Quantitative Measures

EDUC 641: Class 2

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Roadmap

Research is a partnership of questions and data		What types of data are collected?	
		Categorical data	**Continuous data**
What kinds of questions can be asked of those data?	Questions that require us to describe single features of the participants	• How many members of class have black hair? • What proportion of the class attends full-time?	• How tall are class members, on average • How many hours per week do class members report studying, on average?
	Questions that require us to examine relationships between features of participants	• Are male-identifying students more likely to study part-time? • Are PrevSci PhD students more likely to be female-identifying?	• Do people who say they study for more hours also think they'll finish their doctorate earlier? • Are computer-literate students less anxious about statistics?

Class goals

1. Describe types of and differences in measurement scales and why this matters

Types of data

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How we collect and quantify the data informs the kind of analysis we will conduct.

Core concepts in measurement

What is measurement? assigning categories or numbers based on a set of rules

This concept is **critical** to quantitative research: we have some idea of a "thing" we want to examine (sometimes called a construct), and we need to figure how to turn the observed thing into a category or number.

1. A theoretical **construct**: the "thing" you're trying to understand
2. A **measure**: the tool used to observe
3. An **operationalization**: the connection between the measure and the construct
4. A **variable**: the thing that ends up in your data set

Levels/scales of measurement

Levels of measurement: how categories/numbers are defined

Each type of measurement has a set of properties which determines the appropriate analysis.

Four levels/scales of measurement

1. Nominal
2. Ordinal
3. Interval
4. Ratio

Nominal scale

No hierarchy among levels of a variable

Levels are unordered, representing labels

A variable defining whether someone is an omnivore, vegetarian, vegan or fruititarian is on a nominal sclae

Most demographic variables are nominal:

- Hair color
- Race
- Ethnicity
- Gender

Ordinal scale

Levels are logically ordered; a higher level indicates "more"

Distances between levels are not necessarily equal

Level 1 < Level 2 < Level 3 < ... (monotonicity)

Examples:

- Grades (A - F letter grades)
- Competition (1st place, 2nd place, 3rd place)
- Likert scale (on a scale of 1 to 10 with 1 being *very unhappy* and ten being *very happy*, how happy are you today?)

Interval scale

Represents *quantity* and has *equal units*

Ordinal scale + equal measurement units

There is no absolute zero

Examples:

- The Fahrenheit temperature scale
  - The difference between 20 F and 30 F is the same as the difference between 60 F and 70 F
  - 0 does not represent "no temperature"
  - There is no concept of dividing or multiplying values on the scale. There are no ratios. We can't describe 50 F as half as hot as 100 F or twice as hot as 25 F

Ratio scale

Interval scale + True zero point

True zero means a point where the thing being measured does not exist

Examples:

- Height
- Mass
- Distance
- Length of a piece of wood
- Test score (?)

Levels of measurement

	Indicates difference	Indicates direction of difference	Indicates amount of difference	Has absolute zero
?????????	X			
?????????	X	X		
?????????	X	X	X	
?????????	X	X	X	X

Can you match the four measurement scales to their characteristics in the above table?
Try not to peek ahead to the next slide?

Levels of measurement

	Indicates difference	Indicates direction of difference	Indicates amount of difference	Has absolute zero
Nominal	X			
Ordinal	X	X		
Interval	X	X	X	
Ratio	X	X	X	X

Alternative measure terms

Categorical variable

- Nominal and ordinal measures
- Use labels to describe

Continuous variable

- Always possible to have another value in between two other values
- Interval and ratio measures
- Data with arithmetic properties

Discrete variable

- Not possible to have another value in between two other values, **on that scale**
- Nominal and ordinal measures always discrete
- Ratio/interval may or may not be (contrast "degrees Celsius" with "years")

Four levels/scales of measurement

1. Nominal
2. Ordinal
3. Interval
4. Ratio

Why does this matter? Different scales contain different information and have different mathematical properties.

Is someone who says they are at 8 on a happiness scale twice as happy as someone who says they are at a 4?

Is there a mean (or standard deviation) for the hair color of the students in this class?

More complexity

- Quasi-interval scales
- Non-negative ratio scales
- Quasi-ordinal scales

... the point is that sometimes researchers treat measures as having certain kinds of mathematical properties that they may or may not have, which has implications to the conclusions that they make

An example

- Study in prominent journal (w. authors from U Chicago, U Toronto, U Cape Town) found that in more religious countries, children were less altruistic
- Intended to compare within-country differences, so want to "adjust" for country-level "religiosity"
- Included "country" as a ratio-scale variable: US = 1, Canada = 2, S. Africa = 3, etc.
  - $\rightarrow$ Canada has twice as much "country-ness" as US
  - Clearly, it should be a nominal variable and treated as such
- Direction of results flips when measure is appropriately operationalized

Report

CellPress

The Negative Association between Religiousness and Children's Altruism across the World

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RETRACTED

SUMMARY

Prosocial behaviors are ubiquitous across societies. They emerge early in ontogeny [1] and are shaped by interactions between genes and culture [2, 3]. Over the course of middle childhood, sharing approaches equality in distribution [4]. Since 5.8 billion hur representing 84% of the worldwide population, id tify as religious [5], religion is arguably one prevale facet of culture that influences the ...oppme and expression of prosociality. Wh...t is ...nerally accepted that religion contours p...e's n...judg- ments and prosocial behavior...be ...n ...betwn religiosity and morality is a...intentio...ne. Here, we assessed altruism an...-party e...ation of scenarios depicting int...ersc...harm in 1,170 children aged betwee...and 12 ye...in six countries (Canada, China, ...an, Turkey, US...and South Africa), the reli...snes...of their household, and parent-reported ...mpath...nd sensitivity to justice. Acro...l cou...es, p...nts in religious households ...ort...that ...hildren expressed more emp...y and ...ensitivity for justice in everyday life than ...ents. However, religiousness was inv...ly predictive of children's altruism and positively ...elated with their punitive tendencies. Together the...e results reveal the similarity across countries in how religion negatively influences children's altruism, challenging the view that religiosity facilitates prosocial behavior.

RESULTS

Humans have evolved as highly cooperative species, and many

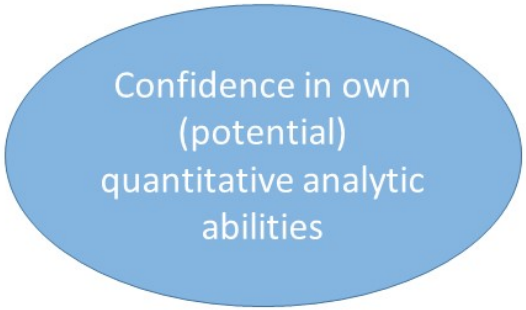
that children in preschool ...nd to share less than a third of their resources ...d by late childhood share nearly half [6].

...ally, children have been and continue to be predominantly ra...in household...where religion is discussed, and oftentimes it p...es fundam...tal guidance for everyday living and moral behav...Yet ...is known about how children's altruistic tendencies ...influenced by the religiousness of their household and how parents perceive their children's moral dispositions. ...gious values and beliefs are transmitted to children through repeated rituals and practices in their communities. If religion promotes prosociality, children reared in religious families should show stronger altruistic behavior. Importantly, most research on the link between religion and morality has focused on convenience populations: college students from western, industrial, educated, rich, and democratic societies. The early experience of religion and variations in the nature of the rearing environment critically influence children's moral development from the standpoint of both psychology and economics [7]. Understanding the impact of religiosity on children's altruism provides insights about how prosocial behavior is shaped by gene-culture coevolution.

To examine the influence of religion on the expression of altruism, we used a resource allocation task, the dictator game, in a large, diverse, and cross-cultural sample of children (n = 1,170, ages 5–12) from Chicago (USA), Toronto (Canada), Amman (Jordan), Izmir and Istanbul (Turkey), Cape Town (South Africa), and Guangzhou (China). Consistent with literature in the development of generosity, age in years was predictive of the total resources shared ($r = 0.408$, $p < 0.001$) [4, 6], but the religious rearing environment fundamentally shaped how their altruism was expressed.

In our sample, 23.9% of households identified as Christian (n = 280), 43% as Muslim (n = 510), 27.6% as not religious (n = 323), 2.5% as Jewish (n = 29), 1.6% as Buddhist (n = 18), 0.4% as Hindu (n = 5), 0.2% as agnostic (n = 3), and 0.5% as other (n = 6). Results from an independent samples t test, comparing

The measure of our class



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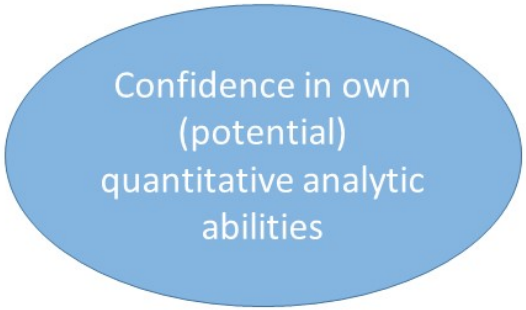

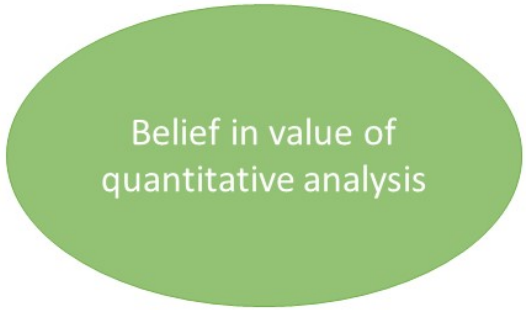

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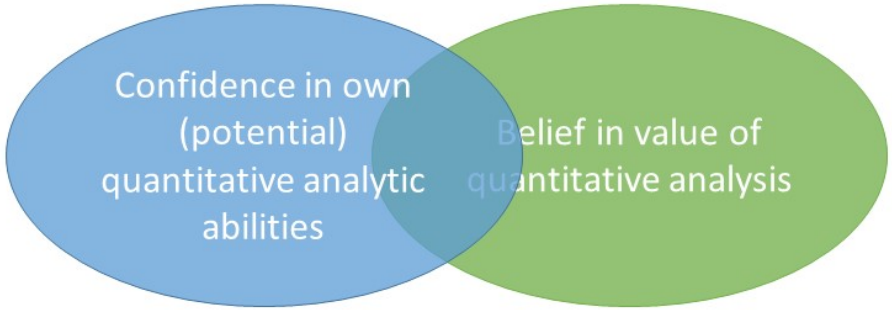

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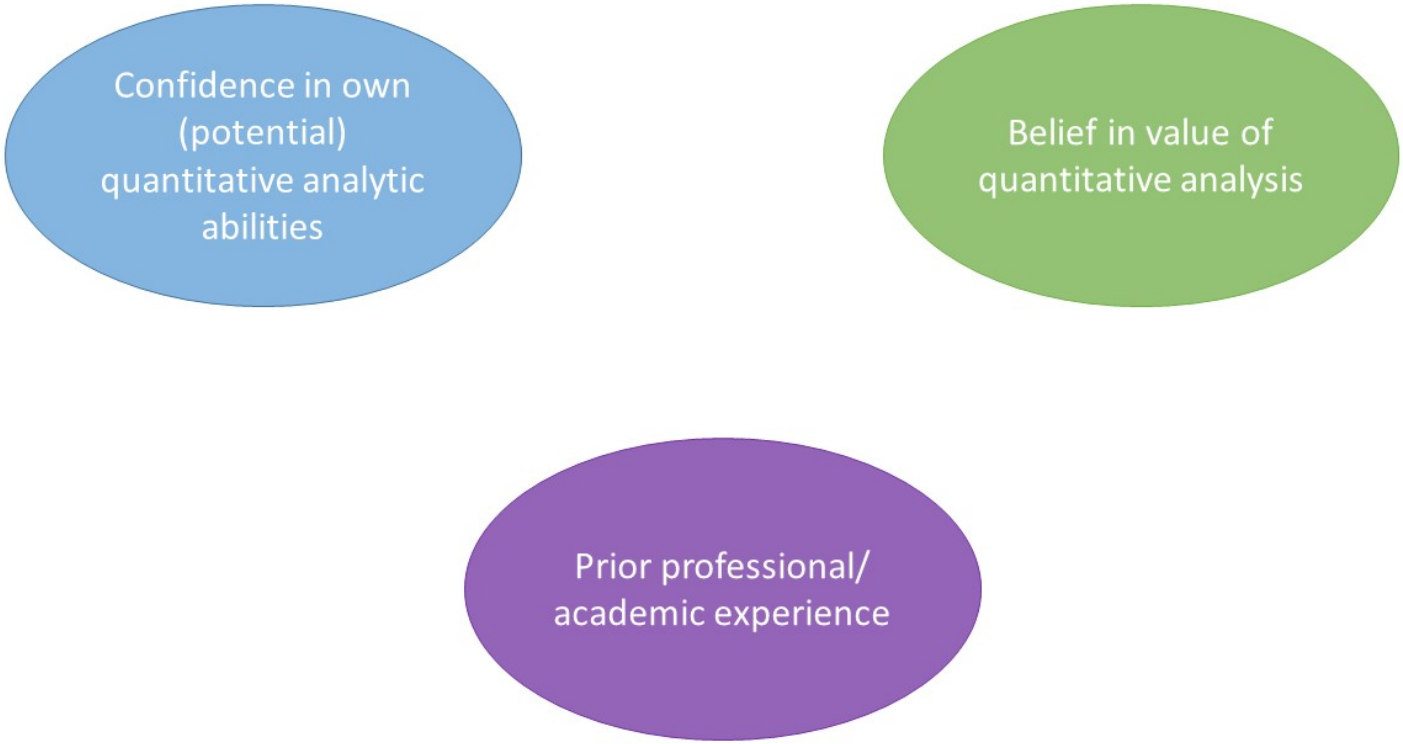

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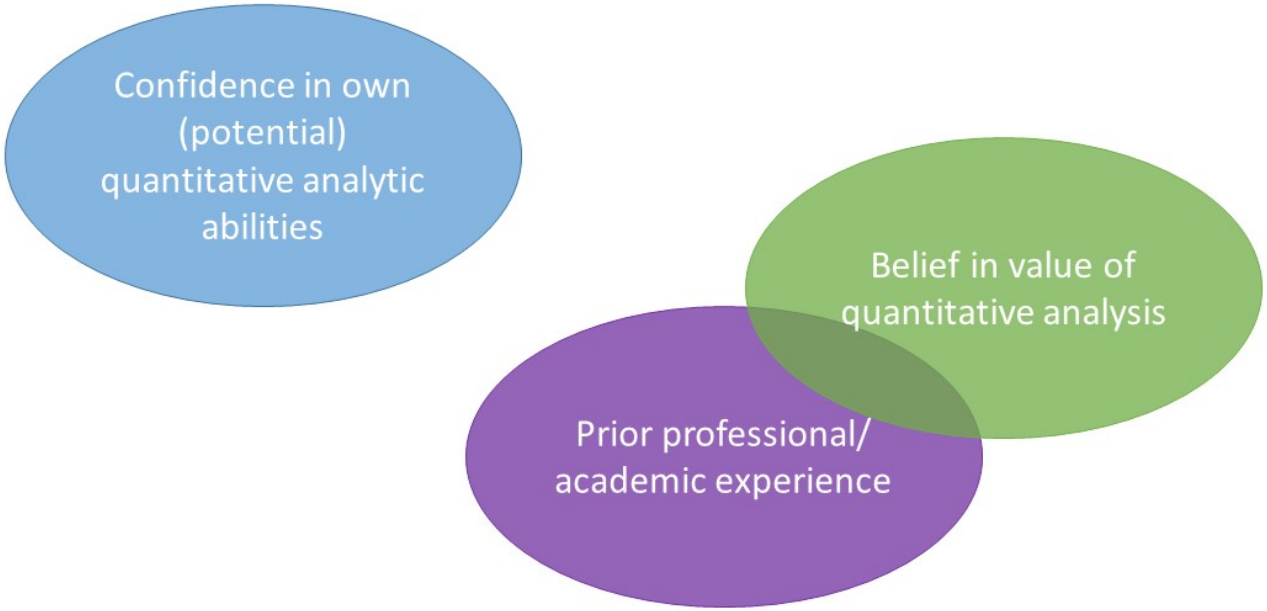

The measure of our class

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Qualtrics: https://oregon.qualtrics.com/jfe/form/SV_0MSB8ExhepNtVdA

or

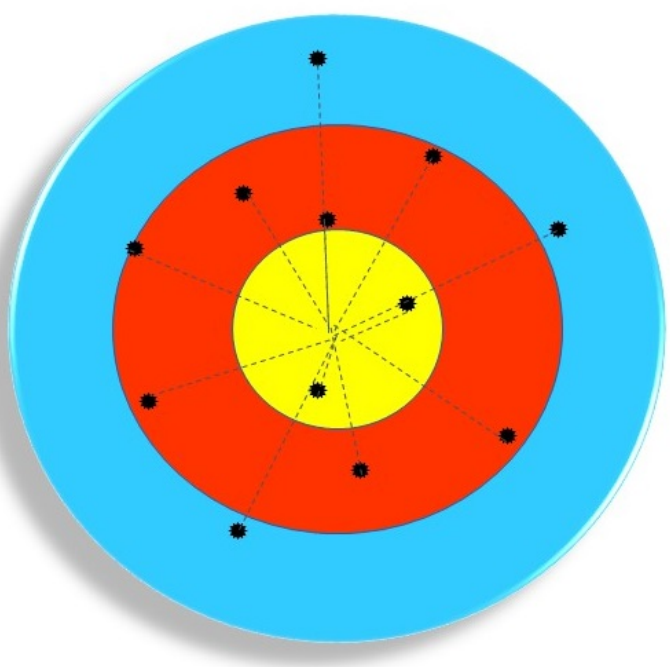
Live coding!

Ahhh! Don't try this at home!

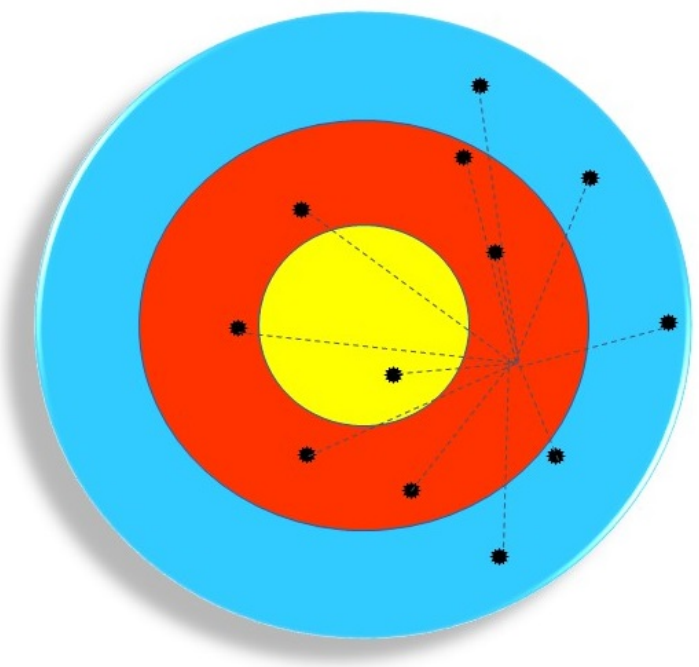
Purpose:

- Get to know a little about class
- Model joy/excitement in exploring data
- Observe process and power of data exploration
- Set you up to do some of this yourselves

Measure reliability & validity



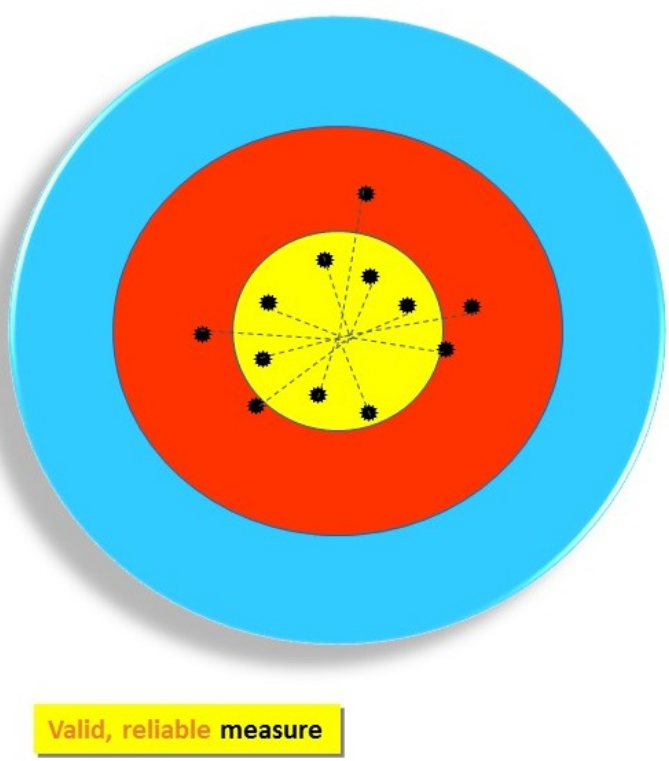
Valid, unreliable measure



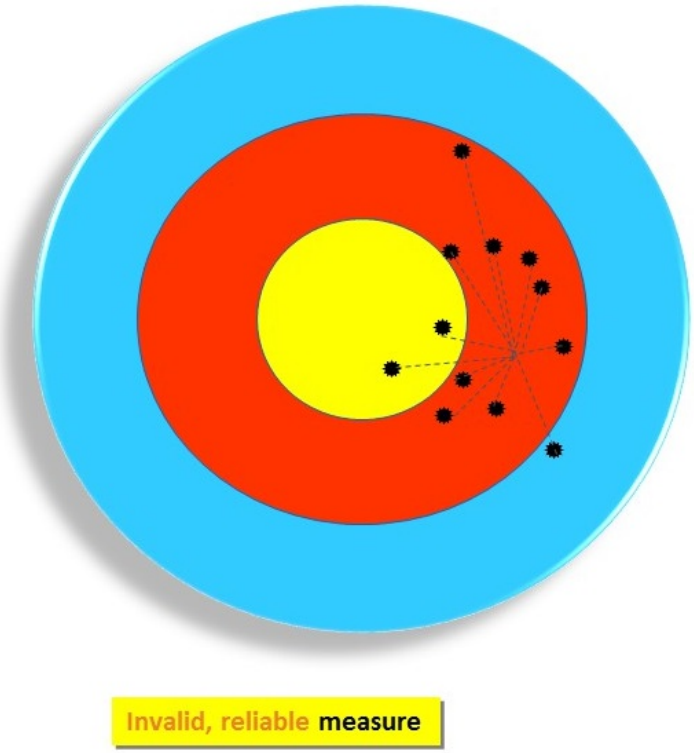
Invalid, unreliable measure

What kind of validity are we referencing here?

Measure reliability & validity



Valid, reliable **measure**



Invalid, reliable **measure**

More on this in EDUC 645, and much more on this in EDLD 663 (*Measurement & Assessment*) and EDLD 661/2 (*Item Response Theory*)!

Synthesis and wrap-up

Class goals

1. Describe types of and differences in measurement scales

To-Dos

Quiz on Unit 0 next class

Optional follow-up:

- Complete Module 4 in R Bootcamp (data types)
- Complete Module 5 in R Bootcamp (vectors)