Lecture 2 Randomised Trials

Filipa Sá

King's College London

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Readings — randomised trials

- Angrist and Pischke chapter 1
- Wooldridge chapter 1

Selection bias

- Suppose that health insurance makes everyone healthier by a constant amount κ :

$$Y_{i1} = Y_{i0} + \kappa \tag{1}$$

- We compare the average health of people with and without insurance:

$$Avg[Y_{i1}|D_i = 1] - Avg[Y_{i0}|D_i = 0] \tag{2}$$

- How does this compare with the causal effect κ?

$$
\begin{aligned}
Avg[Y_{i1}|D_i &= 1] - Avg[Y_{i0}|D_i = 0] = \\
\kappa + [Avg[Y_{i0}|D_i &= 1] - Avg[Y_{i0}|D_i = 0]]
\end{aligned}
$$

Selection bias

- This equation tells us that:
  Difference in group means = Average causal effect + Selection bias

- The **selection bias** is the difference in average Y_{i0} between the groups being compared

- If people who have health insurance are healthier for all sorts of reasons (because they have higher education, higher income, are more likely to be employed, etc.), the selection bias is positive

- We would conclude that health insurance improves health, but we are not comparing like for like

Random assignment

- Randomised trial:
    - Start with a sample of people who are currently uninsured
    - Provide health insurance to a randomly chosen subset of this sample and let the rest go to A&E if the need arises
    - Compare the health of the insured and the uninsured

- Random assignment makes this comparison *ceteris paribus*:
    - Because of random assignment, the two groups differ only in their insurance status
    - Random assignment eliminates the selection bias

RAND health insurance experiment

- Random assignment in economics is rare, but it sometimes happens...
- RAND health insurance experiment
  - from 1974 to 1982 in the US
  - 3,958 people were randomly assigned to one of 14 insurance plans
  - Medicare participants and most Medicaid subscribers were excluded

RAND health insurance experiment

- Some insurance plans were more generous than others. We combine them in 4 groups:
  - Catastrophic plan — subscribers have to pay almost all of their medical expenses up to a fairly high cap
  - Individual deductible plan — provides more coverage, by reducing the cap
  - Coinsurance plan — provides substantially more coverage by splitting health-care costs between the subscriber and the insurer (no cap)
  - Free plan — the most generous plan, close to free health care
- Check for balance:
  - With random assignment, individuals in the four groups should have similar characteristics
  - This is confirmed in Table 1.3

RAND health insurance experiment

TABLE 1.3

Demographic characteristics and baseline health in the RAND HIE

	Means	Differences between plan groups			
	Catastrophic plan (1)	Deductible − catastrophic (2)	Coinsurance − catastrophic (3)	Free − catastrophic (4)	Any insurance − catastrophic (5)
A. Demographic characteristics					
Female	.560	−.023 (.016)	−.025 (.015)	−.038 (.015)	−.030 (.013)
Nonwhite	.172	−.019 (.027)	−.027 (.025)	−.028 (.025)	−.025 (.022)
Age	32.4 [12.9]	.56 (.68)	.97 (.65)	.43 (.61)	.64 (.54)
Education	12.1 [2.9]	−.16 (.19)	−.06 (.19)	−.26 (.18)	−.17 (.16)
Family income	31,603 [18,148]	−2,104 (1,384)	970 (1,389)	−976 (1,345)	−654 (1,181)
Hospitalized last year	.115	.004 (.016)	−.002 (.015)	.001 (.015)	.001 (.013)
B. Baseline health variables					
General health index	70.9 [14.9]	−1.44 (.95)	.21 (.92)	−1.31 (.87)	−.93 (.77)
Cholesterol (mg/dl)	207 [40]	−1.42 (2.99)	−1.93 (2.76)	−5.25 (2.70)	−3.19 (2.29)
Systolic blood pressure (mm Hg)	122 [17]	2.32 (1.15)	.91 (1.08)	1.12 (1.01)	1.39 (.90)
Mental health index	73.8 [14.3]	−.12 (.82)	1.19 (.81)	.89 (.77)	.71 (.68)
Number enrolled	759	881	1,022	1,295	3,198

Notes: This table describes the demographic characteristics and baseline health of subjects in the RAND Health Insurance Experiment (HIE). Column (1) shows the average for the group assigned catastrophic coverage. Columns (2)–(5) compare averages in the deductible, cost-sharing, free care, and any insurance groups with the average in column (1). Standard errors are reported in parentheses in columns (2)–(5); standard deviations are reported in brackets in

Side note: statistical significance

- Suppose we are interested in testing whether the population mean of a variable, $E[Y]$, takes a particular value μ
- We test this hypothesis (called the *null hypothesis*) by looking at the *t-statistic*:

$$t = \frac{\bar{Y} - \mu}{SE(\bar{Y})}$$

where $\bar{Y}$ is the sample mean and $SE(\bar{Y})$ is its standard error

- In a large sample, the t-statistic has a standard normal distribution

Side note: statistical significance

- A standard normal distribution has a mean of 0 and a standard deviation of 1
- Values larger than ± 2 are highly unlikely and appear only about 5% of the time
- When the null hypothesis is $\mu = 0$ and the t-statistic exceeds 2 in absolute value, we say that the sample mean is *significantly different from zero*
- Another way to look at it: if the sample mean is larger than about two standard errors, the sample mean is *significantly different from zero*

Side note: statistical significance

FIGURE 1.4

The distribution of the *t*-statistic for the mean in a sample of size 100
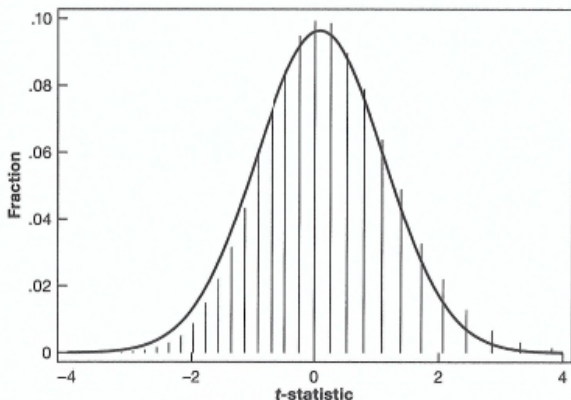
Note: This figure shows the distribution of the sample mean of a dummy variable that equals 1 with probability .8.

RAND health insurance experiment

- In Table 1.3 only two differences are more than twice as large as the associated standard errors (for proportion female in columns (4) and (5))

- Individuals in the four insurance groups have similar characteristics (as we would expect with random assignment)

- Results — Table 1.4
  - Patients assigned to more generous plans consumed more health care
  - But their health outcomes did not improve

RAND health insurance experiment

TABLE 1.4
Health expenditure and health outcomes in the RAND HIE

	Means	Differences between plan groups			
	Catastrophic plan (1)	Deductible − catastrophic (2)	Coinsurance − catastrophic (3)	Free − catastrophic (4)	Any insurance − catastrophic (5)
A. Health-care use					
Face-to-face visits	2.78 [5.50]	.19 (.25)	.48 (.24)	1.66 (.25)	.90 (.20)
Outpatient expenses	248 [488]	42 (21)	60 (21)	169 (20)	101 (17)
Hospital admissions	.099 [.379]	.016 (.011)	.002 (.011)	.029 (.010)	.017 (.009)
Inpatient expenses	388 [2,308]	72 (69)	93 (73)	116 (60)	97 (53)
Total expenses	636 [2,535]	114 (79)	152 (85)	285 (72)	198 (63)
B. Health outcomes					
General health index	68.5 [15.9]	−.87 (.96)	.61 (.90)	−.78 (.87)	−.36 (.77)
Cholesterol (mg/dl)	203 [42]	.69 (2.57)	−2.31 (2.47)	−1.83 (2.39)	−1.32 (2.08)
Systolic blood pressure (mm Hg)	122 [19]	1.17 (1.06)	−1.39 (.99)	−.52 (.93)	−.36 (.85)
Mental health index	75.5 [14.8]	.45 (.91)	1.07 (.87)	.43 (.83)	.64 (.75)
Number enrolled	759	881	1,022	1,295	3,198

Notes: This table reports means and treatment effects for health expenditure and health outcomes in the RAND Health Insurance Experiment (HIE). Column (1) shows the average for the group assigned catastrophic coverage. Columns (2)–(5) compare averages in the deductible, cost-sharing, free care, and any insurance groups with the average in column (1). Standard errors are reported in parentheses in columns (2)–(5); standard deviations are reported in brackets in column (1).

The Oregon experiment

- In 2008 the state of Oregon randomly assigned Medicaid to some people who were not eligible

- Results — Tables 1.5 and 1.6

  - Hospital admissions, prescriptions and emergency department visits increased
  - Some improvement on mental health, but not on physical health
  - Reduction in medical expenditure — perhaps this improvement in financial health accounts for improved mental health in the treatment group

- The RAND and Oregon findings are remarkably similar and suggest that subsidised public health insurance does not improve health outcomes (but improves financial health)

The Oregon experiment

TABLE 1.5

OHP effects on insurance coverage and health-care use

Outcome	Oregon		Portland area	
	Control mean (1)	Treatment effect (2)	Control mean (3)	Treatment effect (4)
A. Administrative data				
Ever on Medicaid	.141	.256 (.004)	.151	.247 (.006)
Any hospital admissions	.067	.005 (.002)		
Any emergency department visit			.345	.017 (.006)
Number of emergency department visits			1.02	.101 (.029)
Sample size	74,922		24,646	
B. Survey data				
Outpatient visits (in the past 6 months)	1.91	.314 (.054)		
Any prescriptions?	.637	.025 (.008)		
Sample size	23,741			

Notes: This table reports estimates of the effect of winning the Oregon Health Plan (OHP) lottery on insurance coverage and use of health care. Odd-numbered columns show control group averages. Even-numbered columns report the regression coefficient on a dummy for lottery winners. Standard errors are reported in parentheses.

The Oregon experiment

TABLE 1.6

OHP effects on health indicators and financial health

	Oregon		Portland area	
	Control mean	Treatment effect	Control mean	Treatment effect
Outcome	(1)	(2)	(3)	(4)
A. Health indicators				
Health is good	.548	.039 (.008)		
Physical health index			45.5	.29 (.21)
Mental health index			44.4	.47 (.24)
Cholesterol			204	.53 (.69)
Systolic blood pressure (mm Hg)			119	−.13 (.30)
B. Financial health				
Medical expenditures >30% of income			.055	−.011 (.005)
Any medical debt?			.568	−.032 (.010)
Sample size	23,741		12,229	

Notes: This table reports estimates of the effect of winning the Oregon Health Plan (OHP) lottery on health indicators and financial health. Odd-numbered columns show control group averages. Even-numbered columns report the regression coefficient on a dummy for lottery winners. Standard errors are reported in parentheses.