

# 1) Randomized Trials

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Tables, Graphics, and Figures from  
**Mastering 'Metrics: The Path from Cause  
to Effect**

Angrist & Pischke (2014): Chapter 1

# 2009 National Health Interview Survey (NHIS)

|                    | Husbands       |                |                   | Wives          |                |                   |
|--------------------|----------------|----------------|-------------------|----------------|----------------|-------------------|
|                    | Some HI<br>(1) | No HI<br>(2)   | Difference<br>(3) | Some HI<br>(4) | No HI<br>(5)   | Difference<br>(6) |
| A. Health          |                |                |                   |                |                |                   |
| Health index       | 4.01<br>[.93]  | 3.70<br>[1.01] | .31<br>(.03)      | 4.02<br>[.92]  | 3.62<br>[1.01] | .39<br>(.04)      |
| B. Characteristics |                |                |                   |                |                |                   |
| Nonwhite           | .16            | .17            | -.01<br>(.01)     | .15            | .17            | -.02<br>(.01)     |
| Age                | 43.98          | 41.26          | 2.71<br>(.29)     | 42.24          | 39.62          | 2.62<br>(.30)     |
| Education          | 14.31          | 11.56          | 2.74<br>(.10)     | 14.44          | 11.80          | 2.64<br>(.11)     |
| Family size        | 3.50           | 3.98           | -.47<br>(.05)     | 3.49           | 3.93           | -.43<br>(.05)     |
| Employed           | .92            | .85            | .07<br>(.01)      | .77            | .56            | .21<br>(.02)      |
| Family income      | 106,467        | 45,656         | 60,810<br>(1,355) | 106,212        | 46,385         | 59,828<br>(1,406) |
| Sample size        | 8,114          | 1,281          |                   | 8,264          | 1,131          |                   |

# Outcomes and Treatments for John and Mary

|                                     |                   | John | Mary |
|-------------------------------------|-------------------|------|------|
| Potential outcome without insurance | $Y_{0i}$          | 3    | 5    |
| Potential outcome with insurance    | $Y_{1i}$          | 4    | 5    |
| Treatment (insurance status chosen) | $D_i$             | 1    | 0    |
| Actual health outcome               | $Y_i$             | 4    | 5    |
| Treatment effect                    | $Y_{1i} - Y_{0i}$ | 1    | 0    |

# Average Causal Effects

$$E[Y_{1i} - Y_{0i}]$$

$$\frac{1}{n} \sum_{i=1}^n [Y_{1i} - Y_{0i}]$$

$$\frac{1}{n} \sum_{i=1}^n Y_{1i} - \frac{1}{n} \sum_{i=1}^n Y_{0i}$$

# Difference in Group Means

$$E[Y_i | D_i = 1] - E[Y_i | D_i = 0]$$

$$E[Y_{1i} | D_i = 1] - E[Y_{0i} | D_i = 0]$$

$$Y_{1i} = Y_{0i} + \kappa$$

# Average Causal Effects + Selection Bias

$$E[Y_{1i}|D_i = 1] - E[Y_{0i}|D_i = 0]$$

$$\{\kappa + E[Y_{0i}|D_i = 1]\} - E[Y_{0i}|D_i = 0]$$

$$\kappa + \{E[Y_{0i}|D_i = 1] - E[Y_{0i}|D_i = 0]\}$$

# Law of Large Numbers (LLN)

A sample average can be brought as close as the average in the population from which it is drawn simply by enlarging the sample.

If the samples are large enough, those in randomly assigned treatment and control samples will be similar, because both groups come from the same population.

$$E[Y_{0i}|D_i = 1] = E[Y_{0i}|D_i = 0]$$



# Randomization Eliminates Selection Bias

$$E[Y_i | D_i = 1] - E[Y_i | D_i = 0]$$

$$E[Y_{1i} | D_i = 1] - E[Y_{0i} | D_i = 0]$$

$$E[Y_{0i} + \kappa | D_i = 1] - E[Y_{0i} | D_i = 0]$$

$$\kappa + E[Y_{0i} | D_i = 1] - E[Y_{0i} | D_i = 0]$$

$$\kappa$$

# The RAND Health Insurance Experiment (HIE) from 1974 to 1982

3,958 people aged 14 to 61

From six areas of the country

Randomly assigned to one of 14 insurance plans

From care for free

to

“catastrophic coverage”

(families pay 95% of their health-care costs)

# Demographic Characteristics in the RAND HIE

|                                | Means                       | Differences between plan groups     |                                      |                               |  |
|--------------------------------|-----------------------------|-------------------------------------|--------------------------------------|-------------------------------|--|
|                                | Catastrophic<br>plan<br>(1) | Deductible –<br>catastrophic<br>(2) | Coinsurance –<br>catastrophic<br>(3) | Free –<br>catastrophic<br>(4) | Any insurance –<br>catastrophic<br>(5) |
| A. Demographic characteristics |                             |                                     |                                      |                               |  |
| Female                         | .560                        | –.023<br>(.016)                     | –.025<br>(.015)                      | –.038<br>(.015)               | –.030<br>(.013)                        |
| Nonwhite                       | .172                        | –.019<br>(.027)                     | –.027<br>(.025)                      | –.028<br>(.025)               | –.025<br>(.022)                        |
| Age                            | 32.4<br>[12.9]              | .56<br>(.68)                        | .97<br>(.65)                         | .43<br>(.61)                  | .64<br>(.54)                           |
| Education                      | 12.1<br>[2.9]               | –.16<br>(.19)                       | –.06<br>(.19)                        | –.26<br>(.18)                 | –.17<br>(.16)                          |
| Family income                  | 31,603<br>[18,148]          | –2,104<br>(1,384)                   | 970<br>(1,389)                       | –976<br>(1,345)               | –654<br>(1,181)                        |
| Hospitalized last year         | .115                        | .004<br>(.016)                      | –.002<br>(.015)                      | .001<br>(.015)                | .001<br>(.013)                         |

# Baseline Health in the RAND HIE

|                                 | Means                    | Differences between plan groups  |                                   |                            |                                     |
|---------------------------------|--------------------------|----------------------------------|-----------------------------------|----------------------------|-------------------------------------|
|                                 | Catastrophic plan<br>(1) | Deductible – catastrophic<br>(2) | Coinsurance – catastrophic<br>(3) | Free – catastrophic<br>(4) | Any insurance – catastrophic<br>(5) |
| B. Baseline health variables    |                          |                                  |                                   |                            |                                     |
| General health index            | 70.9<br>[14.9]           | -1.44<br>(.95)                   | .21<br>(.92)                      | -1.31<br>(.87)             | -.93<br>(.77)                       |
| Cholesterol (mg/dl)             | 207<br>[40]              | -1.42<br>(2.99)                  | -1.93<br>(2.76)                   | -5.25<br>(2.70)            | -3.19<br>(2.29)                     |
| Systolic blood pressure (mm Hg) | 122<br>[17]              | 2.32<br>(1.15)                   | .91<br>(1.08)                     | 1.12<br>(1.01)             | 1.39<br>(.90)                       |
| Mental health index             | 73.8<br>[14.3]           | -.12<br>(.82)                    | 1.19<br>(.81)                     | .89<br>(.77)               | .71<br>(.68)                        |
| Number enrolled                 | 759                      | 881                              | 1,022                             | 1,295                      | 3,198                               |

# Health Expenditure in the RAND HIE

|                     | Means                    | Differences between plan groups  |                                   |                            |                                     |
|---------------------|--------------------------|----------------------------------|-----------------------------------|----------------------------|-------------------------------------|
|                     | Catastrophic plan<br>(1) | Deductible – catastrophic<br>(2) | Coinsurance – catastrophic<br>(3) | Free – catastrophic<br>(4) | Any insurance – catastrophic<br>(5) |
| A. Health-care use  |                          |                                  |                                   |                            |                                     |
| Face-to-face visits | 2.78<br>[5.50]           | .19<br>(.25)                     | .48<br>(.24)                      | 1.66<br>(.25)              | .90<br>(.20)                        |
| Outpatient expenses | 248<br>[488]             | 42<br>(21)                       | 60<br>(21)                        | 169<br>(20)                | 101<br>(17)                         |
| Hospital admissions | .099<br>[.379]           | .016<br>(.011)                   | .002<br>(.011)                    | .029<br>(.010)             | .017<br>(.009)                      |
| Inpatient expenses  | 388<br>[2,308]           | 72<br>(69)                       | 93<br>(73)                        | 116<br>(60)                | 97<br>(53)                          |
| Total expenses      | 636<br>[2,535]           | 114<br>(79)                      | 152<br>(85)                       | 285<br>(72)                | 198<br>(63)                         |

# Health Outcomes in the RAND HIE

|                                 | Means                    | Differences between plan groups  |                                   |                            |                                     |
|---------------------------------|--------------------------|----------------------------------|-----------------------------------|----------------------------|-------------------------------------|
|                                 | Catastrophic plan<br>(1) | Deductible – catastrophic<br>(2) | Coinsurance – catastrophic<br>(3) | Free – catastrophic<br>(4) | Any insurance – catastrophic<br>(5) |
| B. Health outcomes              |                          |                                  |                                   |                            |                                     |
| General health index            | 68.5<br>[15.9]           | -.87<br>(.96)                    | .61<br>(.90)                      | -.78<br>(.87)              | -.36<br>(.77)                       |
| Cholesterol (mg/dl)             | 203<br>[42]              | .69<br>(2.57)                    | -2.31<br>(2.47)                   | -1.83<br>(2.39)            | -1.32<br>(2.08)                     |
| Systolic blood pressure (mm Hg) | 122<br>[19]              | 1.17<br>(1.06)                   | -1.39<br>(.99)                    | -.52<br>(.93)              | -.36<br>(.85)                       |
| Mental health index             | 75.5<br>[14.8]           | .45<br>(.91)                     | 1.07<br>(.87)                     | .43<br>(.83)               | .64<br>(.75)                        |
| Number enrolled                 | 759                      | 881                              | 1,022                             | 1,295                      | 3,198                               |

2008 OHP lottery

75,000 lottery applicants

30,000 were randomly selected

45,000 control sample

# OHP Effects on Insurance Coverage and Health-Care Use

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



# OHP Effects on Health Indicators and Financial Health

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