L&S 39G

Health, Human Behavior, and Data

Prof. Ryan Edwards

Class 6

October 6, 2015

Today's agenda

- Reminder about deadlines
- Some quick i>clicker questions about the readings
- X on the reading
- Probability density distributions (pdf's)
- More in depth on the readings

First draft deadline is in 3 weeks: Monday October 26

- Needs to be at least a mockup of your paper
- With sections that include complete sentences
- At least one table or figure produced and discussed
- Be sure that the 3 sentences from your topic appear in the draft, whether verbatim or updated

  1. Question you're asking
  2. Data
  3. Answer you expect

Sep 8	Bhattacharya chaps 1-2	Alastair & Catherine	Oct 27	Ashenfelter & Ziliak
Sep 15	Cutler et al. and Wachter	Eric & Natalie	Nov 3	Ruhm
Sep 22	Bhattacharya chap 3	Catherine & Kyle	Nov 10	Small & Rosenbaum
Sep 29	Bhattacharya chap 4	Kyle	Nov 17	Buckles & Hungerman
Oct 6	Sutton and Bartholomew		Nov 24	Carpenter & Dobkin
Oct 13	Aron-Dine et al.		Dec 1	Edwards & Mason
Oct 20	Oster			

Current events: 2015 Nobel Prize in Medicine

- Shared by 3 researchers for work on parasites (1/2) and malaria (1/2)
- Malaria: Youyou Tu, born 1930, is the first scientist citizen of the People's Republic of China to win
- According to the NY Times:
  - Mao Zedong initiated a military project to help North Vietnam treat its soldiers for malaria
  - Skilled in Chinese and Western medicine, Youyou Tu isolated **artemisinin**
  - A recipe written more than 1,600 years ago in a text titled "Emergency Prescriptions Kept Up One's Sleeve" — soak one bunch of wormwood in water and then drink the juice.

i>clicker question 6.1

James Lind was known for what?

A. Treating malaria aboard a British ship

B. Treating dysentery aboard a British ship

C. Treating scurvy aboard a British ship

D. Dying while on a British ship

i>clicker question 6.2

What was unique about Lind's scurvy experiment?

A. He administered separate treatments to groups

B. He tried giving lemons & oranges to sick sailors

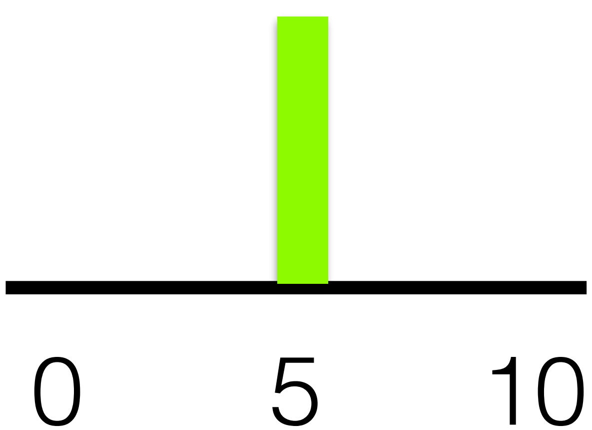
C. In his trial, sailors actually got better

D. The admiralty actually paid attention to his results

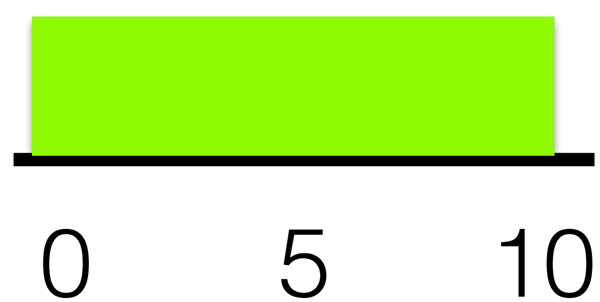
i>clicker question 6.3

Suppose I flipped 10 coins. Then I did it again, and again, and again for like a day. What would the distribution of the *number of heads* look like?

A.



B.



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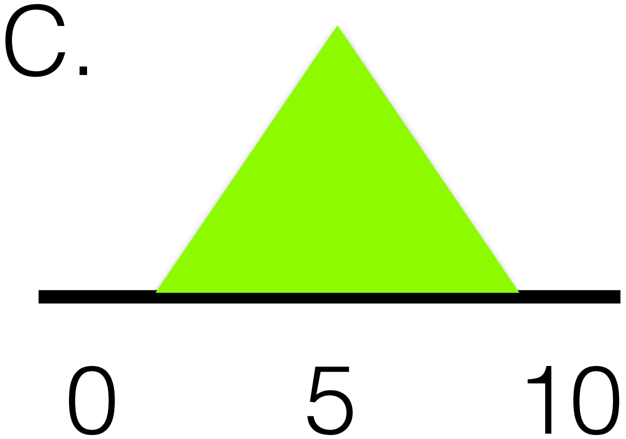

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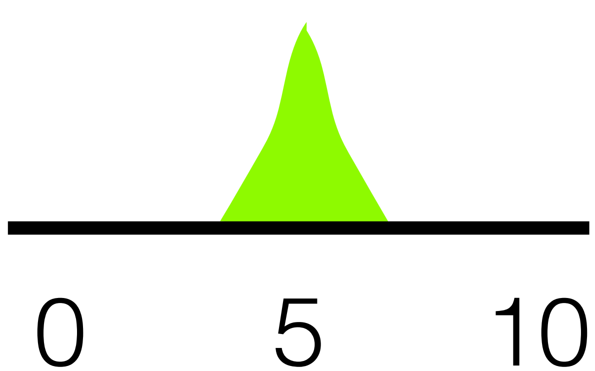
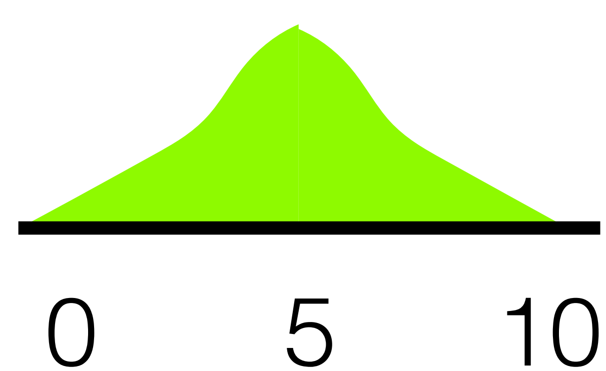


E.

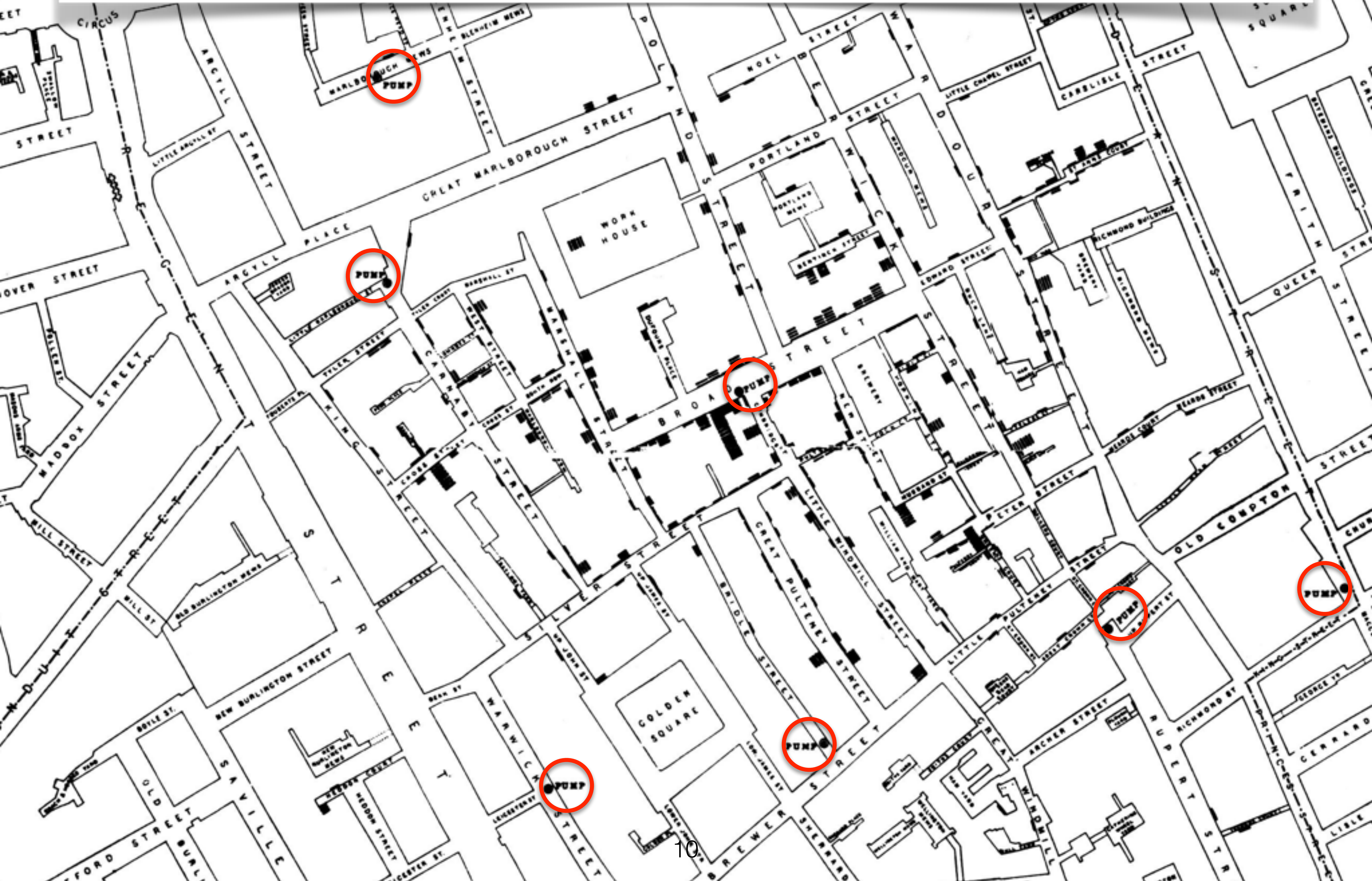


For context, some historical events

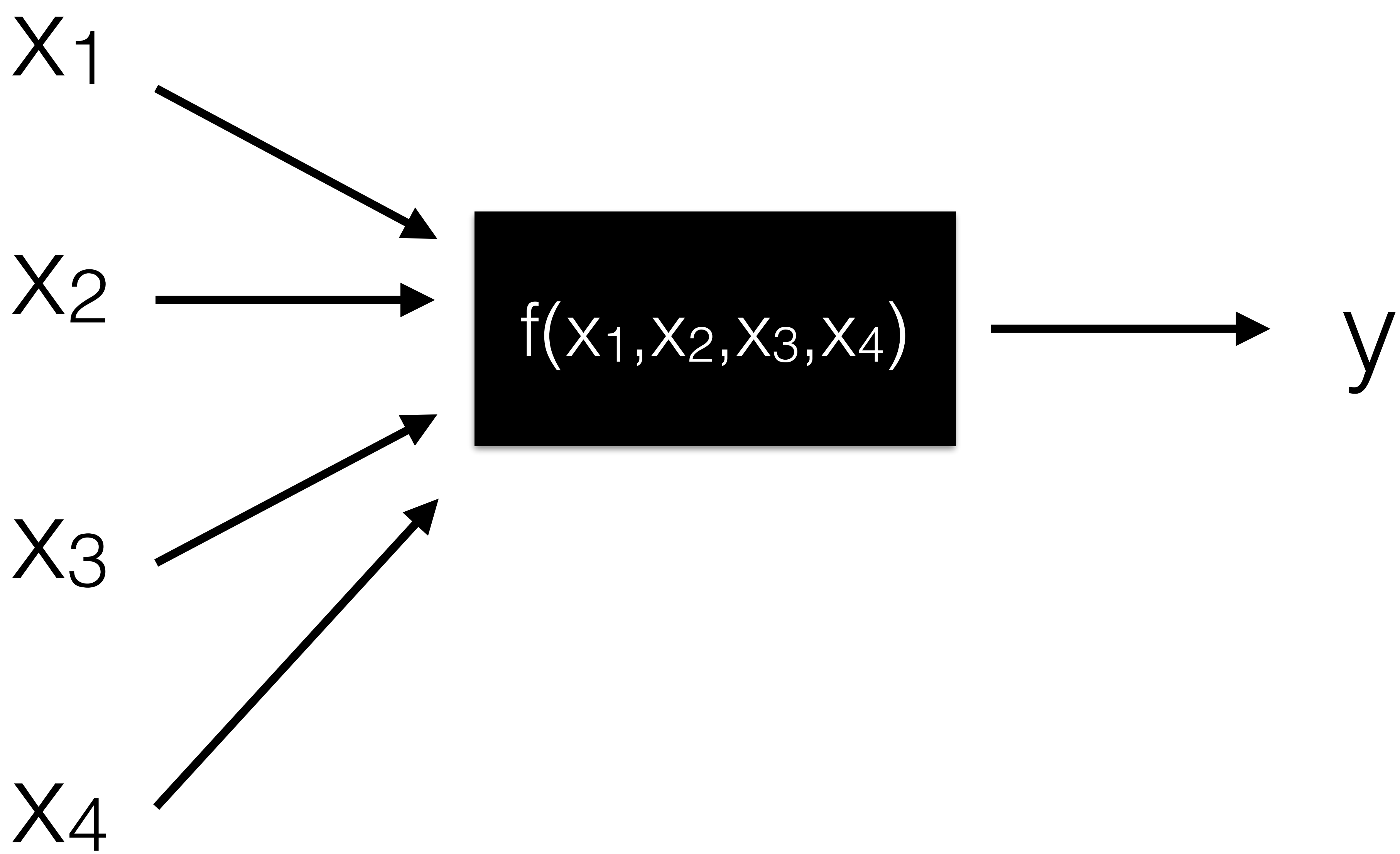
- **1000** — variolation is practiced in China
- **1579** — Sir Francis Drake visits Pt. Reyes during his circumnavigation

- **1607** — Jamestown, VA, settled
- **1747** — James Lind conducts scurvy experiments
- **1777** — Washington orders army variolated
- **1855** — John Snow maps cholera to a public water pump in London's Soho

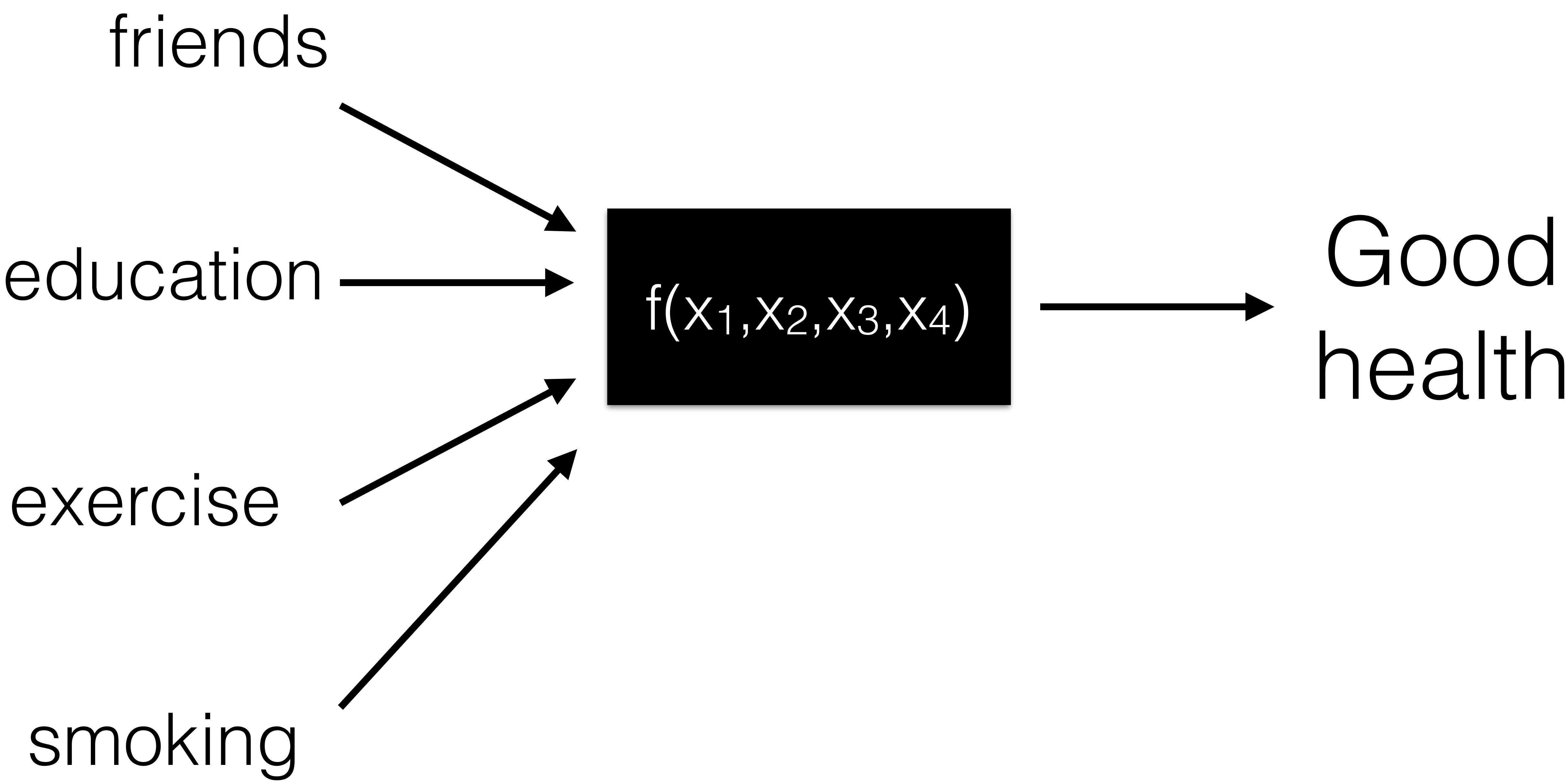
John Snow maps cholera to a public water pump in London's Soho



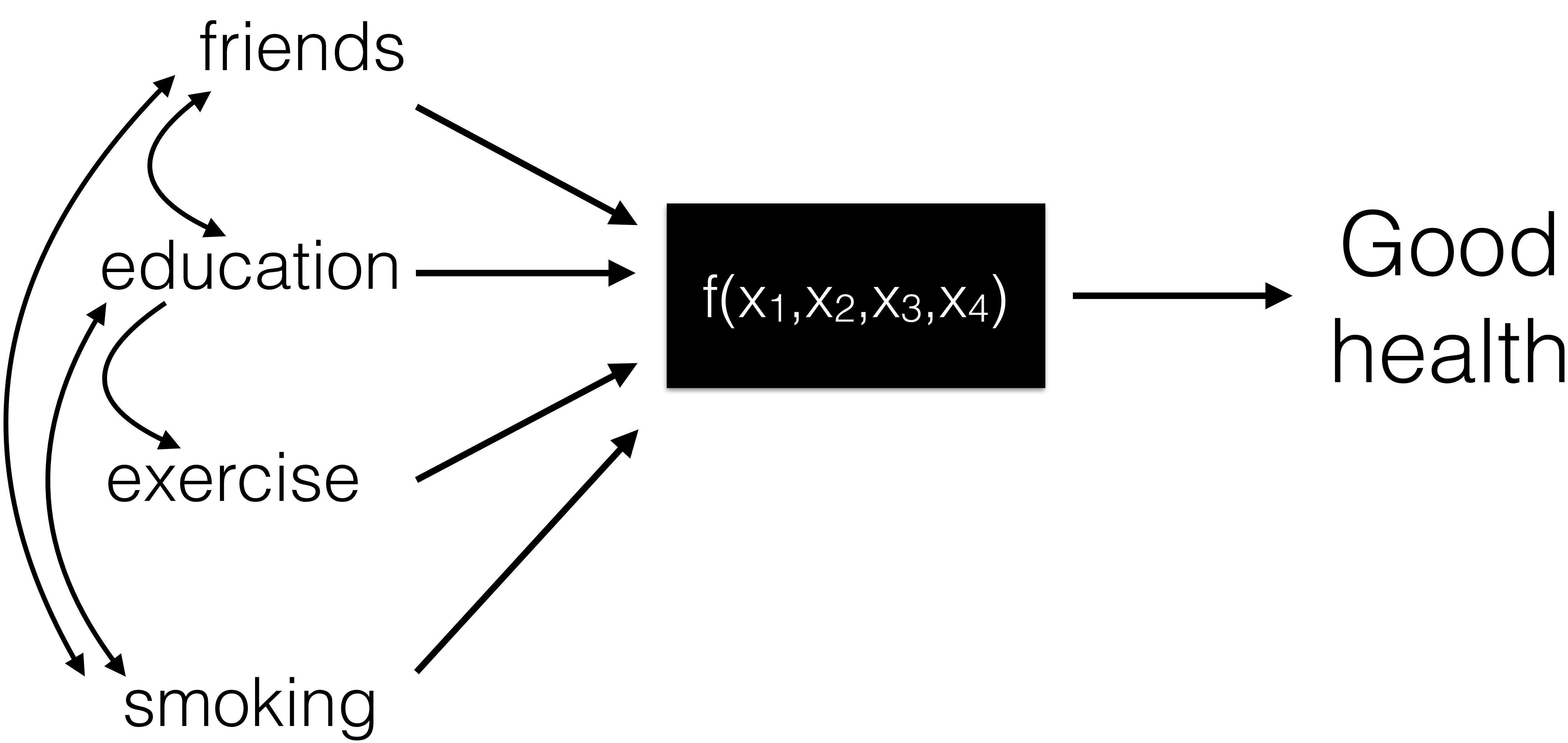
An outcome **y** is a function f(•) of lots of things



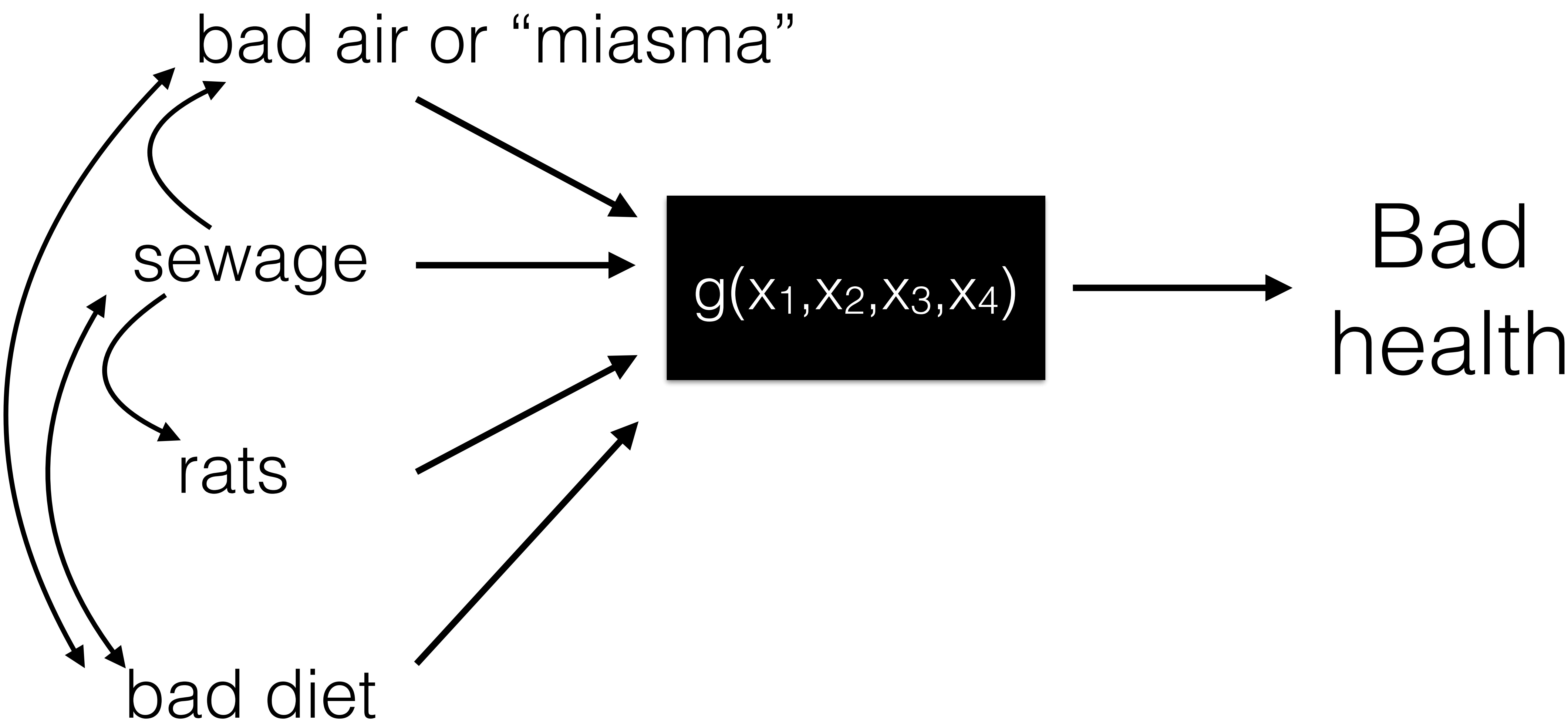
Good health in particular depends on lots of related things



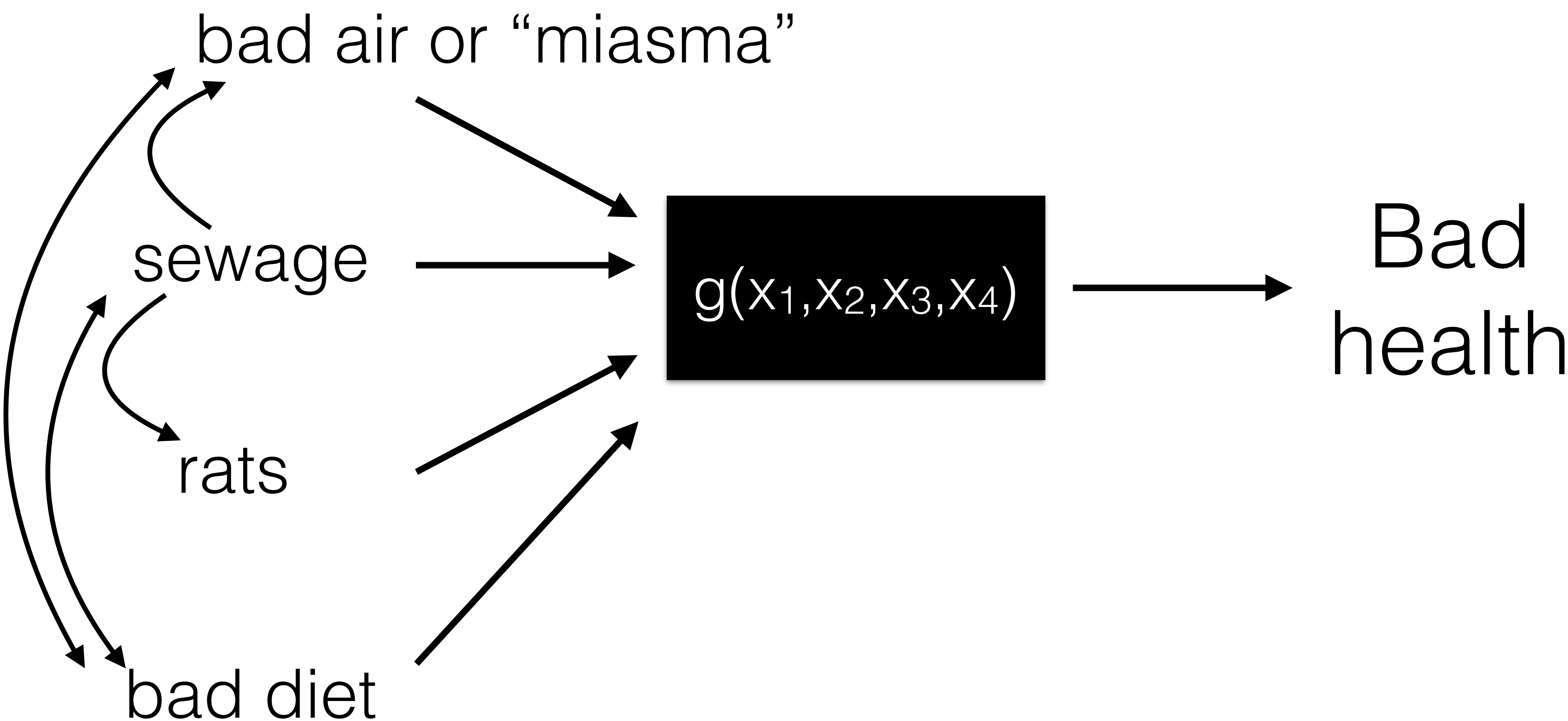
The inter-relationships are part of the issue



Before the germ theory of disease, people fixated on bad smells and bad air, bad diet



When the x's are inter-related, how do you tell which one is important?



The setup

- Objective: to determine the effect on x_1 on $y = f(\cdot)$

- With calculus, this is $\partial f/\partial x_1$ with other things constant

- When x_1 is a dichotomous 0/1 kind of treatment, we can also look at

$$f(x_1,\bar{x}_2,\bar{x}_3,\bar{x}_4) - f(0,\bar{x}_2,\bar{x}_3,\bar{x}_4)$$

- Here, we evaluate $f(\cdot)$ at the averages of the other x's treatment – control

$$f(x_1,\bar{x}_2,\bar{x}_3,\bar{x}_4) - f(0,\bar{x}_2,\bar{x}_3,\bar{x}_4)$$

- You could pick any x's that you like as long as they were the same across treatment and control
- Picking the averages means the experiment is valid for the average individual, which is handy
- You could also measure the average outcome $\mathbf{E}[\cdot]$ over groups that have varying x's

$$\mathbf{E}[\ f(x_1,x_2,x_3,x_4)\ ] - \mathbf{E}[\ f(0,x_2,x_3,x_4)\ ]$$

treatment – control

$$f(x_1,\bar{x}_2,\bar{x}_3,\bar{x}_4) - f(0,\bar{x}_2,\bar{x}_3,\bar{x}_4)$$

- It's best to have a control group or "business as usual" with which to compare
- But merely observing a suffering group is dicey at best
- **James Lind** picked 12 sailors with scurvy out of 30 or 40 and specified 6 treatments, 2 sailors for each
- "Their cases were so similar as I could have them" "They lay together in one place … and had one diet common to all"

He's trying to control for the other x's

Lind’s scurvy experiments

- There were many theories about why scurvy afflicted sailors, and citrus fruit was one of the common remedies
- Lind’s 6 treatments included
    - Cider
    - Elixir of vitriol: sulfuric acid, alcohol, aromatics
    - Vinegar
    - Sea water
    - Oranges and lemons
    - Purgative mixture: maybe sodium sulfate, a laxative

The setup & the outcome

- 8 weeks after leaving port, May 20th, 1747, *HMS Salisbury* was patrolling the French coast, part of the War of the Austrian Succession
- 10% of the crew had scurvy! *But the roll call showed nobody sick*
- We now know that scurvy is caused by a deficiency of vitamin C
- Sailors who received the oranges and lemons grew healthier by the end of May

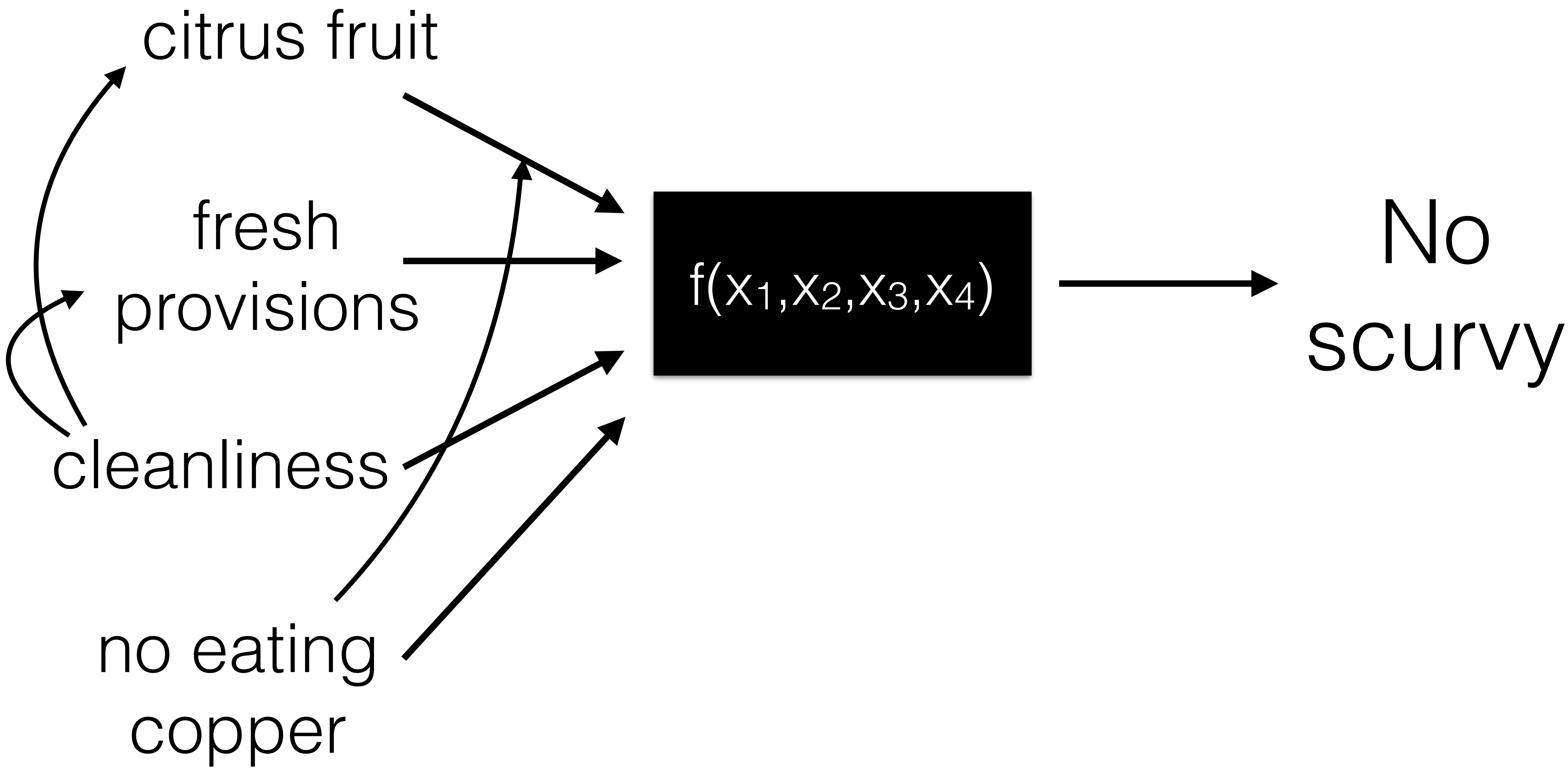
The context & aftermath

- The Royal Navy didn't adopt citrus rations until 1795, a year after James Lind died
- For us, Lind's scurvy experiment is convincing; it fits our thinking
- But at the time:
  - Deaths onboard were commonplace, illnesses were overlooked (Sutton)
  - Other diseases like dysentery could be more debilitating & deadly
  - There was no way to know why citrus (i.e., vitamin C) should work any more than anything else; differentiation between food types was elusive
  - Lind himself thought highly of the navy diet and hypothesized that digestion and evacuation were impeded onboard (Bartholomew's)

Why was Lind's experiment noteworthy?

- One of the few early studies we know of in which there were "control groups"
- An ideal control group resembles the treated in every way except receives no treatment
- Here, Lind **isolated** 6 treatments across 12 sailors (but also observed other sick sailors? Maybe)
- In other cases of scurvy prevention, multiple treatments were overlaid, impeding inference

How do you know which x is important?



- Is it right to observe a control group without providing an intervention?
- What about actively denying interventions?
- Tuskegee syphilis experiment in the U.S.
    - Begun in 1932 as an observational comparison of African American males with and without syphilis
    - No participants were ever told their status
    - By the 1940s, penicillin was known to cure it, but researchers kept it and other treatments from the participants
    - The study continued until 1972, when a whistleblower took it to the media. The CDC and the AMA had colluded to keep it going
    - In years since, its legacy has motivated human subjects protections and institutional review boards (IRBs)

Domain of IRBs protecting human subjects

- Government-funded studies that have traditionally been undertaken at research universities
- Other studies at research universities
- Research labs receiving government funds
- What's missing?
  - Big Data adventures. Facebook. Google

Challenges for RCTs

- When participants suspect that a treatment is going to improve their conditions,
- And if they know they're in a control group, not receiving the treatment,
- Members of the control group may seek the treatment and "contaminate" the experiment
- In medical studies, researchers use placebos; in other studies, vigilance