DAY 3: DATA VISUALIZATION - PART 2

BSTA 511/611, OHSU

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BACK TO RESEARCH QUESTION

CASE STUDY: DISCRIMINATION IN DEVELOPMENTAL DISABILITY SUPPORT (1.7.1)

- **Previous research**
  - Researchers examined DDS expenditures for developmentally disabled residents by ethnicity
  - Found that the mean annual expenditures on Hispanics was less than that on White non-Hispanics.
- **Result**: an allegation of ethnic discrimination was brought against the California DDS.
- **Question: Are the data sufficient evidence of ethnic discrimination?**

LOAD `dds.discr` DATASET FROM `oibiostat` PACKAGE

- The textbook's datasets are in the R package `oibiostat`
- Make sure the `oibiostat` package is installed before running the code below.
- Load the `oibiostat` package and the dataset `dds.discr`

the code below needs to be run *every time* you restart R or render a Qmd file

```r
library(oibiostat)
data("dds.discr")
```

- After loading the dataset `dds.discr` using `data("dds.discr")`, you will see `dds.discr` in the Data list of the Environment window.

glimpse()

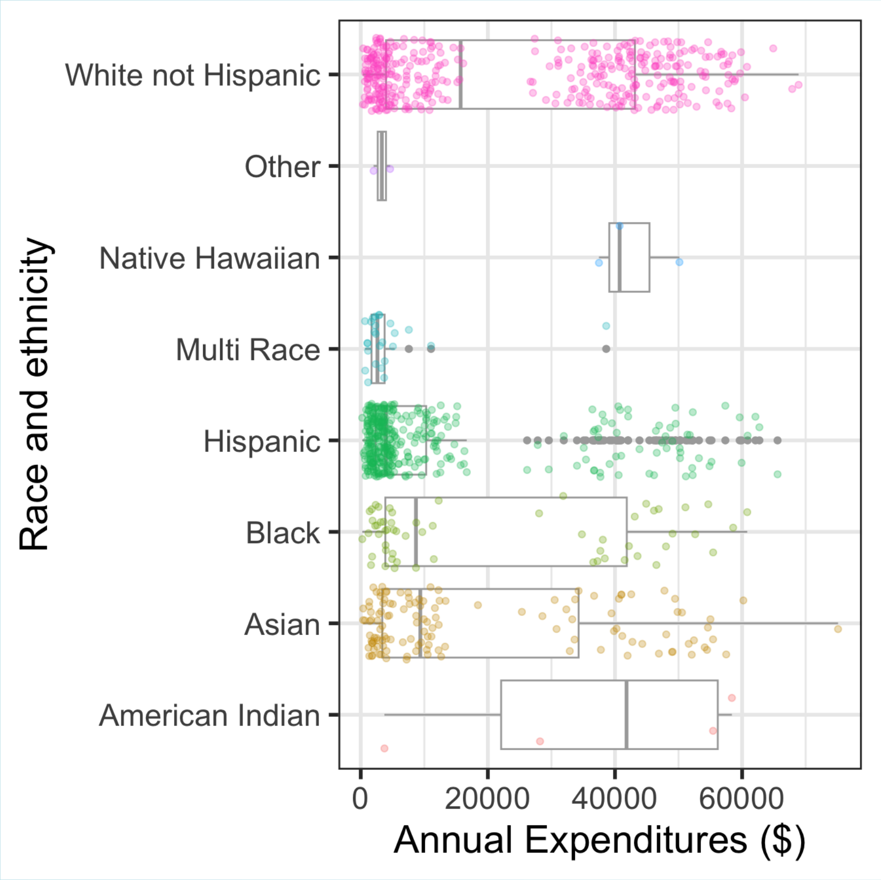
New: `glimpse()`

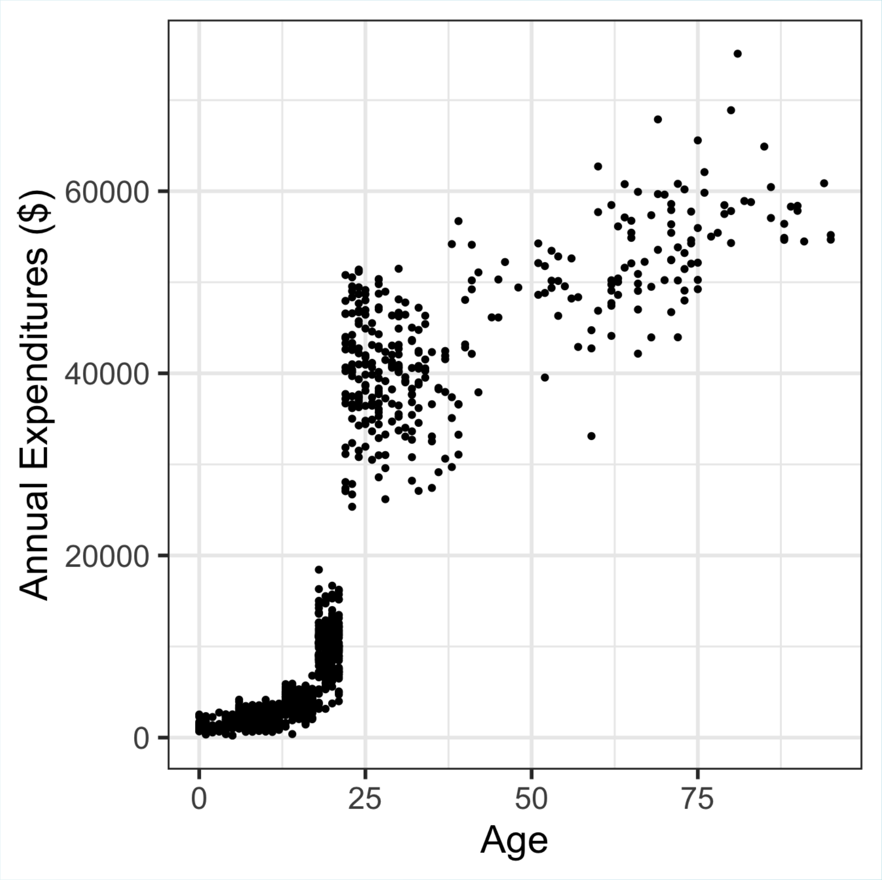
- Use `glimpse()` from the `tidyverse` package (technically it's from the `dplyr` package) to get information about variable types.
- `glimpse()` tends to have nicer output for `tibbles` than `str()`

```r
library(tidyverse)
glimpse(dds.discr)  # from tidyverse package (dplyr)
```

```
Rows: 1,000
Columns: 6
$ id           <int> 10210, 10409, 10486, 10538, 10568, 10690, 10711, 10778, 1…
$ age.cohort   <fct> 13-17, 22-50, 0-5, 18-21, 13-17, 13-17, 13-17, 13-17, 13-…
$ age          <int> 17, 37, 3, 19, 13, 15, 13, 17, 14, 13, 13, 14, 15, 17, 20…
$ gender       <fct> Female, Male, Male, Female, Male, Female, Female, Male, F…
$ expenditures <int> 2113, 41924, 1454, 6400, 4412, 4566, 3915, 3873, 5021, 28…
$ ethnicity    <fct> White not Hispanic, White not Hispanic, Hispanic, Hispani…
```

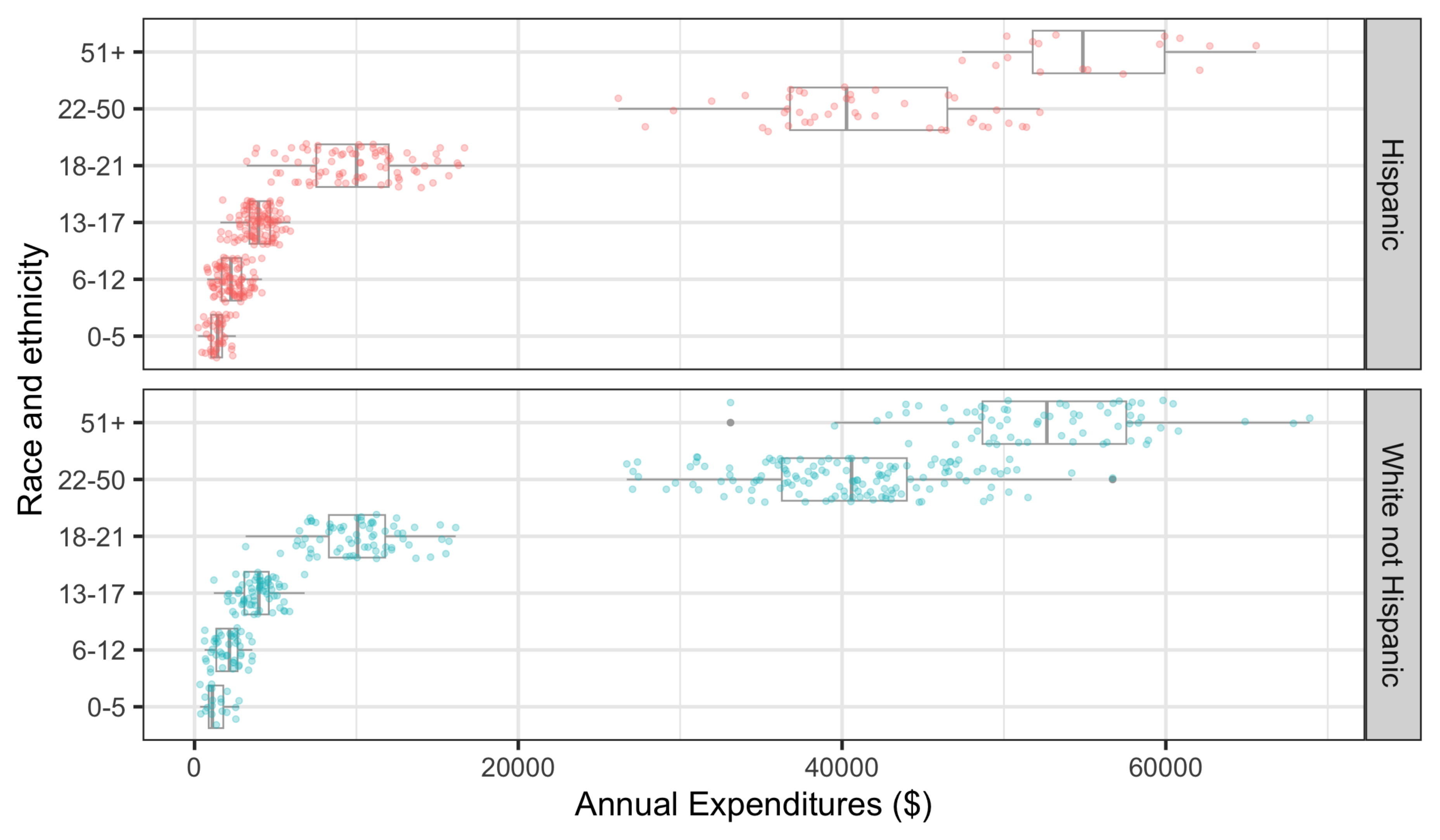
RECALL PREVIOUS DATA VIZ





VISUALIZE IN MORE DETAIL:

ethnicity, age, and expenditures (code on next slide)



CODE FOR VISUALIZE IN MORE DETAIL: ETHNICITY, AGE, AND EXPENDITURES

Plot on previous slide

```r
dds.discr_Hips_WhnH <- dds.discr %>%
  filter(ethnicity == "White not Hispanic" | ethnicity == "Hispanic" ) %>%
  droplevels()   # remove empty factor levels

ggplot(data = dds.discr_Hips_WhnH,
       aes(x = expenditures,
           y = age.cohort)) +
  geom_boxplot(color="darkgrey") +
  facet_grid(rows = "ethnicity") +
  labs(x = "Annual Expenditures ($)",
       y = "Race and ethnicity") +
  geom_jitter(
    aes(color = ethnicity),
    alpha = 0.3,
    show.legend = FALSE,
    position = position_jitter(
      height = 0.4))
```

MEAN ANNUAL DDS EXPENDITURES BY RACE/ETHNICITY: DEFAULT LONG FORMAT

```r
mean_expend <-
  dds.discr_Hips_WhnH %>%
  group_by(
    ethnicity, age.cohort)%>%
  summarize(
    ave = mean(expenditures))
```

```r
mean_expend
```

```
# A tibble: 12 × 3
# Groups:   ethnicity [2]
   ethnicity          age.cohort    ave
   <fct>              <fct>       <dbl>
 1 Hispanic           0-5         1393.
 2 Hispanic           6-12        2312.
 3 Hispanic           13-17       3955.
 4 Hispanic           18-21       9960.
 5 Hispanic           22-50      40924.
 6 Hispanic           51+        55585 
 7 White not Hispanic 0-5         1367.
 8 White not Hispanic 6-12        2052.
 9 White not Hispanic 13-17       3904.
10 White not Hispanic 18-21      10133.
11 White not Hispanic 22-50      40188.
12 White not Hispanic 51+        52670.
```

MEAN ANNUAL DDS EXPENDITURES BY RACE/ETHNICITY: WIDE FORMAT

```
mean_expend_wide <-
  mean_expend %>%
  pivot_wider(
    names_from = ethnicity,
    values_from = ave)
```

```
mean_expend_wide
```

```
# A tibble: 6 × 3
  age.cohort Hispanic `White not Hispanic`
  <fct>         <dbl>                <dbl>
1 0-5           1393.                1367.
2 6-12          2312.                2052.
3 13-17         3955.                3904.
4 18-21         9960.               10133.
5 22-50        40924.               40188.
6 51+          55585                52670.
```

DIFFERENCES IN MEAN ANNUAL DDS EXPENDITURES BY AGE COHORT AND RACE/ETHNICITY

```r
mean_expend_wide <- mean_expend_wide %>%
  mutate(diff_mean = `White not Hispanic` - Hispanic)

mean_expend_wide
```

```
# A tibble: 6 × 4
  age.cohort Hispanic `White not Hispanic` diff_mean
  <fct>         <dbl>                <dbl>     <dbl>
1 0-5           1393.                1367.     -26.3
2 6-12          2312.                2052.    -260.
3 13-17         3955.                3904.     -50.9
4 18-21         9960.               10133.     173.
5 22-50        40924.               40188.    -736.
6 51+          55585                52670.   -2915.
```

Question: Are the data sufficient evidence of ethnic discrimination in DDS expenditures when comparing Hispanics with White non-Hispanics?

SIMPSON'S PARADOX

- This case study is an example of **confounding** known as Simpson's paradox
- **Simpson's paradox** happens when an association observed in several groups disappears or reverses direction when the groups are combined.
- In other words, an association between two variables X and Y may disappear or reverse direction once data are partitioned into subpopulations based on a third variable Z (i.e., a confounding variable).

THE TIDYVERSE

Artwork by @allison_horst

TOOLS FOR WRANGLING DATA

- `tidyverse` functions
  - `tidyverse` is a suite of packages that implement `tidy` methods for data importing, cleaning, wrangling, and visualizing
  - load the `tidyverse` packages by running the code `library(tidyverse)`
    - Don’t forget to first install `tidyverse`!
- Functions to easily work with rows and columns, such as
  - subset rows/columns
  - add new rows/columns
  - join together different data sets
  - make data *long* or *wide*
- There are often many steps to tidy data
  - we string together commands
  - to be performed sequentially
  - using pipes `%>%`

SUMMARY OF DATA WRANGLING SO FAR

- The pipe `%>%` to string together commands in sequence
- `mutate()` to add a new variable to a dataset
- `select()` to select columns (or deselect columns with -variable)
- `filter()` to select specific rows
- `pivot_wider()` to reshape a dataset from a long to a wide format

Summarizing data

- `tabyl()` from `janitor` package to make frequency tables of categorical variables
- `summarize()` to get summary statistics of variables
- `group_by()` to group data by categorical variables before finding summaries

WHAT PACKAGES ARE INCLUDED IN THE `tidyverse`?

Core packages
These automatically load when loading the tidyverse package

dplyr
ggplot2
forcats
TIBBLE
tidyr
readr
stringr
purrr

https://www.tidyverse.org/

List of all packages:

```r
tidyverse_packages(include_self = TRUE)
```

```
 [1] "broom"         "conflicted"    "cli"           "dbplyr"       
 [5] "dplyr"         "dtplyr"        "forcats"       "ggplot2"      
 [9] "googledrive"   "googlesheets4" "haven"         "hms"          
[13] "httr"          "jsonlite"      "lubridate"     "magrittr"     
[17] "modelr"        "pillar"        "purrr"         "ragg"         
[21] "readr"         "readxl"        "reprex"        "rlang"        
[25] "rstudioapi"    "rvest"         "stringr"       "tibble"       
[29] "tidyr"         "xml2"          "tidyverse"    
```

- Packages not a part of the core get installed with the tidyverse suite, but need to be loaded separately.
- See https://www.tidyverse.org/packages/ for more info.