Plotting in R

EC 425/525, Lab 5

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Prologue

Schedule

Last time

Regession

Today

Plotting in `R` (especially `ggplot2`)

Plotting

Plotting

The default option: `plot()`

While we'll quickly move on to other options, `R`'s `plot()` function (in the default `graphics` package) is a great tool for basic data exploration—it's fast, simple, and flexible.

In fact, `plot()` is a generic function, that works for many classes.

General arguments for `plot()`:

- `x` and `y` for coordinates
- `type = {` `"p"` oints, `"l"` ines, *etc.*} *(optional)*
- `xlab`, `ylab`, `main`, and `sub` for axis labels and (sub)title *(optional)*
- `col` and `pch` for color and plot character *(optional)*
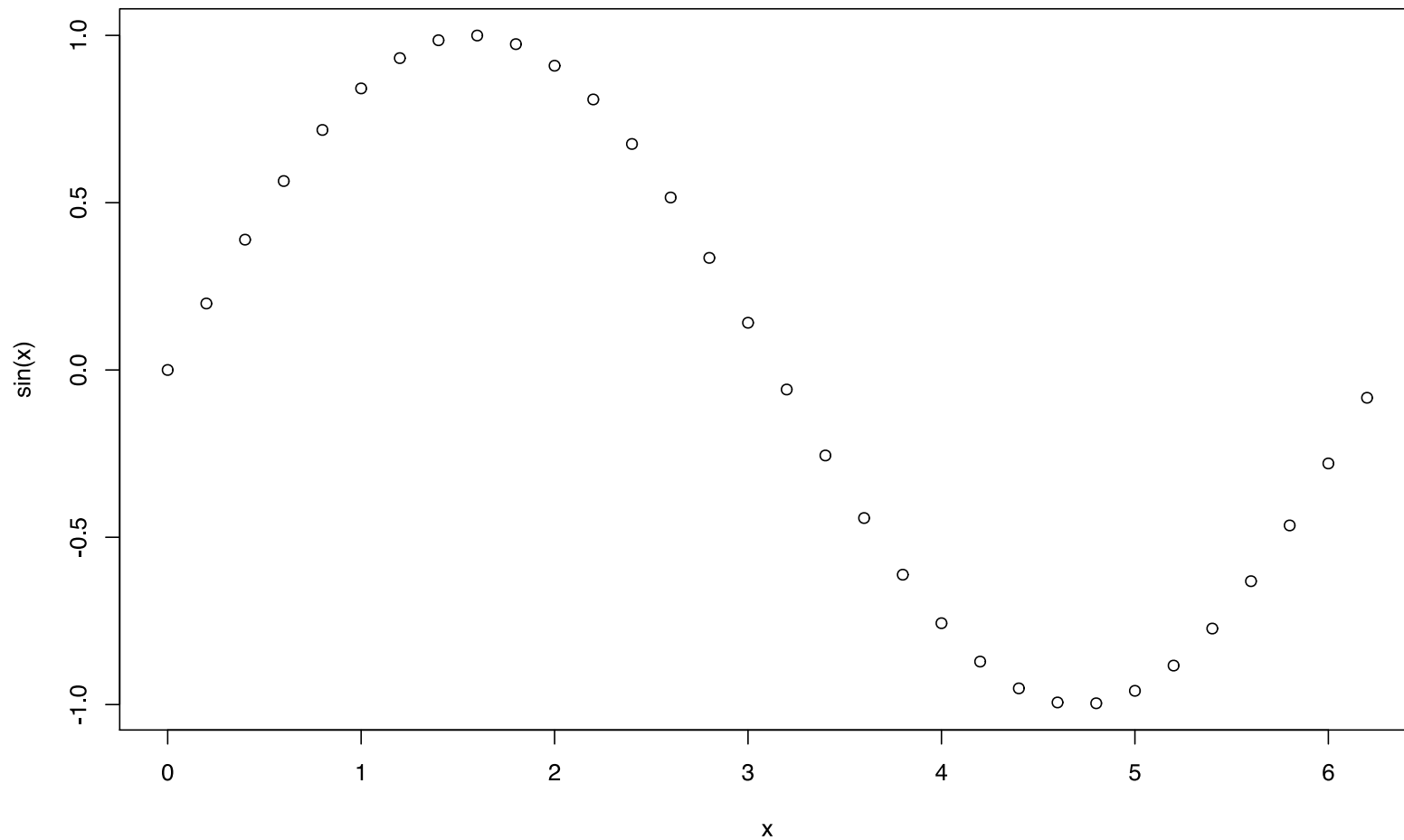- `lty` and `lwd` for line type, and line width *(optional)*

Let's see `plot()` in action.

```r
# Define two vectors
a ← seq(from = 0, to = 2*pi, by = 0.2)
b ← sin(a)
```
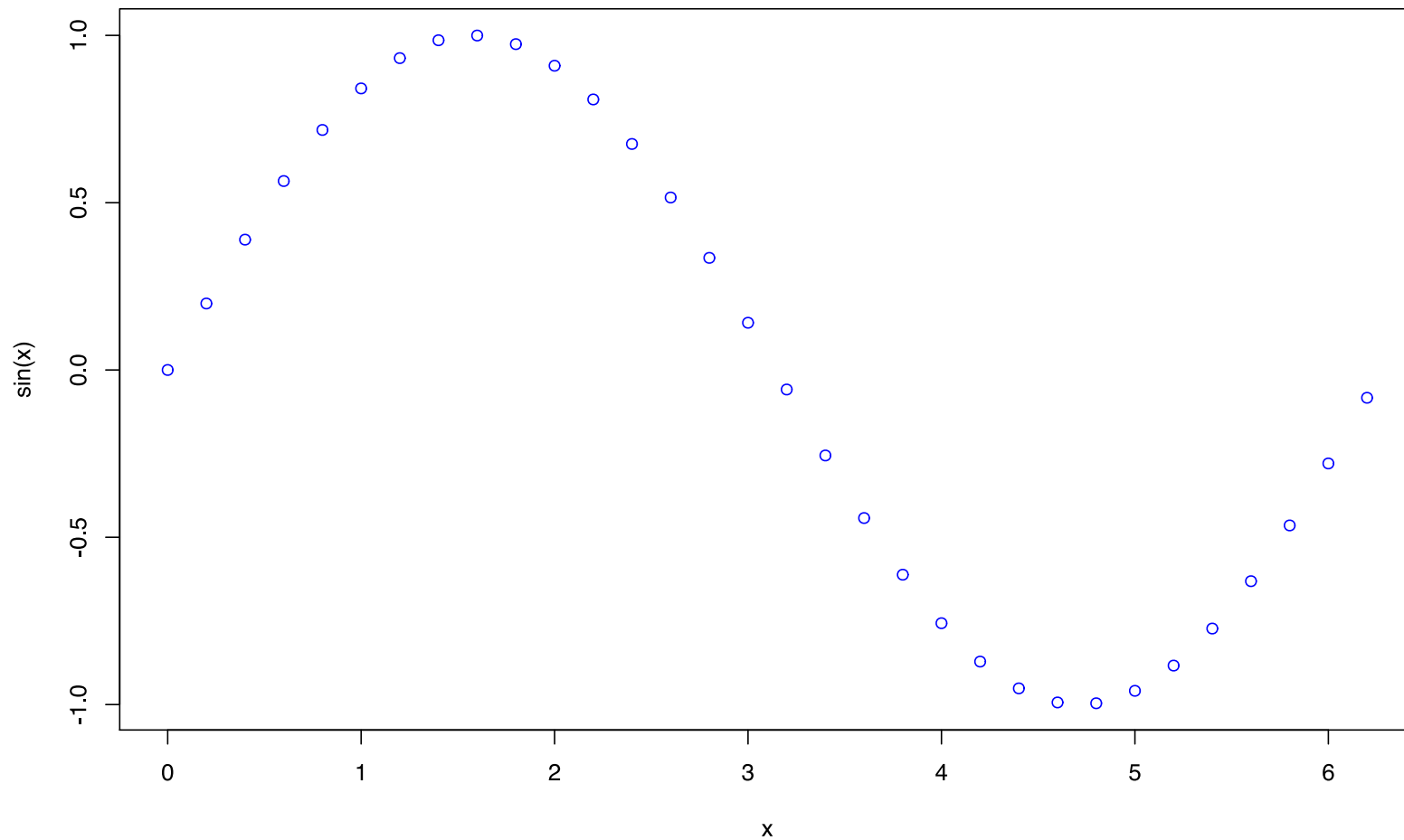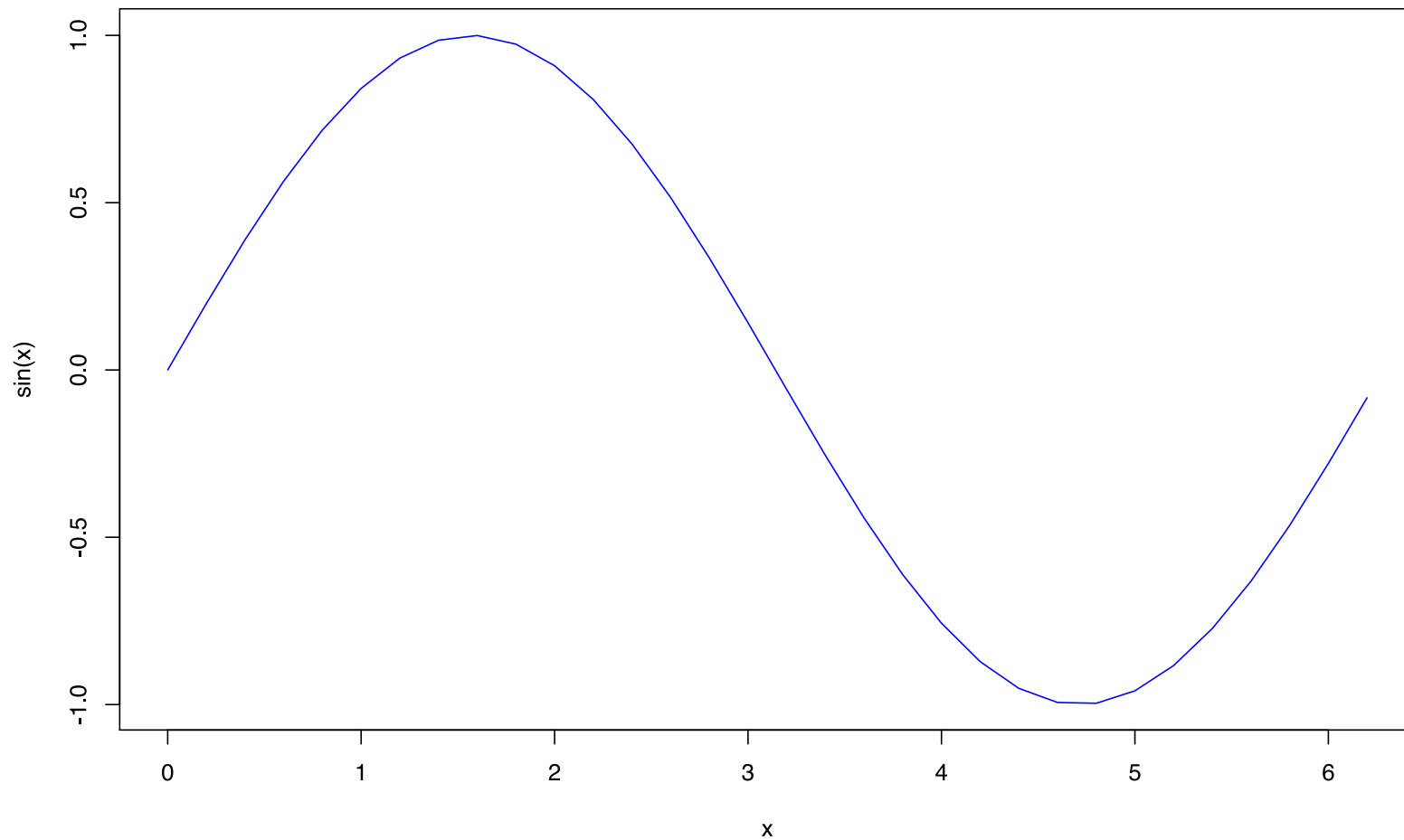
```
plot(x = a, y = b)
```

```
plot(x = a, y = b, xlab = "x", ylab = "sin(x)")
```
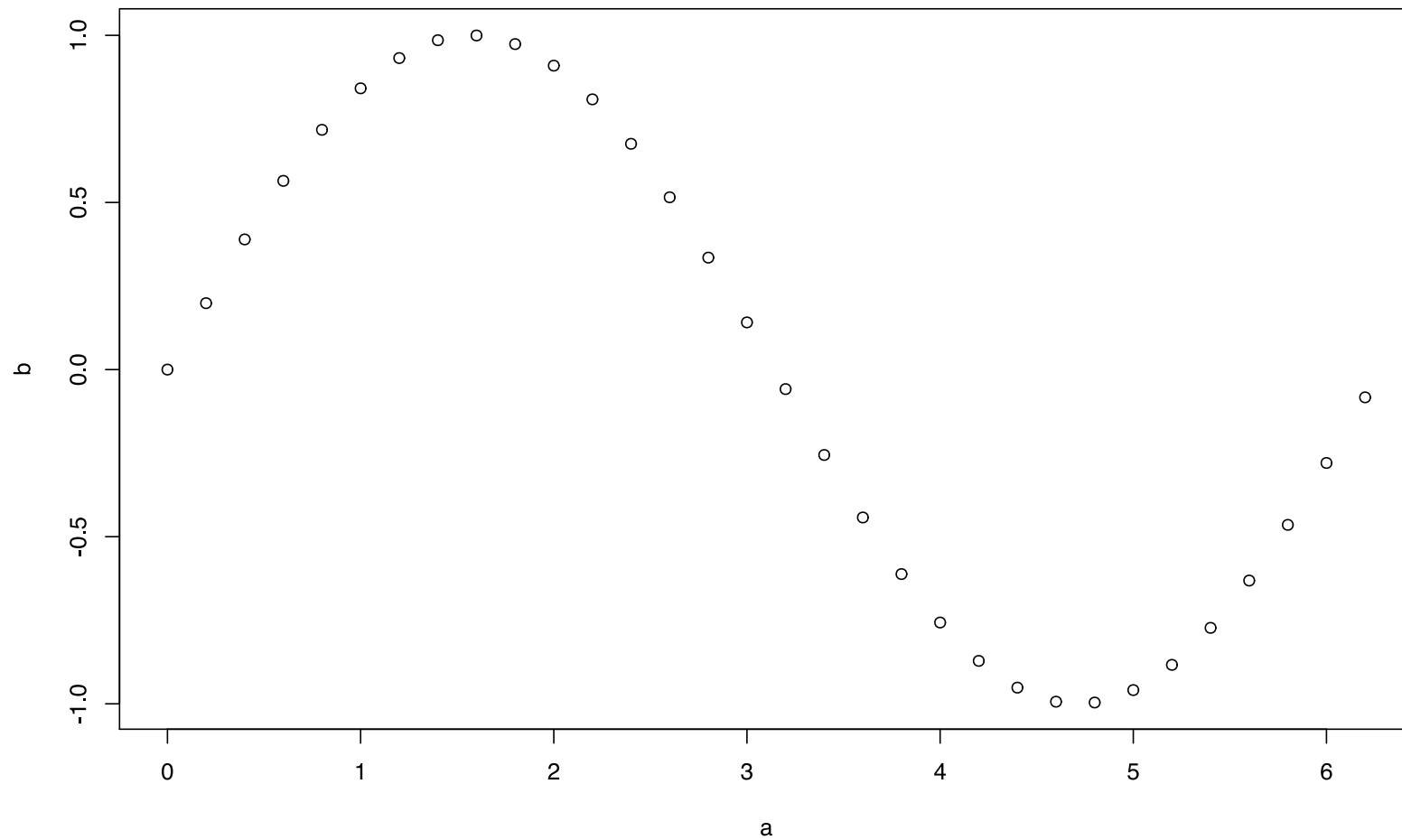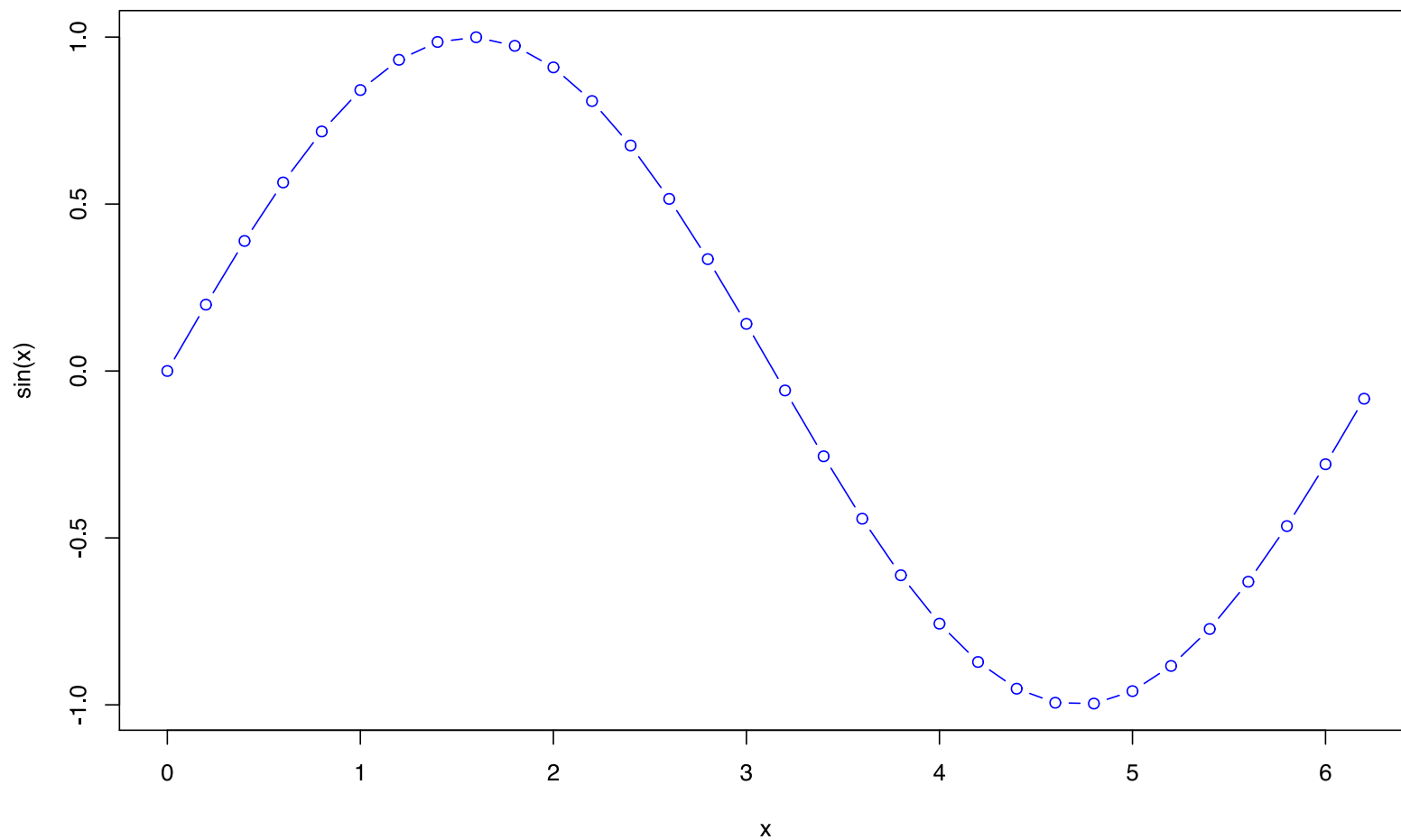
```r
plot(x = a, y = b, xlab = "x", ylab = "sin(x)", col = "blue")
```
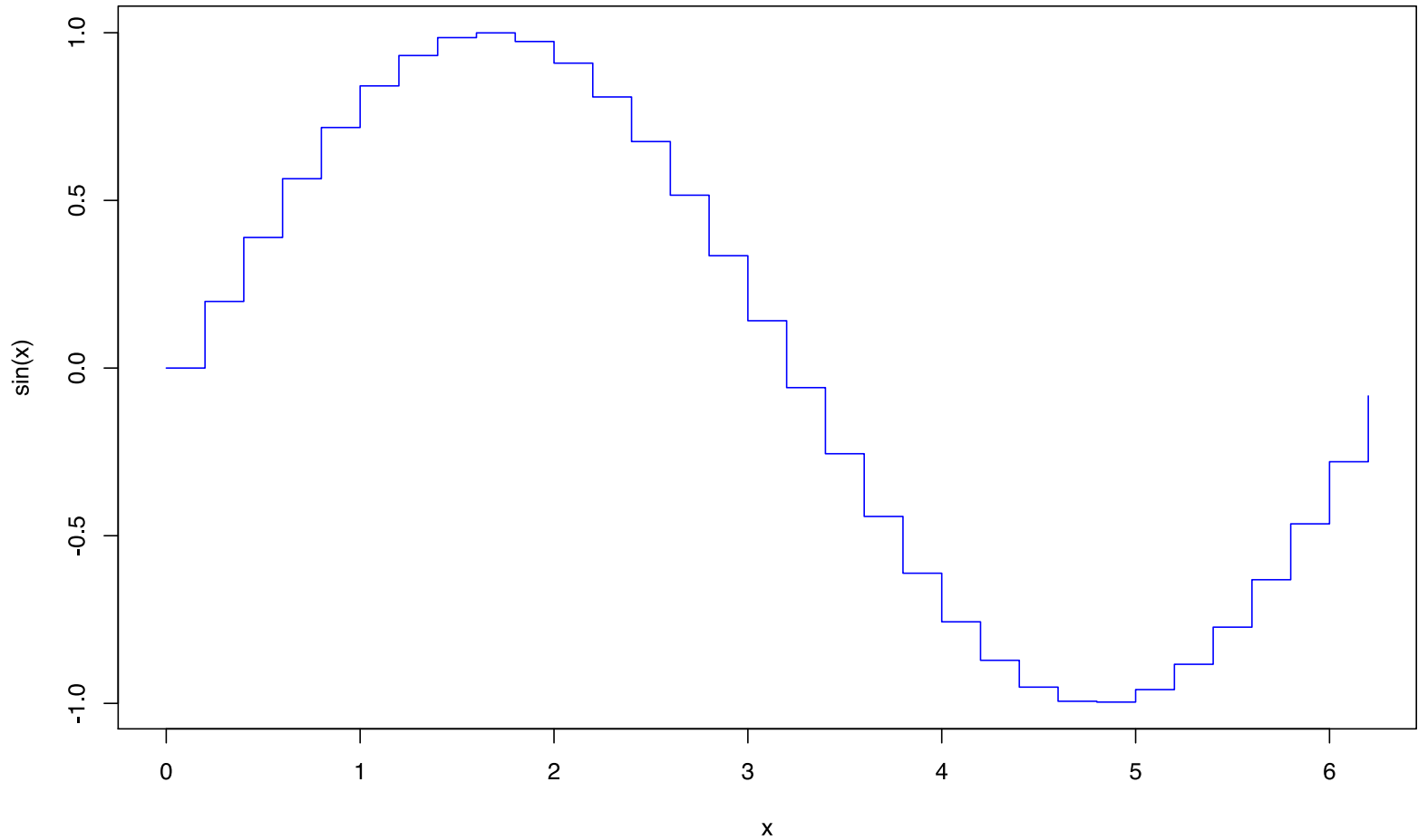
```
plot(x = a, y = b, xlab = "x", ylab = "sin(x)", col = "blue", type = "l")
```

```
plot(x = a, y = b, xlab = "x", ylab = "sin(x)", col = "blue", type = "b")
```
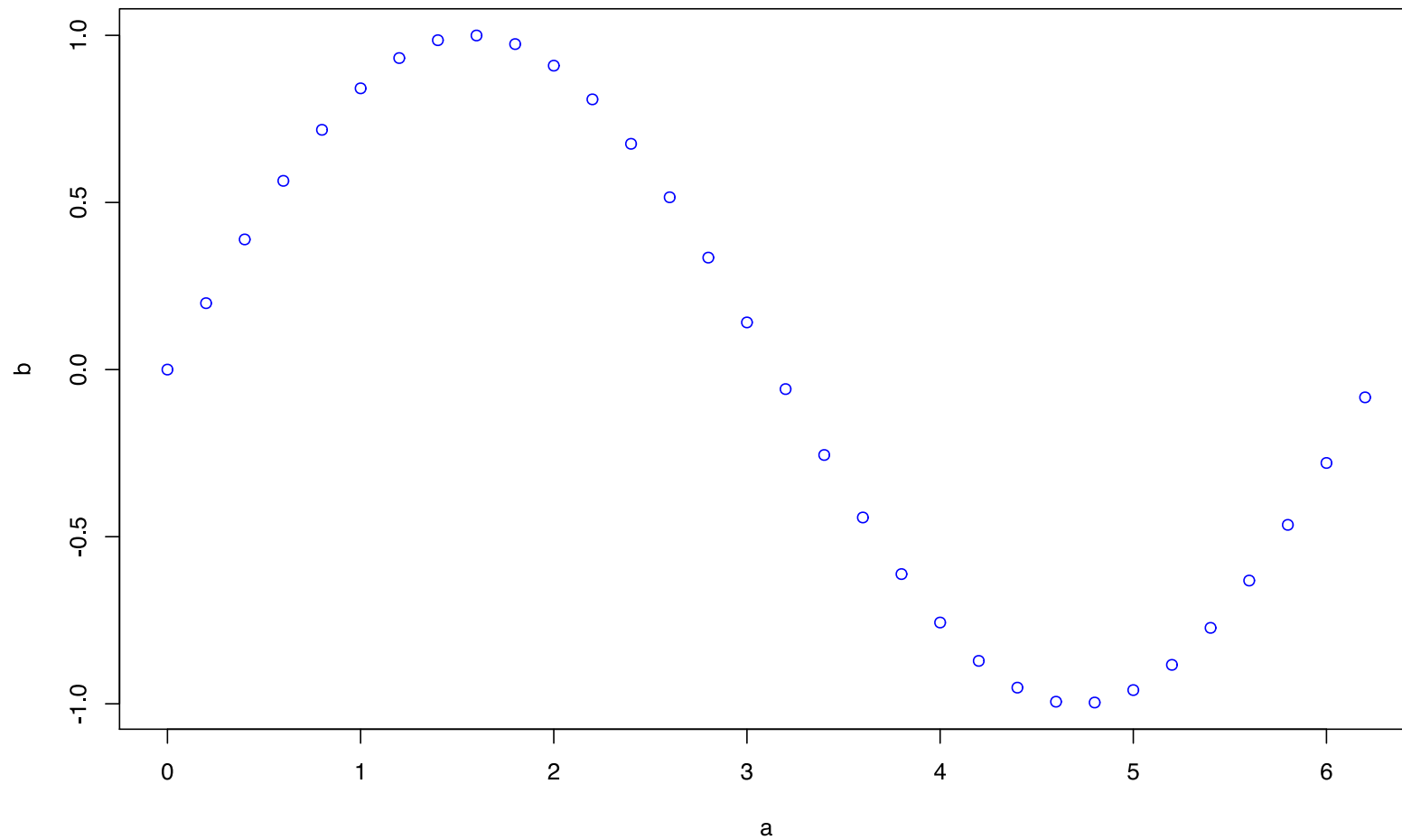
```
plot(x = a, y = b, xlab = "x", ylab = "sin(x)", col = "blue", type = "s")
```
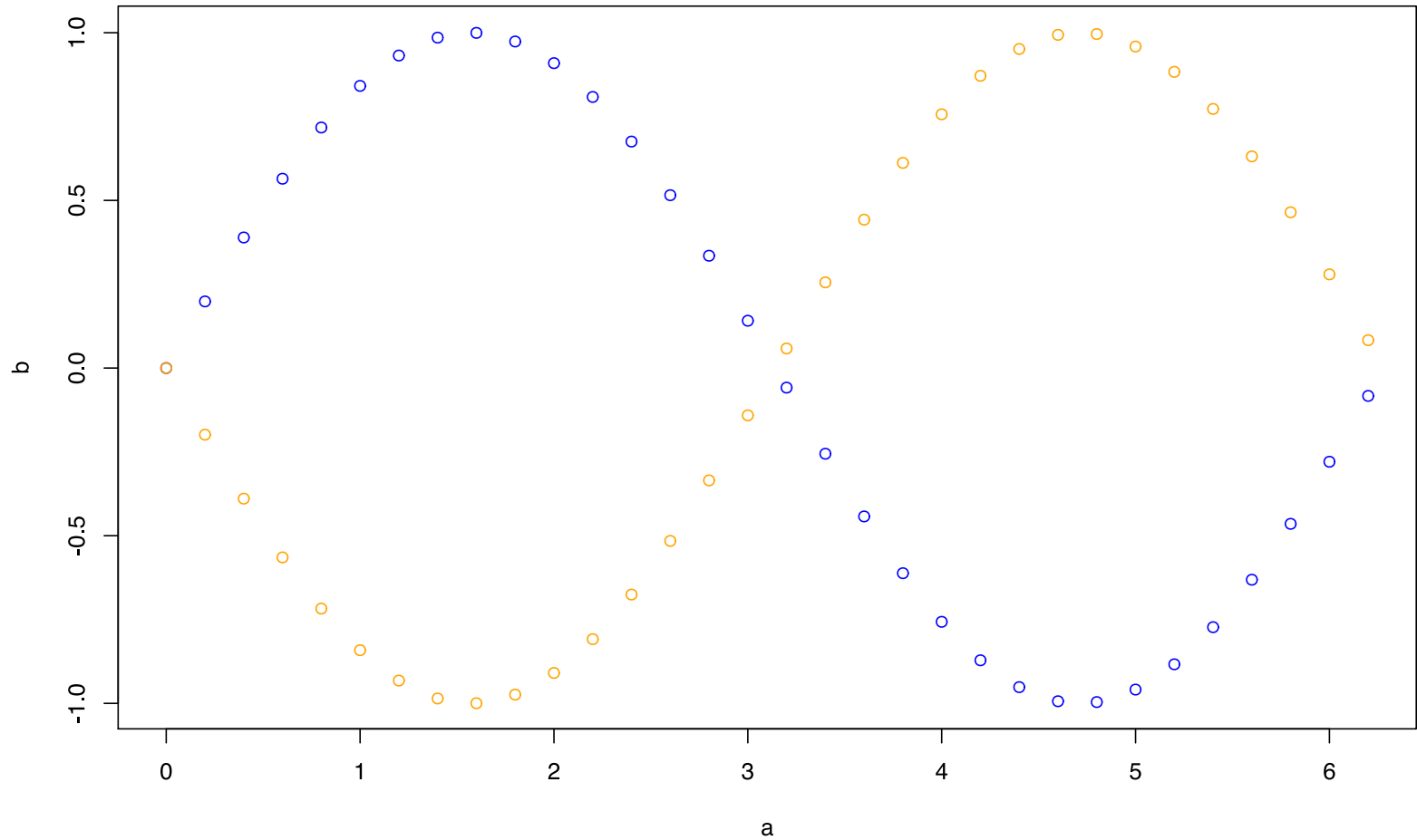
`plot()` is essentially calling `points()` or `lines()`.

You can layer plots by using these individual functions.
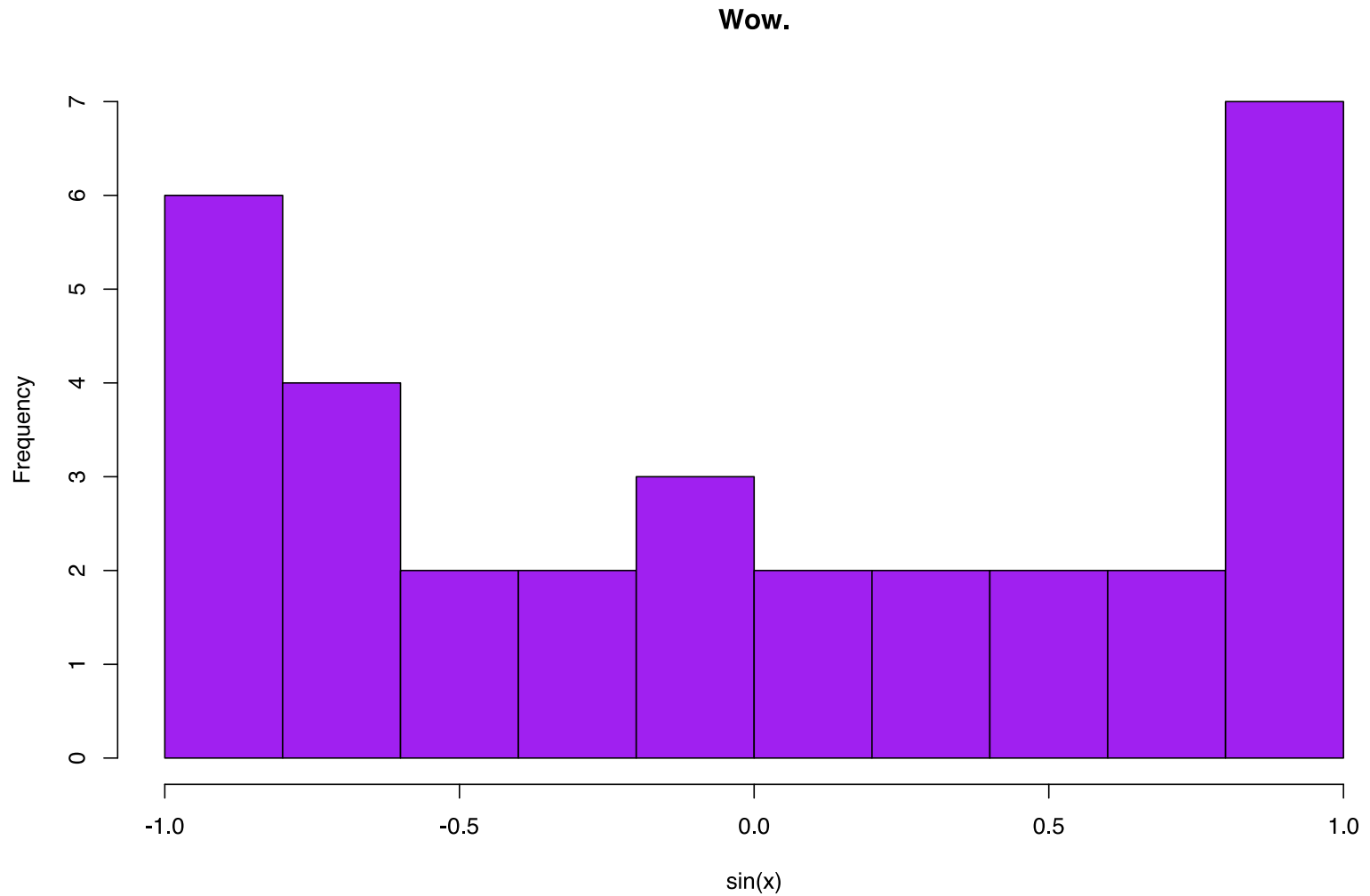
```
plot(x = a, y = b, col = "blue")
```

```
plot(x = a, y = b, col = "blue"); points(x = a, y = -b, col = "orange")
```

`graphics` also offers a nice histogram function in `hist()`.

```
hist(x = b, breaks = 10, col = "purple", xlab = "sin(x)", main = "Wow.")
```

That said/done, further customization/manipulation of your graphics using `graphics` plotting functions can become quite difficult.

Enter `ggplot2`

ggplot2

ggplot2

The grammar

The `ggplot2` package offers an incredibly flexible, diverse, and powerful set of functions for creating graphics in R.

The `gg` stands for the *grammar of graphics*.

`ggplot2`

1. centers on a **data frame** (the `data` argument)
2. maps variables to **aesthetics** (the `aes` argument)
3. **layers geometries** to *build up* your graphic

Note The package is called `ggplot2`, but the main function is `ggplot()`.

ggplot2

`ggplot()`

Main arguments

1. `data` Your dataset. As a data frame (or `tibble`).

1. `aes()` Maps variables in `data` to "aesthetics" like `x`, `color`, `shape`.

Example A time series of problems, `color` defined by money

```
library(ggplot2)
ggplot(
  data = pretend_df,
  aes(x = time, y = problems, color = money)
)
```

ggplot2

Layers

The `ggplot()` function doesn't plot anything—it *sets up* the plot.

To create the actual figure, you layer **geometries** (*e.g.*, `geom_point()`), **scales** (*e.g.*, `scale_color_manual()`), and other **options** (*e.g.*, `xlab()`).

You **add layers** using the addition sign (`+`).

Example A time series of problems, `color` defined by money

```r
library(ggplot2)
ggplot(
  data = pretend_df,
  aes(x = time, y = problems, color = money)
) +
geom_point() + geom_line()
```

Alright, let's build a plot.

We'll use the `economics` dataset that comes with `ggplot2` (because economics).

	date	pce	pop	psavert	uempmed	unemploy
1	1967-07-01	507.4	198712	12.5	4.5	2944
2	1967-08-01	510.5	198911	12.5	4.7	2945
3	1967-09-01	516.3	199113	11.7	4.6	2958
4	1967-10-01	512.9	199311	12.5	4.9	3143
5	1967-11-01	518.1	199498	12.5	4.7	3066
6	1967-12-01	525.8	199657	12.1	4.8	3018
7	1968-01-01	531.5	199808	11.7	5.1	2878
8	1968-02-01	534.2	199920	12.2	4.5	3001

Showing 1 to 8 of 574 entries
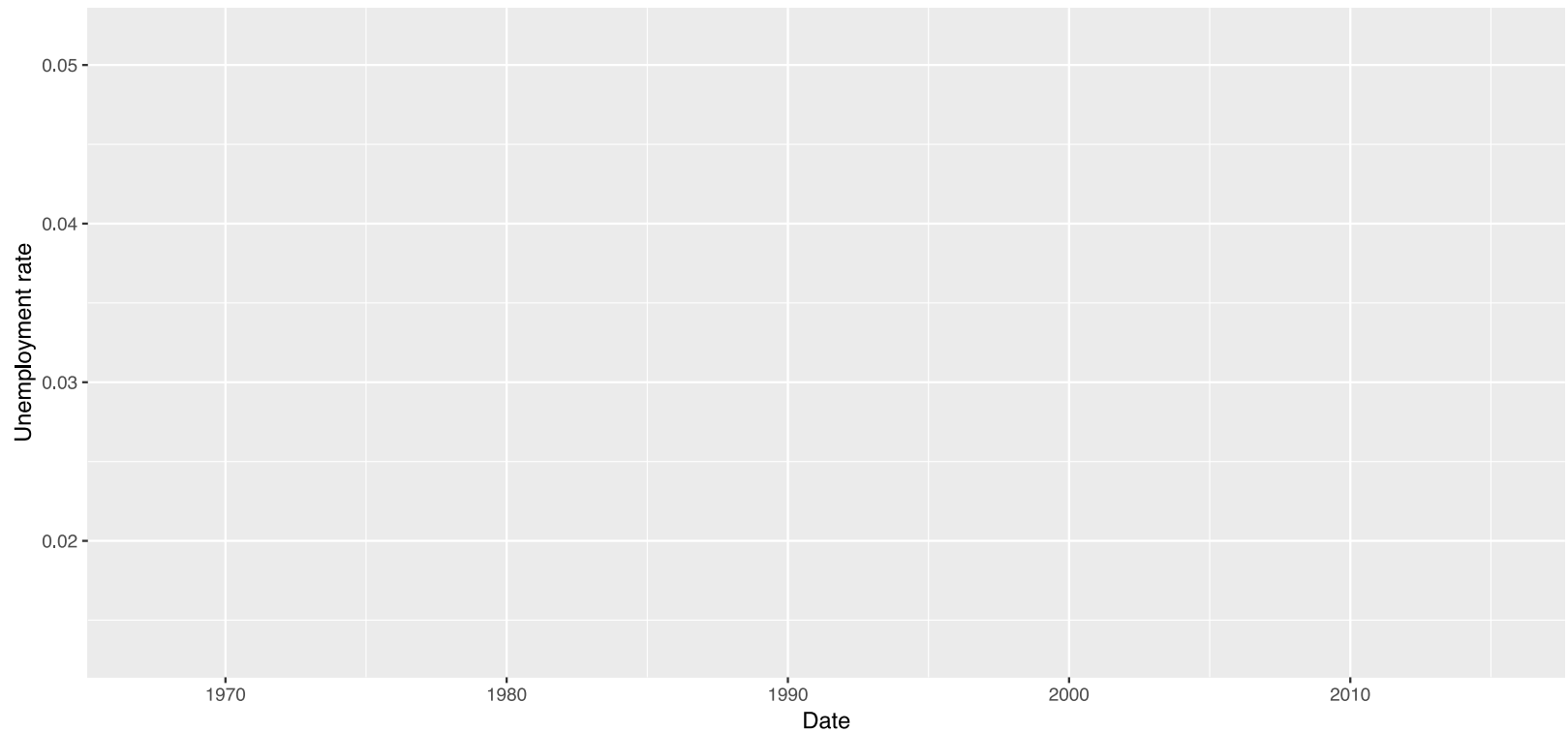
Previous | 1 | 2 | 3 | 4 | 5 | … | 72 | Next

Set up the plot.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop))
```
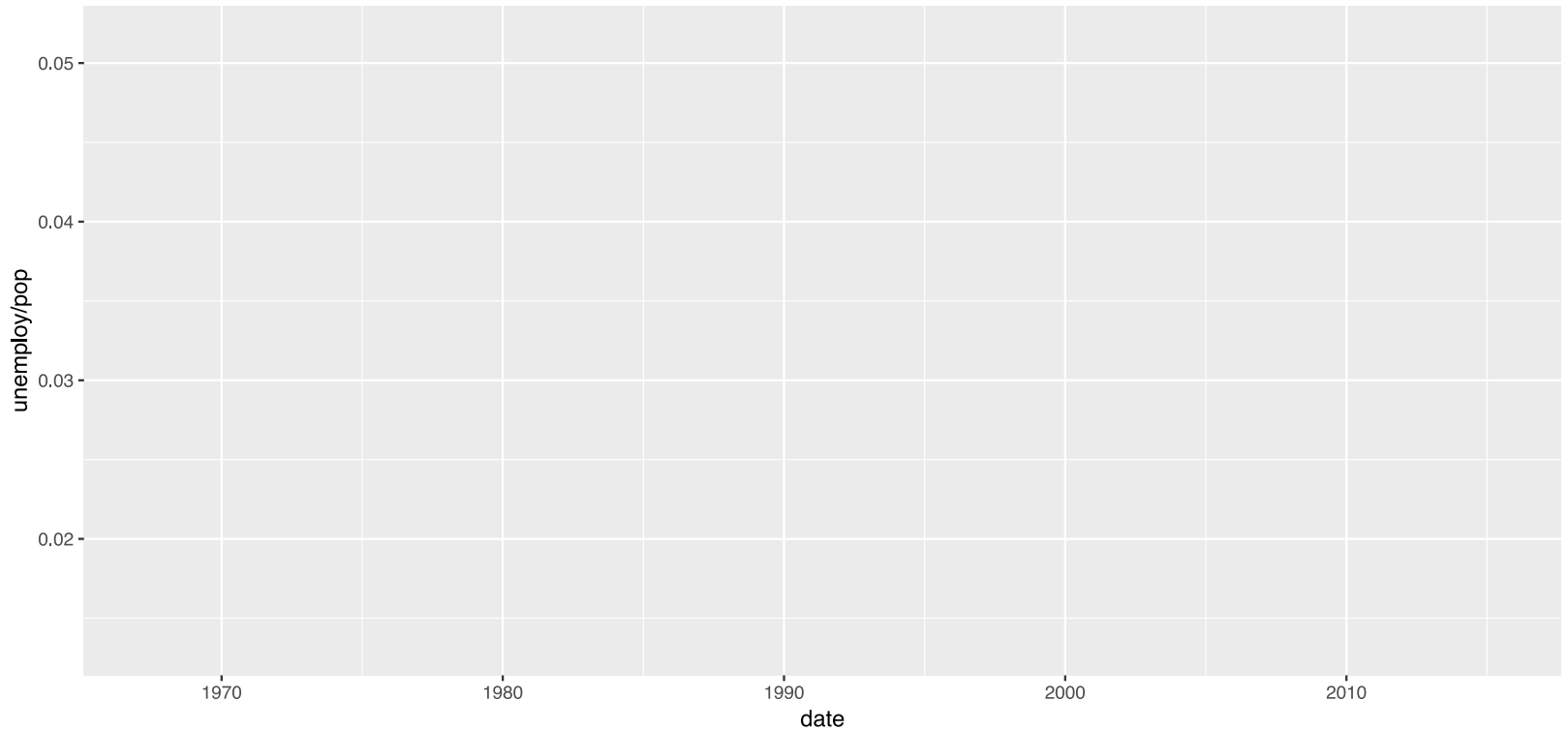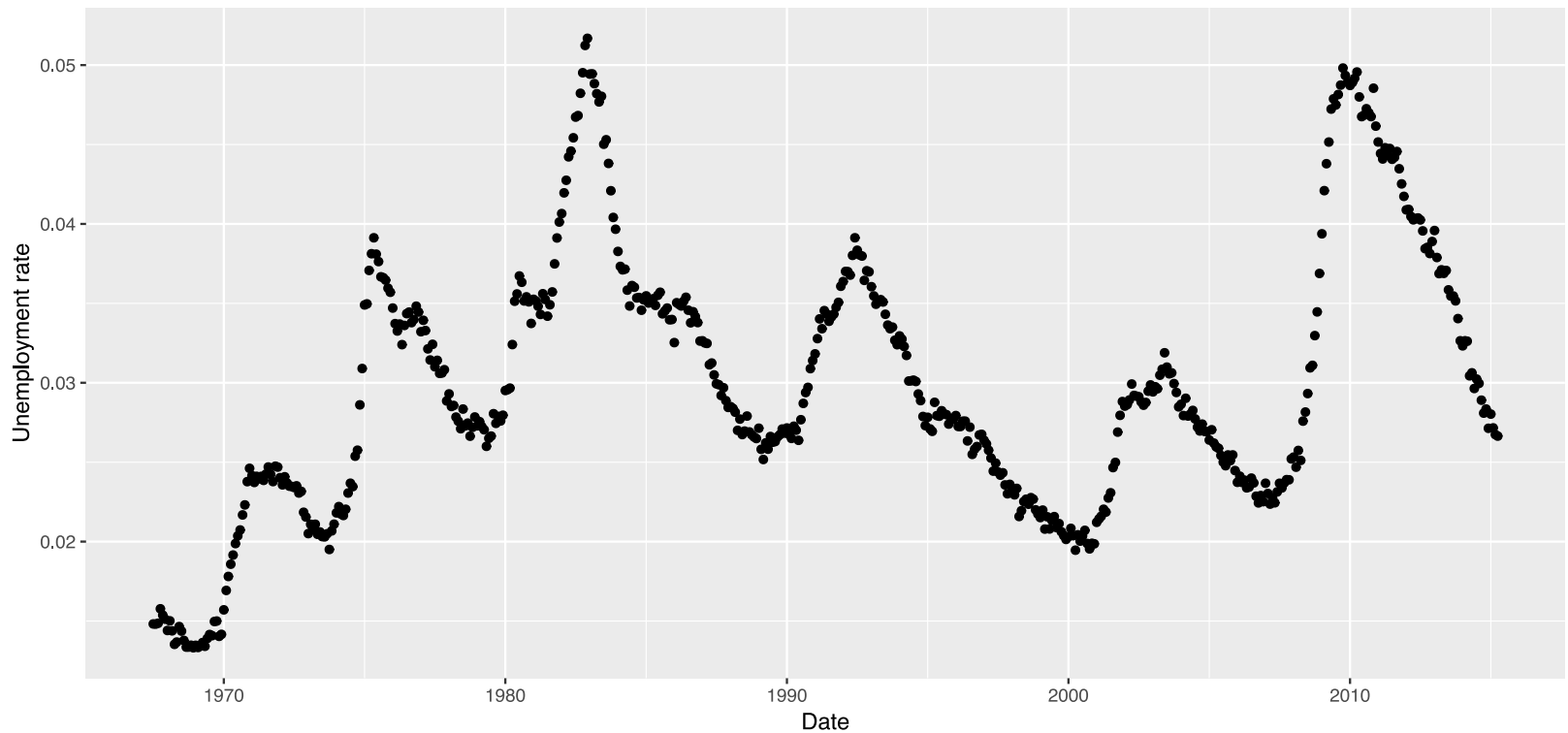
Label the axes.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop)) +
ylab("Unemployment rate") + xlab("Date")
```
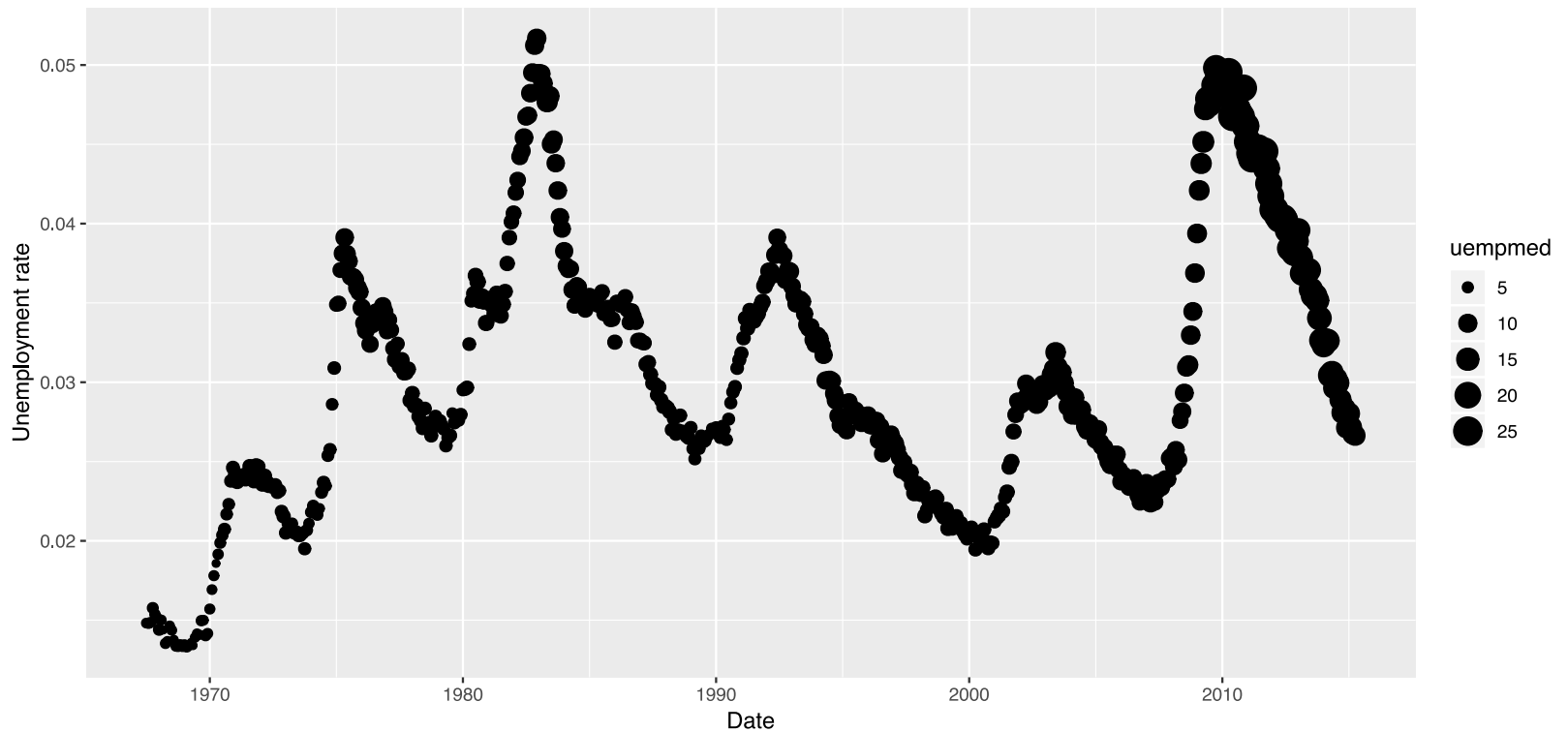
Draw some points.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point()
```
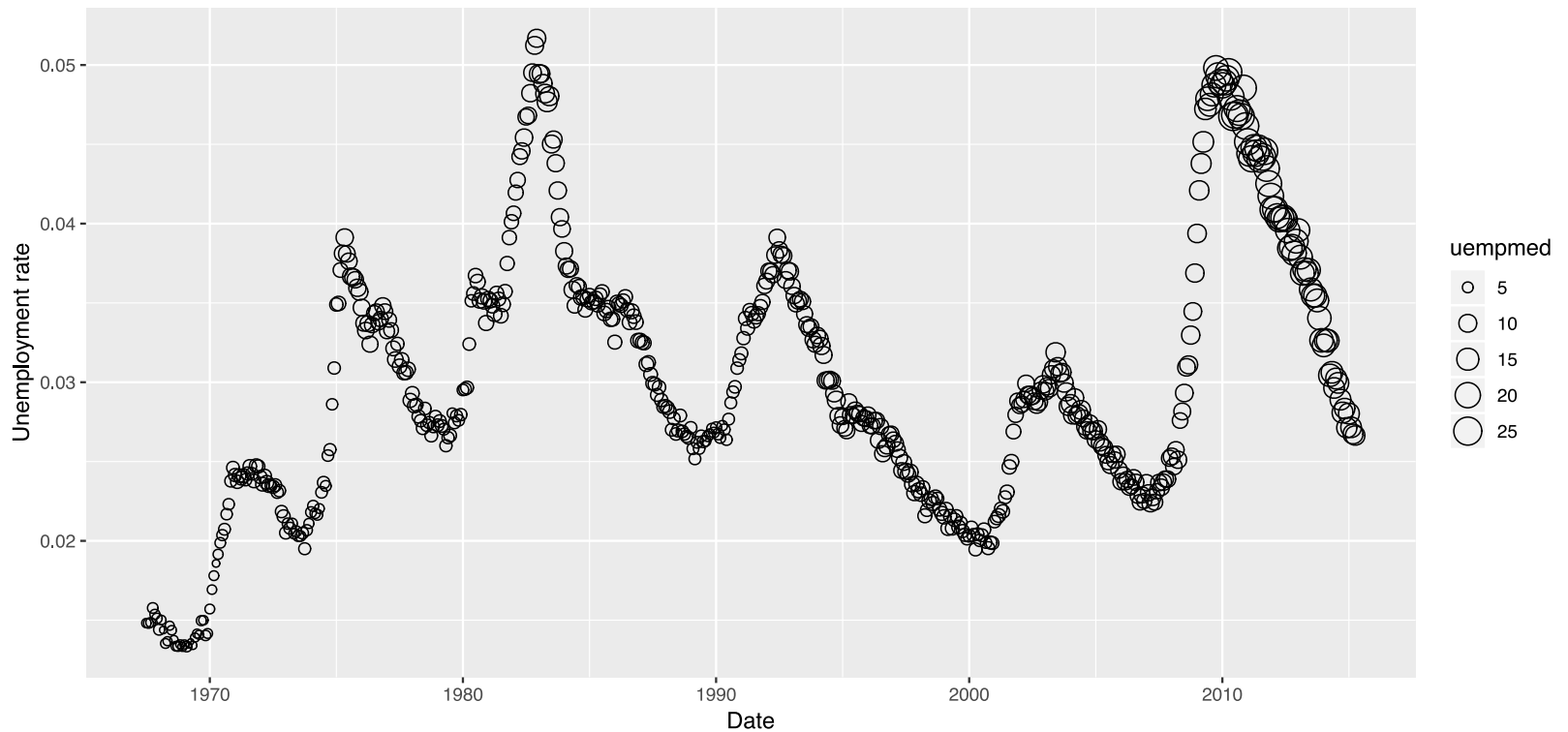
Map the `size` to the median duration of unemployment.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop, size = uempmed)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point()
```
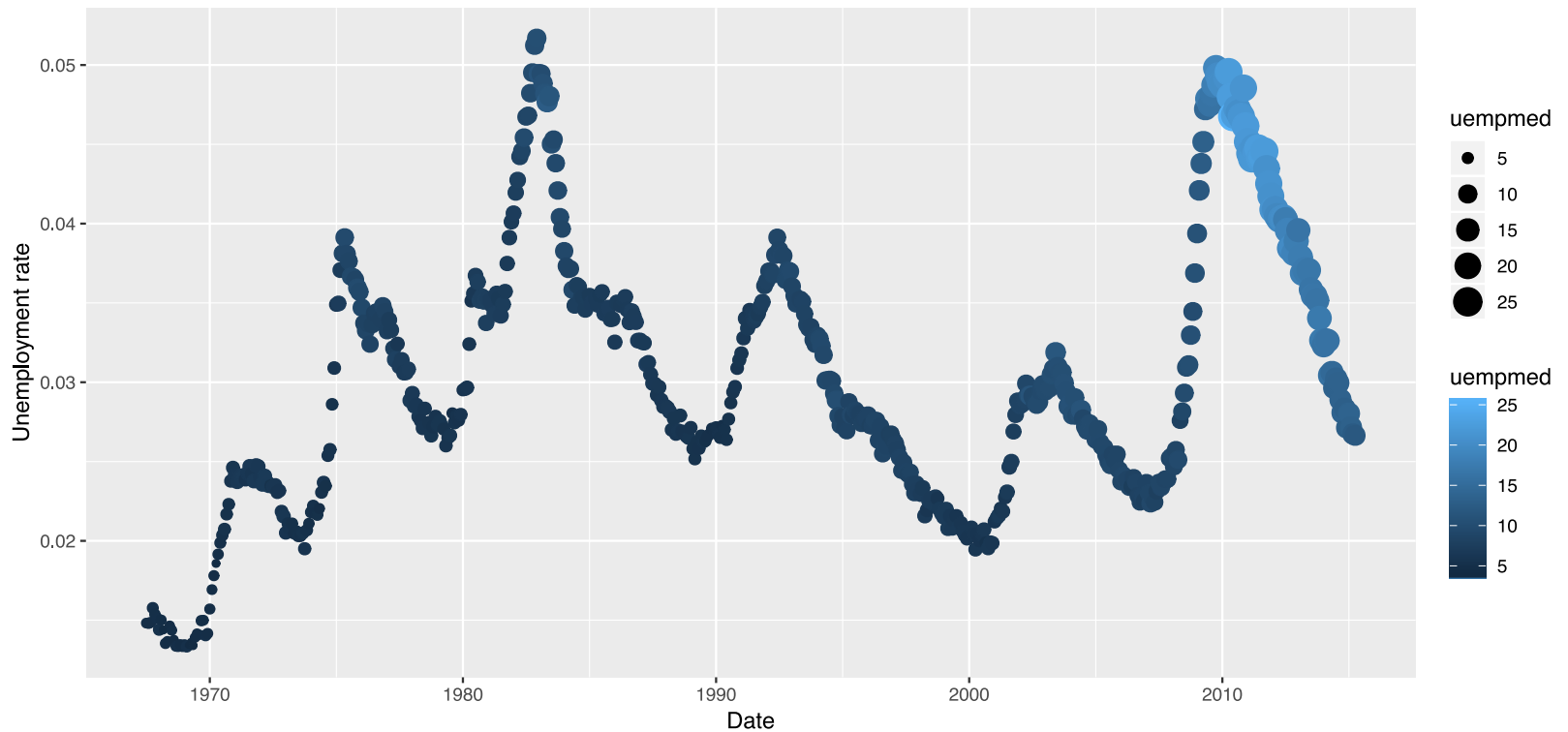
Change the `shape` of the points.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop, size = uempmed)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point(shape = 1)
```
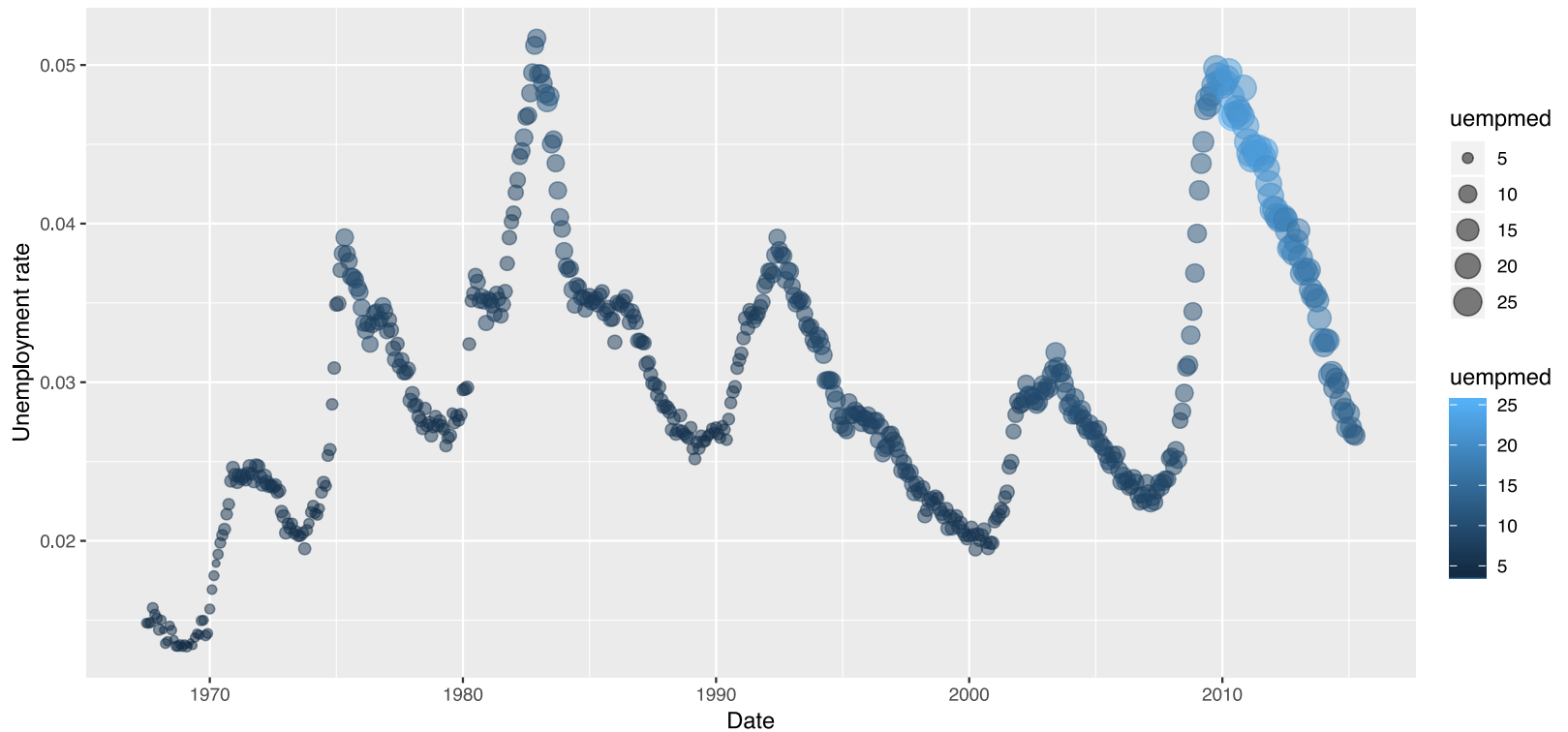
Map points' `color` to the median duration of unemployment.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop, size = uempmed)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point(aes(color = uempmed))
```
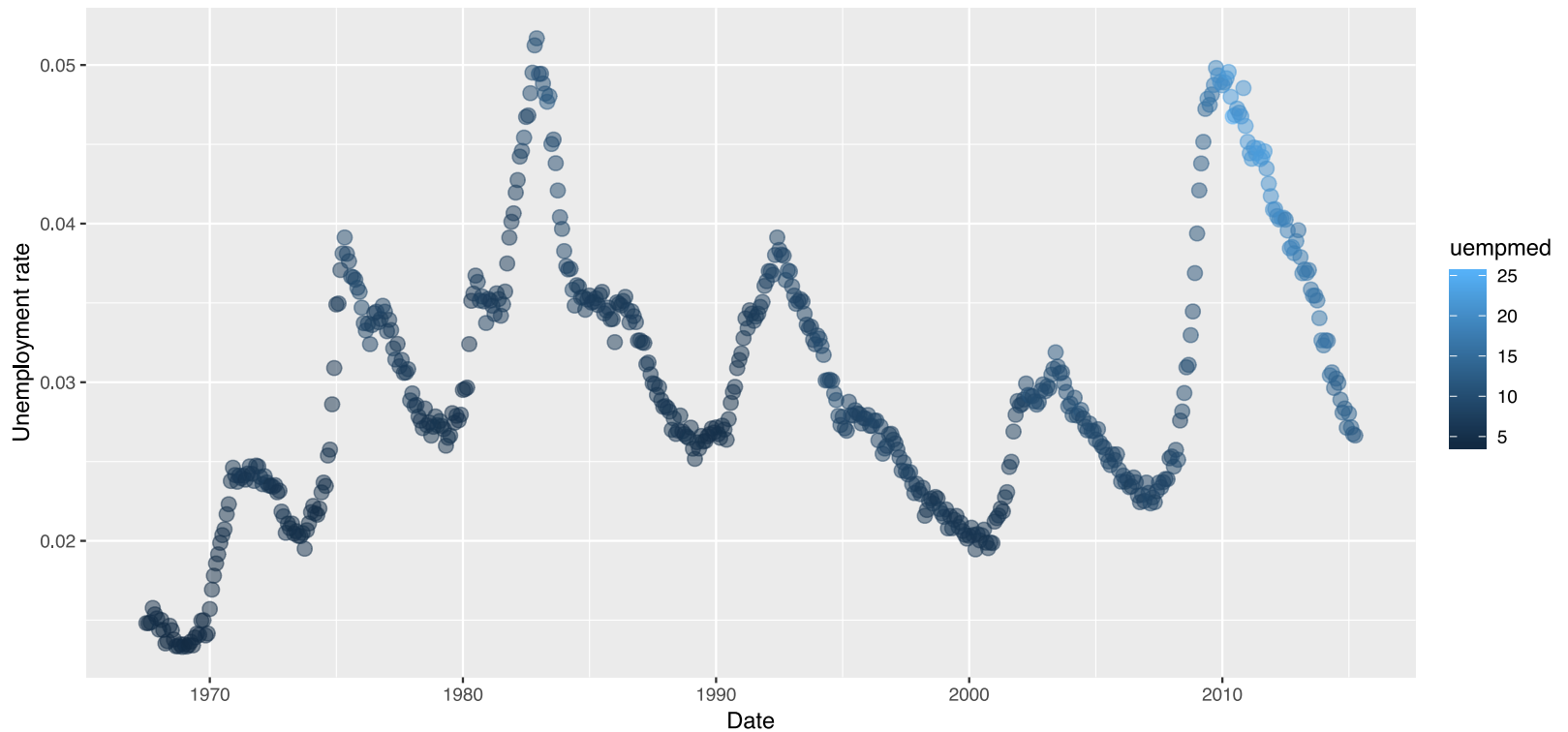
Add some transparency (`alpha`) to our points.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop, size = uempmed)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point(aes(color = uempmed), alpha = 0.5)
```
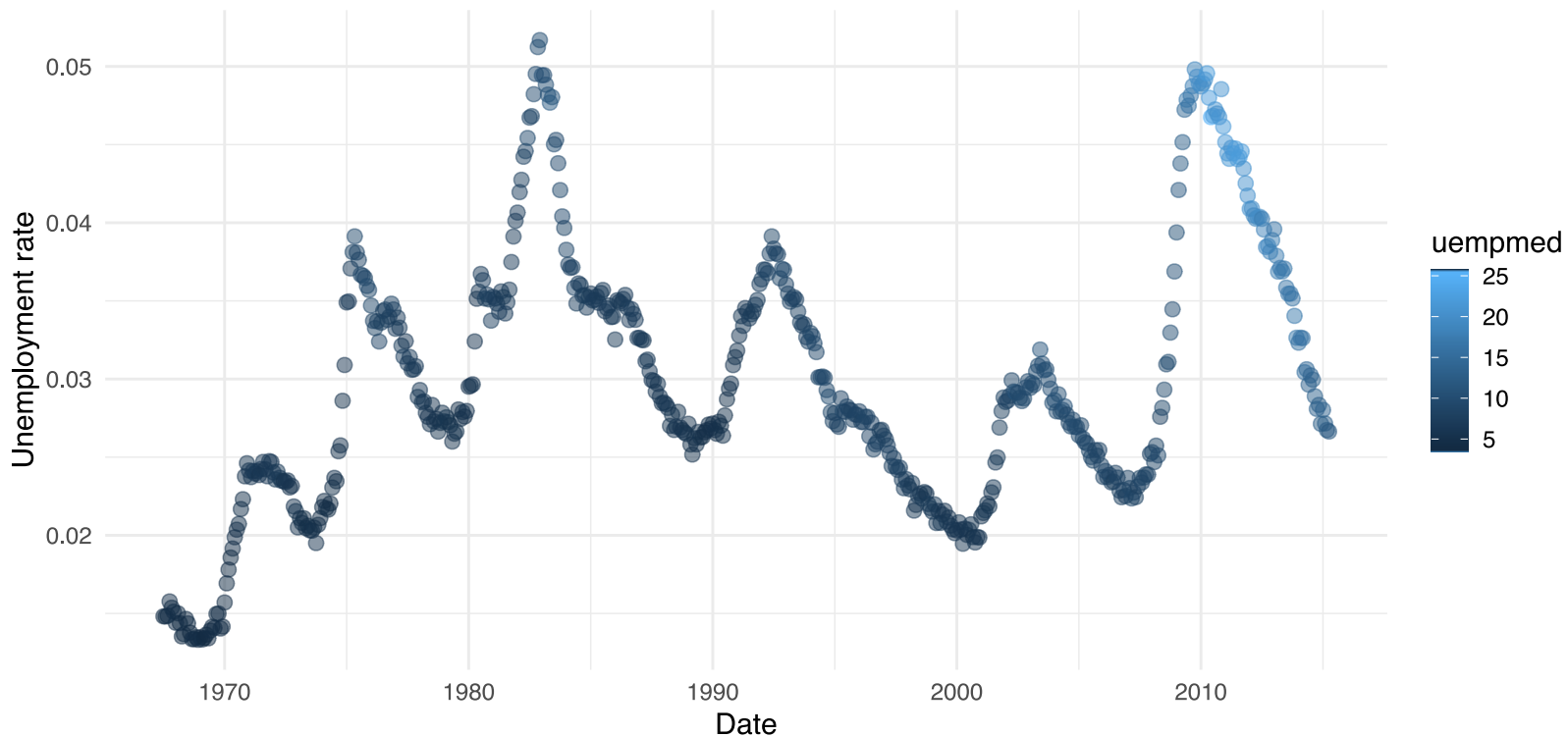
Same size points; all bigger.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point(aes(color = uempmed), alpha = 0.5, size = 3)
```
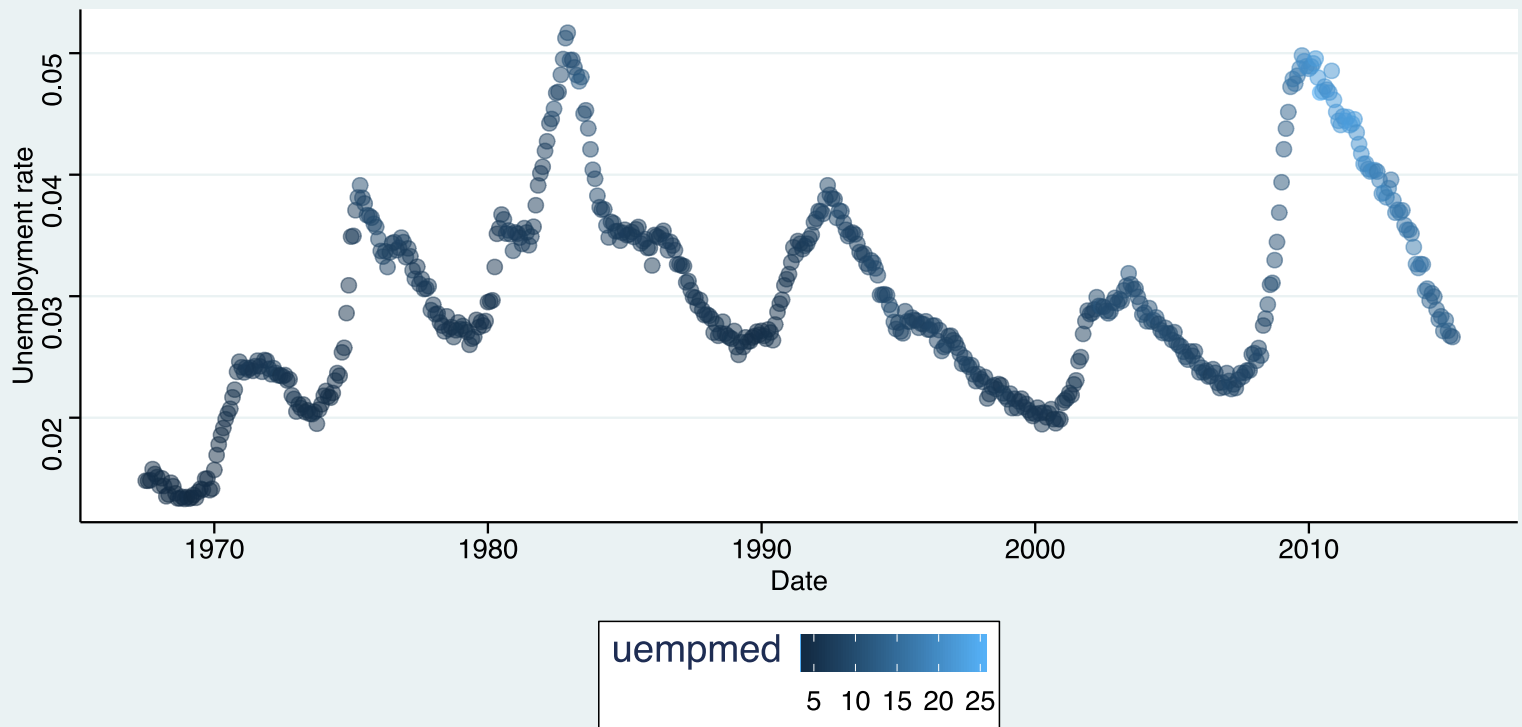
Change our theme—maybe you're a minimalist (but want slightly larger fonts)?

```
ggplot(data = economics, aes(x = date, y = unemploy/pop)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point(aes(color = uempmed), alpha = 0.5, size = 3) +
theme_minimal(base_size = 14)
```
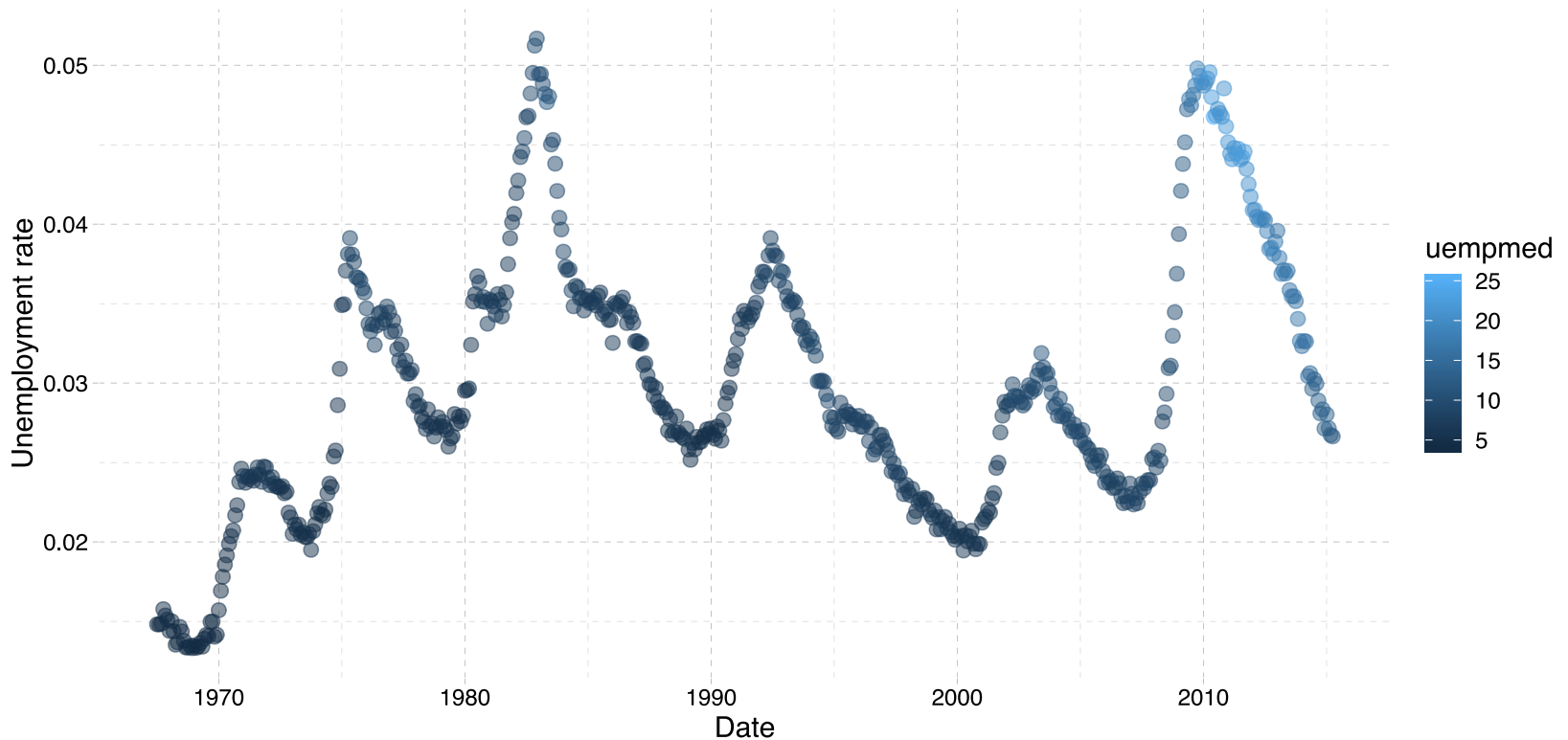
Want your figure to look like Stata made it?

```
ggplot(data = economics, aes(x = date, y = unemploy/pop)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point(aes(color = uempmed), alpha = 0.5, size = 3) +
ggthemes :: theme_stata(base_size = 14)
```
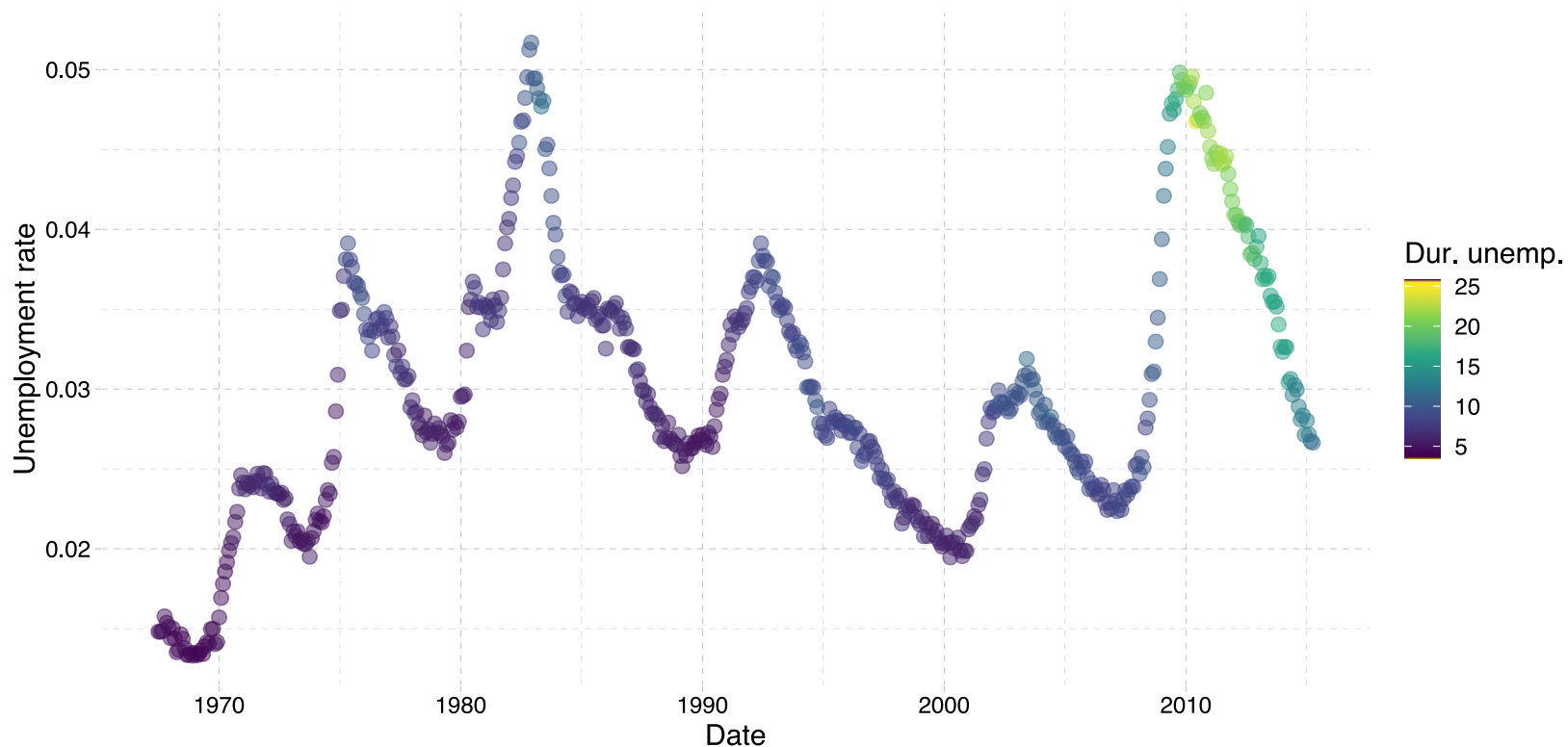
The "pander" theme from the `ggthemes` package.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point(aes(color = uempmed), alpha = 0.5, size = 3) +
ggthemes :: theme_pander(base_size = 14)
```
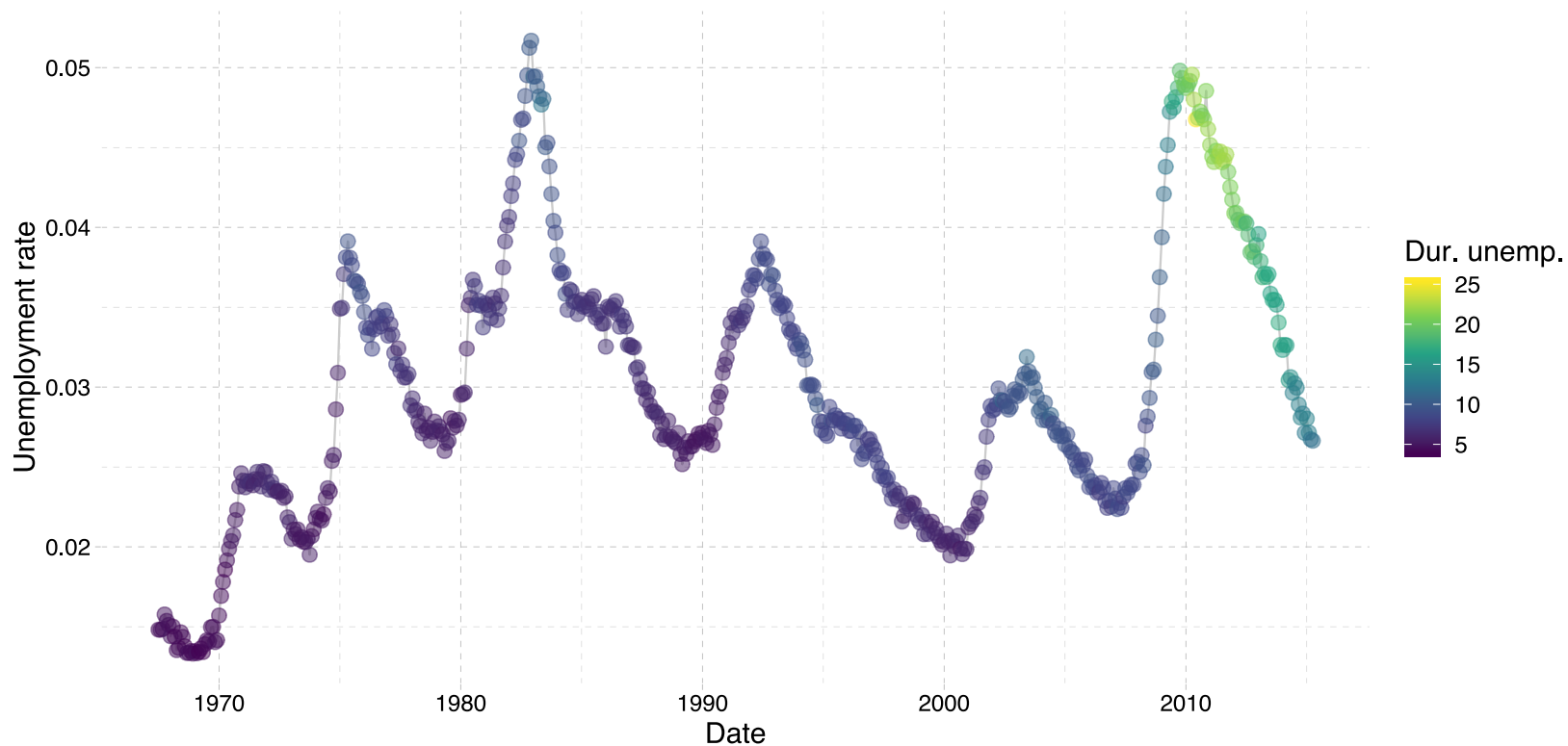
Change (and label) our color scale. *Note* `viridis` is the best.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point(aes(color = uempmed), alpha = 0.5, size = 3) +
ggthemes::theme_pander(base_size = 14) +
scale_color_viridis_c("Dur. unemp.")
```
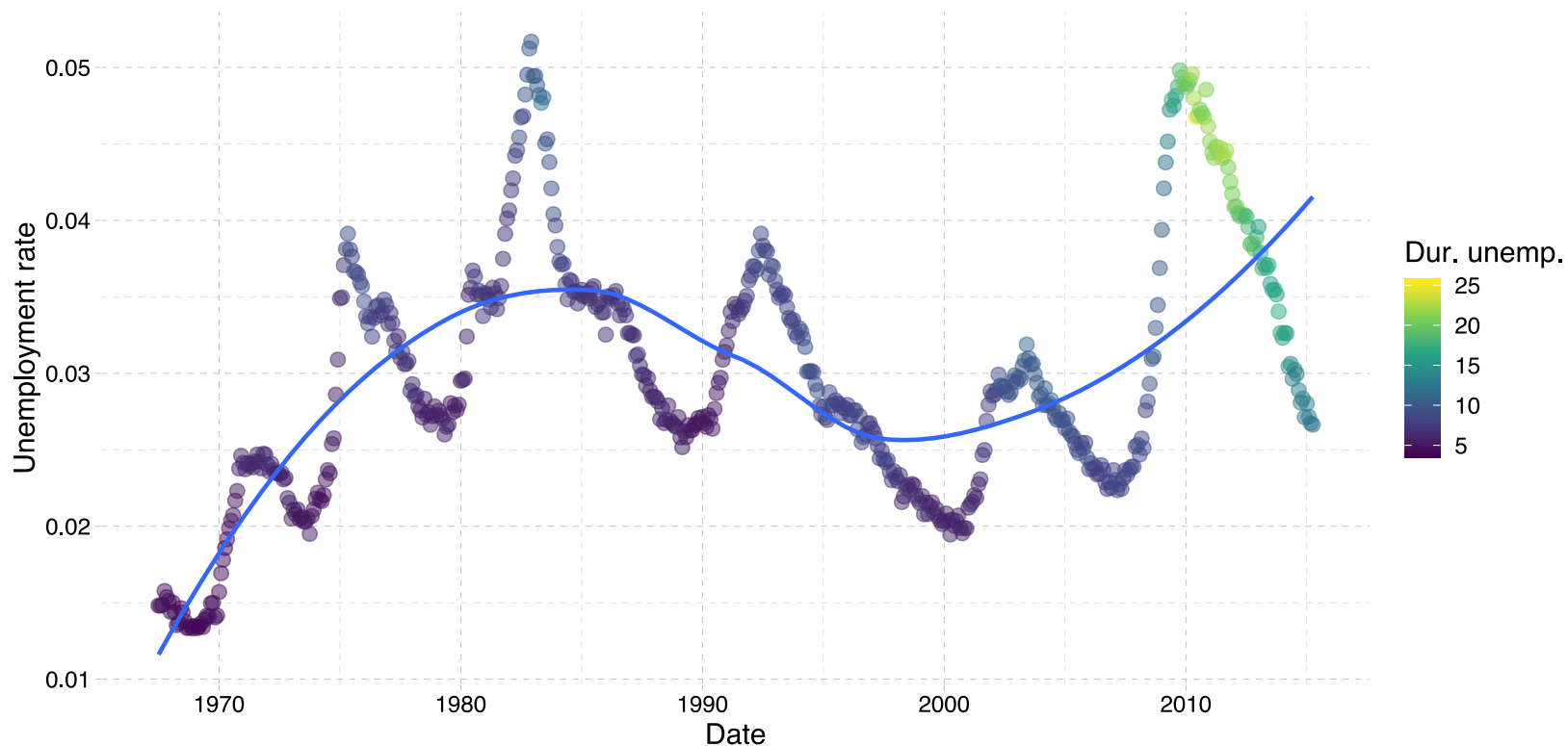
Connect the dots.

```r
ggplot(data = economics, aes(x = date, y = unemploy/pop)) +
ylab("Unemployment rate") + xlab("Date") +
geom_line(color = "grey80") +
geom_point(aes(color = uempmed), alpha = 0.5, size = 3) +
ggthemes::theme_pander(base_size = 14) +
scale_color_viridis_c("Dur. unemp.")
```

How about a smoother?

```
ggplot(data = economics, aes(x = date, y = unemploy/pop)) +
ylab("Unemployment rate") + xlab("Date") +
geom_point(aes(color = uempmed), alpha = 0.5, size = 3) +
geom_smooth(se = F) +
ggthemes::theme_pander(base_size = 14) +
scale_color_viridis_c("Dur. unemp.")
```

The `group` aesthetic separates groups.

```
ggplot(data = economics, aes(x = date, y = unemploy/pop, group = date < ymd(19900101)))
ylab("Unemployment rate") + xlab("Date") +
geom_point(aes(color = uempmed), alpha = 0.5, size = 3) +
geom_smooth(se = F) +
ggthemes::theme_pander(base_size = 14) +
scale_color_viridis_c("Dur. unemp.")
```
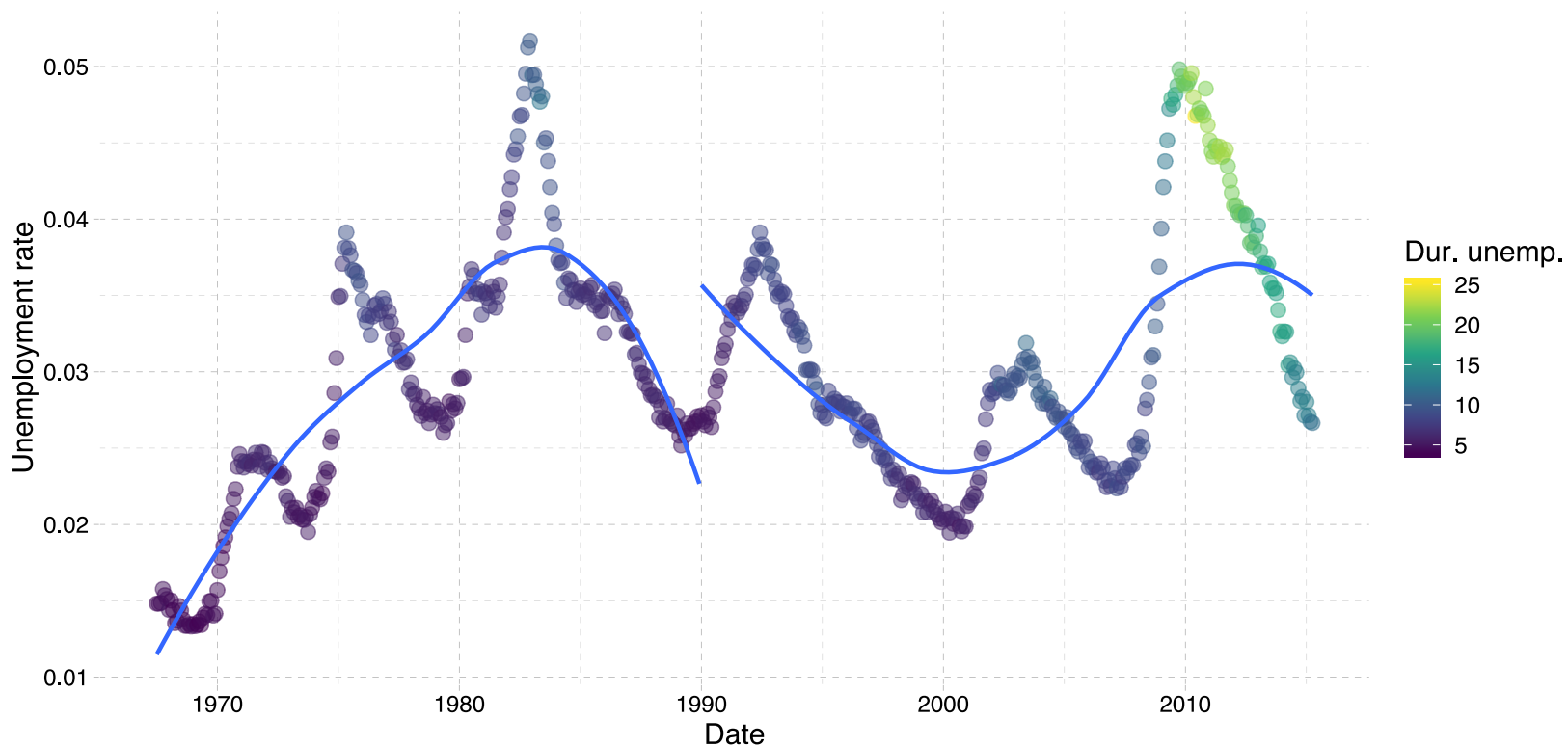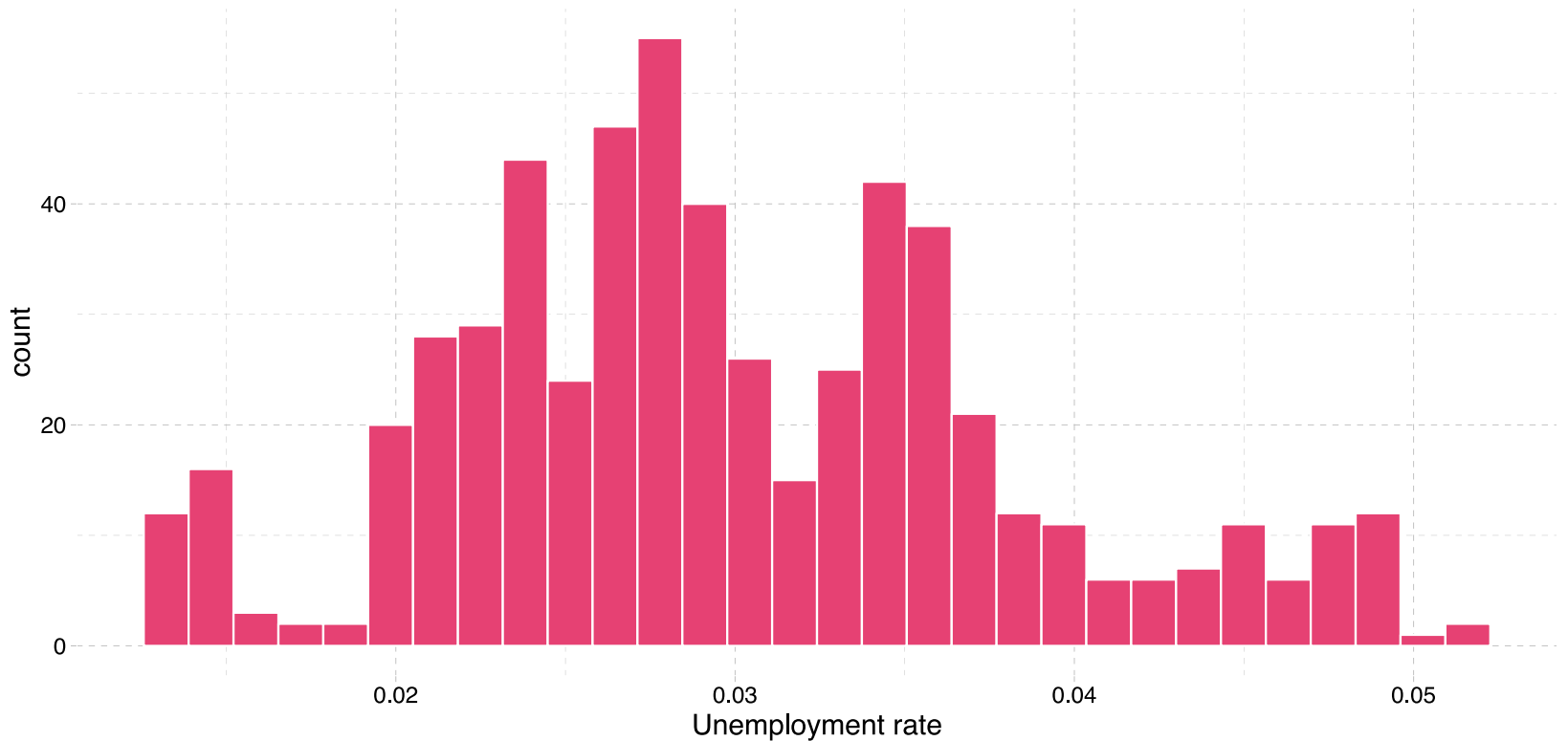
Note The `ymd()` function comes from the `lubridate` package.
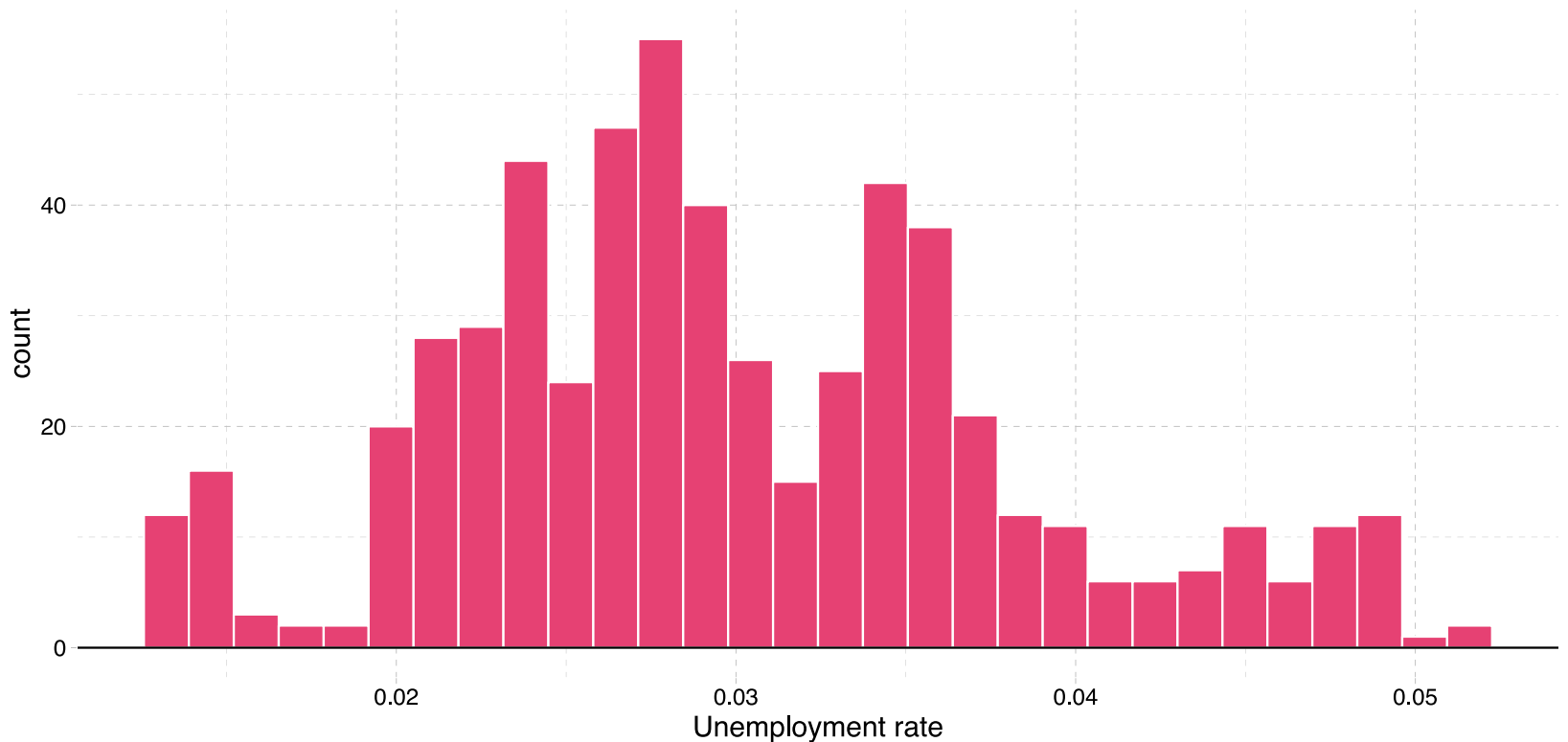
`ggplot2` knows histogams.

A histogram.

```
ggplot(data = economics, aes(x = unemploy/pop)) +
xlab("Unemployment rate") +
geom_histogram(color = "white", fill = "#e64173") +
ggthemes::theme_pander(base_size = 14)
```
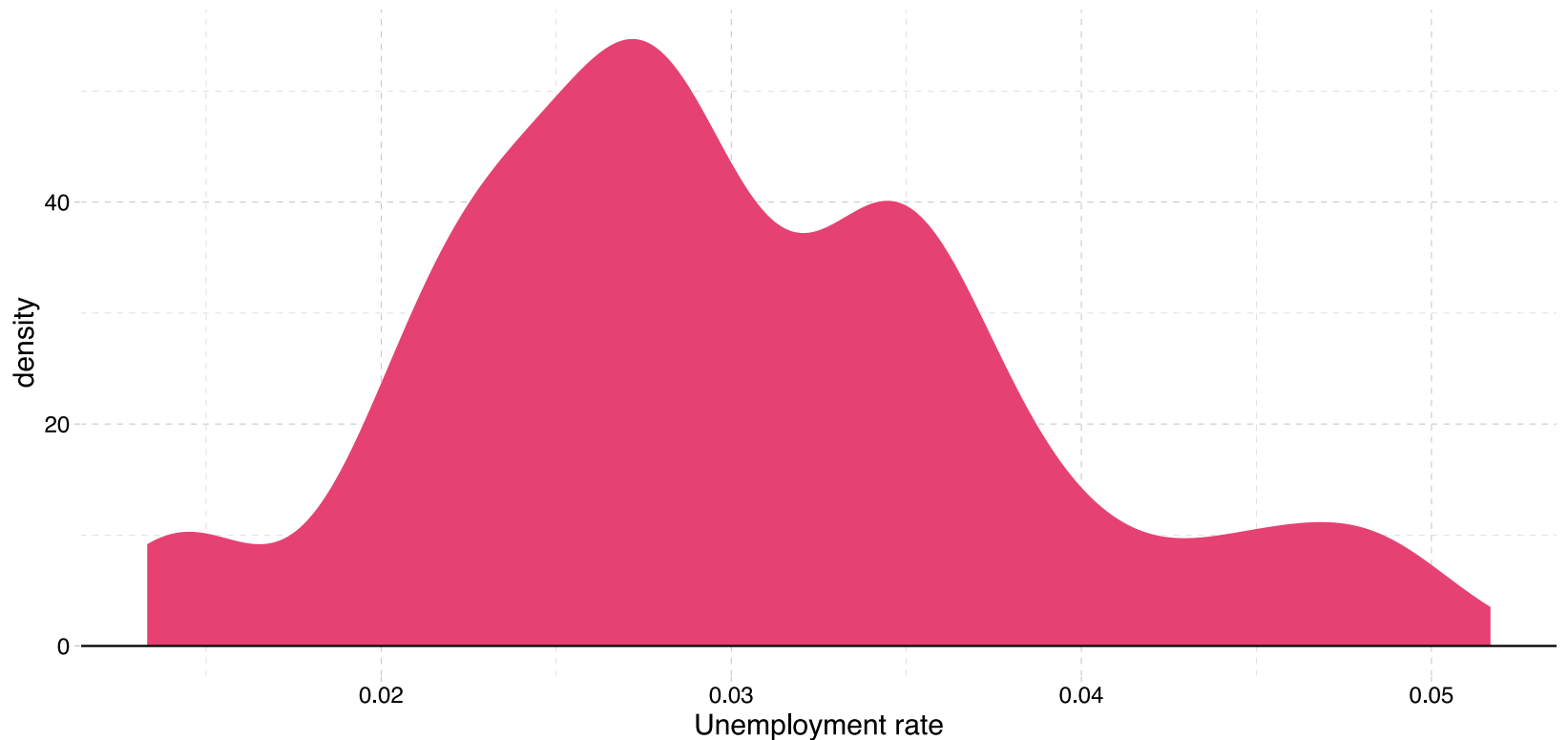
Add a horizontal line where count = 0.

```
ggplot(data = economics, aes(x = unemploy/pop)) +
xlab("Unemployment rate") +
geom_histogram(color = "white", fill = "#e64173") +
geom_hline(yintercept = 0) +
ggthemes::theme_pander(base_size = 14)
```

`ggplot2` knows densities.

A density plot.

```
ggplot(data = economics, aes(x = unemploy/pop)) +
xlab("Unemployment rate") +
geom_density(color = NA, fill = "#e64173") +
geom_hline(yintercept = 0) +
ggthemes :: theme_pander(base_size = 14)
```

Now with Epanechnikov kernel!

```r
ggplot(data = economics, aes(x = unemploy/pop)) +
xlab("Unemployment rate") +
geom_density(kernel = "epanechnikov", color = NA, fill = "#e64173") +
geom_hline(yintercept = 0) +
ggthemes::theme_pander(base_size = 14)
```
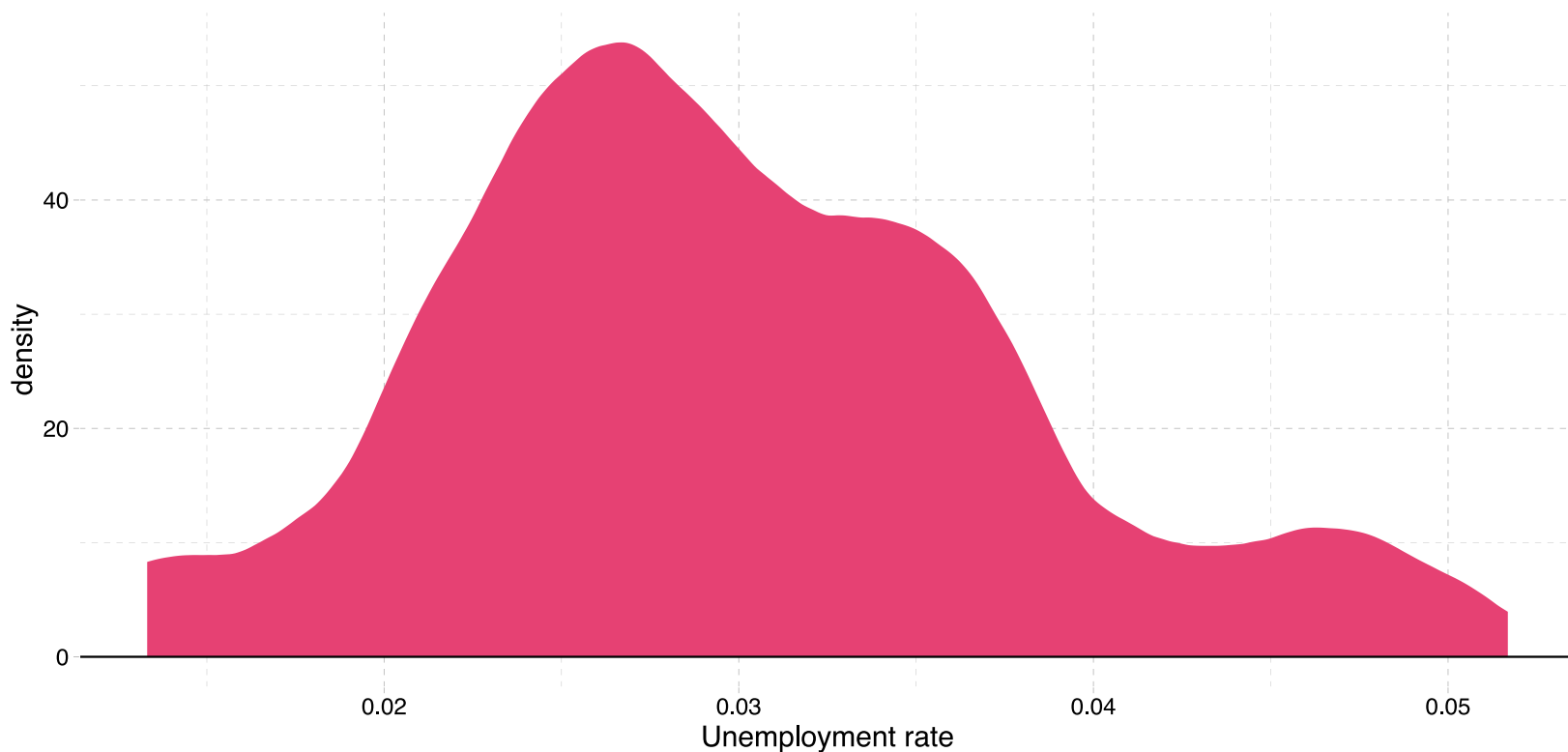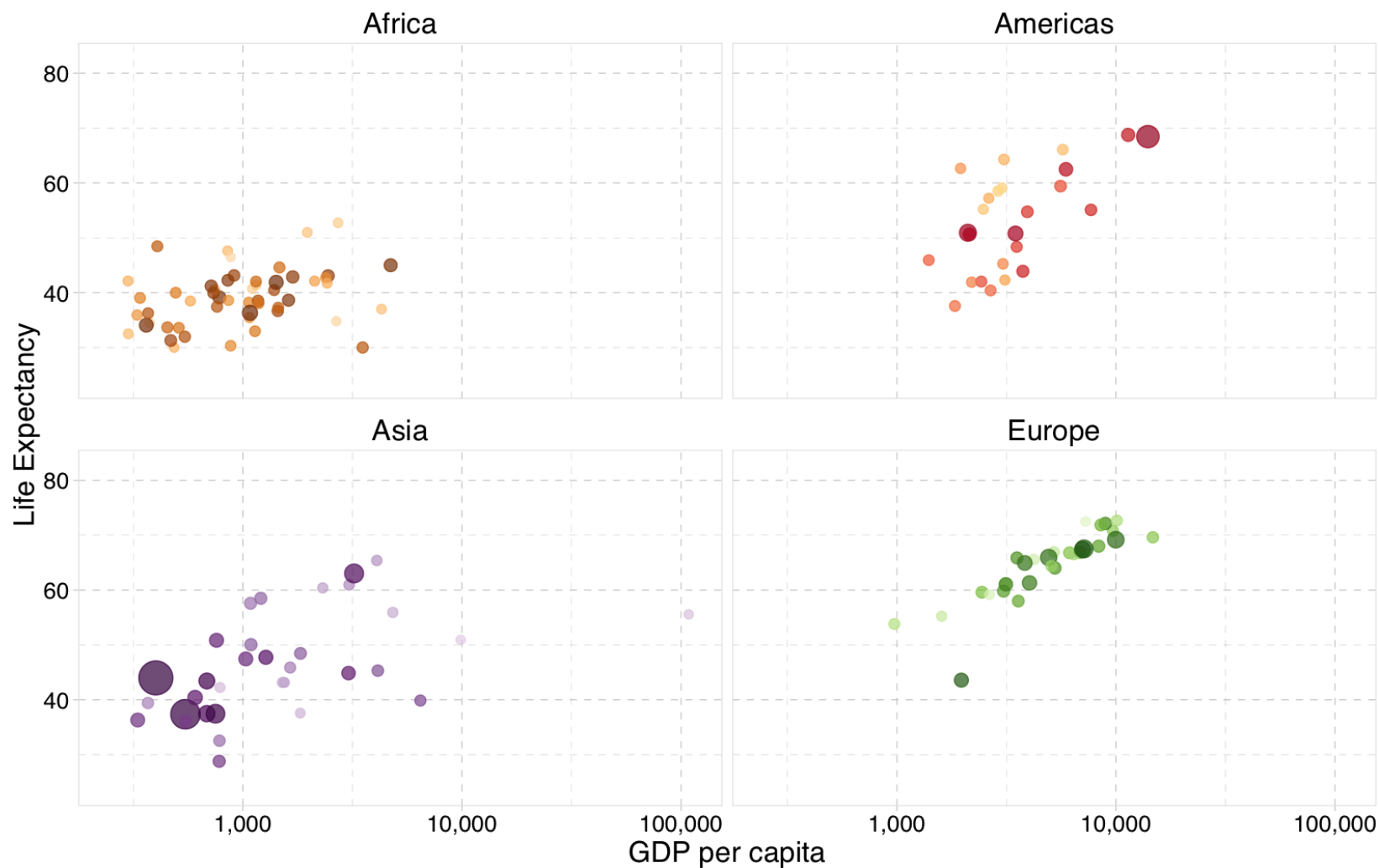
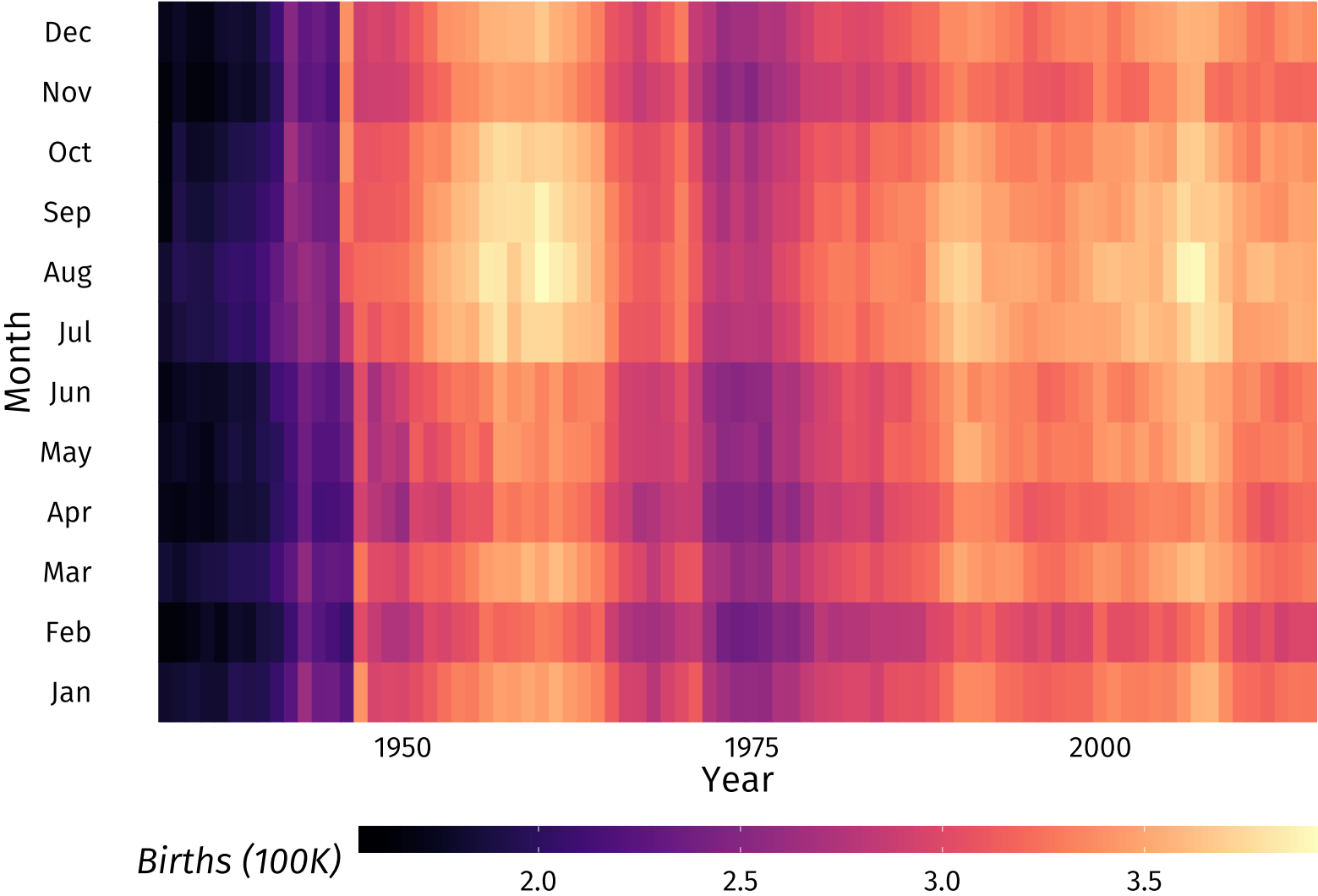`ggplot2` itself is incredibly flexible/powerful.

But there are even more packages that extend its power—*e.g.*, `ggthemes`, `gganimate`, `cowplot`, `ggmap`, `ggExtra`, and (of course) `viridis`.

Gapminder meets `gganimate`

Year: 1952

US births by month since 1933

Births (100K)

Resources

There's always more

`ggplot2`

1. RStudio's cheat sheet for `ggplot2`.
2. `ggplot2` reference index
3. The `tidyverse` page on `ggplot2`.
4. Hadley Wickham's on *Data visualization* in his data science book.

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Plotting

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