Visualization and Summary Statistics

UCLA Soc 114

Review of last class

Say this code in English:

```
numbers <- c(1,2,3)
x_length <- length(numbers)
```

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Say this code in English:

```
numbers <- c(1,2,3)
x_length <- length(numbers)
```

- Store the vector `c(1,2,3)` in the object `numbers`
- Use the `length()` function to get the length of `numbers`

Learning goals for today

- Reason about distributions
  - and visualize with `ggplot()`
- Understand summary statistics
  - and construct with `summarize()`
- Write clean code with the pipe `|>`

How to visualize?

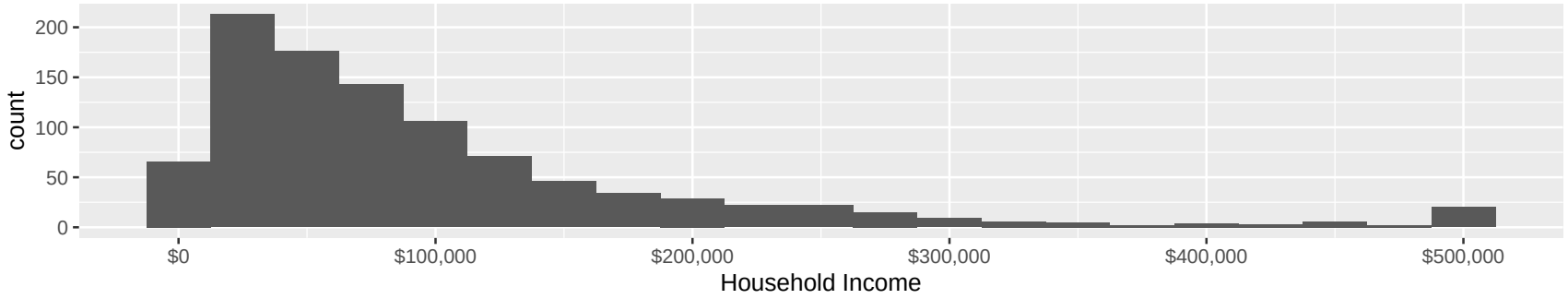
How might we visualize the U.S. income distribution?

Here are some data:

```
library(tidyverse)
incomeSimulated <- read_csv(
  file = "https://soc114.github.io/data/incomeSimulated.csv
)
```

```
# A tibble: 1,000 x 2
     id hhincome
  <dbl>    <dbl>
1     1   19170.
2     2  124474.
3     3   25114.
# i 997 more rows
```

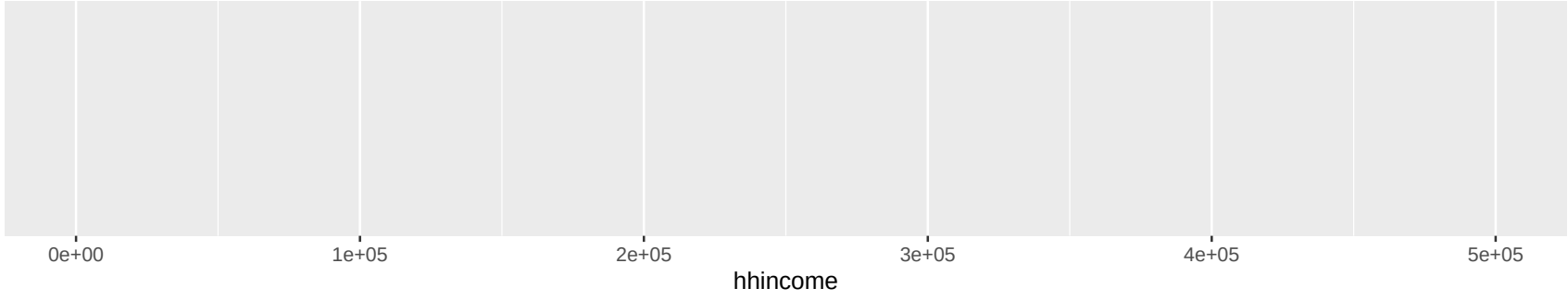
Visualize with a histogram



- Bins of $25,000
- In each bin, count number of people

Learning a new function: ggplot

```
ggplot(
  data = incomeSimulated,
  mapping = aes(x = hhincome)
)
```



Learning a new function: ggplot

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  data = incomeSimulated,
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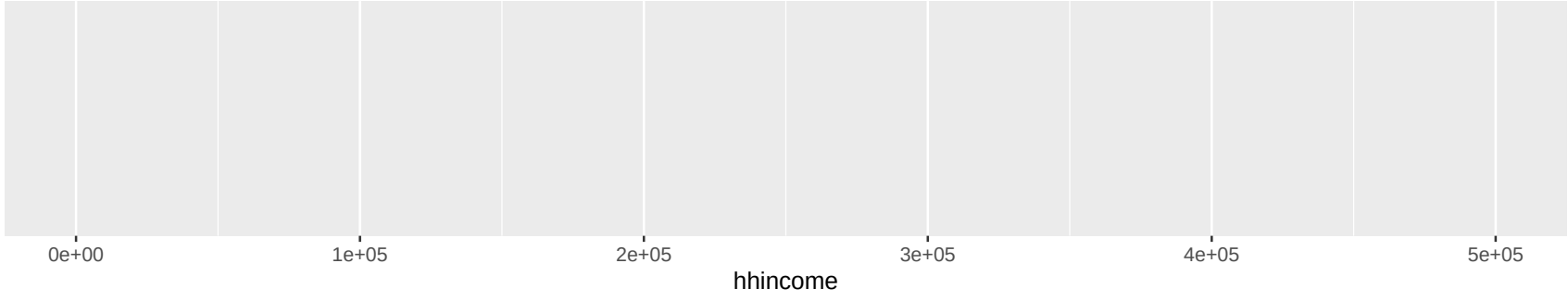

Two arguments get us started:

- `data` argument contains data
- `mapping` argument maps data to plot elements

Learning a new function: ggplot

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  data = incomeSimulated,
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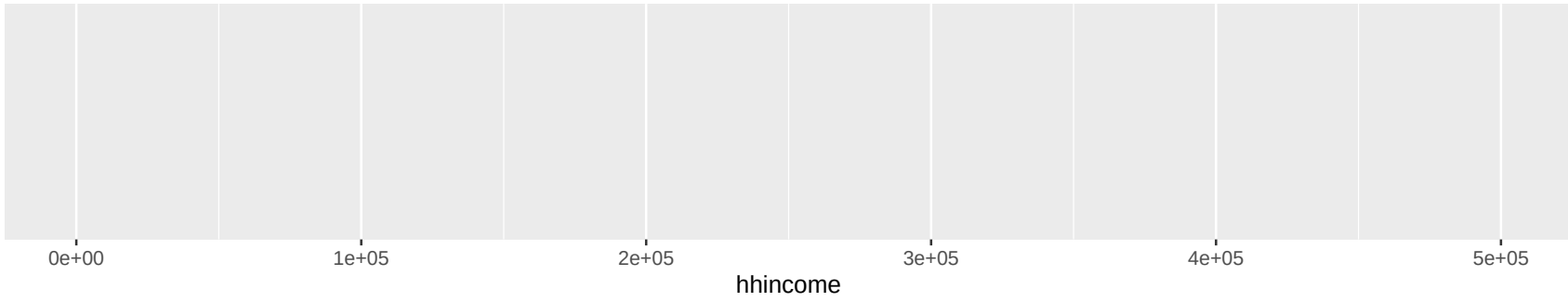


Two arguments get us started:

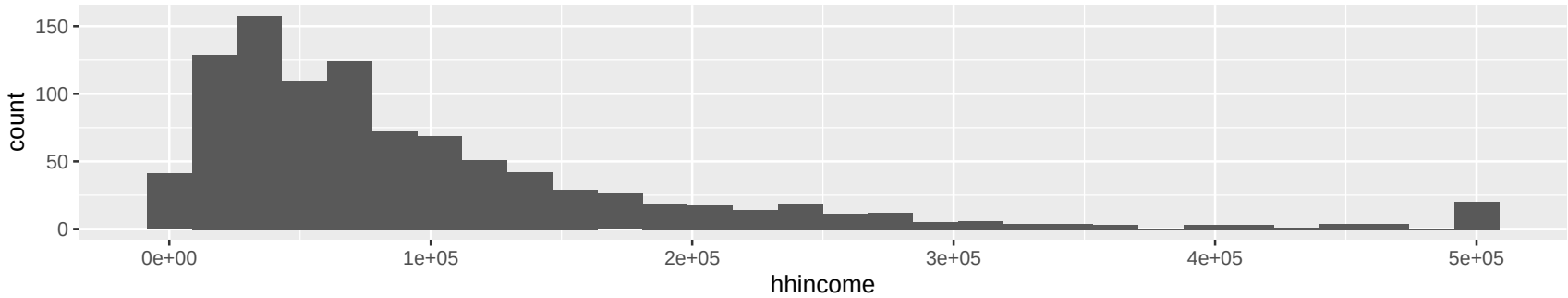
- `data` argument contains data
- `mapping` argument maps data to plot elements

Within `mapping`,

- `aes()` defines the aesthetics of the plot
- i.e. which variable goes along x-axis

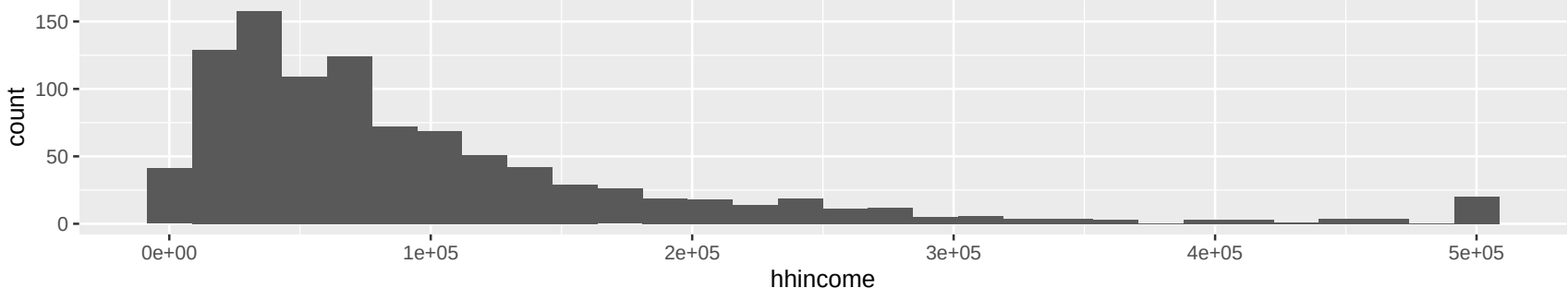
Adding a layer: geom_histogram()

```
ggplot(
  data = incomeSimulated,
  mapping = aes(x = hhincome)
) +
  geom_histogram()
```



Adding a layer: geom_histogram()

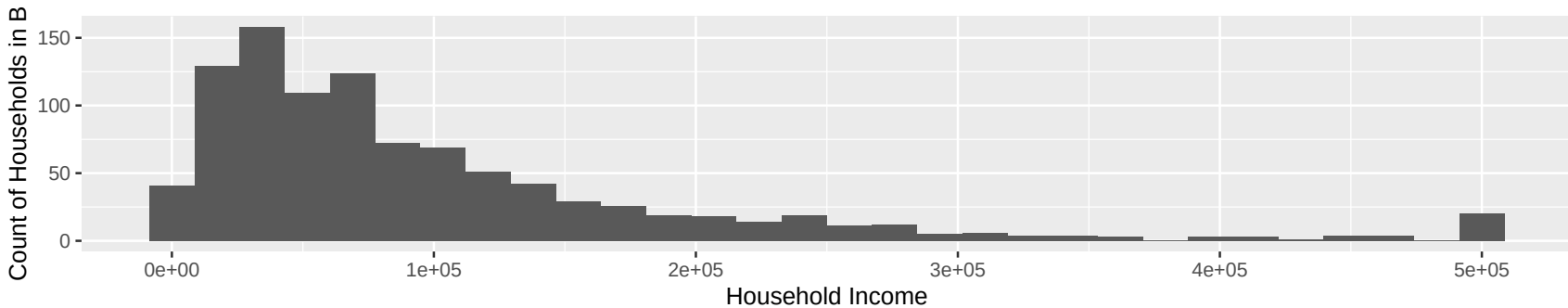
```
ggplot(
  data = incomeSimulated,
  mapping = aes(x = hhincome)
) +
  geom_histogram()
```



- The + indicates that a new layer is coming
- `geom_histogram()` is the new layer
- Inherits the `data` and `mapping` of the plot

Update axis titles

```
ggplot(
  data = incomeSimulated,
  mapping = aes(x = hhincome)
) +
  geom_histogram() +
  labs(
    x = "Household Income",
    y = "Count of Households in Bin"
  )
```



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Imagine 3 income distributions

Household	Distribution 1	Distribution 2	Distribution 3
1	\$10k	\$40k	\$50k
2	\$60k	\$65k	\$60k
3	\$150k	\$70k	\$65k

Normative question: Which one is better?

Summary statistic

A **summary statistic** aggregates a distribution to one number

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For example, the mean

$$\text{mean}(\vec{x}) = \frac{x_1 + x_2 + \cdots}{n}$$

Summary statistic: Mean

Household	Distribution 1	Distribution 2	Distribution 3
1	\$10k	\$40k	\$50k
2	\$60k	\$65k	\$60k
3	\$150k	\$70k	\$65k
Mean	**\$73k**	**\$58k**	**\$58k**

Summary statistic: Mean

Household	Distribution 1	Distribution 2	Distribution 3
1	\$10k	\$40k	\$50k
2	\$60k	\$65k	\$60k
3	\$150k	\$70k	\$65k
Mean	**\$73k**	**\$58k**	**\$58k**

By the mean, **Distribution 1** seems the best.

Summary statistic: Median

1. Sort households by income.
2. Find where 50% of households have higher incomes

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1	\$10k	\$40k	\$50k
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Summary statistic: Median

1. Sort households by income.
2. Find where 50% of households have higher incomes

Household	Distribution 1	Distribution 2	Distribution 3
1	\$10k	\$40k	\$50k
2	\$60k	\$65k	\$60k
3	\$150k	\$70k	\$65k
Median	**\$60k**	**\$65k**	**\$60k**

Summary statistic: Median

1. Sort households by income.
2. Find where 50% of households have higher incomes

Household	Distribution 1	Distribution 2	Distribution 3
1	\$10k	\$40k	\$50k
2	\$60k	\$65k	\$60k
3	\$150k	\$70k	\$65k
Median	**\$60k**	**\$65k**	**\$60k**

By the median, **Distribution 2** seems the best.

Aside: Percentiles generalize the median

The median is the value in the middle

- 50% of people have lower values
- Also called the 50th percentile

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Generalizes to other percentiles

- 10th percentile: Value such that 10% are lower
- 90th percentile: Value such that 90% are lower

These summarize the bottom and top of a distribution.

Summary statistic: Minimum

Find the lowest value.

Household	Distribution 1	Distribution 2	Distribution 3
1	\$10k	\$40k	\$50k
2	\$60k	\$65k	\$60k
3	\$150k	\$70k	\$65k

Summary statistic: Minimum

Find the lowest value.

Household	Distribution 1	Distribution 2	Distribution 3
1	\$10k	\$40k	\$50k
2	\$60k	\$65k	\$60k
3	\$150k	\$70k	\$65k
Minimum	**\$10k**	**\$40k**	**\$50k**

Summary statistic: Minimum

Find the lowest value.

Household	Distribution 1	Distribution 2	Distribution 3
1	\$10k	\$40k	\$50k
2	\$60k	\$65k	\$60k
3	\$150k	\$70k	\$65k
Minimum	**\$10k**	**\$40k**	**\$50k**

By the minimum, **Distribution 3** seems the best.

Which summary statistic to choose?

Minimum? Median? Mean?

Household	Distribution 1	Distribution 2	Distribution 3
1	\$10k	\$40k	\$50k
2	\$60k	\$65k	\$60k
3	\$150k	\$70k	\$65k

Choosing a summary statistic

Which summary to choose is not an empirical question.

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- Depends on what aspect of the distribution matters to you

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Which summary to choose is not an empirical question.

- Depends on what aspect of the distribution matters to you

The value of a chosen summary statistic is empirical.

- Data can tell us a value for the mean, the median, the minimum, etc.

The `summarize()` function

The `summarize()` function aggregates data to summaries.

- Input is a dataset with n rows
- Output is a summary with 1 row

The summarize() function

```
incomeSimulated
```

```
# A tibble: 1,000 x 2
     id hhincome
  <dbl>    <dbl>
1     1   19170.
2     2  124474.
3     3   25114.
# i 997 more rows
```

The summarize() function

```
summarize(
  .data = incomeSimulated,
  estimated_mean = mean(hhincome)
)
```

```
# A tibble: 1 x 1
  estimated_mean
           <dbl>
1         100899.
```

- .data is input data
- estimated_mean is a variable in output data
- mean(hhincome) is the mean household income

The summarize() function: Several summaries

```
summarize(
  .data = incomeSimulated,
  estimated_mean = mean(hhincome),
  estimated_median = median(hhincome),
  esitmated_min = min(hhincome)
)
```

```
# A tibble: 1 x 3
  estimated_mean estimated_median esitmated_min
           <dbl>            <dbl>         <dbl>
1        100899.           69035.             0
```

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Piping code with |>

```
x <- c(1,2,3)
length(x)
```

```
[1] 3
```

```
x |> length()
```

```
[1] 3
```

The pipe |> passes x as the first argument to the length() function.

Piping code with |>

Stylistically helpful

- Data is a different kind of argument
- Pipes will help us in the future

```
incomeSimulated |>
  summarize(
    estimated_mean = mean(hhincome),
    estimated_median = median(hhincome),
    esitmated_min = min(hhincome)
  )
```

```
# A tibble: 1 x 3
  estimated_mean estimated_median esitmated_min
           <dbl>            <dbl>         <dbl>
1        100899.           69035.             0
```

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You can now learn more: R4DS Ch 1 and Ch 3