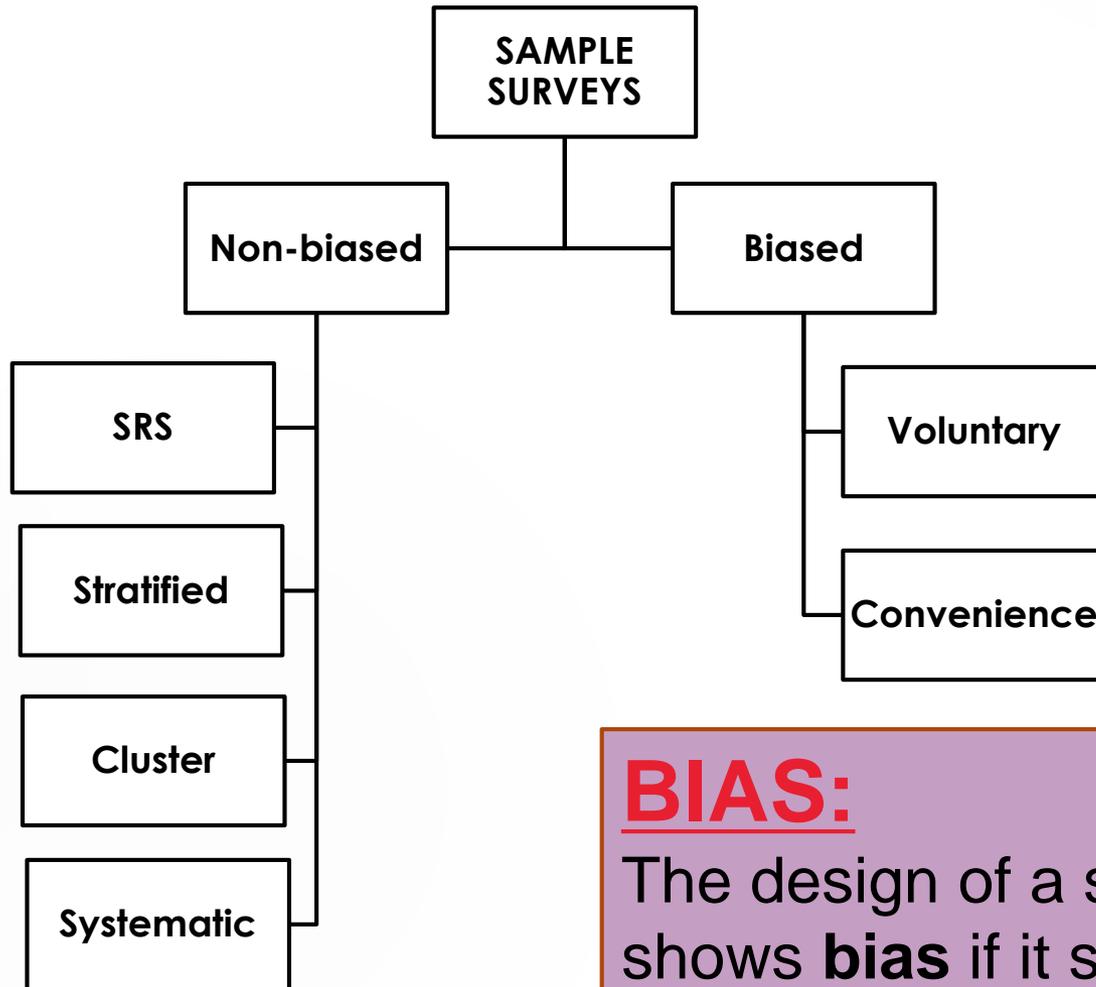


ASK ME FOR
A FREE
.....
SAMPLE!



Bad Sampling

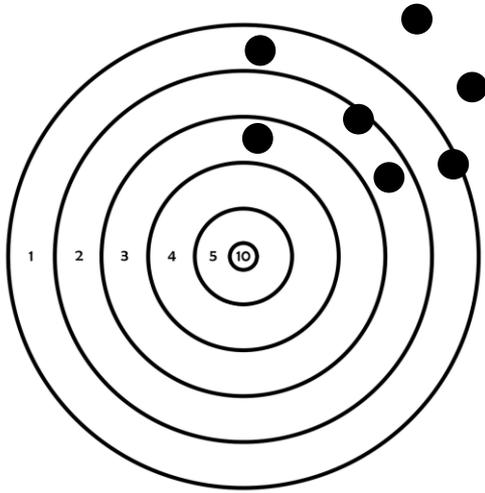


BIAS:

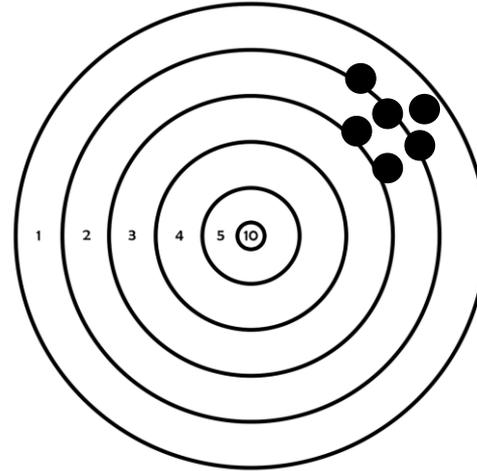
The design of a statistical study shows **bias** if it systematically favors certain outcomes.

Problems when sampling:

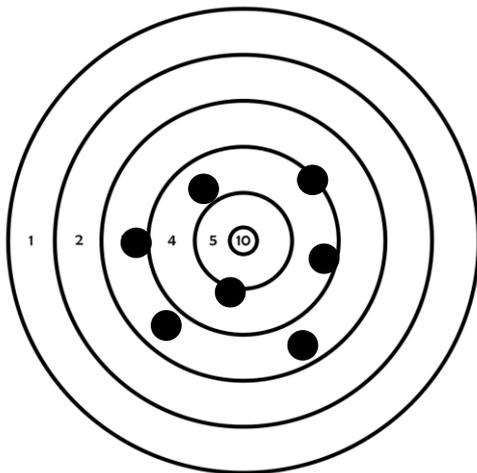
- ▶ Bias is consistent, repeated deviation of the sample statistic from the population parameter in the same direction when we take many samples
- ▶ Variability describes how spread out the values of the sample statistic are when we take many samples



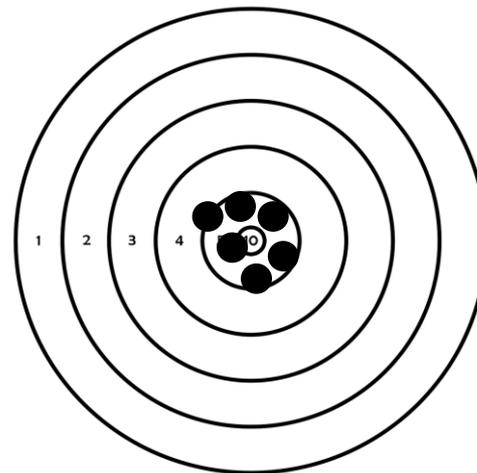
High Bias, High Variability



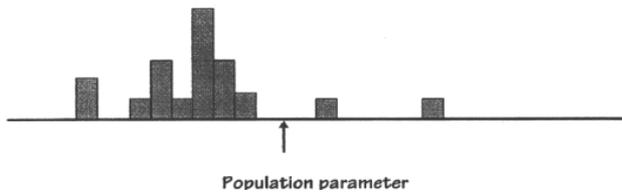
High bias, low variability



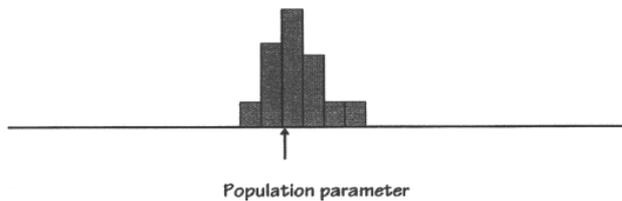
Low bias, high variability



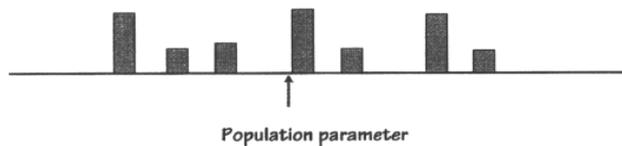
Low bias, low variability



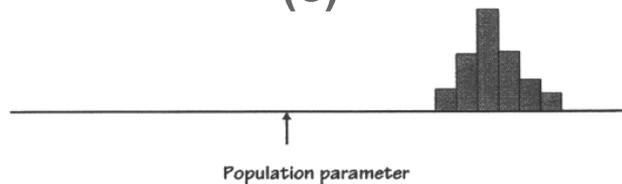
(a)



(b)



(c)



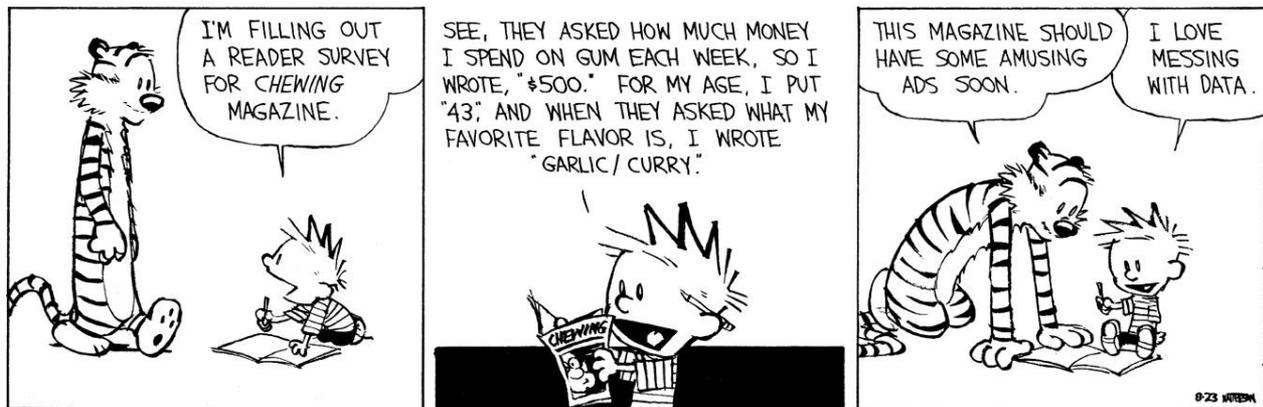
(d)

Matching:

- a. High Bias, High Variability
- b. High bias, low variability
- c. Low bias, high variability
- d. Low bias, low variability

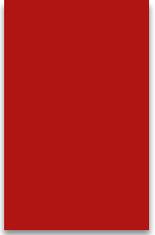
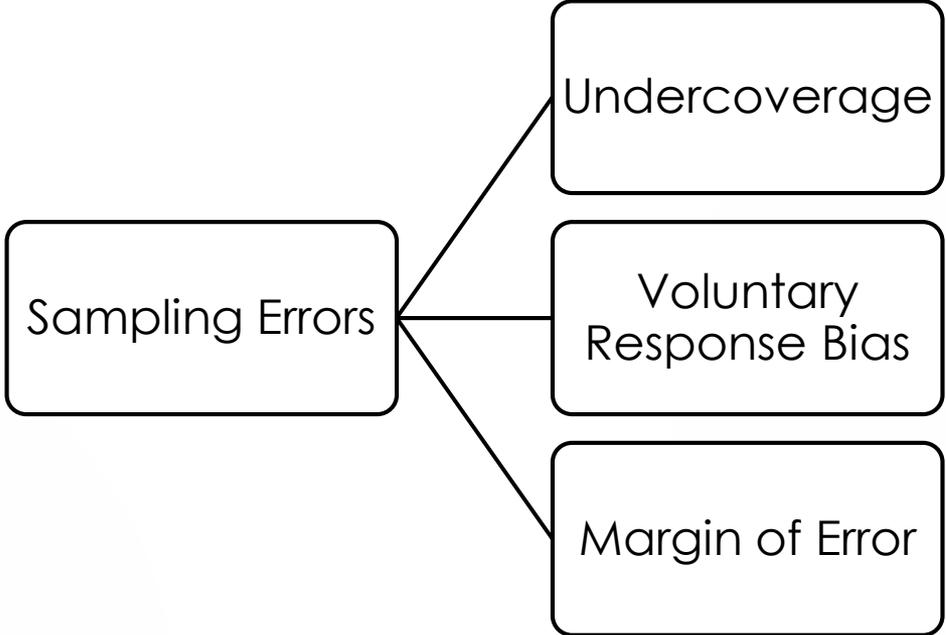
Sample Surveys: What Can Go Wrong?

- ▶ Most sample surveys are affected by errors in addition to sampling variability.
- ▶ Good sampling technique includes the art of reducing all sources of error.



BEFORE the study begins:

Sampling error is one of two reasons for the difference between an estimate of a population parameter and the true, but unknown, value of the population parameter.



Sampling Errors

SAMPLING ERROR: Sampling error is the error that arises in a data collection process as a result of taking a sample from a population rather than using the whole population.

Undercoverage

- ▶ Undercoverage is a **selection bias** . It occurs when some members of the population are inadequately represented, or left out, in the sample.
- ▶ An example would be...
 - ▶ The *Literary Digest* voter survey, which predicted that Alfred Landon would beat Franklin Roosevelt in the 1936 presidential election. The survey sample suffered from undercoverage of low-income voters, who tended to be Democrats. Undercoverage is often a problem with convenience samples .

Voluntary Response Bias

- ▶ Voluntary response bias occurs when sample members are self-selected volunteers, as in voluntary samples.
- ▶ An example would be...
 - ▶ A call-in radio show that solicits audience participation in surveys on controversial topics (abortion, affirmative action, gun control, etc.). The resulting sample tends to over represent individuals who have strong opinions about the topic.

Margin of error

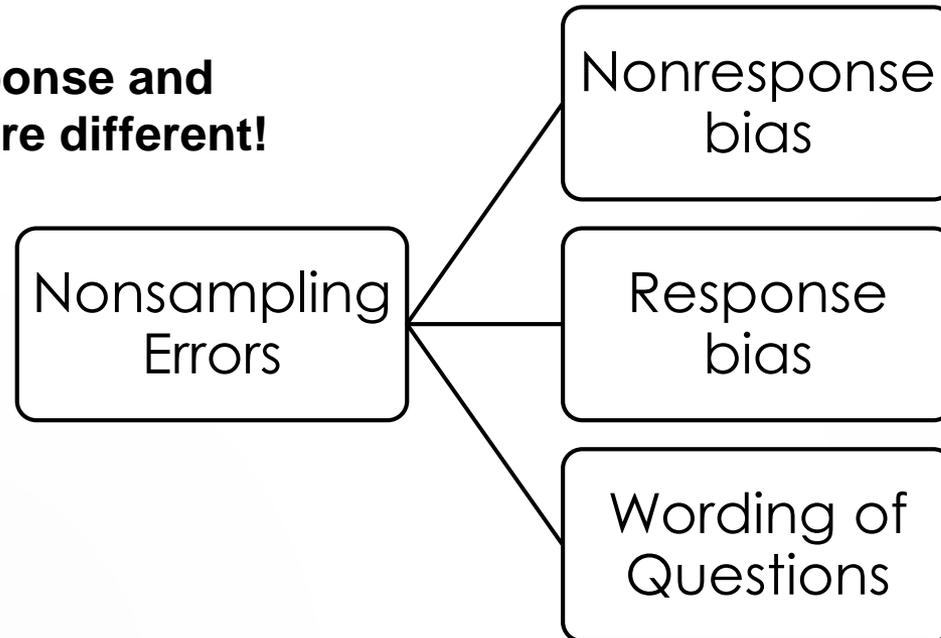
- ▶ A good sample represents the population, but rarely does the sample perfectly measure the population. There is an expectation that there is some margin of error. Margin of error is a statement about how much confidence there is with the result.
- ▶ ***margin of error*** = $\pm \frac{1}{\sqrt{n}}$, where **n** is the sample size
- ▶ An example would be...
 - ▶ Given a sample size of 300.
 - ▶ ***margin of error*** = $\pm \frac{1}{\sqrt{300}} = 0.058 \rightarrow 5.8\%$
 - ▶ I am 95% confident that the true mean is within +5.8% -5.8% of the data.

AFTER the survey begins:

Watch out:

**Voluntary Response and
Nonresponse are different!**

How?



NONSAMPLING ERROR:

Nonsampling errors are caused by factors other than those related to sample selection. It refers to the presence of any factor, whether systemic or random, that results in the data values not accurately reflecting the 'true' value for the population

Nonresponse bias

- ▶ Sometimes, individuals chosen for the sample are unwilling to participate in the survey.
- ▶ Nonresponse bias also occurs when an individual chosen for the sample can't be contacted.
- ▶ An example is...
 - ▶ Mr. Hybart is giving an end of the year survey to ask his students their favorite/least favorite lessons and ways to improve his classroom experience. Only 3 students actually wrote anything while the others turned in blank surveys. He is sad now.

Response bias

- ▶ **Response bias** refers to the bias that results from problems in the measurement process. A systematic pattern of incorrect responses in a sample survey leads to **response bias**.

Response bias

▶ Response bias:

- ▶ **Leading questions.** The way in which they ask the questions can lead respondents to a particular choice.
 - ▶ For example, a satisfaction survey may ask the respondent to indicate if she is “satisfied or **dissatisfied**”. By emphasizing one response option over another. The option of “dissatisfied” is more likely to be chosen over the other option.

Response bias

▶ Response bias:

- ▶ **Social desirability.** Most people like to present themselves in a favorable light, so they will be reluctant to admit to unsavory attitudes or illegal activities in a survey, particularly if survey results are not confidential. Instead, their responses may be biased toward what they believe is socially desirable.

Response bias

- ▶ **Response bias:**

- ▶ **Processing Error** are mistakes in arithmetic or data entry.

Wording of Questions Bias

- ▶ The choice of words and phrases in a question is critical in expressing the meaning and intent of the question.
- ▶ All respondents should interpret the question the same way.
- ▶ Even small wording differences can substantially affect the answers people
- ▶ The **wording of questions** is the most important influence on the answers given to a sample survey.
- ▶ An example is...
 - ▶ How was your experience at the Music Festival?
 - a. Highly satisfied
 - b. Very satisfied
 - c. Very satisfied
 - d. Slightly satisfied

A police officer is interested in the drug and alcohol use of all high school students. He goes to his local high school to question some of the students.

- ▶ Suppose the officer initially decides to question students by asking them face-to-face. If a student does not want to tell the officer the truth and simply declares himself drug-free, what error is introduced into the study?
 - a. Nonresponse
 - b. Undercoverage
 - c. Response error

A police officer is interested in the drug and alcohol use of all high school students. He goes to his local high school to question some of the students.

- ▶ Suppose the officer grabs a random sample but only does so of the freshman students. What type of bias does this study suffer from?
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A police officer is interested in the drug and alcohol use of all high school students. He goes to his local high school to question some of the students.

- ▶ Suppose the officer distributes anonymous surveys to 100 random high school students but only receives 12 of the surveys back. What type of bias does this study suffer from?
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You try...

- ▶ <http://www.criticalcommons.org/Members/BaileyNorwood/clips/a-biased-survey-question-on-parks-recreation>
- ▶ Parks and recreation “Canvassing” episode

ASK ME FOR
A FREE
.....
SAMPLE!



Bad Sampling

SAMPLE SURVEYS

Non-biased

Biased

[Empty box for non-biased survey type]

[Empty box for biased survey type]

[Empty box for biased survey type]

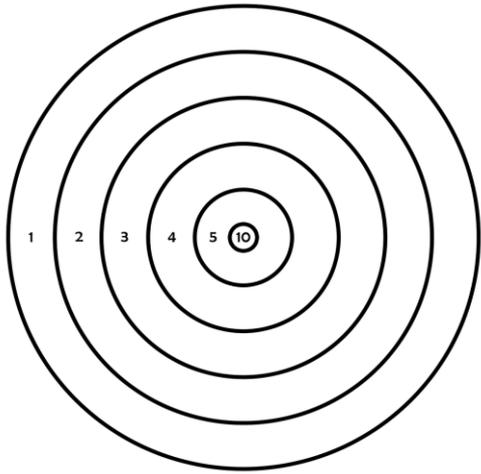
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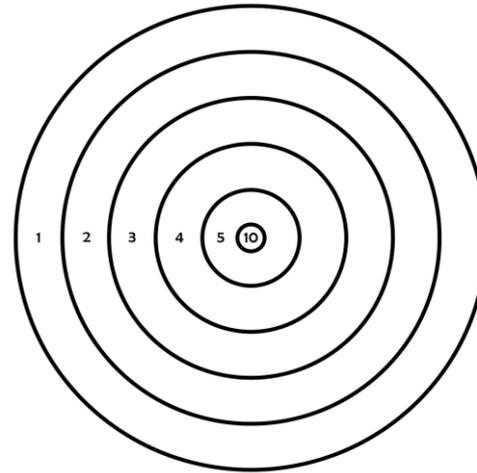
Bad Sampling

Problems when sampling:

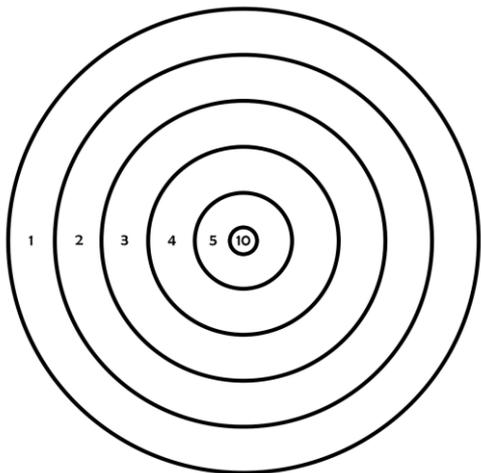
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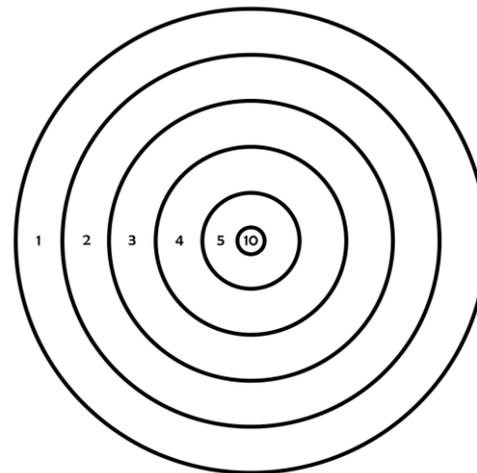
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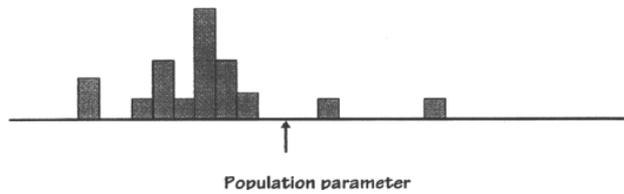
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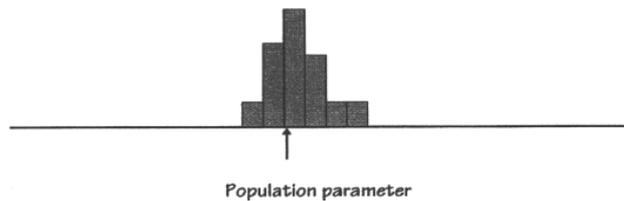
Low bias, high variability



Low bias, low variability



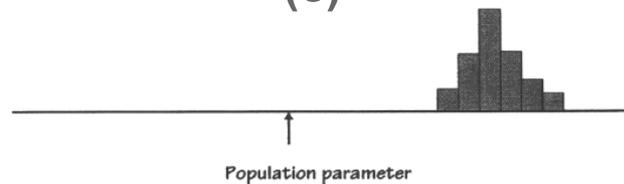
(a)



(b)



(c)



(d)

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- ▶ Most sample surveys are affected by
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- ▶ Good sampling technique includes
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Sampling error is one of two reasons for the difference between an estimate of a population parameter and the true, but unknown, value of the population parameter.

Sampling Errors

```
graph LR; A[Sampling Errors] --- B[ ]; A --- C[ ]; A --- D[ ];
```

Sampling Errors

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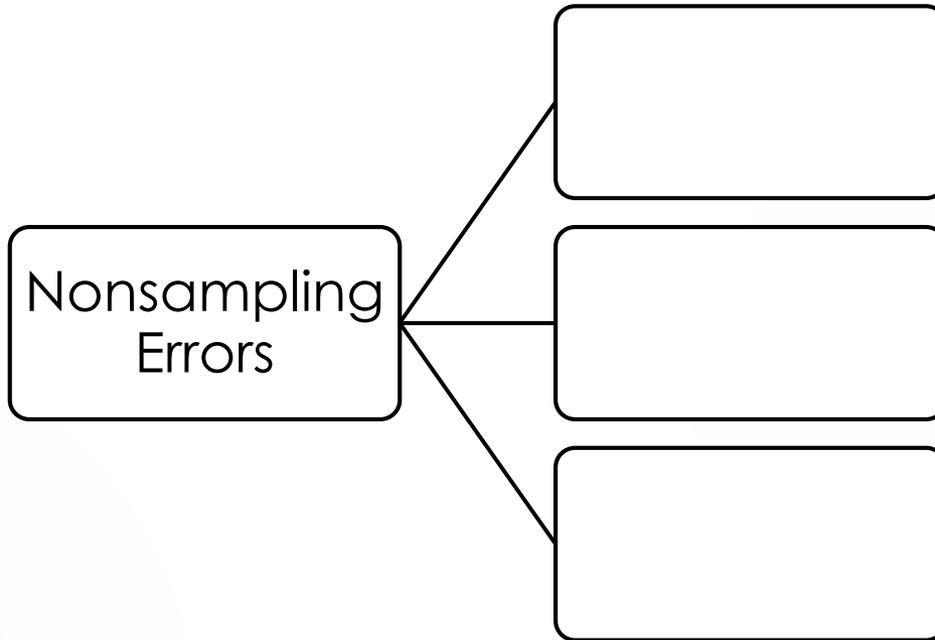
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Nonsampling Errors

NONSAMPLING ERROR:

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