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MF2070

Workshop 2

The Quantitative Approach

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No Questions to the Workshops...

- You ask questions at the seminars to be able to write the report.
- To be able to ask questions you have to understand the basics of the theory of science, quantitative methods and qualitative methods.
- These workshops will support this, but are only as good as you make them.

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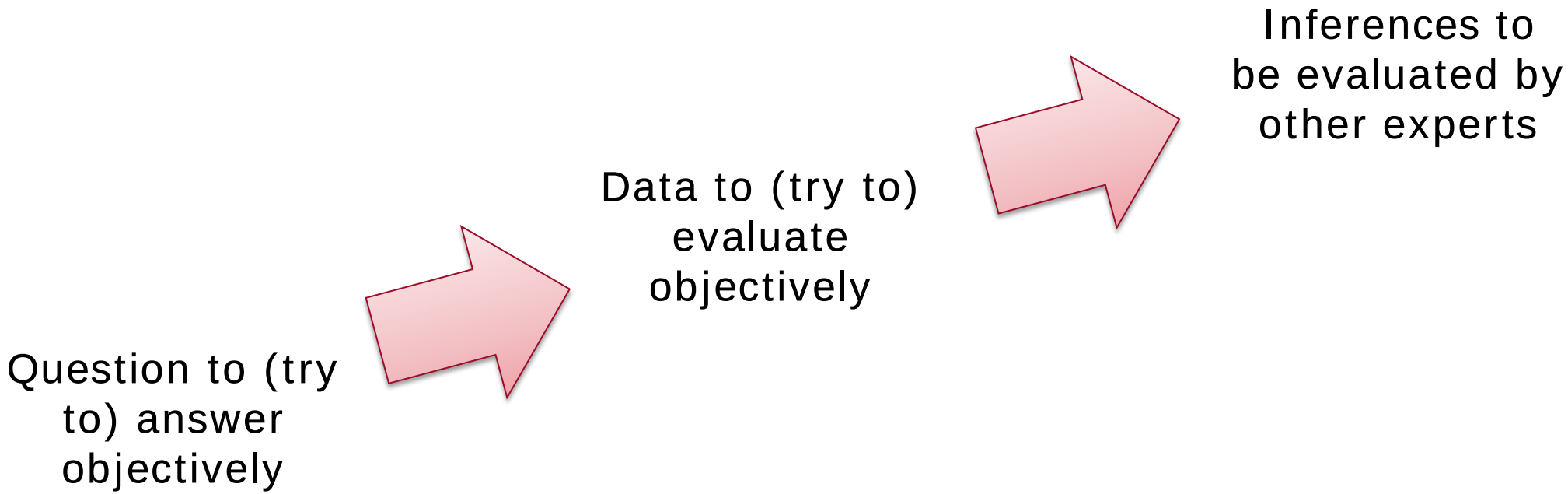
Outline

- Quantitative Data Gathering
- Quantitative Data Analysis

The Quantitative Extreme According to the Previous Lecture



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Methods?

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Data Gathering

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Ways of gathering data?

- (Structured/Controlled) Observation
- (Structured) Interview
- (Structured) Questionnaire

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Focus:

Objective Measurements of an Objective Reality

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An Example

Question: Is a particular type of machine "unsafe"?

- Count reports on workplace fatalities.
- Ask each worker how many incidents of a number of clearly listed types have occurred.

Study designed (e.g. order of questions) not to be provocative, confusing or otherwise open to dispute.

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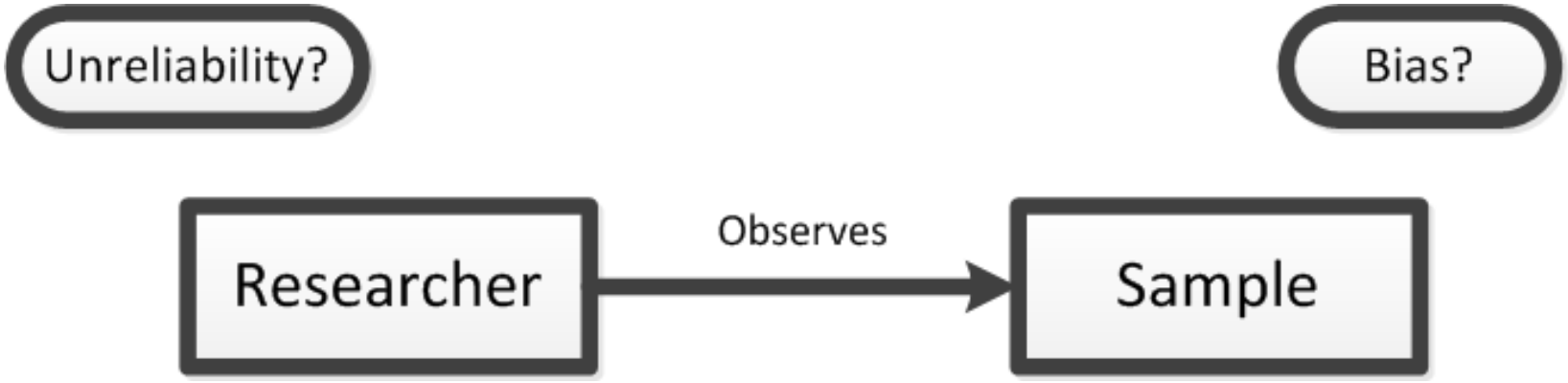
Methodology 1: The Survey

- Studies the characteristics of a sample of a population and draws inferences, i.e. a descriptive methodology.
- Does **not** manipulate or arrange for events to happen.
- Widely assumed to only be usable for **hypothesis formulation**. The reason being that you cannot define a confidence level for an established relationship between a cause and an effect.

Methodology 1: The Survey

- Basically you consider threats through **bias** and **unreliability**.

What can go wrong?



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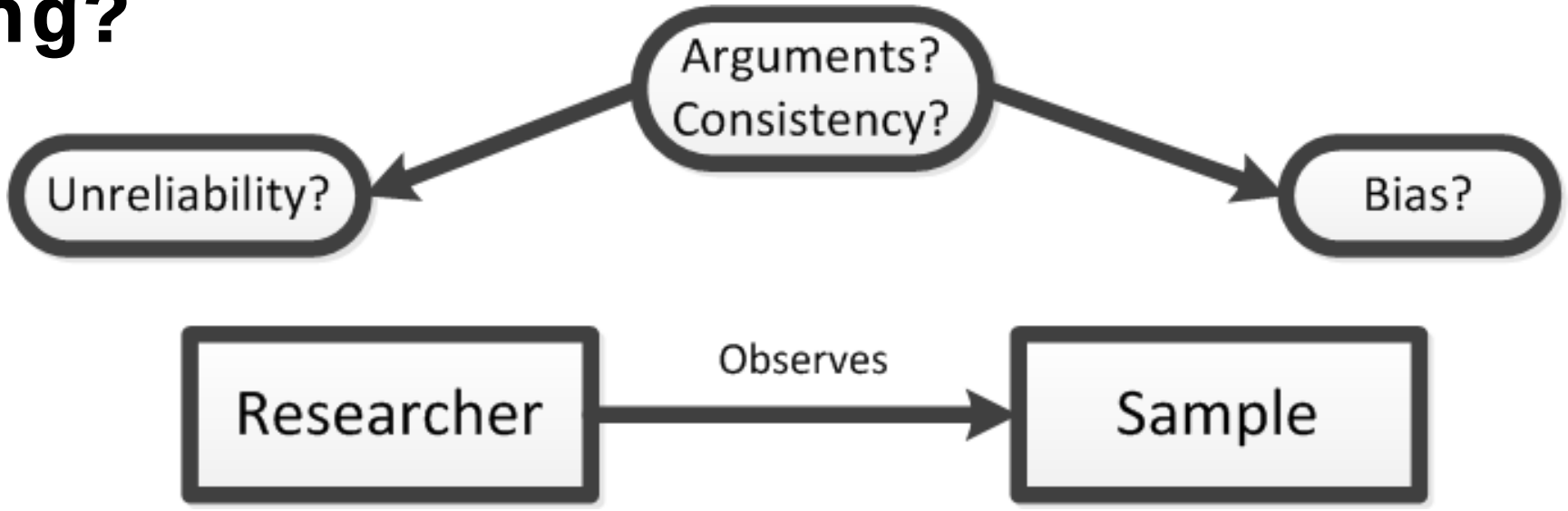

What can be / is done about it?

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Methodology 2: The Experiment

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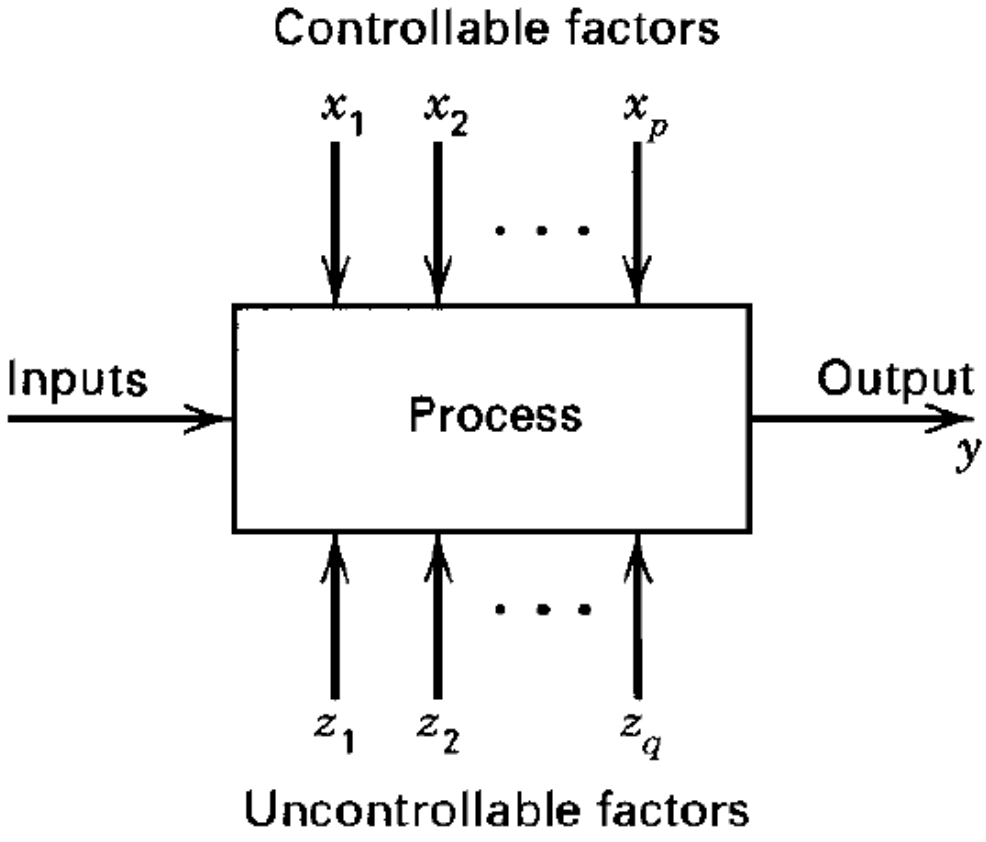

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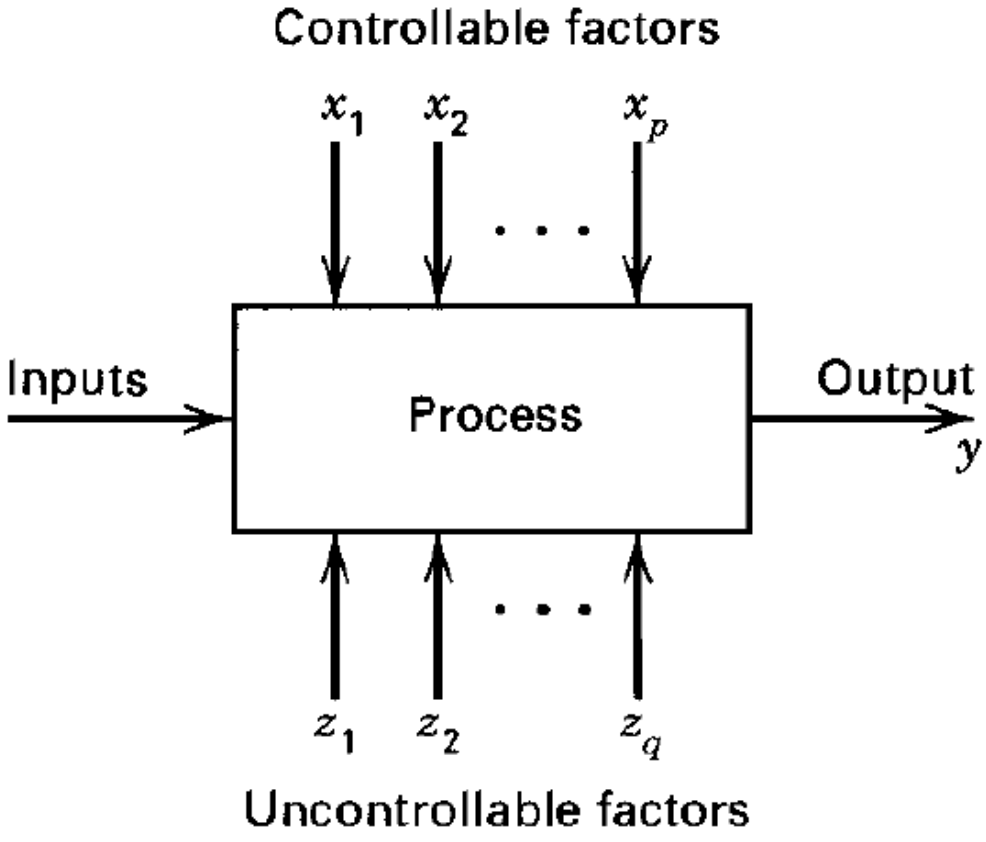

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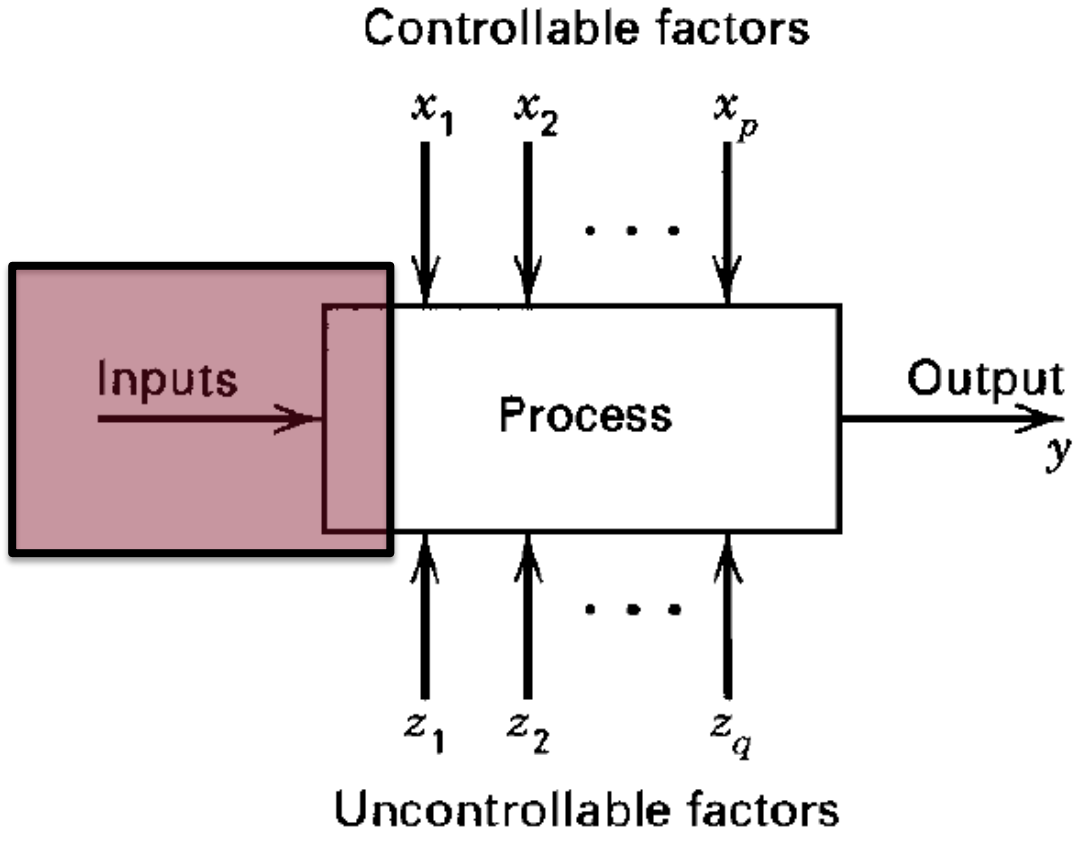

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Bias related to Inputs (Example)

- Researchers are exploring whether a **new variant** of a machine is more “unsafe” than the old variant.

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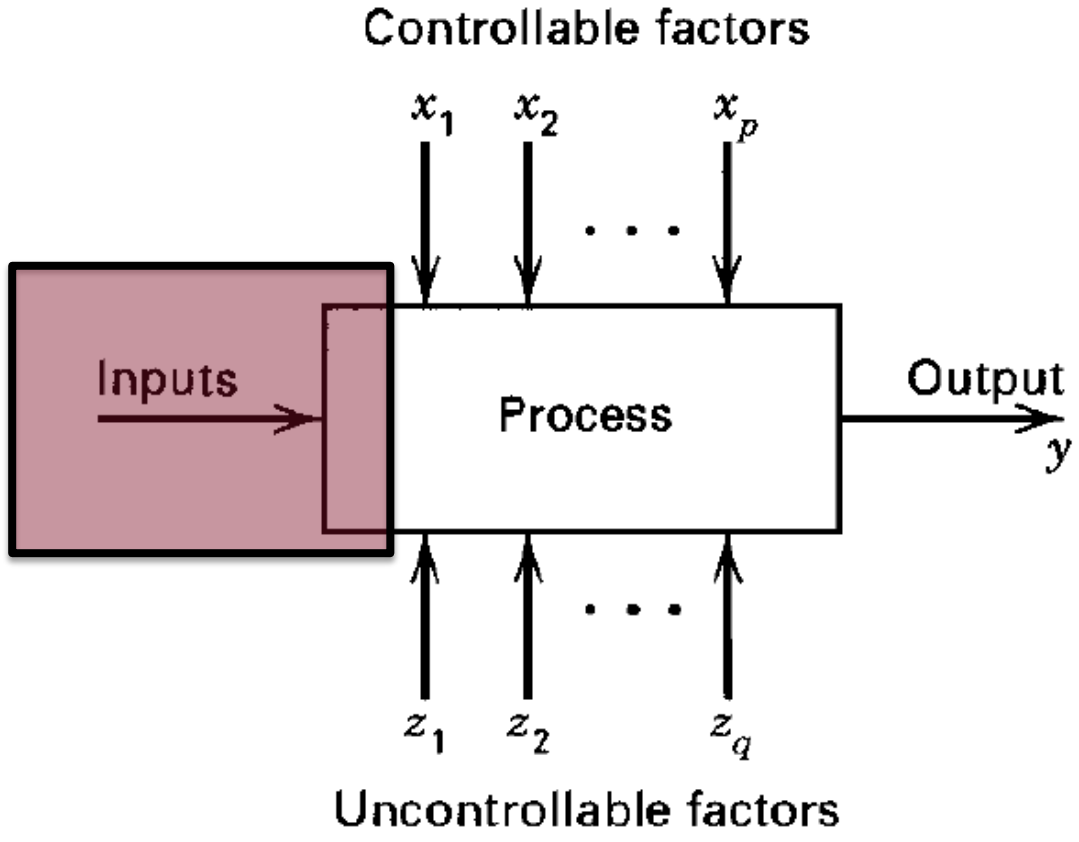

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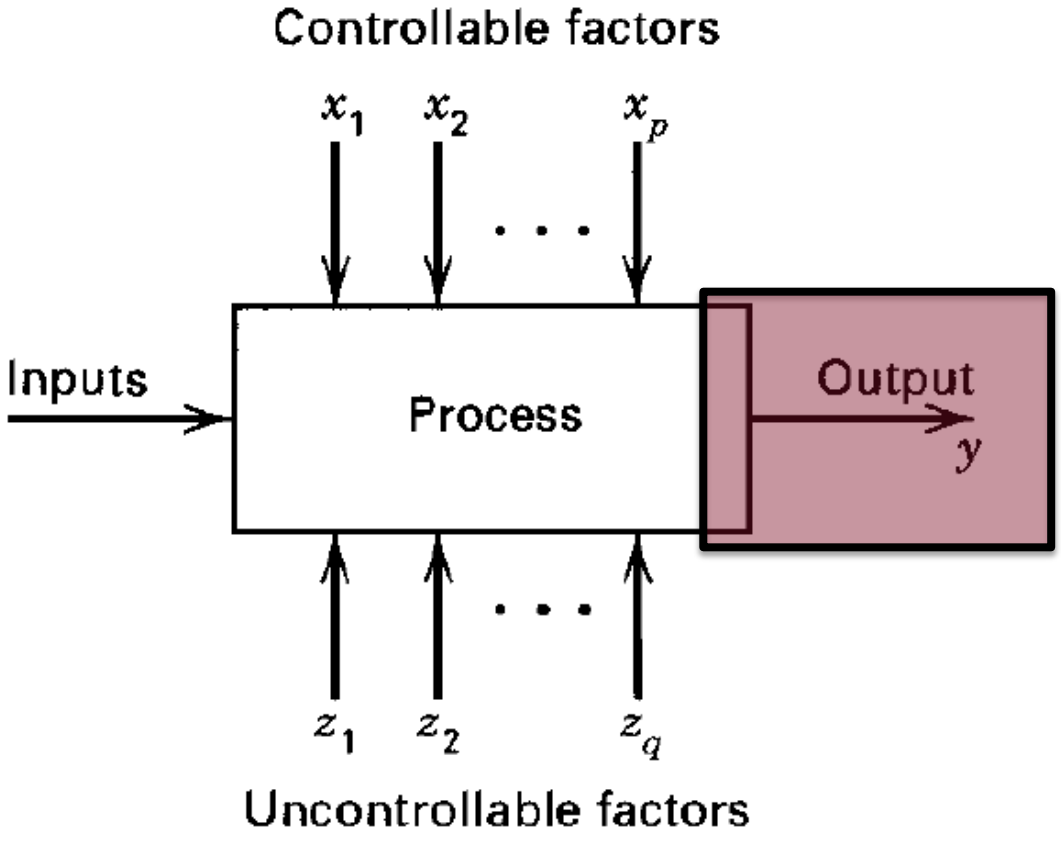

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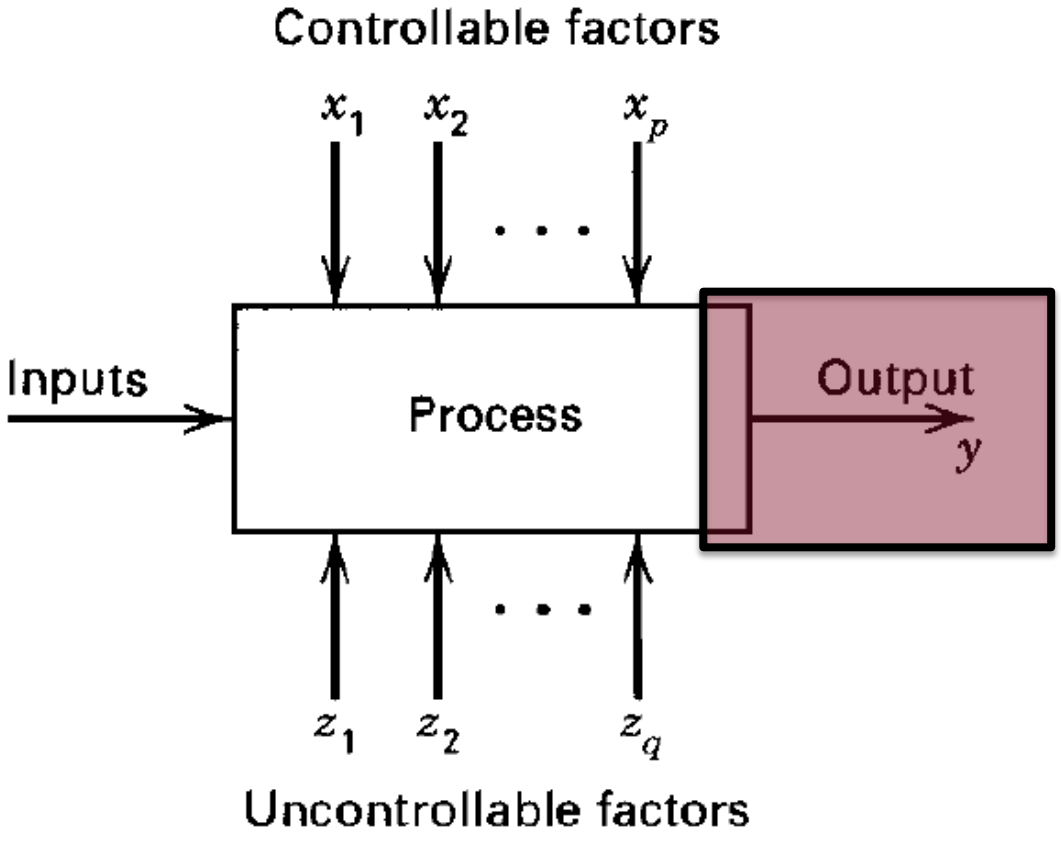

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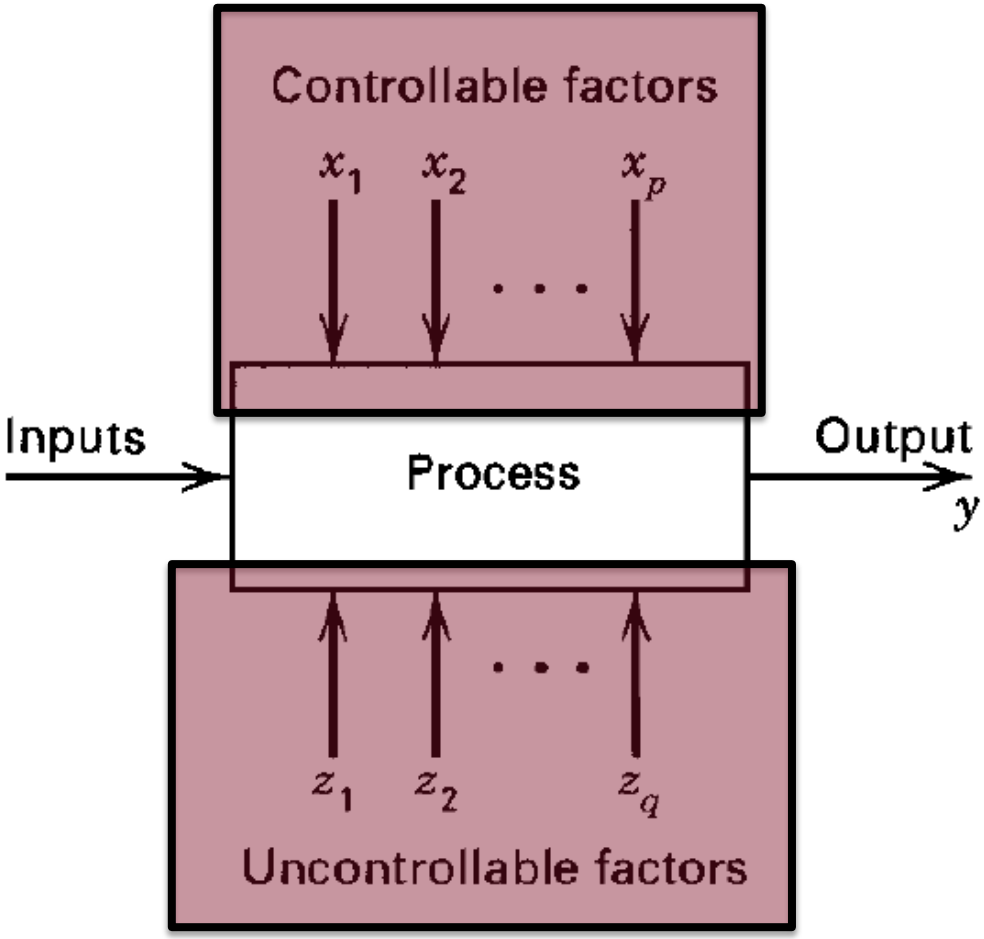

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Confounding / Uncontrollable Factors (Example)

- Researchers are exploring whether a **new variant** of a machine is more “unsafe” than the old variant.
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- The study is conducted during the summer, when workers walk through the plant more often for breaks outside.
- The risks associated with other tasks or places in the factory may be the explanation for any “effect”.

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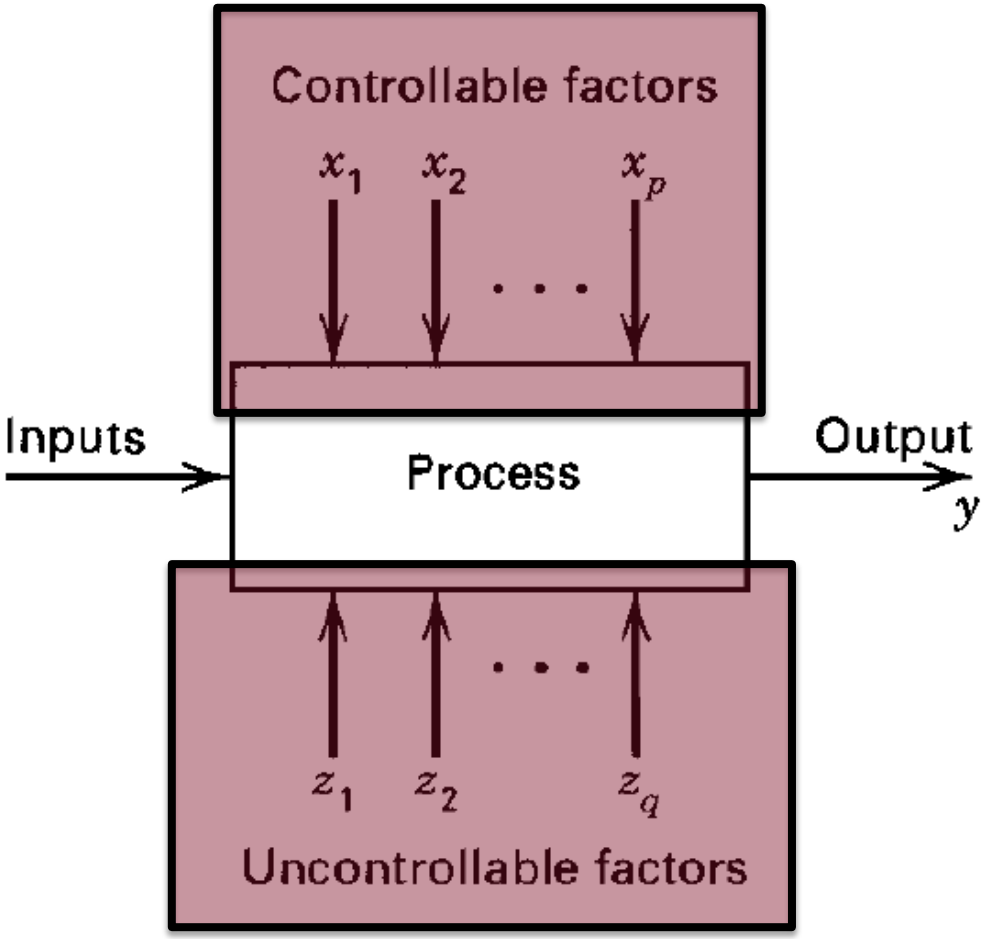

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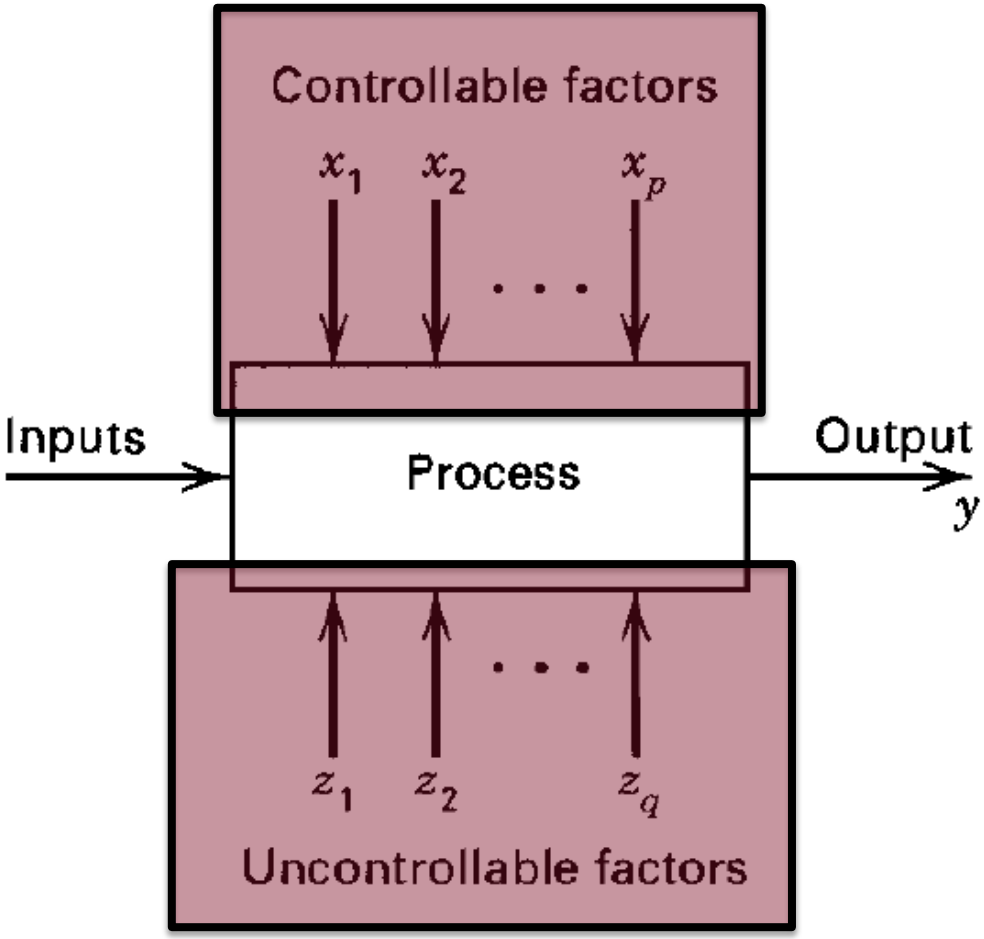

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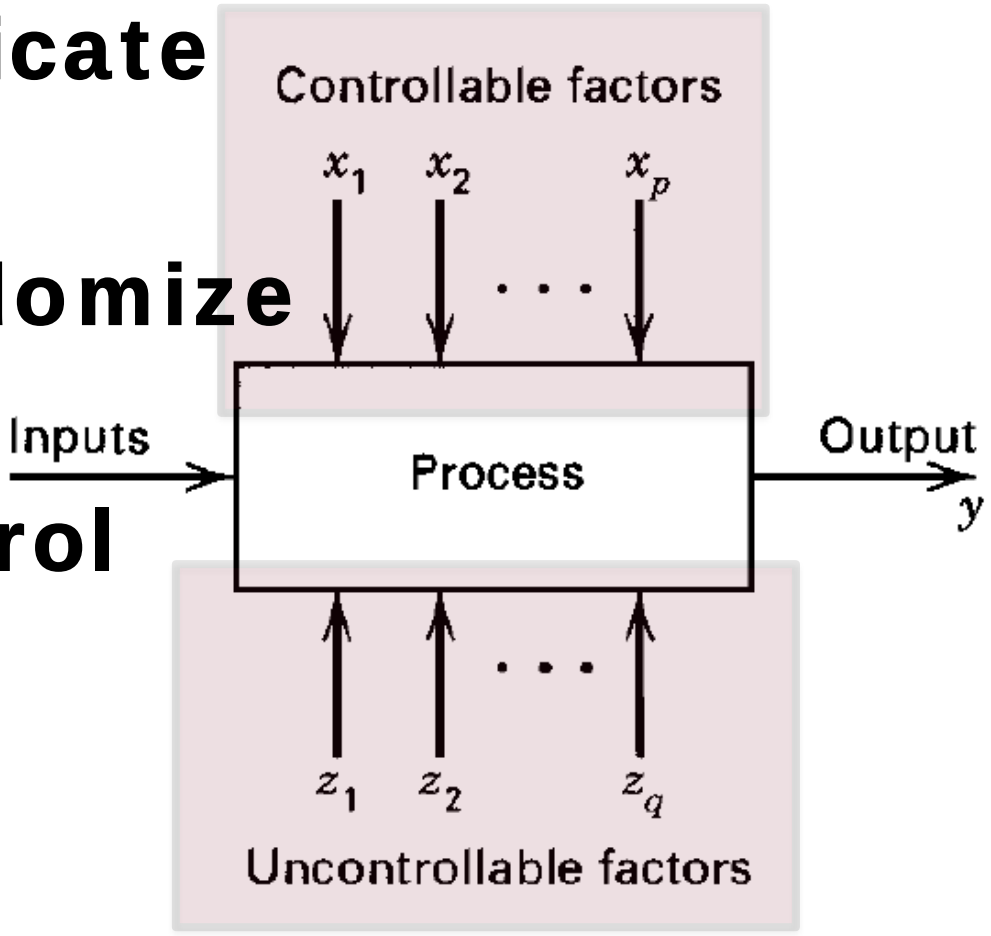
What can go wrong?

What can be / is done about it?

- **Replicate**
- **Randomize**
- **Control**



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Replicate, Randomize, Control... ?

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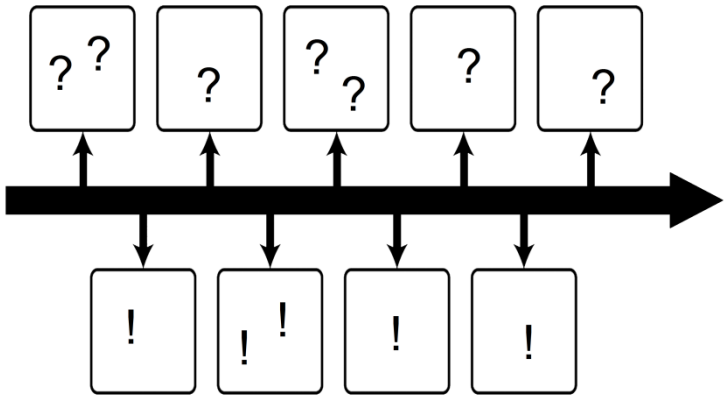

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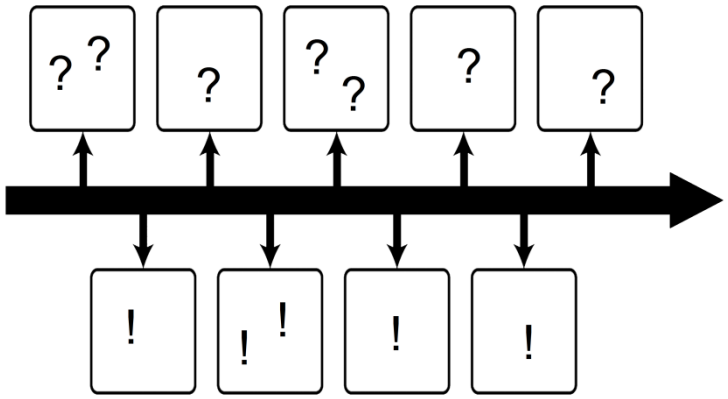
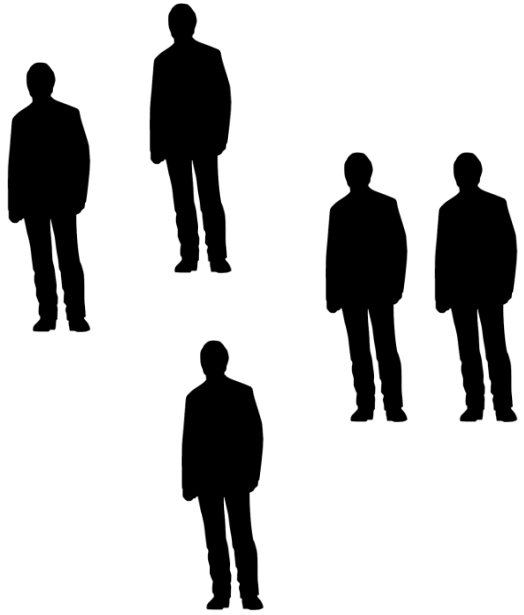


Time?

Entities?



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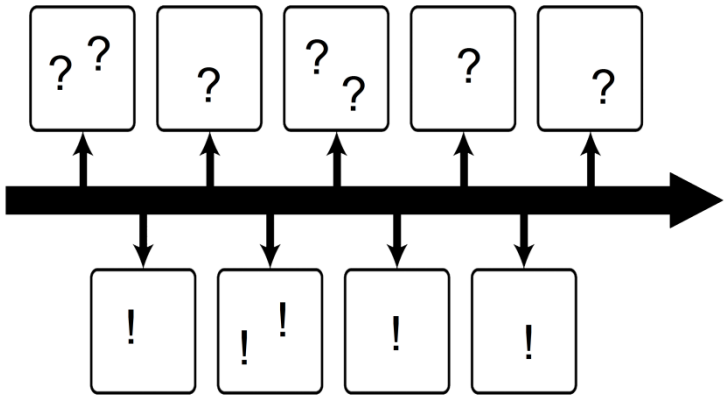

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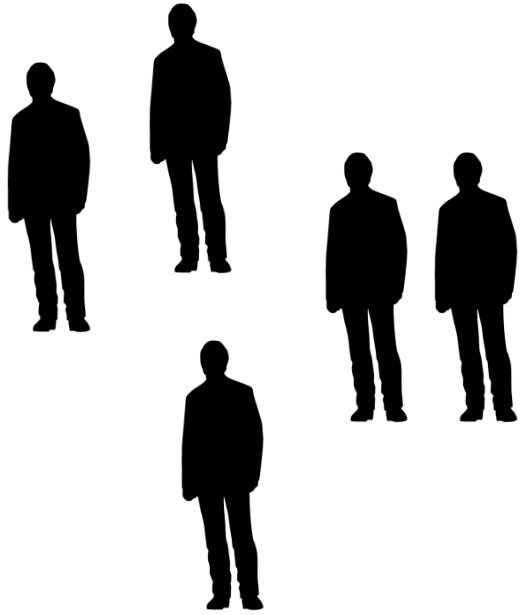

Entities?

?

Information?

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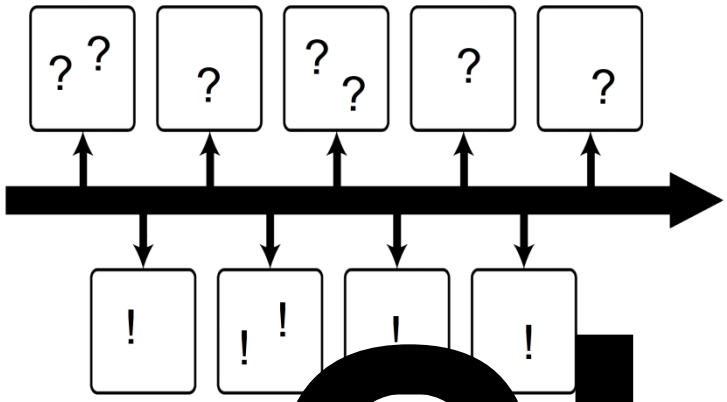
Replicate, Randomize, Control… ?



Time?

Chance

Entities?

?

Information?

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Internal and External Validity

- The **internal validity** of a study is basically its ability to measure what it says it measures.
- The **external validity** of study is basically the possibility to generalize the findings of the study.

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Methodology 3: The Quasi-Experiment

- An “experiment” in which treatment or control is not assigned randomly.
- This is a risk, so why would one do this?

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Problems:

- **Practical**
- **Ethical**

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Validity:

- **Artificial vs Natural**

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Data Analysis

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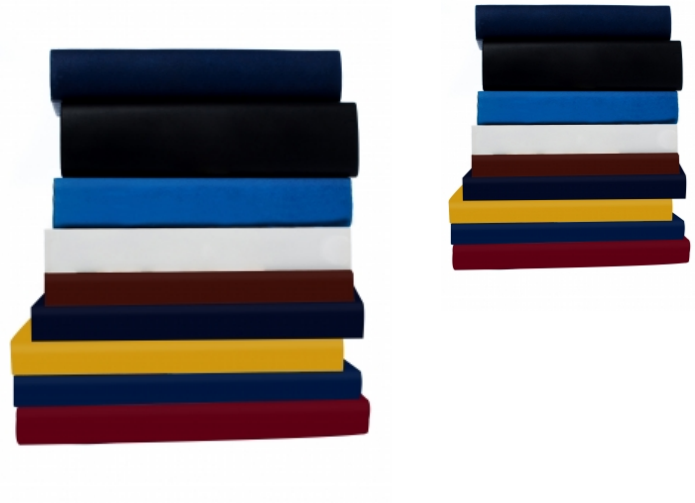
Statistics, Statistics and ... Statistics

- **Descriptive Statistics** is the development of indices from raw data.

- **Inferential statistics** are concerned with two major type of problems:
  - The **estimation** of **population parameters**.
  - The **testing** of **statistical hypotheses**.

This is a large area of study...



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Measures of ...

- **Central Tendency** - Mean, Median, Mode…
  - Summarizes a large set of data into a single value.
  - Descriptive, Inferential (Comparative)
- **Variability** – Range, Interquartile Range, Standard Deviation…
  - Descriptive (The degree to which the scores are spread out or clustered together), Inferential (How accurately any individual score or sample represents the entire population)
- **Probability…**

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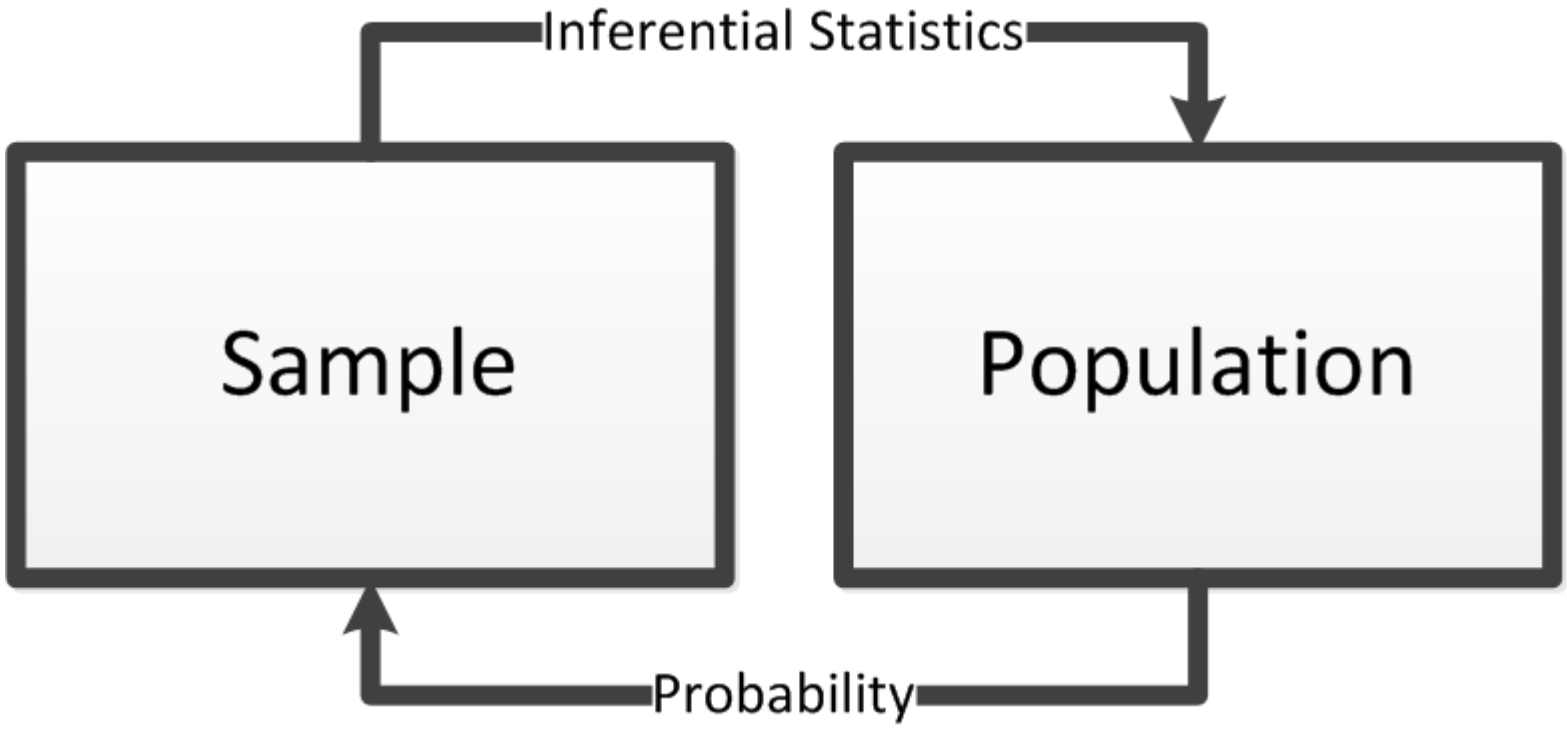
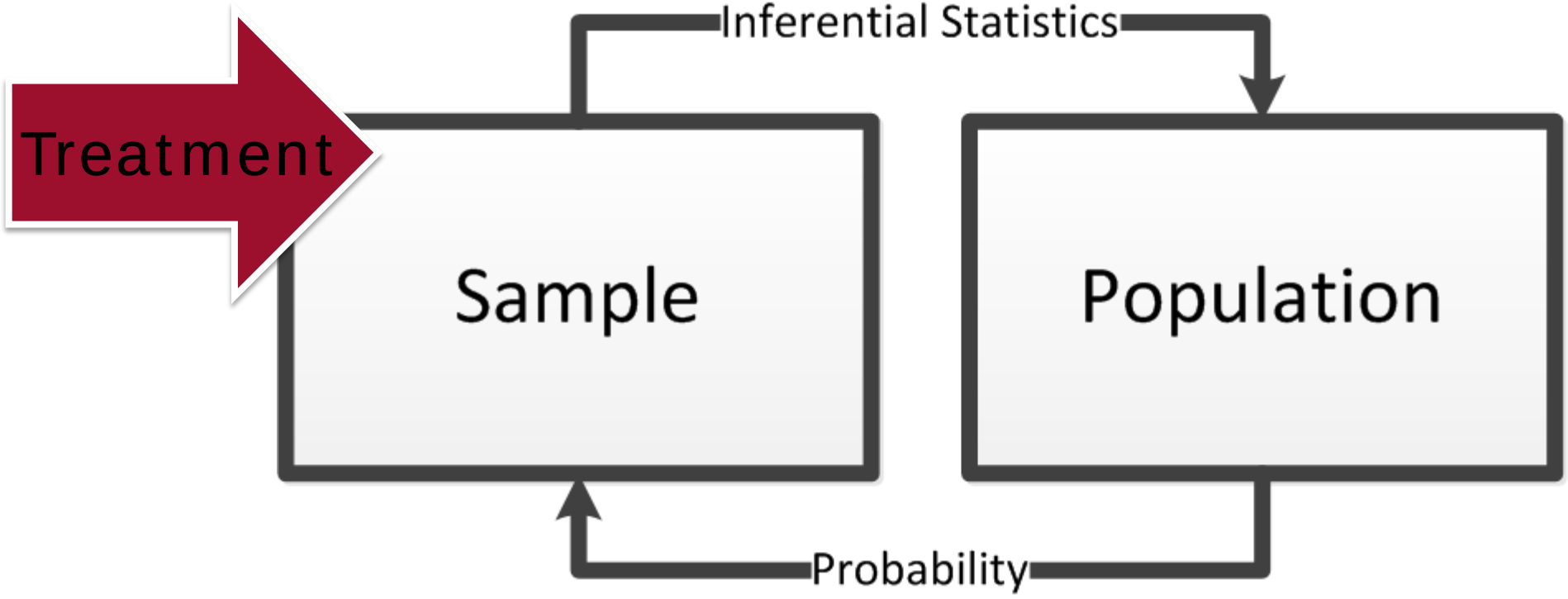
Probability

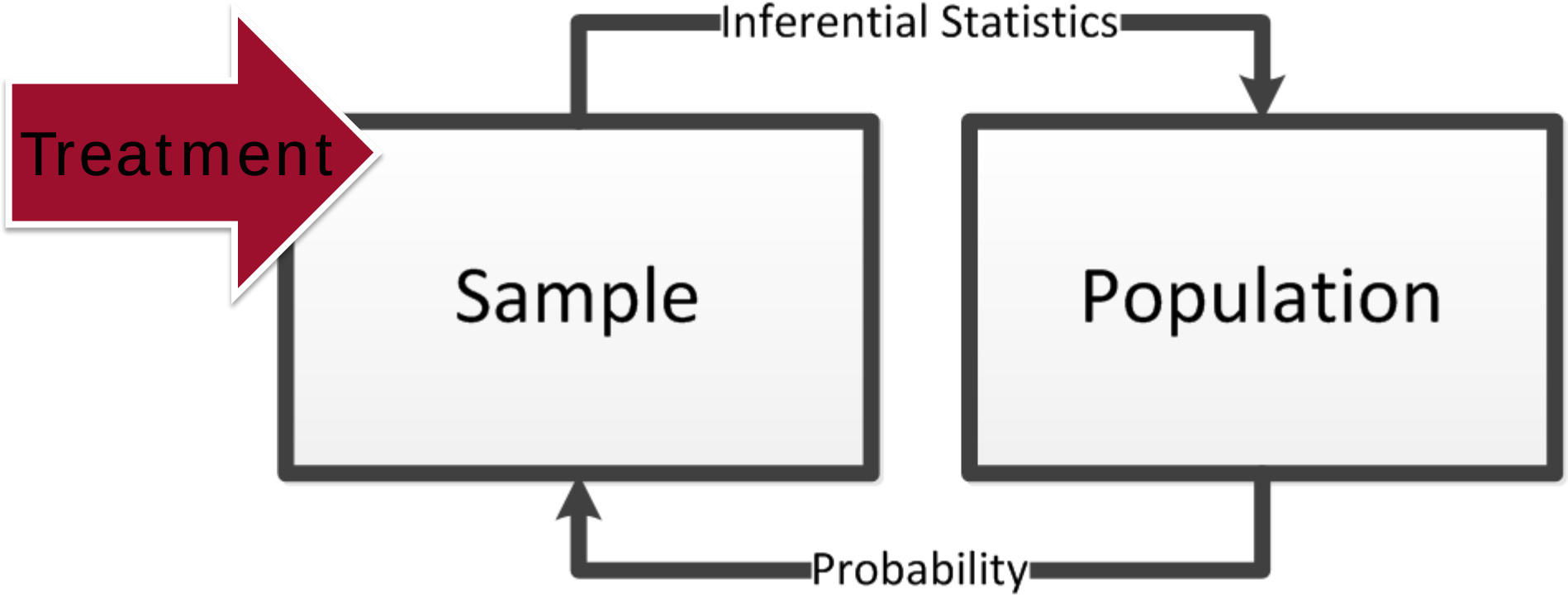


Example 1



Probability that the observed values after the treatment could be from the original population?

Example 2



Size of sample gives probability that observed strength of effect is representative!

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Beware...

- The offhand use of statistics by researchers.
  - Is the type of data appropriate?
  - Is the sample size correct?

- Is the goal to describe, test or estimate?
  - Requires different types of statistics.