

Why model?

UCLA SOCIOL 114
Winter 2025
soc114.github.io

11 Feb 2025

Arc of the course

- ▶ Working with data
- ▶ Inference without models
- ▶ Inference with models

Learning goals for today (Part 1)

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 question¹

Income inequality across households depends on

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

A college degree affects (1) and (2)

¹Mare 1991, Schwartz 2013

Research question

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

Research question

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

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:	<input type="text"/>
Last name:	<input type="text"/>
Organization:	<input type="text"/>
Email: *	<input type="text"/>
Confirm Email: *	<input type="text"/>

Enter your username and password - All fields are required

Username: *	<input type="text"/> Username is automatically filled in from email field.
Password: *	<input type="password"/>
Confirm password: *	<input type="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

Choose the NLSY97 study

NLS Investigator

Select the study you want to work with:

NLSY97 (National Longitudinal Survey of Youth 1997) ▾

Select a substudy:

NLSY97 1997-2019 (rounds 1-19) ▾

Released November 01, 2021

Upload our tagset

Choose Tagsets

Variable Search

Review Sele

Upload Tagset (from PC):

Choose File

No file chosen

Upload

Download the data

Choose Tagsets | Variable Search | Review Selected Variables (6) | Codebook | Save / Download

Save Tagset | Basic Download | Advanced Download | Manage Downloads

Customize your advanced download:

Create Download of Data

Tagset (list of selected variables)
 SAS® control file (includes the datafile of selected variables)
 SPSS® control file (includes the datafile of selected variables)
 STATA® dictionary file of selected variables
 R® Source code (includes the datafile of selected variables)
 Codebook of selected variables
 Short Description File
 Comma-delimited datafile of selected variables (to be read in Excel, etc.)
Column headers -- Use Reference Number Question Name (does not guarantee uniqueness)

Create Frequency / Table

Apply Universe Restrictors ([How to use Universe Restrictors](#))
 Notify me by email when download is complete.

Filename: 

Filename must only contain alpha, numeric, hyphen or underscore characters.

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?

Research question

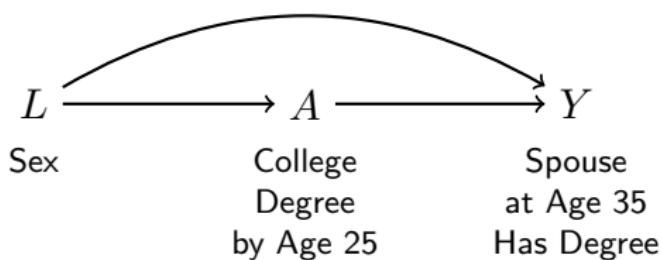
To what degree does finishing college increase the probability of having a spouse who finished college?

- ▶ 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

Research question

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



Research question

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



Adjustment procedure

- 1) Estimate within subgroups defined by $\{\text{sex}\}$
- 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
```

```
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
```

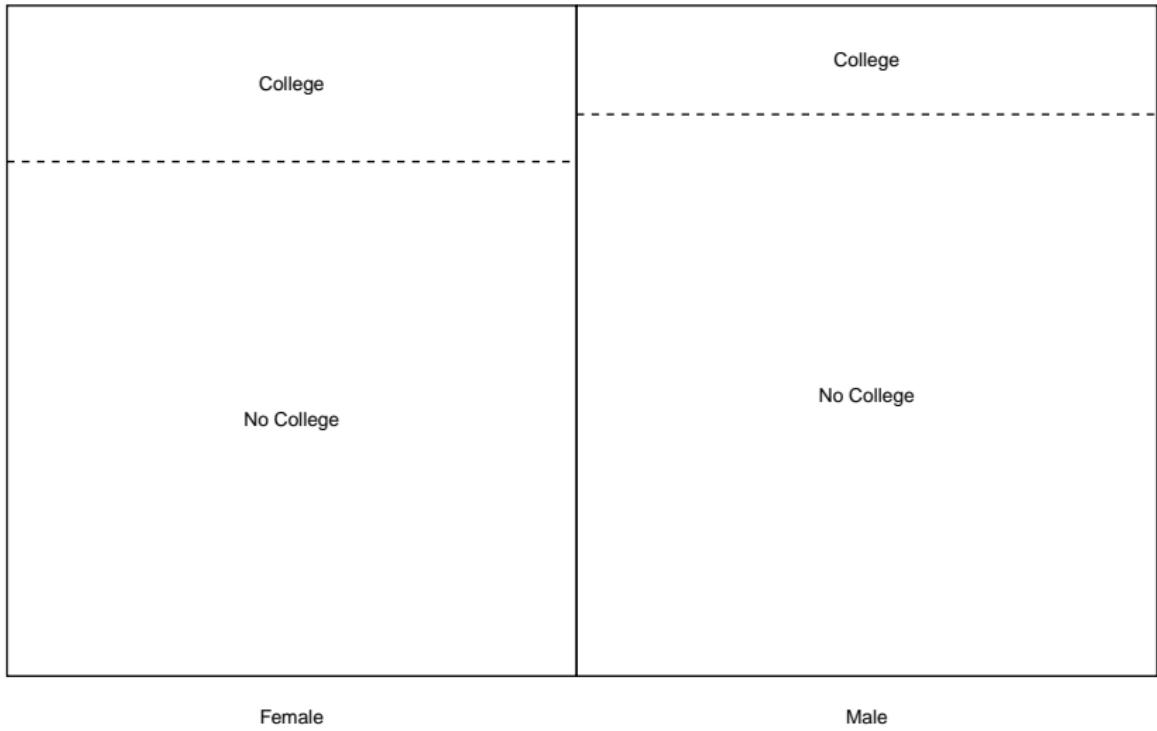
2) Aggregate over subgroups

```
# 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

```
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

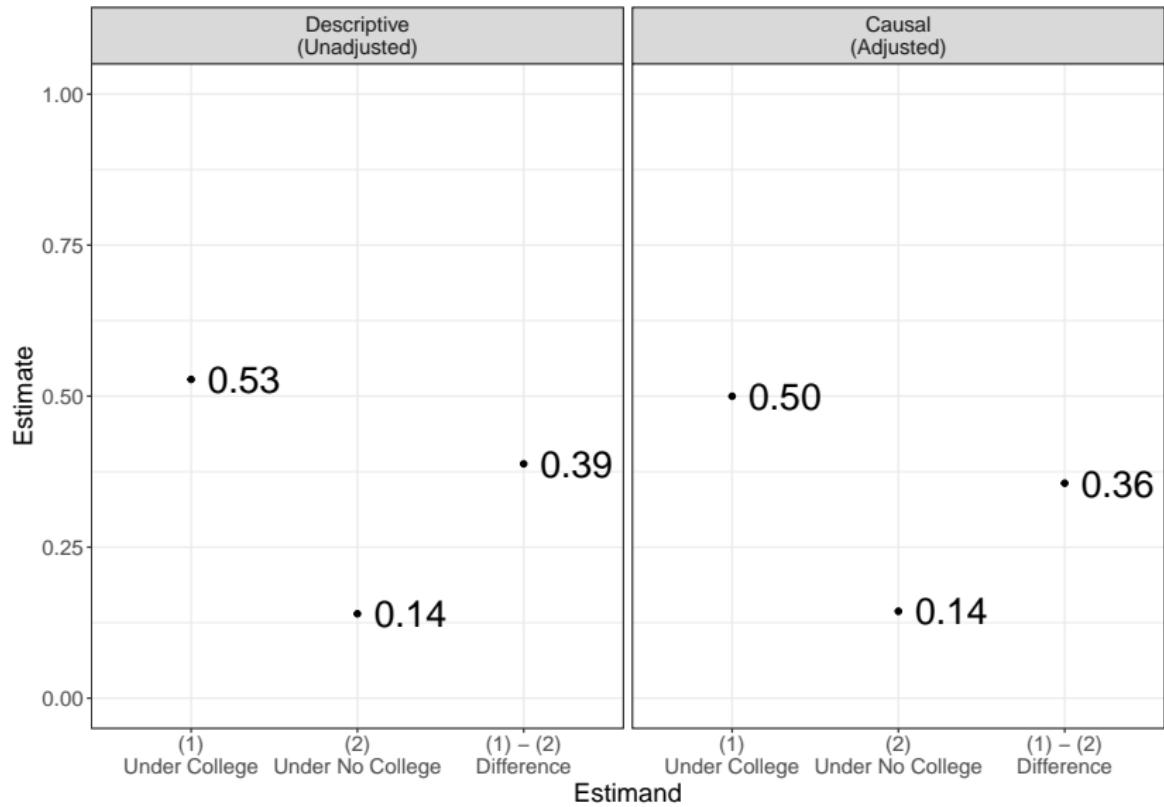


- 1) Estimate effects within subgroups defined by {sex, race}
- 2) Aggregate over subgroups

Adjust for sex and race



Adjust for sex and race



Adjust for sex, race, mom education



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

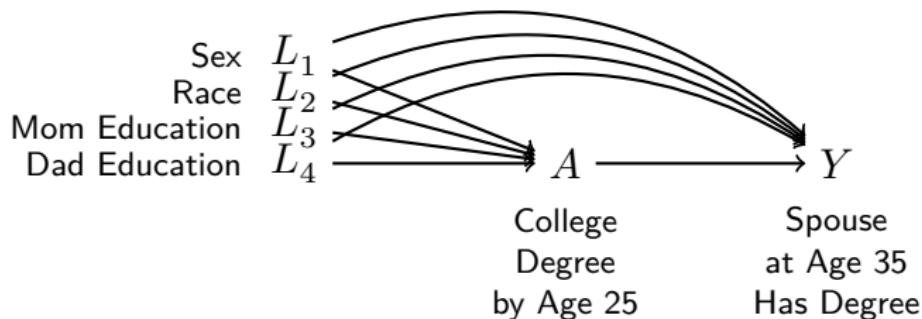
Adjust for sex, race, mom education

Hispanic	Non-Hispanic Black	Non-Hispanic Non-Black																																					
<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	No mom
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	< HS
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	High school
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	Some college
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	<table><tr><td>College</td><td>College</td><td>College</td><td>College</td></tr><tr><td>No College</td><td>No College</td><td>No College</td><td>No College</td></tr><tr><td>Female</td><td>Male</td><td>Female</td><td>Male</td></tr></table>	College	College	College	College	No College	No College	No College	No College	Female	Male	Female	Male	College
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				
College	College	College	College																																				
No College	No College	No College	No College																																				
Female	Male	Female	Male																																				

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



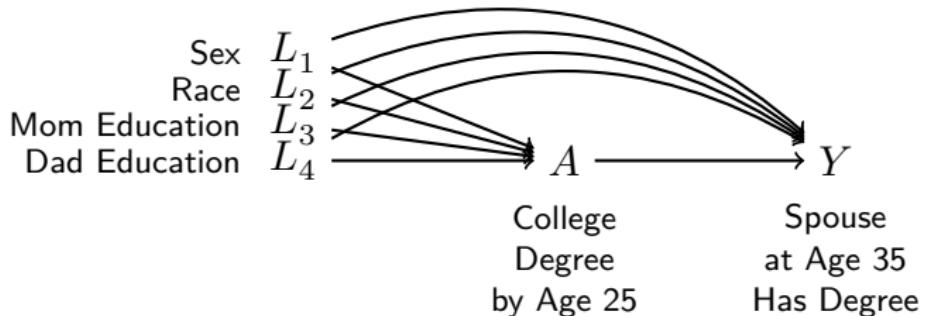
Adjust for sex, race, mom education, dad education



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

Optionally, read [Hernán & Robins Ch 11](#)