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Overview of ongoing & future research

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Ongoing & Future Research

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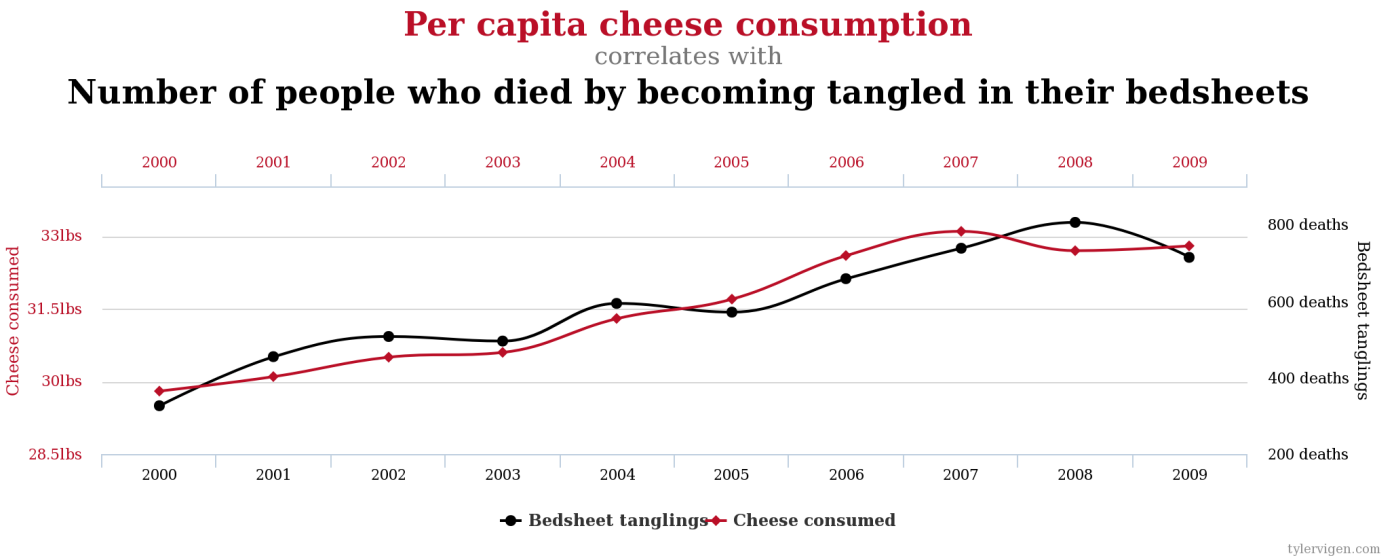
Prospective Student Day
Feb 2018

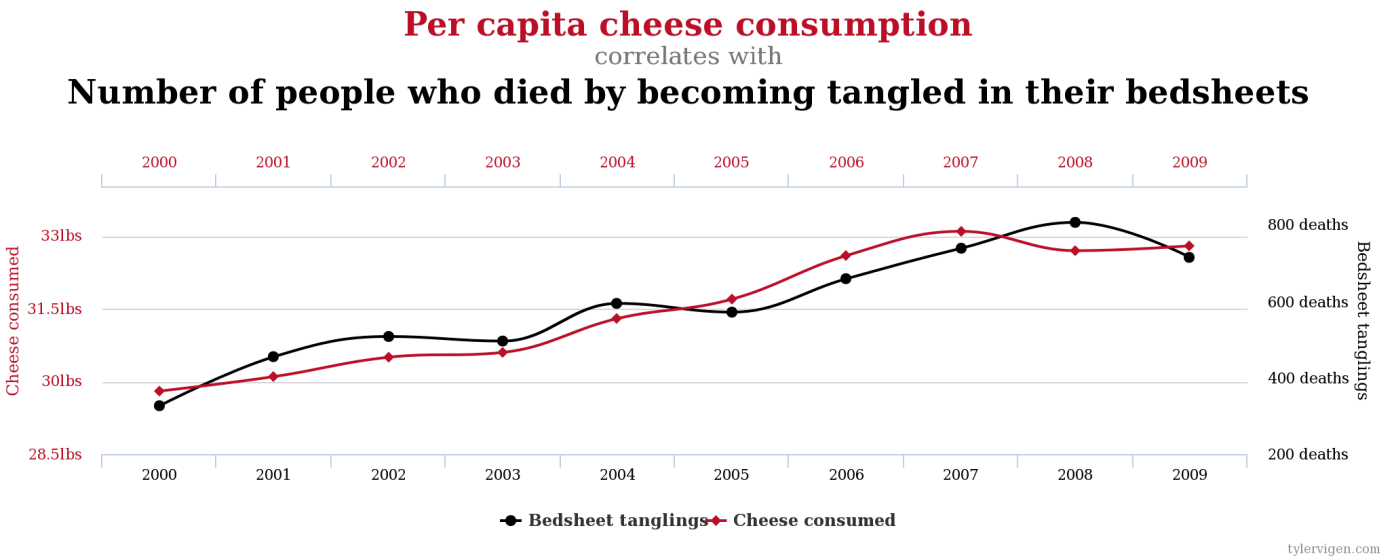
UMASS AMHERST

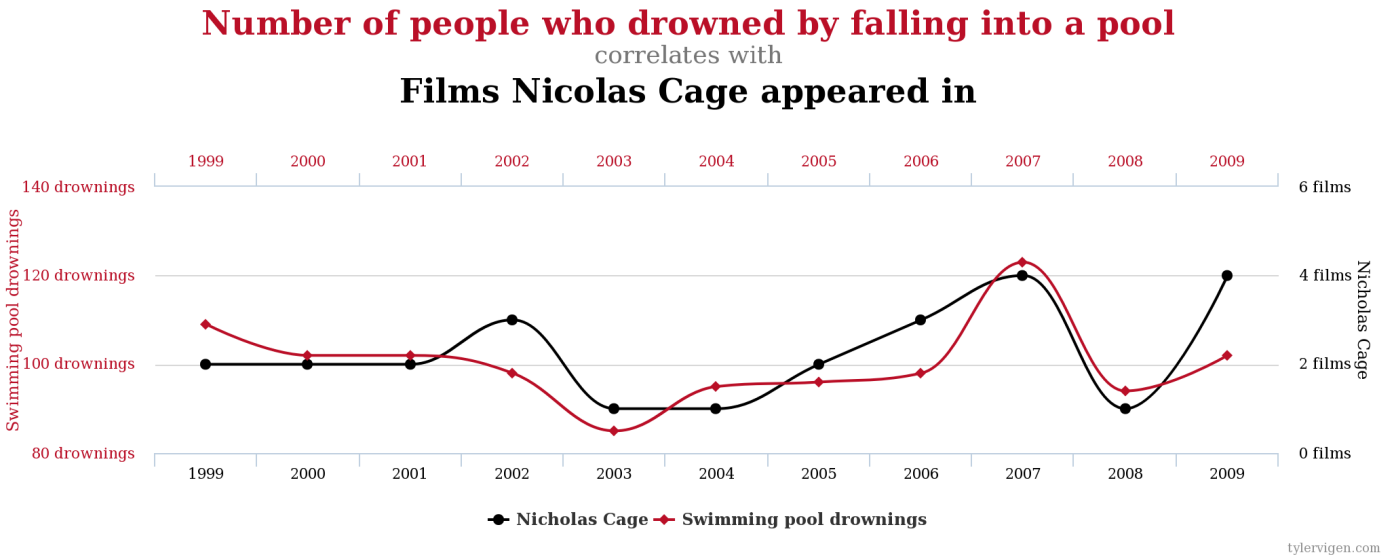
SEARCH
SUSTAINABLE EAST AFRICA RESEARCH IN COMMUNITY HEALTH

Causal inference



Causal inference





Causal inference: "Correlation is not causation"

Potential sources of association

(a) direct effects

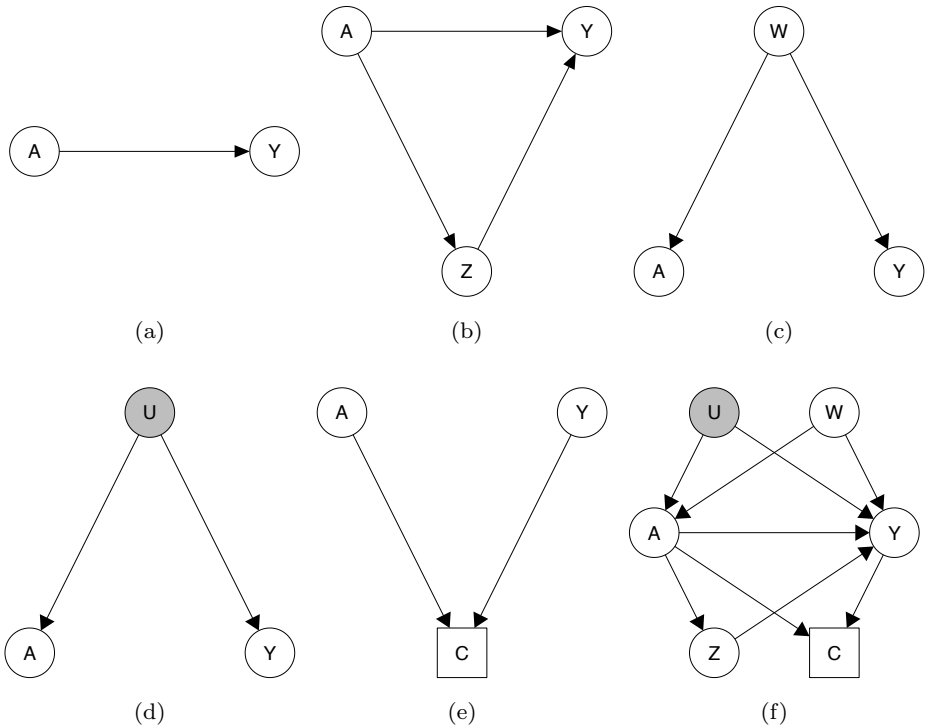
(b) indirect effects

(c) measured confounding

(d) unmeasured confounding

(e) selection bias

(f) all



Causal inference: a roadmap

0. Scientific question
1. Causal model representing **real** knowledge
2. Counterfactuals & causal parameter
3. Observed data & link to causal model
4. Identify: Knowledge + data sufficient?
5. Commit to an estimand as close to question as possible, and a statistical model representing real knowledge
6. Estimation
7. Interpretation

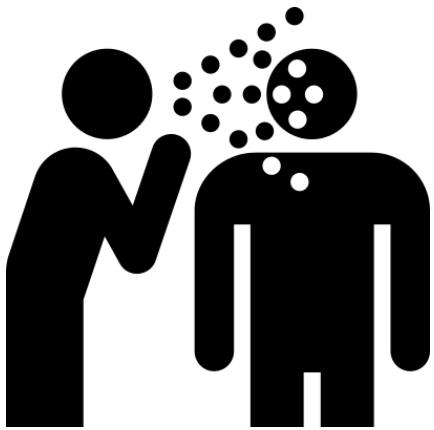
Want more? Biostat690B

Machine learning for prediction

- How can we build an optimal predictor for health outcomes?
  - "Optimal" depends on the research question
  - Single variable?
  - Parametric regression?
  - Too many variables; too little knowledge
- Machine learning: Automated approach to flexibly discover complex relationships from data
  - Super Learner: ensemble method to best weighted combination of algorithms

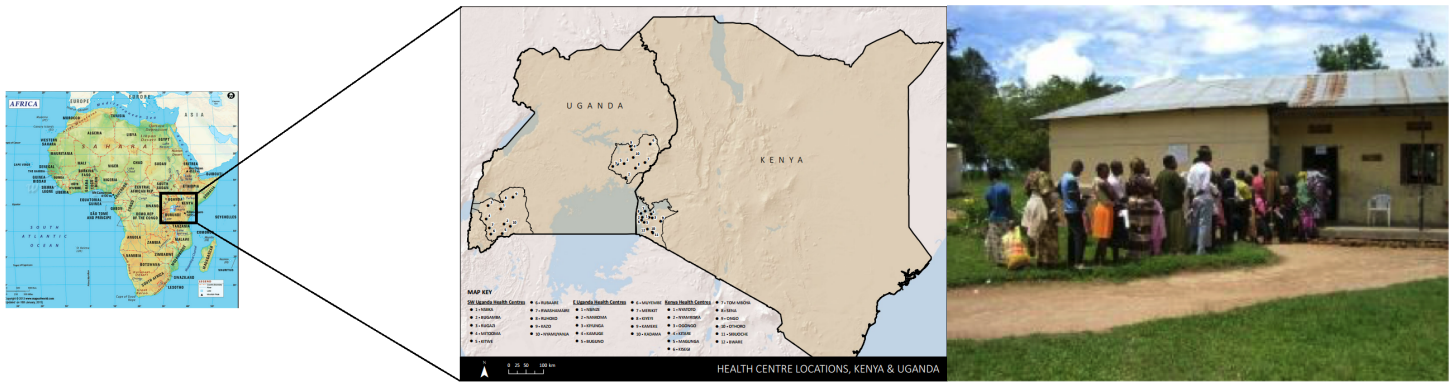
Statistics with highly dependent data

- Our health and well-being rarely are i.i.d. (independent identically distributed)
  - Clustering within households, neighborhoods, schools, communities
  - Longitudinal (repeated measures)
  - Hierarchical or multi-level
- Account for highly dependent data while minimizing assumptions
  - Let's not assume to know more than we actually know
    - Machine learning with statistical inference



The SEARCH Study - Integrating research & practice

- Ongoing cluster randomized trial (NCT:01864603)
  - Baseline: 2013-2014
- 32 communities in rural Uganda and Kenya
- >320,000 persons
- Pragmatic trial: the effect community-based HIV testing and ART-based interventions in real world settings



www.searchendaids.com

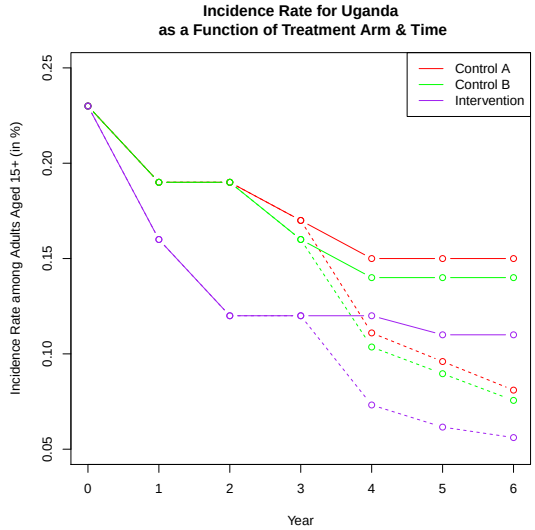
The SEARCH Study - Integrating research & practice

- Intervention:
  - Annual community-wide HIV testing
  - Patient-centered ART for all HIV+
- Control:
  - Baseline community-wide HIV testing
  - Country-guided ART for HIV+
- Primary outcome:
  - Three-year cumulative incidence of HIV
    - Proportion of baseline HIV-negative adult residents who become HIV-positive within 3 years
  - Cohort: 118,038 individuals

The SEARCH Study - Integrating research & practice

Design and analysis issues

- What is our parameter of interest?
  - How do we translate our scientific question into a causal quantity?
- How should we design the trial?
  - To pair-match or not to pair-match?
- How should we analyze our data?
  - Maximally unbiased and efficient estimator?
  - Statistical inference?
  - Adaptive yet pre-specified analysis?
- Ever-changing landscape of HIV prevention and treatment



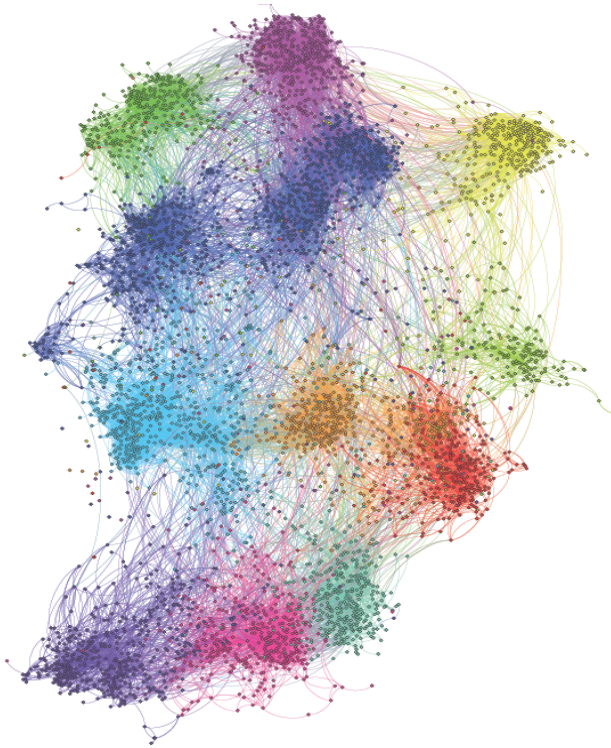
Machine learning in the field

Prediction: Who is at high risk for HIV infection?

- Self-assessment of risk
  - After community sensitization, education, counseling
- HIV-negative individual with a HIV-positive partner
- Who else?
  - Self-assessment may not be accurate
  - Basic demographic risk groups (e.g. young women) may miss many in a generalized epidemic setting
- Developed and deployed Super Learner on tablets
  - Risk classification for intervention targeting in real time and with limited resources

Social networks and public health

- Our health and well-being is affected by members of our social (and sexual) network
- How do we incorporate these dependencies into a causal and statistical inference framework?
- How can we use measures of the network to optimize interventions?
- How can we incorporate our knowledge of the network in our design and analysis?



***Community-wide social network**: Nodes (persons) are color-coded by village represent social links between persons.*

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