Quantitative Sociological Analysis

Prefacing Statistics: Science and the Research Process

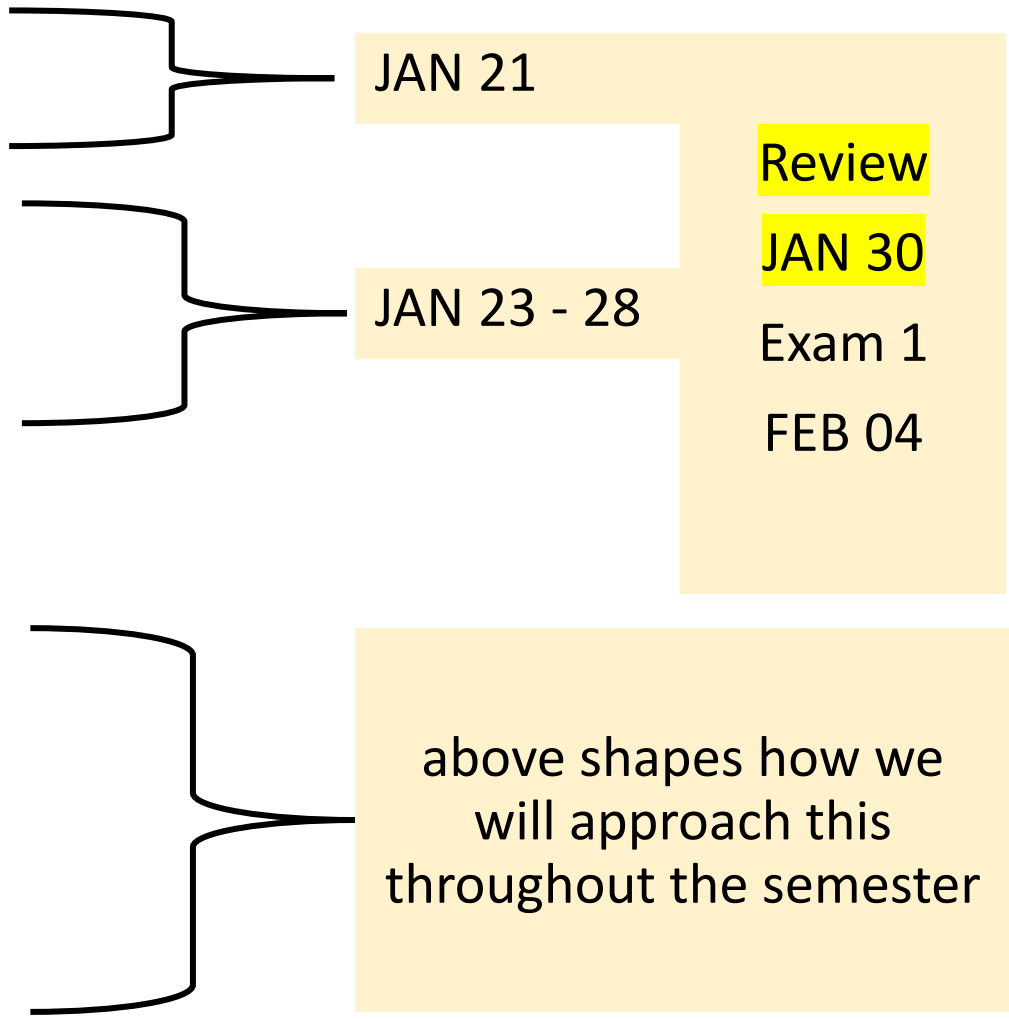
Review Parts 1-3

January 28, 2025

Science: a **process** of organizing, and acquiring new, knowledge

Steps in the process

1. Start with a perspective
2. Select a theory
3. Derive a research proposition
4. Derive a research question
5. Derive a hypothesis
6. Find or collect data
7. Analyze data
8. Report results & Answer question
9. Interpret results in terms of theory
10. Draw implications for theory



Now that we have a common language

- shared understanding of scientific process
  - leading up to *relationships* between *variables*

- let's assess this foundation that will guide the remained of our semester where we will learn
  - why and how to apply statistical methods
  - interpret results, and
  - critically evaluate claims

Hypothesis

- falsifiable statement that makes a prediction based on the literature, grounded in a scientific perspective, and guided by a specific theory

- What can we do with hypotheses?

Science

- process of organizing, and acquiring new, *knowledge*

- If that process revolves around rejecting or failing to reject hypotheses, then what is scientific knowledge?

Theory

- set of interrelated propositions that explain a particular phenomenon

- Oh yeah, so if scientific knowledge is an accumulation of theories, then science is all about *explaining* phenomenon

- Okay, but what do you mean by “phenomenon?”
  - observable events/occurrences in the natural or social world

Perspective

- overarching lens thought to offer an accurate view into a defined portion of the natural or social world

- Given that phenomena are observable events/occurrences,
  - why is it so important to start the process with a perspective?

Scientific process: game analogy

- perspectives don’t explain phenomena, they’re just assumed realities
  - since we can never prove what we observe as real/fact

- No need to get super meta and delve into the Matrix
  - consider like a game of skill with a set of instructions that outlines the
    - characteristics and qualities of all potential elements, and
    - rules that players must follow when manipulating those elements

- Skill-based games test players’ strategy and ability
  - Now, consider theory like a unique strategic ability
    - Each player is a theory…

Theoretical propositions

- statements describing the roles specific elements play in *explaining* a particular phenomenon

- Consider like the details that characterize each player's/theory's unique strategy and ability
  - In most any game of skill, can you play out your entire strategy to your full ability in one move/turn?

Research propositions

- statements describing the roles of elements in explaining a particular phenomena
  - which typically address a theoretical proposition

- Consider like assessing the status of the game to inform your next move/turn, which first requires using your strategic ability to
  - make sense/meaning of the elements you plan to engage
    - What's this process of specifically defining elements called?

Research questions

- The proposition with its conceptualized elements is restated
- Consider like declaring your next move in the game,
  - but being uncertain/questionable about the success of this move
- While you are uncertain, you made this move because you trust in your strategic ability to arrange elements in the game
  - your decision to move was an informed prediction that could be wrong

Hypothesis

- falsifiable statement that makes a prediction based on the literature, grounded in a scientific perspective, and guided by specific theory which is often formulated as an if-then statement

- Consider how making an informed prediction about your next move required you to move beyond making sense/meaning of the game
  - you have now taken measurable circumstances into account
    - What's this process of turning concepts into variables called?

Dependent variable

- outcome caused by agent of change
  - the phenomena being explained

- Consider like the outcome of your move in the game
  - Did your move result in what you expected?
    - How do you know?

Hypotheses test

- this involves an evaluation of empirical vs expected results
  - empirical results refer to output produced by a research study
  - expected results are what a research study's output was hypothesized to look like

- Consider that your move was a success if it resulted in an arrangement of elements as you expected
  - supported, failed to be rejected

- Consider that your move was a failure if it resulted in an arrangement of elements different from what you expected
  - rejected

Independent variable

- an agent of change that caused an outcome
- Consider like a move you took in the game
  - you may have engaged many elements, but you made one move
- Many of the elements, variables, were connected to one another and your outcome
  - In other words, they were _____
    - This provided useful information to help you play the game, but…

Relationship

- knowing how closely the variables were associated, and
  - This is called?
- knowing how the variables move in relation to each other
  - This is called?
- is critical for determining whether your move caused the outcome you expected
- Can we depict what this might look like?

Scientific process: game analogy continued

- No player/theory can win the game, but they can
  - remain in the game by engaging with the same elements in the same ways without any major disturbances that could prohibit such engagement
  - advance in the game by engaging with the same elements in new ways or by engaging new combinations of elements
  - be ejected from the game by no longer being able to meaningfully engage,
    - which often makes room for another player/theory to join the game
      - Why might that concern remaining players'/theories' strategy and ability?

Scientific process: game analogy continued

- Given that no player/theory can win, is the game never ending?
  - No, because all players/theories can be ejected, and
  - there may be no alternative players/theories that want to join
    - Game over: the perspective shown to provide a false view of reality

- Science is like the universe of games, and even though our goal is to eliminate players (theory) and end games (perspectives) no one wants to be a loser
  - this can lead to bias and issues surrounding fallacies

Biases and fallacies: population health cont.

- Consider our lecture examples
  - Public health framing: How can we help medicine better serve people in the community and/or across our country?
  - Sociological framing: To what extent might the interplay between agency and structure explain social inequalities in health?

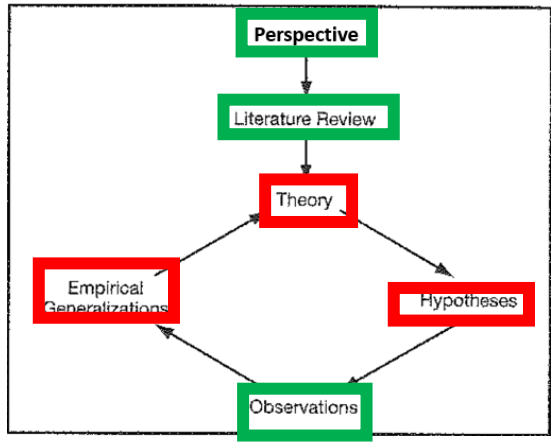
SOURCES OF MISINFORMATION ABOUT SCIENCE

Through its review, the committee found that misinformation about science can originate from a diversity of sources and types of media, including but not limited to corporations, governments and politicians, alternative health and science industries, entertainment media, non-governmental organizations, science organizations and institutions, press offices and news media organizations, individual scientists, and ordinary citizens.[2] Reasons and/or motivations for disseminating misinformation about science are diverse, but misinformation about science has greater potential for influence when it:

- originates from authoritative sources,
- is amplified by powerful actors,
- reaches large audiences,
- is targeted to specific populations, or

Let's revisit the scientific process: biases

- recall how data or statistics w/o theory ≠ science
  - let's break this down further
- w/o theory to inform study design and data analysis
  - claims are especially suspect to bias
    - two types of bias particularly relevant to this course include…



- Confirmation Bias
  - (un)conscious tendency to search for, interpret, or report information that is consistent with one's existing beliefs

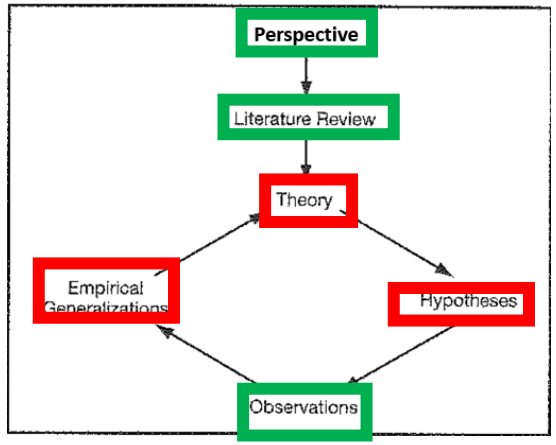
recall why motivating factors important to critique when you evaluate claims supported by a particular perspective

- Selection Bias
  - occurs when the observations, sample, does not accurately reflect the whole, population, it was intended to represent

consider this topically unrelated but helpful example

Let's revisit the scientific process: fallacies

- recall how data or statistics w/o theory ≠ science
  - let's break this down further
- w/o theory to inform study design and data analysis
  - claims are especially suspect to fallacies
    - two types of fallacies particularly relevant to this course include…



- Ecological Fallacy
  - occurs when individual-level claims are drawn from group-level observations
    - Examples? see here for further explanation
- Individualistic Fallacy
  - occurs when group-level claims are drawn from individual-level observations
    - Examples? underlies most "isms"