What are the computational and data sciences?

Data overview

Definitions

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Observation

A set of measurements made under similar conditions (you usually make all of the measurements in an observation at the same time and on the same object). An observation contains several values, each associated with a different variable.

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Labeling variables as explanatory and response does not guarantee the relationship between the two is actually causal, even if there is an association identified between the two variables. We use these labels only to keep track of which variable we suspect affects the other.

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Stu.	**sex**	**sleep**	$\cdots$	**dread**
1	male	5	$\cdots$	3
2	female	7	$\cdots$	2
3	female	5.5	$\cdots$	4
4	female	7	$\cdots$	2
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
21	male	6	$\cdots$	3

Data collected on students in a data science class on a variety of variables

Kinds of data

Numerical

Data that is a number, either an *integer* (whole numbers) or a *float* (real numbers). This kind of data is collected from device sensors, through counting and polling, outputs of computational simulations, etc.

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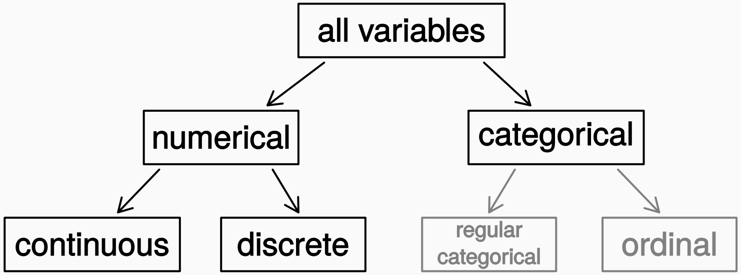
Textual

Plain text that is too varied to be treated as a category. Some examples can be full names, the text of a literary work, tweets, etc.

Kinds of data



Example: types of variables

Stu.	sex	sleep	bedtime	countries	dread
1	male	5	12 – 2	13	3
2	female	7	10 – 12	7	2
3	female	5.5	12 – 2	1	4
4	female	7	12 – 2		2
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- *sex:* categorical
- *sleep:* numerical, continuous
- *bedtime:* categorical, ordinal
- *countries:* numerical, discrete
- *dread:* categorical, ordinal (or numerical)

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    - Careful tuning of one parameter of an experimental appartus, changing a single chemical component, altering one nutrient in an organism's diet, etc.
    - Blind studies: randomly assign subjects to treatments. Becomes double blind if experimental observers are also randomly assigned.

How do we obtain data?

Manual measurements

- Compared to a baseline: ruler, scale, stopwatch
- Record-keeping: counting, behaviorial notes, ledgers, timelines, relationships
- Self-reporting: surveys and interviews

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Sensor measurements

- Electrical, temperature, mechanical, chemical, electromagnetic, navigation, cameras/light, pressure, etc.
- A lot of these are in a cell phone!
- Benefits: automation, precision, access to properties that manual methods cannot measure

How do we obtain data?

Digital artifacts

- Internet: server logs, social network activity, web search, online transactions, data transmissions, etc.
- Digital text corpus: digital books, articles, government documents, email, messaging, etc.
- Databases: scientific, social, government, business, etc.

Credits

License

Acknowledgments

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- The Lecture 7 - Sensors and Scientific Measurements by John Wallin