Why model?

UCLA SOCIOL 114
Winter 2025
soc114.github.io

11 Feb 2025

Arc of the course

We began by asking causal questions

- Defining counterfactuals

Then we discussed causal assumptions

- Exchangeability and experiments
- Consistency and positivity
- Directed Acyclic Graphs

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5 weeks

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0 statistical models

Learning goals for today

At the end of class, you will be able to

- explain the curse of dimensionality
- recognize the possible futility of nonparametric estimation

Motivating a research question[1]

Income inequality across households depends on

1. inequality across individuals
2. how individuals pool into households

A college degree affects (1) and (2)

[1] Mare 1991, Schwartz 2013

Research question

To what degree does finishing college increase the probability of having a spouse who finished college?

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Data. National Longitudinal Survey of Youth 1997

- Probability sample of U.S. non-institutional civilian youth age 12–16 on Dec 31 1996
- Surveyed annually 1997–2011, then biennially
- $n = 8{,}984$

Data access

To access these data, first

- set your working directory where you will be working
- download two supporting files from us
    1. `nlsy97.NLSY97` is a tagset file containing the variable names
    2. `prepare_nlsy97.R` is an R script to prepare the data

Data access

Now go to the data distributor

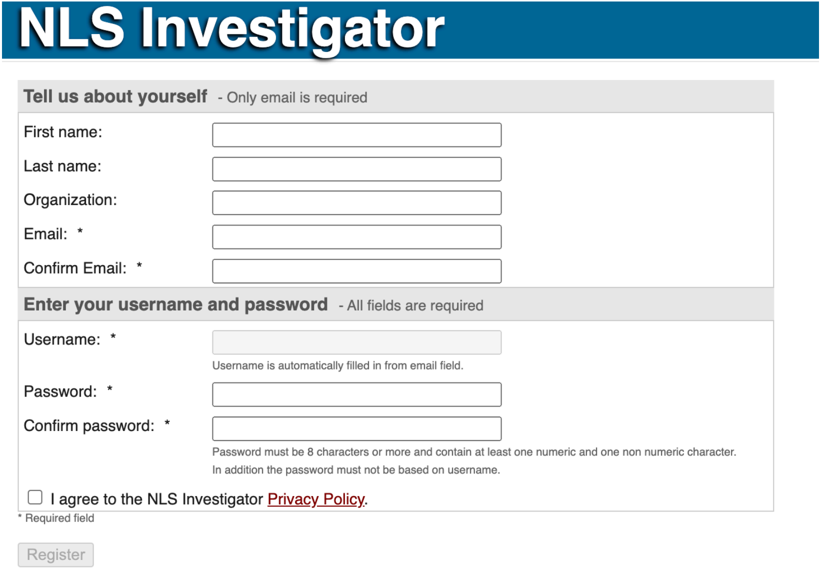
1. Register with the survey
2. Log in to the NLS Investigator
3. Choose the NLSY97 study
4. Upload the tagset `nlsy97.NLSY97` that you downloaded from us
5. In the Investigator, download the data. Type to change the file name from `default` to `nlsy97`
6. Unzip the file. Drag `nlsy97.dat` into the folder you will work in
7. In your R console, run the line of code below
   - this will take about 30 seconds to run
   - you will need these R packages: `tidyverse` and `Amelia`

```
source("prepare_nlsy97.R")
```

In the future, you can now load the data with

```
d <- readRDS("d.RDS")
```

Register with the survey


NLS Investigator

Tell us about yourself - Only email is required

First name:

Last name:

Organization:

Email: *

Confirm Email: *

Enter your username and password - All fields are required

Username: *

Username is automatically filled in from email field.

Password: *

Confirm password: *

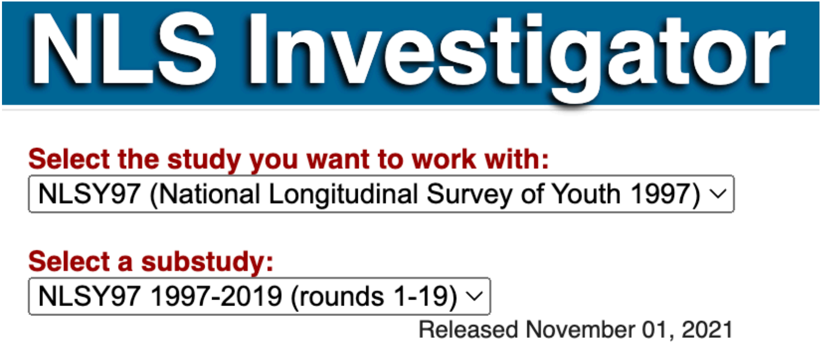
Password must be 8 characters or more and contain at least one numeric and one non numeric character.
In addition the password must not be based on username.

I agree to the NLS Investigator Privacy Policy.

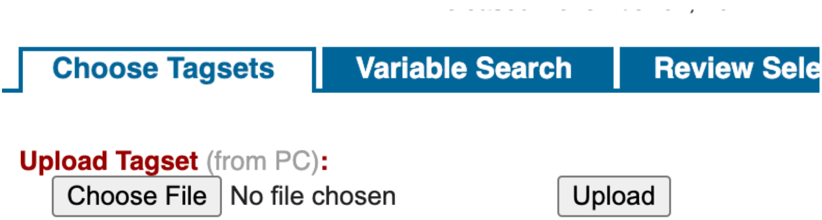
* Required field

Register

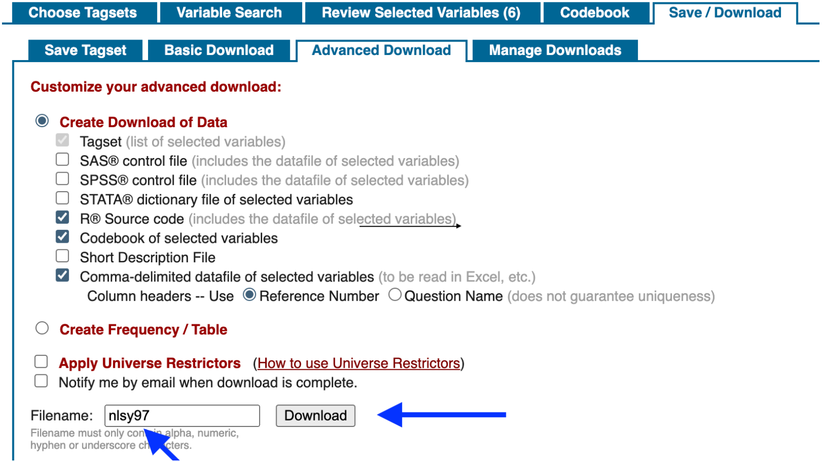
Choose the NLSY97 study



Upload our tagset



Download the data



Run our code

This code prepares the data file (one time, takes about 30 seconds)

```
source("prepare_NLSY97.R")
```

This code loads the prepared data (after the above, very fast)

```
d <- readRDS("d.RDS")
```

Research question

To what degree does finishing college increase the probability of having a spouse who finished college?

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To what degree does finishing college increase the probability of having a spouse who finished college?

- Treatment A: Finished BA by age 25
- Outcome Y: Spouse or partner at age 30–40 holds a BA
  - 0 if no spouse or partner, or partner with no BA
  - 1 if spouse or partner holds a BA

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To what degree does finishing college increase the probability of having a spouse who finished college?

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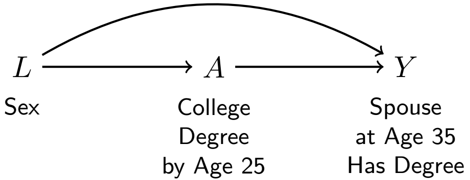

Research question

To what degree does finishing college increase the probability of having a spouse who finished college?

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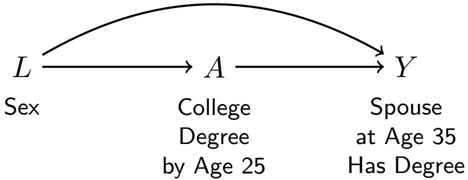


Adjustment procedure

1) Estimate within subgroups defined by {sex}
2) Aggregate over the subgroups

Data

```
d %>%
  select(sex, a, y) %>%
  print(n = 8)
```

```
# A tibble: 7,771 x 3
  sex    a          y
  <chr>  <chr>      <lgl>
1 Female college    FALSE
2 Male   no_college FALSE
3 Female no_college FALSE
4 Male   no_college TRUE
5 Female no_college FALSE
6 Male   no_college FALSE
7 Female college    FALSE
8 Male   college    TRUE
# i 7,763 more rows
```

1) Estimate in subgroups

```
ybar_in_subgroups <- d %>%
  # Group by confounders and treatment
  group_by(sex, a) %>%
  # Summarize mean outcomes and nber of cases
  summarize(ybar = mean(y),
            n = n(),
            .groups = "drop") %>%
  print()
```

```
# A tibble: 4 x 4
  sex    a           ybar     n
  <chr>  <chr>      <dbl> <int>
1 Female college    0.467   896
2 Female no_college 0.102  2953
3 Male   college    0.614   637
4 Male   no_college 0.174  3285
```

1) Estimate in subgroups

```
# A tibble: 4 x 4
  sex    a           ybar     n
  <chr>  <chr>      <dbl> <int>
1 Female college    0.467   896
2 Female no_college 0.102  2953
3 Male   college    0.614   637
4 Male   no_college 0.174  3285
```

1) Estimate in subgroups

```
# A tibble: 4 x 4
  sex    a           ybar     n
  <chr>  <chr>      <dbl> <int>
1 Female college    0.467   896
2 Female no_college 0.102  2953
3 Male   college    0.614   637
4 Male   no_college 0.174  3285
```

```
pivoted <- ybar_in_subgroups %>%
  pivot_wider(names_from = a,
              values_from = c("ybar","n")) %>%
  print()
```

```
# A tibble: 2 x 5
  sex    ybar_college ybar_no_college n_college n_no_college
  <chr>         <dbl>           <dbl>     <int>        <int>
1 Female        0.467           0.102       896         2953
2 Male          0.614           0.174       637         3285
```

1) Estimate in subgroups

```
# A tibble: 2 x 5
  sex    ybar_college ybar_no_college n_college n_no_college
  <chr>         <dbl>           <dbl>     <int>        <int>
1 Female        0.467           0.102       896         2953
2 Male          0.614           0.174       637         3285
```

1) Estimate in subgroups

```
# A tibble: 2 x 5
  sex    ybar_college ybar_no_college n_college n_no_college
  <chr>         <dbl>           <dbl>     <int>        <int>
1 Female        0.467           0.102       896         2953
2 Male          0.614           0.174       637         3285
```

```r
cate <- pivoted %>%
  mutate(conditional_effect = ybar_college - ybar_no_college,
         n_in_stratum = n_college + n_no_college) %>%
  select(sex, conditional_effect, n_in_stratum) %>%
  print()
```

```
# A tibble: 2 x 3
  sex    conditional_effect n_in_stratum
  <chr>               <dbl>        <int>
1 Female              0.365         3849
2 Male                0.440         3922
```

2) Aggregate over subgroups

```
# A tibble: 2 x 3
  sex    conditional_effect n_in_stratum
  <chr>               <dbl>        <int>
1 Female              0.365         3849
2 Male                0.440         3922
```

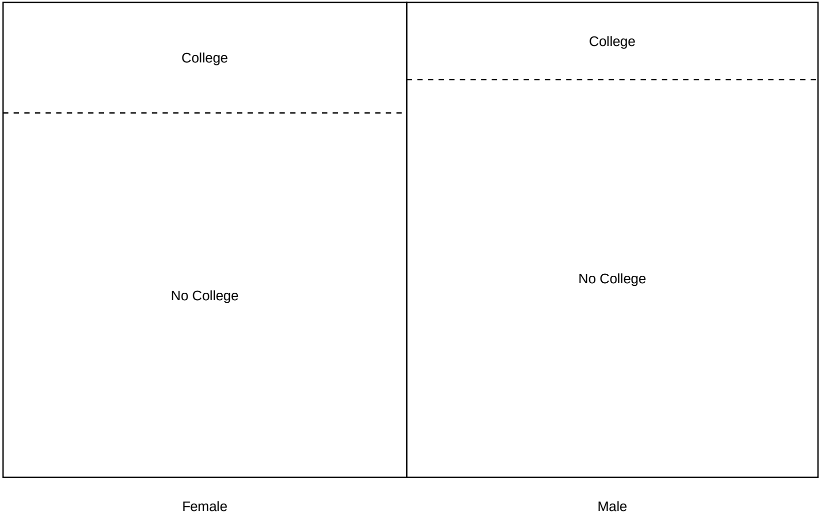
2) Aggregate over subgroups

```
# A tibble: 2 x 3
  sex    conditional_effect n_in_stratum
  <chr>               <dbl>        <int>
1 Female              0.365         3849
2 Male                0.440         3922
```

```
cate %>%
  summarize(population_average_effect = weighted.mean(
    conditional_effect,
    w = n_in_stratum
  ))
```

```
# A tibble: 1 x 1
  population_average_effect
                      <dbl>
1                     0.403
```

Recap: Intuition

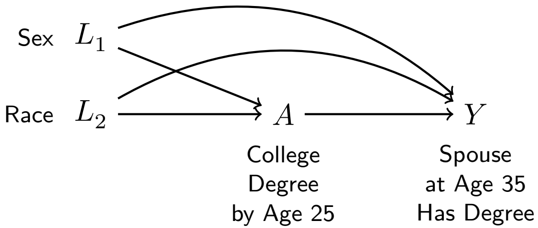


Recap: In code

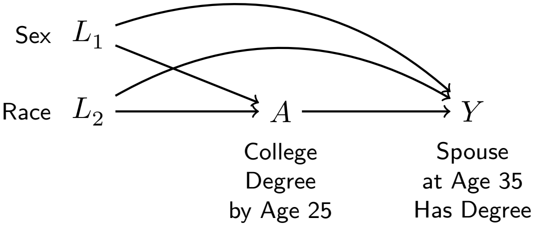
```r
d %>%
  # Group by confounders and treatment
  group_by(sex, a) %>%
  # Estimate within subgroups
  summarize(ybar = mean(y),
            n = n(),
            .groups = "drop") %>%
  pivot_wider(names_from = a,
              values_from = c("ybar","n")) %>%
  mutate(conditional_effect = ybar_college - ybar_no_college,
         n_in_stratum = n_college + n_no_college) %>%
  # Aggregate over subgroups
  summarize(population_average_effect = weighted.mean(
    conditional_effect,
    w = n_in_stratum
  ))
```

```
# A tibble: 1 x 1
  population_average_effect
                      <dbl>
1                     0.403
```

Adjust for sex and race

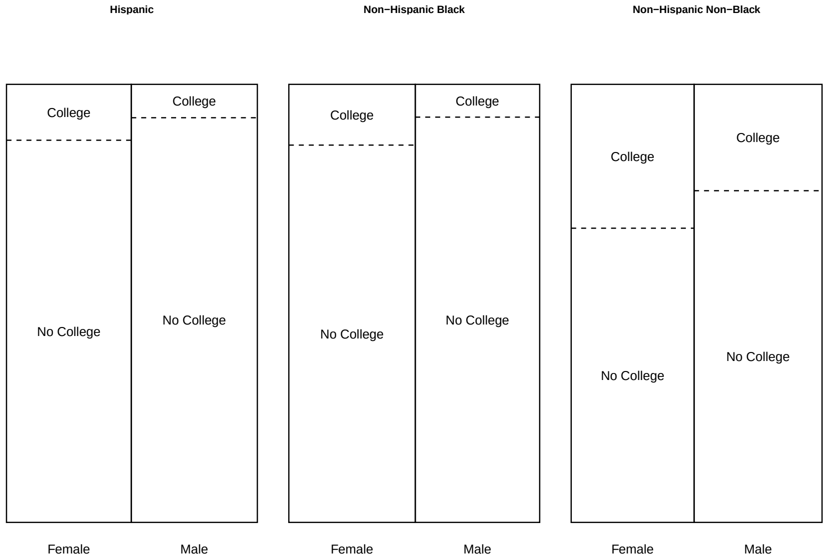


Adjust for sex and race



1) Estimate effects within subgroups defined by {sex, race}
2) Aggregate over subgroups

Adjust for sex and race



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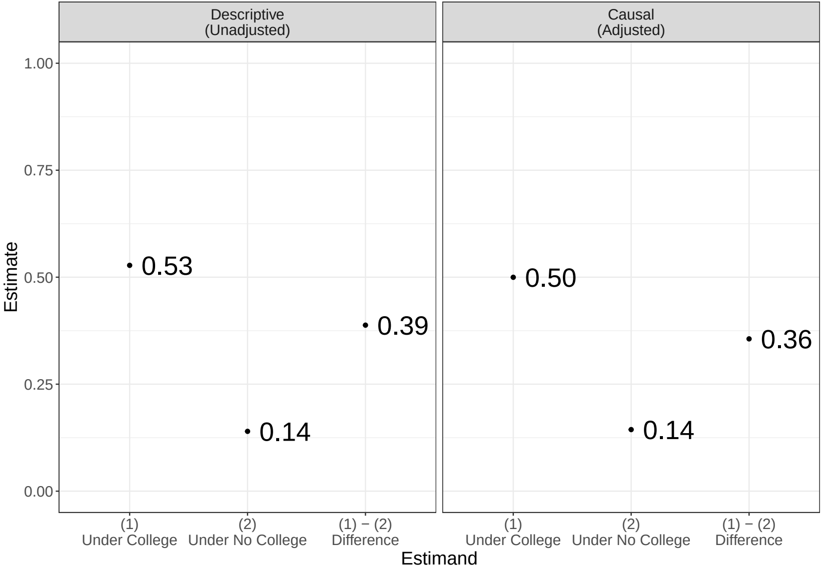
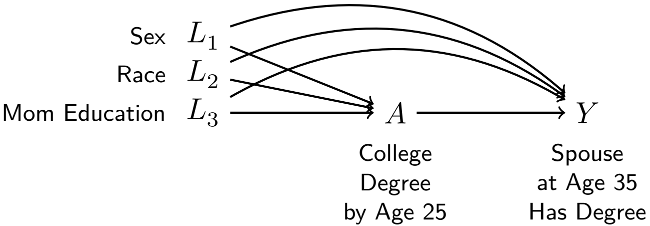
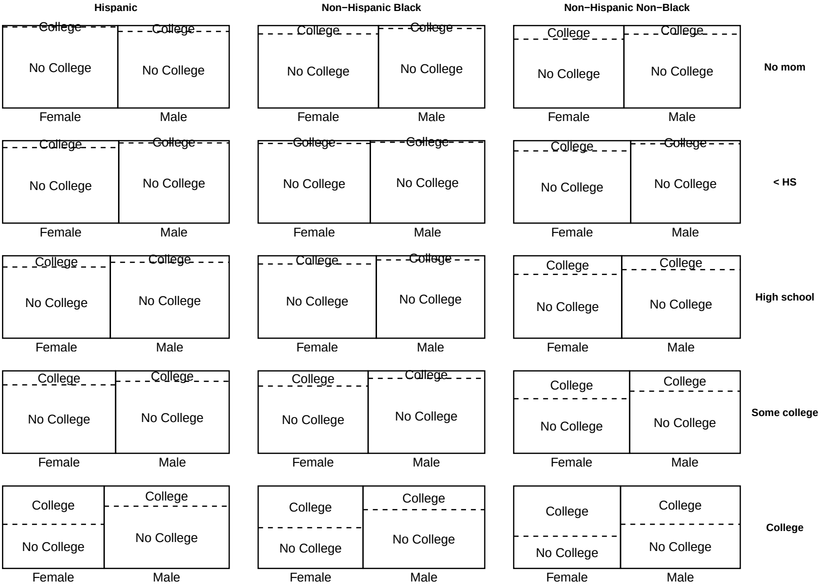


Adjust for sex, race, mom education

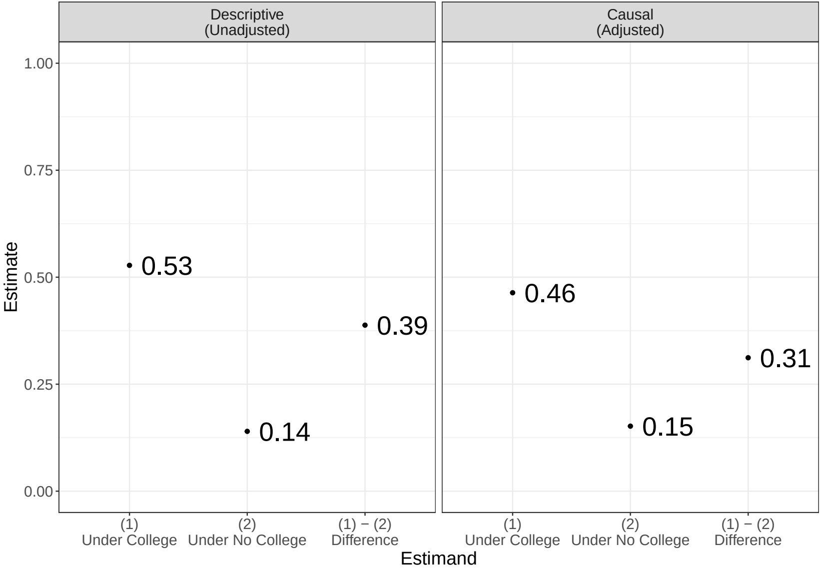


1) Estimate effects within subgroups defined by {race,sex, mom education}
2) Aggregate over subgroups

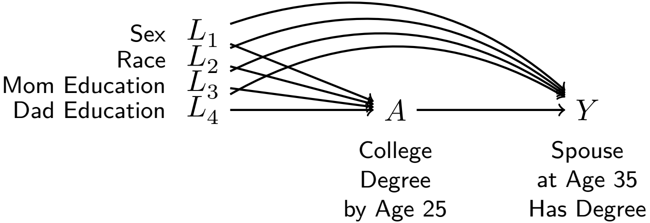
Adjust for sex, race, mom education



Adjust for sex, race, mom education

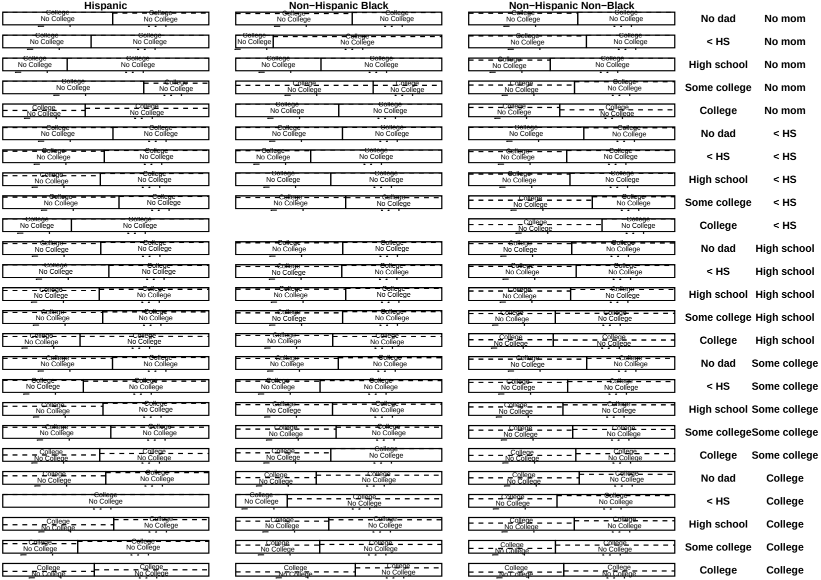


Adjust for sex, race, mom education, dad education

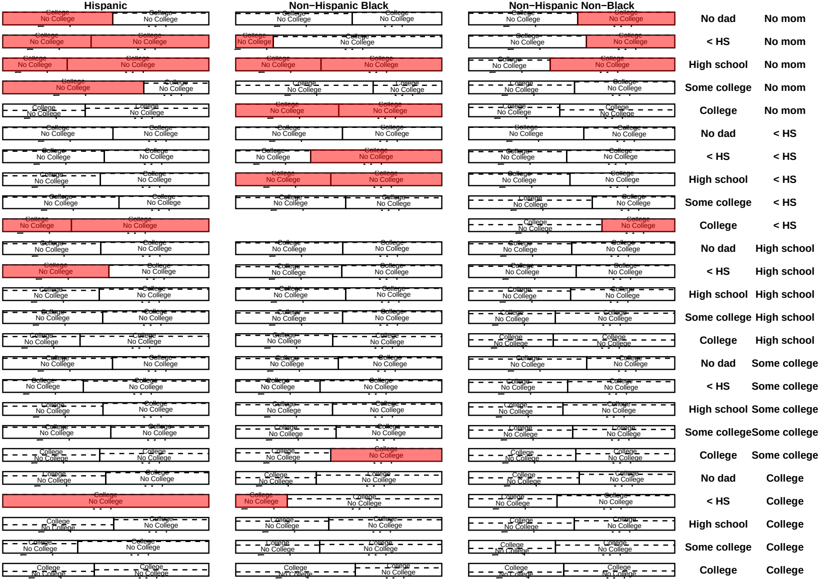


1) Estimate effects within subgroups defined by {race,sex, mom education, dad education}
2) Aggregate over subgroups

Adjust for sex, race, mom education, dad education



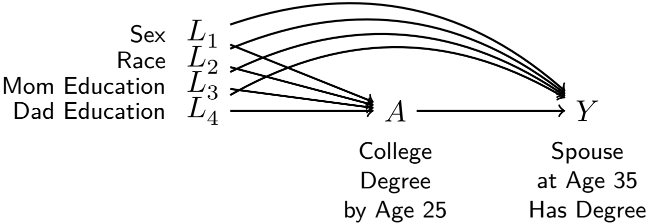
Adjust for sex, race, mom education, dad education



Curse of dimensionality: Unpopulated cells

```
# A tibble: 147 x 6
   sex    race    mom_educ    dad_educ     n_college n_no_college
   <chr>  <chr>   <fct>       <fct>            <int>        <int>
 1 Female H       No mom      No dad              NA           32
 2 Female H       No mom      < HS                NA            6
 3 Female H       No mom      High school         NA            5
 4 Female H       No mom      Some college        NA           13
 5 Female H       < HS        College             NA            1
 6 Female H       High school < HS                NA           34
 7 Female Non-H B No mom      < HS                NA            2
 8 Female Non-H B No mom      High school         NA           12
 9 Female Non-H B No mom      College             NA            4
10 Female Non-H B < HS        High school         NA           24
# i 137 more rows
```

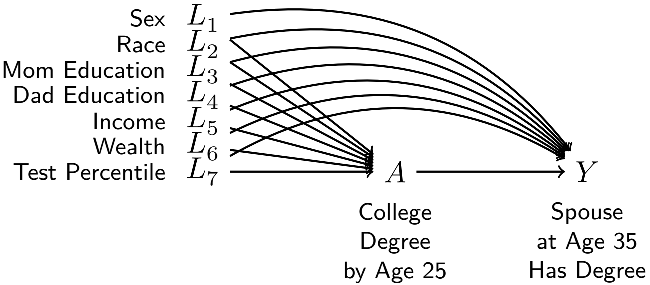
Curse of dimensionality



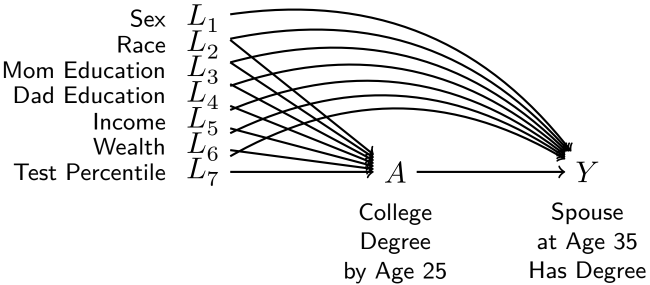
4.2% of the sample

is in a subgroup with either 0 treated or 0 untreated units

Curse of dimensionality



Curse of dimensionality



100% of the sample

is in a subgroup with either 0 treated or 0 untreated units

Learning goals for today

At the end of class, you will be able to

- explain the curse of dimensionality
- recognize the possible futility of nonparametric estimation

After class, you should

- read Hernán & Robins Ch 11
- attend discussion: you will learn to use models!