Correlational hypotheses and research

Phil 12: Logic and Decision Making
Winter 2010
UC San Diego
2/3/2010
Intuitions
Call for Papers

UCSD’s undergraduate philosophy journal is inviting students to submit papers for publication.

For more information, see:
Where we’ve been

• Variables: things that vary
• Variables differ in the way they can be measured
  - nominal & ordinal vs. score variables
• Hypotheses: conjectures about the way some phenomenon behaves
  - Need to be tested by predictions
• One type of hypothesis: how a single variable is distributed
  - Ages of people in food court
  - Amount of time animal spends foraging
  - Amount of time you spend studying
Hypotheses involving more than one variable

• Many of the hypotheses of interest in science and in ordinary life involve relations between variables
  - Amount of sleep and ability to recall information
  - Pressure, volume, and temperature of a gas
  - Experience and job performance
  - SAT score and grades in college
  - Vitamin intake and health condition
  - Sexual activity and sexually transmitted diseases
  - Smoking and lung cancer
  - Miles per gallon and horsepower of cars
Clicker question 1

More than 98% of convicted felons are bread eaters. Does this mean bread-eating is related to criminal activity?

A. Yes

B. No
The case against bread

- More than 98% of convicted felons are bread eaters.

- Fully half of all children who grow up in bread consuming households score below average on standardized tests.

- In the 18th century, when virtually all bread was baked in the home, the average life expectancy was less than 50 years.

- More than 90% of all violent crimes are committed within 24 hours of eating bread.

- Primitive tribal societies that have no bread exhibit a low incidence of cancer, Alzheimer's, and Parkinson's disease.

Not all statistics meaningful!
Correlational and causal hypotheses

• Many of the hypotheses of interest in science and in ordinary life are causal
  - Red wine and (reduced) cholesterol levels
  - Smoking and lung cancer
  - Vitamin C and prevention of colds
  - Deficit spending and economic recovery
  - Use of imagery and increased memory

• But causal claims are more difficult to establish than correlational claims

• So for now we focus on correlations only
Correlations and why they are interesting

• A correlational claim is a claim that the values on two variables vary systematically
  - Not necessarily in the same direction

• Why care about correlations if they are not (known to be) causal?
  - They may indicate causal relations
  - They can be used to make predictions about the value of one variable from the known value of another variable
SAT and College Grades

• Should the SAT be used as a (or maybe the) basis for admission to the University of California?

• If so, then it must be justified
  - Does it predict success in college?
  - If it doesn’t, then it may be an inappropriate measure to use in judging admissions

• Compare: basing admissions to UC on
  - Running speed for the mile
  - Length of one’s index finger
For shoe size to be used as a basis for determining life insurance rates:

A. Shoe size must be a score variable

B. There must be a high percentage of those with large shoe sizes among those who live long

C. An individual’s shoe size must be a good predictor of life expectancy

D. Shoe size could never be employed as a basis for deciding on life insurance rates
Correlational Research: Examples

- Is there a relationship between:
  - education and income later in life?
  - number of hours of part time employment and grade point average?
  - family income and grade point average?
From the general to the testable

• Not all hypotheses relating variables are directly testable, since hypotheses are presented in general terms
  
  - Force is equivalent to mass x acceleration
  - Entropy always increases
  - Fitter people live longer
  - Better education correlates with greater happiness
  - Greater pollution corresponds to greater global warming
  - Animals living in colder climates are larger
Testable predictions

- To test hypotheses such as these, we need to make specific predictions
  - Predictions which can be evaluated
    - Must predict something that we can detect and measure, either with our senses directly or via instruments
Operational “definitions”

• Relate the variables used in the hypothesis to measurable variables

• Variables such as force, entropy, memory ability, happiness, etc., are not directly measurable (observable)
  - Must specify a measurement procedure, i.e., an operational definition

• The operational definitions of any non-observational terms are major auxiliary assumptions in any test of a hypothesis
Distance

- Inch: width of a grown man’s thumb
  - King Edward II (14th C.): the length of an inch shall be equal to three grains of barley, dry and round, placed end to end lengthwise

- Foot: the name gives away its original reference
  - Standardized to 12 inches

- Yard: the length of a person’s belt
  - King Henry I (13th C.): distance from his nose to the thumb of his outstretched arm, which came to about 36 inches
The meter standard

- Meter introduced by the French in 1791 as one ten-millionth of the distance from the equator to the north pole along a meridian through Paris.

- Standard meter bar: A platinum bar with a rectangular cross section and polished parallel ends at a specific temperature.

- 1859: J.C. Maxwell defined it in terms of the wavelength of the yellow spectral line of sodium.

- 1892: A.A. Michelson 1,553,164.13 times the wavelength of cadmium red in air, at 760 mm of atmospheric pressure at 15 °C.
• 1960: 1,650,763.73 vacuum wavelengths of light resulting from orange-red light, in a vacuum, produced by burning the element krypton (Kr-86)

• 1983: length of the path traveled by light in vacuum during 1/299,792,458 of a second
The case of IQ

In 1904 the French government commissioned Alfred Binet to devise a test to differentiate children who would not do well in usual schools from those who would.

- The latter were to be assigned to special schools with greater individual attention but not disrupt the intellectually normal children.

- "It seems to us that in intelligence there is a fundamental faculty, the alteration or the lack of which, is of the utmost importance for practical life. This faculty is judgment, otherwise called good sense, practical sense, initiative, the faculty of adapting one's self to circumstances. A person may be a moron or an imbecile if he is lacking in judgment; but with good judgment he can never be either. Indeed the rest of the intellectual faculties seem of little importance in comparison with judgment" (Binet & Simon, 1916/1973, pp. 42-43).
The case of IQ - 2

- 30 item test, with different questions typically solved by children at different ages
  - attend to simple instructions
  - name parts of the body
  - compare lengths and weights
  - count coins
  - assess which of several faces is "prettier"
  - name objects in a picture
  - remember digits from a list
  - define words
  - fill in the missing words in sentences
The case of IQ - 3

- Intelligence Quotient (William Stern in 1914): age level of test results ÷ chronological age, normed to 100
  - an 8 year old who passes the 10-year-old's test would have an IQ of \( 10 ÷ 8 \times 100 = 125 \)

- Lewis Terman of Stanford (1916):
  - Items on Binet’s test didn’t predict well in California so revised the test—the Stanford-Binet test
  - Adopted Stern’s notion of IQ
  - Extended test to adults
  - Studied, and promoted, 1000+ of those who scored high
  - Advocated forced sterilization of "feebleminded"
IQ joins the army

- Entering World War I, the US army needed to assess the intelligence of recruits in order to assign them appropriately.
- The Stanford-Binet test required a skilled test administrator, which the army could not afford.
- Robert Yerkes et al. created a paper and pencil version.
But what does IQ measure?

- Tests designed to predict success in specific functions
- Charles Spearman
  - Noted people who did well on IQ tests tended to do well in other intellectual activities, and people who did poorly on IQ tests tended to do poorly on other intellectual activities
  - His proposal:
    \[
    \text{Intelligent Behavior} = \text{General ability} + \text{specific abilities}
    \]
  - Advocated that voting and procreation be restricted to those exceeding a base value for \( g \)
Beyond IQ?

• Howard Gardner: multiple intelligences
  - Verbal
  - Mathematical
  - Musical
  - Spatial
  - Kinaesthetic
  - Interpersonal (social skills)
  - Intrapersonal (self-understanding)

• Robert Sternberg: three kinds of intelligence
  - Academic
  - Practical
  - Creative
Construct Validity

- Does the way you operationalize a variable really capture that variable?
  - Does a ruler (grains of barley) really measure height?
  - Does an intelligence test measure intelligence?
  - Does a word-list test measure memory?