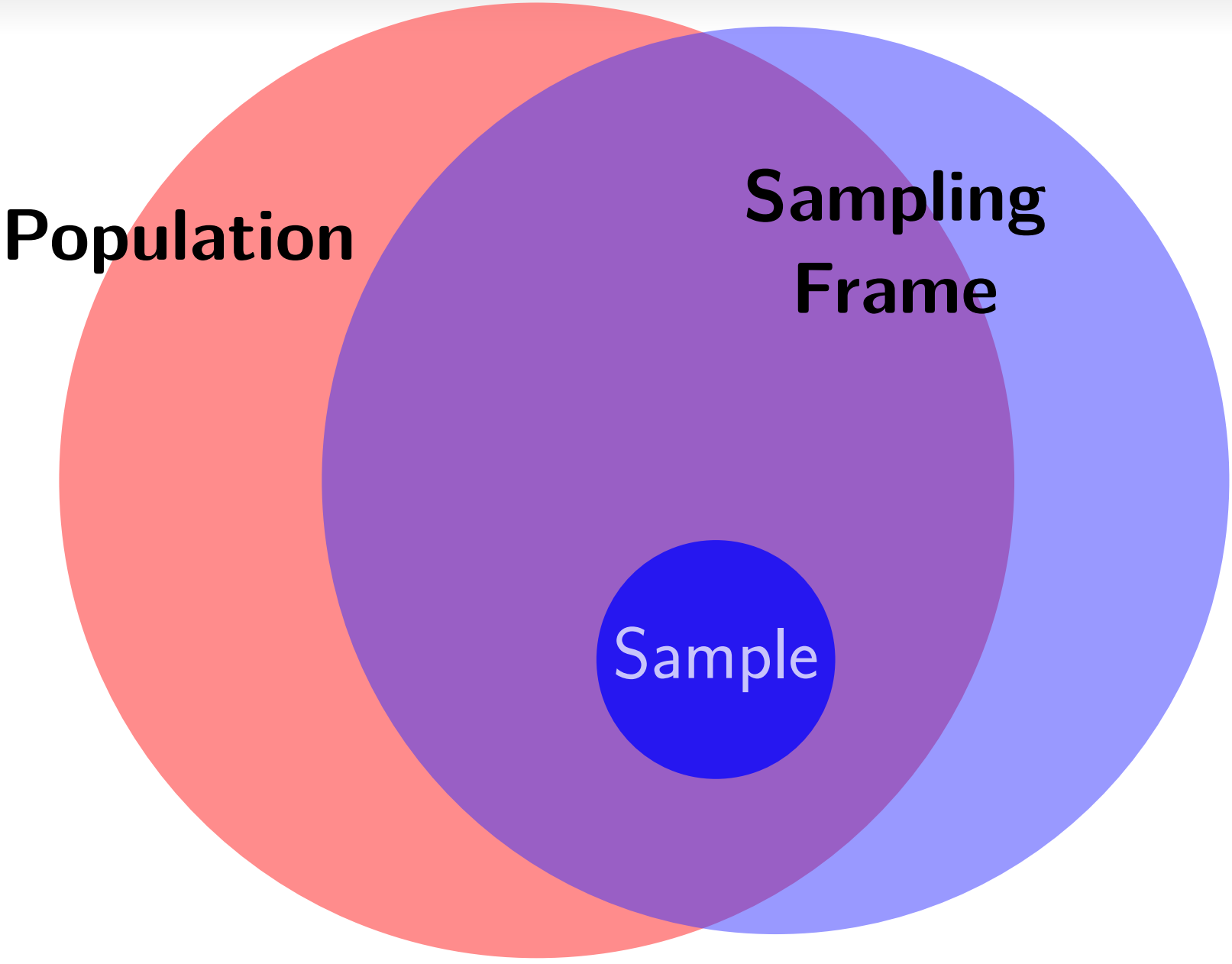
- What range of values for θ does our $\hat{\theta}$ imply?

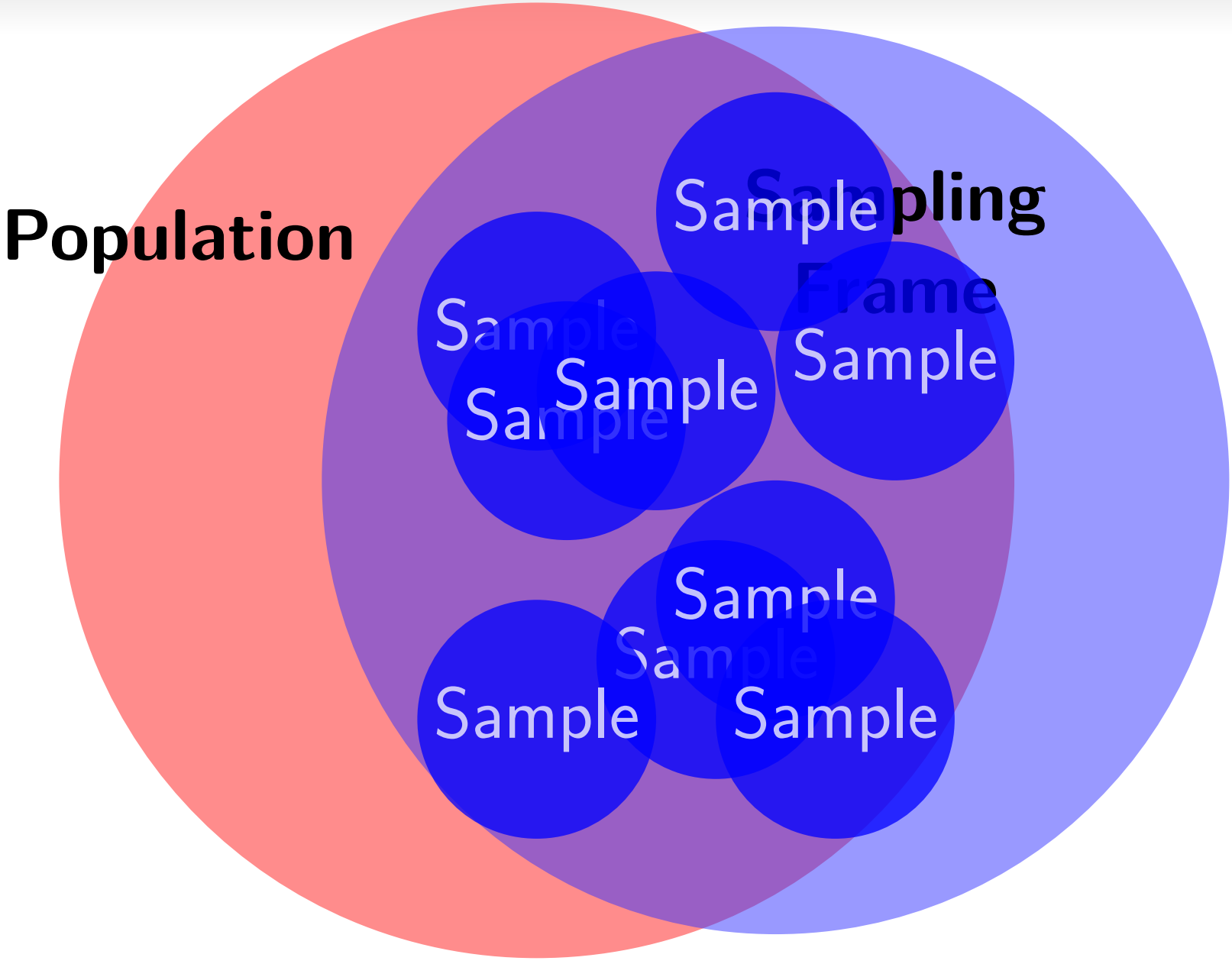
Simple Random Sampling

1. Define target population
2. Create "sampling frame"
3. Each unit in frame has equal probability of selection
4. Collect data on each unit
5. Calculate sample *statistic*
6. Draw an inference to the population


Population


Population
Sampling
Frame


Population
Sampling Frame
Sample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Statistical Inference I

To calculate a sample mean (or proportion):

$$\bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_i \tag{1}$$

where y_i = value for a unit, and

n = sample size

Statistical Inference II

- If we calculate $\bar{y}$ in our *sample*, what does this tell us about the $\bar{Y}$ in the *population*?

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- If we calculate $\bar{y}$ in our *sample*, what does this tell us about the $\bar{Y}$ in the *population*?
- The sample *estimate* is our guess at the value of the population *parameter* within some degree of uncertainty

Law of Large Numbers

- Definition: The *mean* of the $\hat{\theta}$ from each of a number of samples will converge on the population θ, as the number of samples increases

Sampling Variance

- The $\hat{\theta}$ in any particular sample can differ from the population value θ
- This variation is calling "sampling variance" or "sampling error"
- The standard error describes the average amount of variation of the $\hat{\theta}$'s around θ

How Uncertain Are We?

- Our uncertainty depends on sampling procedures
- Most importantly, *sample size*
  - As $n \to \infty$, uncertainty $\to 0$
- We typically summarize our uncertainty as the *standard error*

Standard Errors (SEs)

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- Square root of the sampling variance

Sample mean

$$\bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_i \tag{2}$$

where y_i = value for a unit, and
n = sample size

$$SE_{\bar{y}} = \sqrt{(1 - f)\frac{s^2}{n}} \tag{3}$$

where f = proportion of population sampled,
s^2 = sample (element) variance, and
n = sample size

Sample proportion

$$\bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_i \tag{4}$$

where y_i = value for a unit, and
n = sample size

$$SE_p = \sqrt{(1 - f)\frac{p(1 - p)}{n}} \tag{5}$$

where f = proportion of population sampled,
p = sample proportion, and
n = sample size

Margin of Error

- Uncertainty often stated in terms of a "margin of error"
- Standard MoE is twice the SE
- For estimated proportions, expressed as: "p $\pm$ MoE percentage points"

New poll shows widening support for UK to leave EU in wake of Paris attacks, Cologne assaults

Posted 17 Jan 2016, 1:01am

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The poll put the EU exit camp in the lead by 53 per cent to 47 ahead of a referendum promised by the end of 2017, but which could take place as early as June.

The Survation poll for the centre-right, euro-sceptic Mail on Sunday newspaper excludes undecided voters.

If they are included, 42 per cent are in favour of leaving, 38 for remaining with 20 per cent yet to make up their mind.

The survey, which was conducted online on January 15 and 16 and had 1,004 respondents, had a margin of error of 2 percentage points.

PHOTO: David Cameron is pushing the EU to give more power to Britain. (Reuters: Kirsty Wigglesworth, file photo)

RELATED STORY: British PM lays out demands to avoid 'Brexit' from EU

RELATED STORY: Germany to speed up deportations after Cologne attacks

MAP: England

Survation's last poll published in September showed 49 per cent in favour of staying, and 51 per cent for leaving when undecided voters were excluded.

Source: `http://www.abc.net.au/news/2016-01-17/new-poll-show-widening-support-for-uk-to-leave-eu/7093730`

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Questions?

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(There is an R lab activity about this.)

Activity!

What proportion of all Haribo Starmix gummies are ♡s?

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3. Calculate element variance:
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4. Calculate MoE: $\hat{p} \pm \left(2 * \sqrt{\frac{Var(x)}{n}}\right)$

How large of a sample do we need?

[1] Population element variance is estimated by sample element variance.

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  - Sample size
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- Uncertainty is influenced by:
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  - Population size?
- So what do we do?
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  - Guess at element variance
  - Adjust sample size based on feasibility

[1] Population element variance is estimated by sample element variance.

Estimating sample size

What precision (margin of error) do we want?

- ± 2 percentage points: $SE = 0.01$

$$n = \frac{0.25}{0.01^2} = \frac{0.25}{0.0001} = 2500 \tag{6}$$

Estimating sample size

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- ± 5 percentage points: $SE = 0.025$

$$n = \frac{0.25}{0.000625} = 400 \tag{7}$$

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- ± 5 percentage points: $SE = 0.025$

$$n = \frac{0.25}{0.000625} = 400 \tag{7}$$

- ± 0.5 percentage points: $SE = 0.0025$

$$n = \frac{0.25}{0.00000625} = 40,000 \tag{8}$$

Preview

- Continue with statistics in middle of LT
- Next week we'll discuss ethics
  - Read Activity on Moodle before lecture
- PS4 due December 13
- Sample Exam on Moodle (soon!)