A decision tree for statistical fallacies

Philosophy and Logic
Unit 5
Summary
A checklist for healthy statistical inferences

Learn how it *should* be done.
Then you can identify fallacies as deviations from that path.
(See Huff, Chapter 10).
The five steps of the path

• Sample
• Measure
• Compute
• Generalize
• Infer
The notion of a “decision tree” for fallacies

Your goal is to identify the fallacy that the passage most clearly commits.

– Make the best (most likely) diagnosis.
– One where there is evidence in the passage itself sufficient to be sure that that fallacy is committed.

• You only need to name one.
A. Sample
   1. Biased sample  (Huff  ch.1)
   2. Inadequate sample

B. Measure
   1. Impossible precision
   2. Dangling comparative
   3. Bogus measurement  (Huff ch. 3)

C. Compute
   1. Wrong type of average  (Huff ch. 2)
   2. Number instead of a percent
   3. Shifting bases (denominators)

D. Generalize
   1. Ignoring dispersion  (Huff ch. 3)
   2. Ignoring probable error  (Huff ch. 4)

E. Infer relations
   1. Comparing unlike groups  (Huff ch. 7)
   2. Post hoc ergo propter hoc  (Huff ch. 8)
A. Sample

1. Biased sample  (Huff ch.1)

Some subgroups in the population have a bigger chance of showing up in the sample than others. Watch out for techniques that

– require people to volunteer responses (as in mail-in surveys)
– use a particular sample because they are easy to reach
– favor those that have access to a particular technology, time, or place
– favor those with a particular lifestyle, income, personality, etc.
A. Sample

2. Inadequate sample
   - A dead giveaway: we report measurements on only \textbf{one or two} individuals. The hardest to detect: a "case study", with N = 1!
   - N < 30 is typically useless. Generally: a sample size too small to give reliable results for that population.
B. Measure

- The mere presence of numbers does not make the report scientific. Look at the numbers and look at the term attached to the numbers.
- A giveaway: that term is ambiguous, hard to measure, or vague. Ask:
- What does a difference in those numbers entail about differences in properties?
B.1. Impossible precision

- Look at the last decimal place reported.
- Could differences that small be accurately measured?
- If not: impossible precision.
B.2. Dangling comparative

– The passage uses a comparative term (greater than, faster than, brighter than, etc) but does not name both of the parties being compared. Only one is named.
B. 3. Bogus measurement
(Huff ch. 3)

Look at the word that the number is attached to.

– Is it clear what differences in the number mean about differences in that property?

– Is there a clear and reliable way to put a ruler up against that property?

If not: dubious measurement procedure. There is no clear rule attaching numbers to that property.

– Often the term is ambiguous or vague (or both). It is silly to think you could measure it with a ruler.

– Another giveaway: you can imagine two different ways of “measuring” the property that would be equally good but would give different results.
C. Compute

1. Wrong type of average  (Huff ch. 2)
   – Using a mean in a skewed distribution.
   – More generally: confusing mean, median, and mode.
   – Typical skewed distributions are
     • ones with no natural upper limit; or
     • distributions that reflect social and cultural norms, rather than laws of nature
   – Examples:
     • income
     • consumption (beers per weekend!)
     • various social behaviors: who you hang out with, what you buy, what you'll say in a group, how often you date, how many traffic tickets you've gotten, etc etc.
C. 2. **Number instead of a percent.**
(Black Sheep Fallacy)

– Context: *We are interested in the rate of occurrences of some X. That's the conclusion.*
– But the premises only describes the number of occurrences of X.
– Result: no correct inference can be drawn. To get a percent you also need a denominator!
C. 3.  Shifting bases

– We are trying to compute some sort of fraction (often a rate or a percent). That's the conclusion.

– In one place in the premises we use one number as the denominator, then later we use some different number. The base (the denominator) has shifted.

– A typical example: we use the numbers for one sample in the first use of the fraction. Then we pretend the same fraction applies to some different sample, one with a different N.
D. Generalize

1. Ignoring dispersion  (Huff ch. 3)
   - We are interested in how much each individual has or requires. The conclusion makes a claim about that.
   - In the premises we use an average to summarize the central tendency of a sample.
   - But the passage contains no indication of how much the values spread out around that average.

   - Result: you don’t enough information to settle the question. The answer depends on something you don’t know: whether the bell shaped curve is “wide” or “narrow”.
D. 2. Ignoring probable error (Huff ch. 4)

- Treating differences that might be due simply to measurement error as if they are real.
- A giveaway: treating any small difference in measurements as if they reflect some real difference in properties.
- Slightly less blatant: we are given a “margin of error” of (±R), but then treat differences less than R as if they are real.
E. Infer relations

1. Comparing unlike groups (Huff ch. 7)
   - The conclusion is a causal claim.
   - The premises present numbers for two different groups.
   - The conclusion claims the different effects are produced by some factor X.
   - But the groups are from different populations. They differ in some other factor Y which could also explain the differences in the numbers.
E. 2. Post hoc ergo propter hoc (Huff ch. 8)

- After X happens, Y happens.
- Hence (ergo) X causes Y.

More generally: the premises state nothing but a correlation. The conclusion makes some sort of causal claim.
- X and Y occur together.
- Hence X causes Y.
Remember: Name the fallacy that the passage most clearly commits.

• There should be evidence in the passage sufficient to *convict* the author of the fallacy in question.

• Sometimes there is more than one possible correct answer.
  – Name the one in which it would be *easiest* to get a conviction.
  – Usually one is an open and shut case: there's no *question* that that mistake has been made.

• One answer should stick out like a sore thumb. It is blatant and unarguable. That’s the only one you need to name.
End