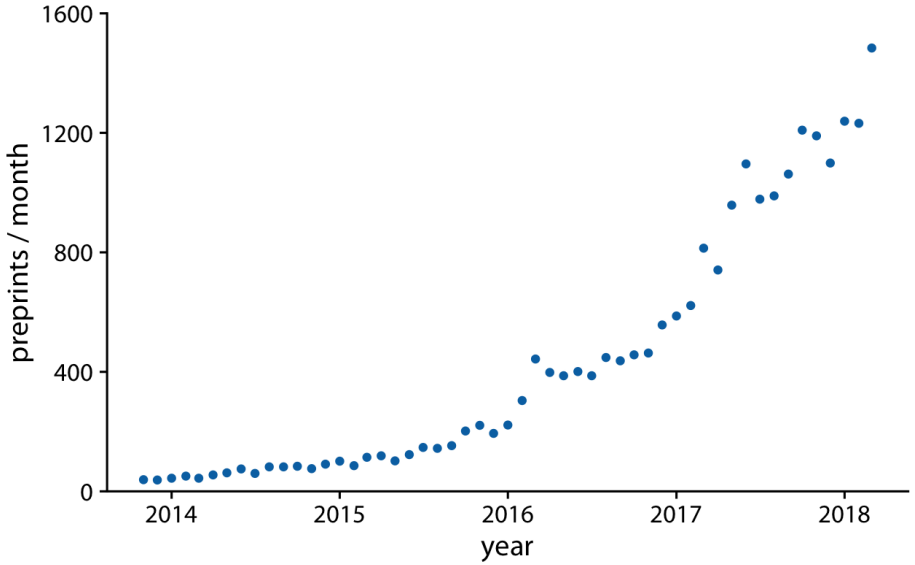
# CSCI 491: Data Visualization

## 21- Visualizing Time Series

# What is a Timeseries

- A special case of scatterplot when one of the two variables can be thought of as time
- As the data points have an inherent order ; we can arrange the points in order of increasing time and define a predecessor and successor for each data point.
- Time imposes additional structure on the data




The dots are spaced evenly along the *x* axis, and there is a defined order among them
Each dot has exactly one left and one right neighbor

Monthly submissions to the preprint server bioRxiv, from its inception in November 2013 until April 2018. Each dot represents the number of submissions in one month. There has been a steady increase in submission volume throughout the entire 4.5-year period. Data source: Jordan Anaya, http://www.prepubmed.org.

# Line Graph

- We frequently want to visualize this temporal order, and we do so with line graphs.
- Line graphs are not limited to time series, however. They are appropriate whenever one variable imposes an ordering on the data.
- The lines between points may help with perception when the points are spaced far apart or are unevenly spaced.

We can visually emphasize on the order by connecting neighboring points with lines called a line graph.

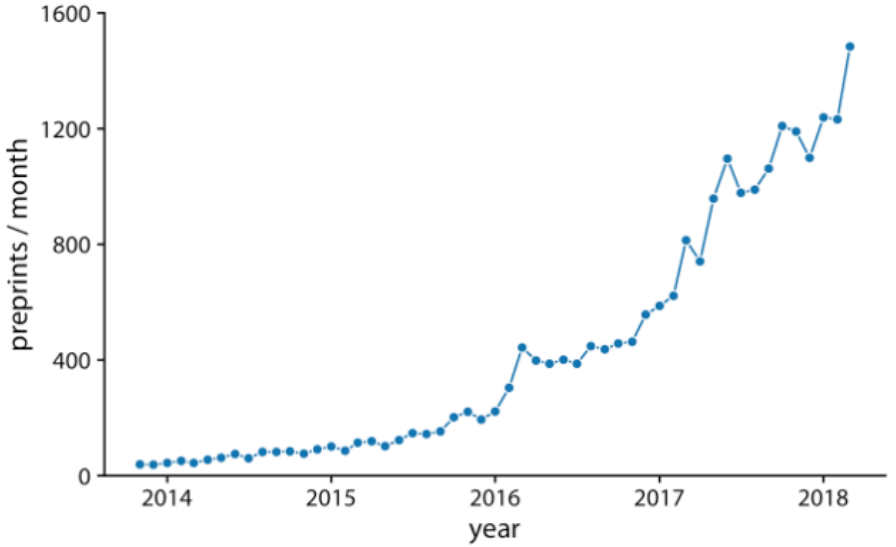



Figure 13-2. Monthly submissions to the preprint server bioRxiv, shown as dots connected by lines. The lines do not represent data and are only meant as a guide to the eye. By connecting the individual dots with lines, we emphasize that there is an order between the dots: each dot has exactly one neighbor that comes before it and one that comes after. Data source: Jordan Anaya, http://www.prepubmed.org.

# Line Graph

- Using  only to represent time series is generally accepted practice
- Without dots, the figure places more emphasis on the overall trend in the data and less on individual observations.
- A figure without dots is also visually less busy
- In general, the denser the time series, the less important it is to show individual observations with dots

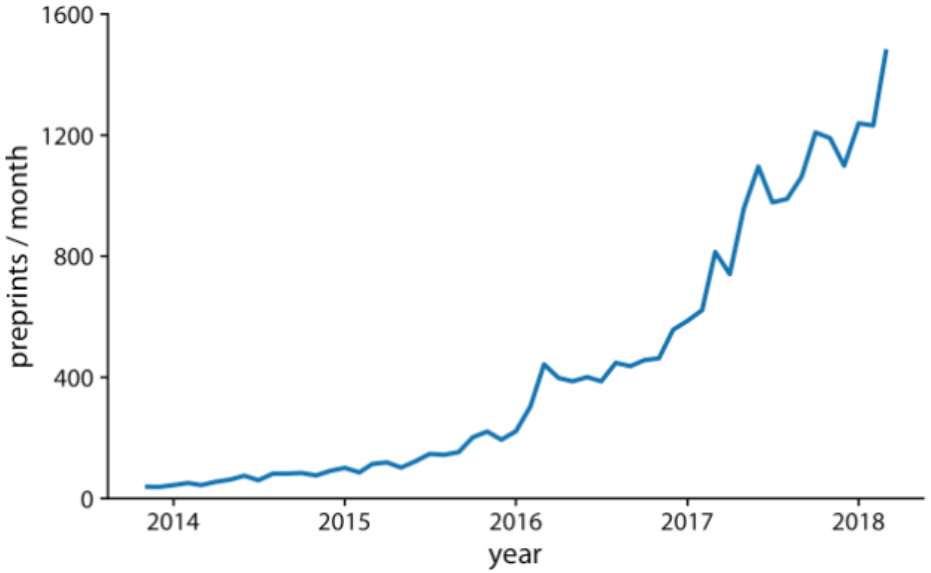



Figure 13-3. Monthly submissions to the preprint server bioRxiv, shown as a line graph without dots. Omitting the dots emphasizes the overall temporal trend while deemphasizing individual observations at specific time points. It is particularly useful when the time points are spaced very densely. Data source: Jordan Anaya, http://www.prepubmed.org.

# Line Graph

- We can also fill the area under the curve with a solid color
- This visualization is only valid if the y axis starts at zero

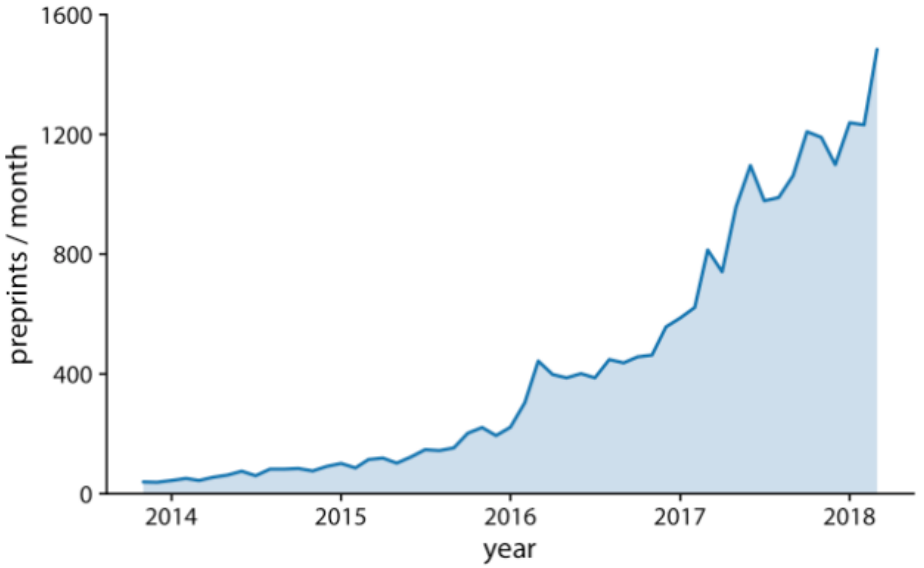
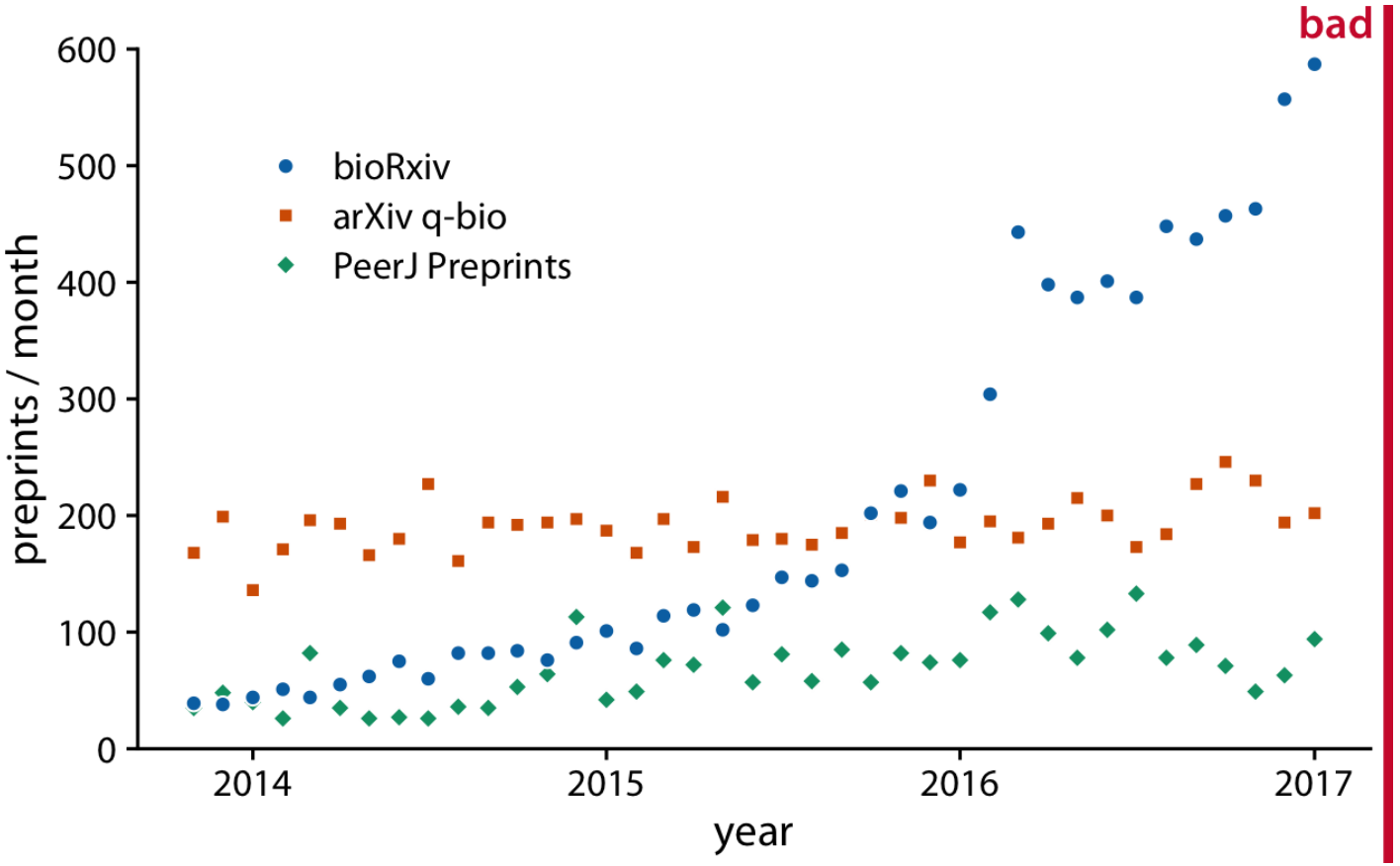
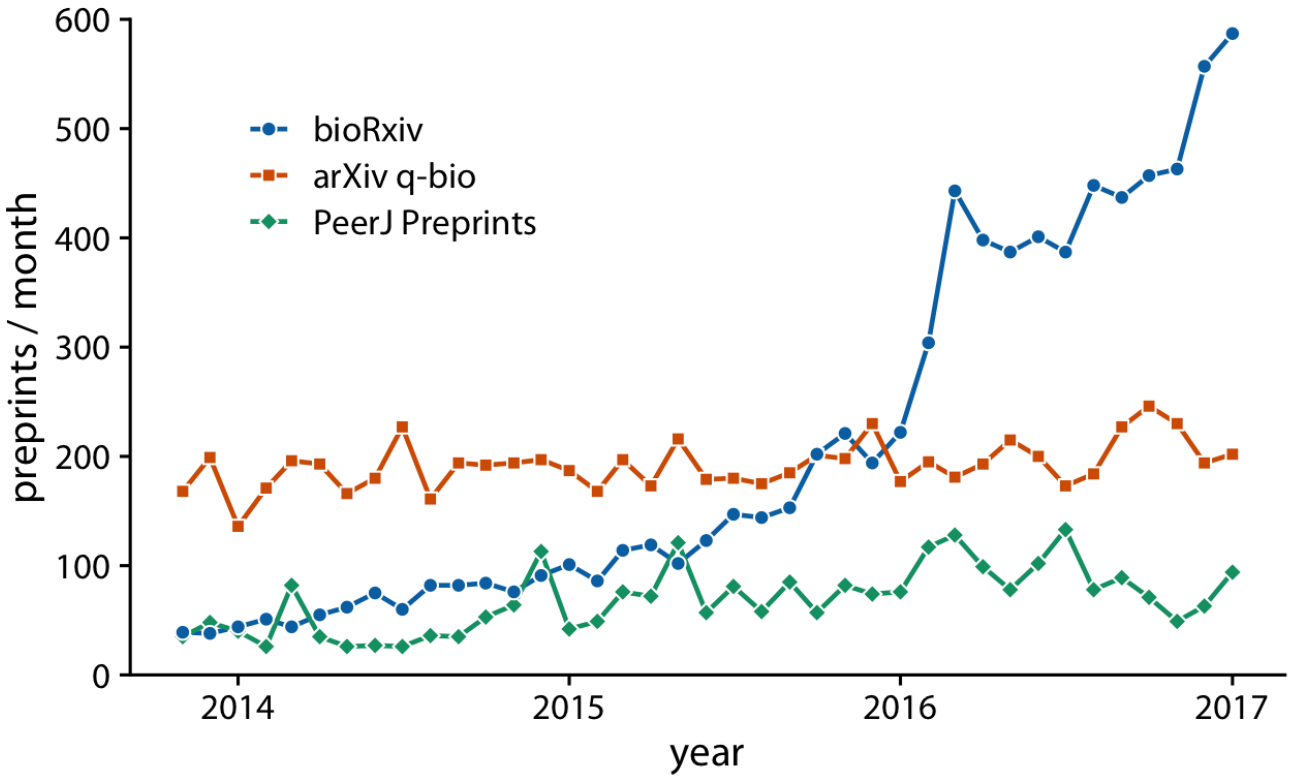



Figure 13-4. Monthly submissions to the preprint server bioRxiv, shown as a line graph with filled area underneath. By filling the area under the curve, we put even more emphasis on the overarching temporal trend than if we just draw a line (Figure 13-3). Data source: Jordan Anaya, *http://www.prepubmed.org*.

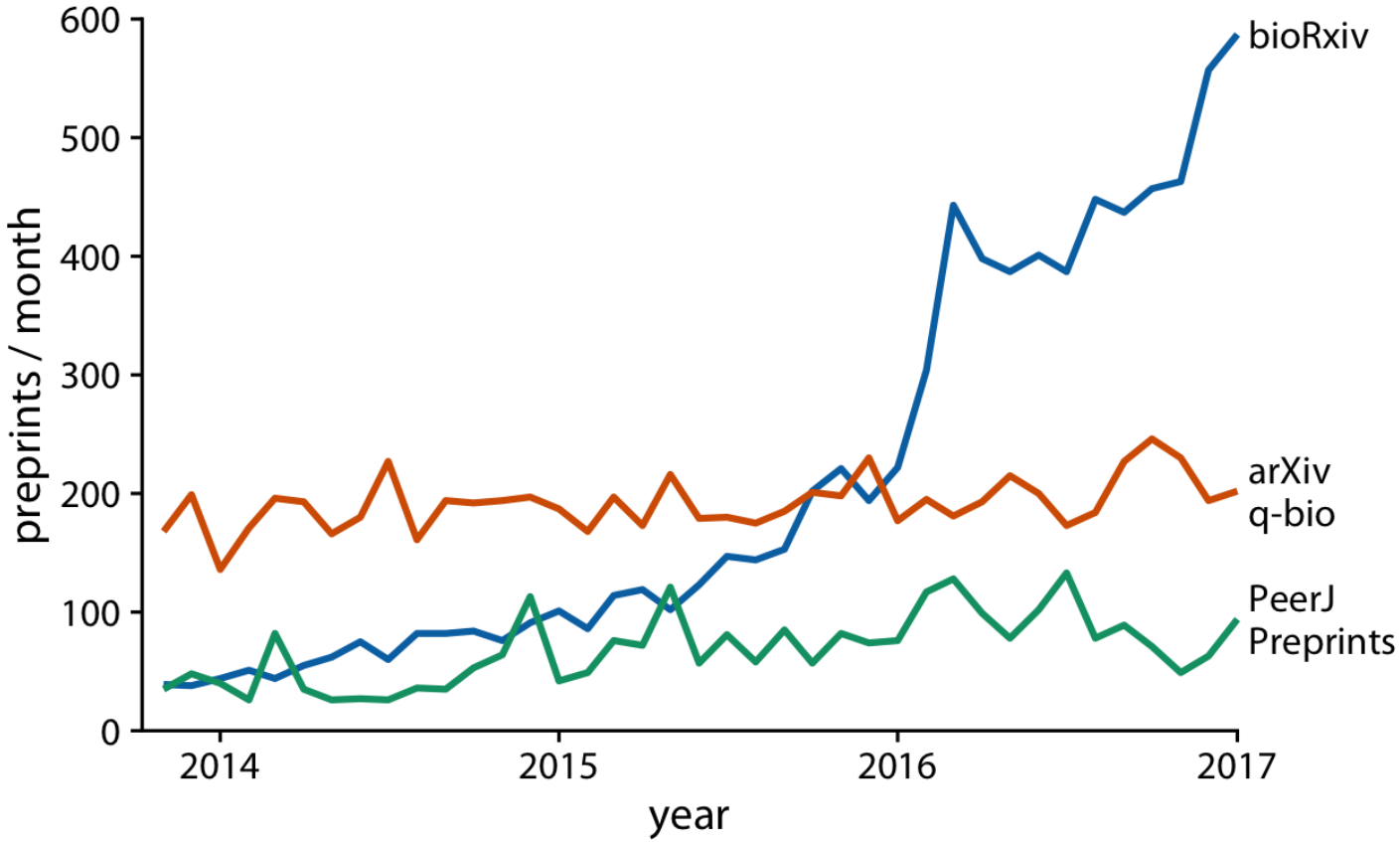
# Multiple Time Series



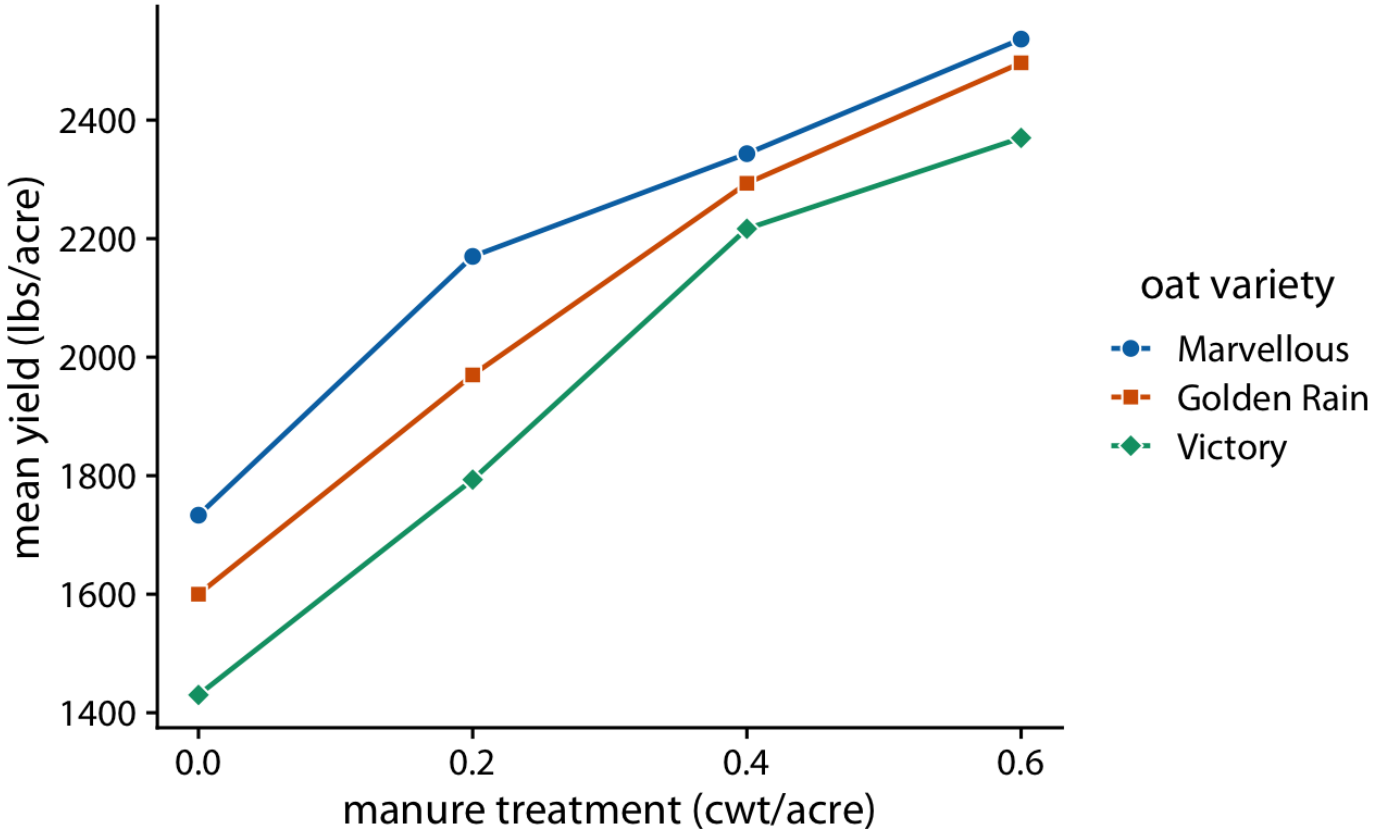
# Multiple Time Series



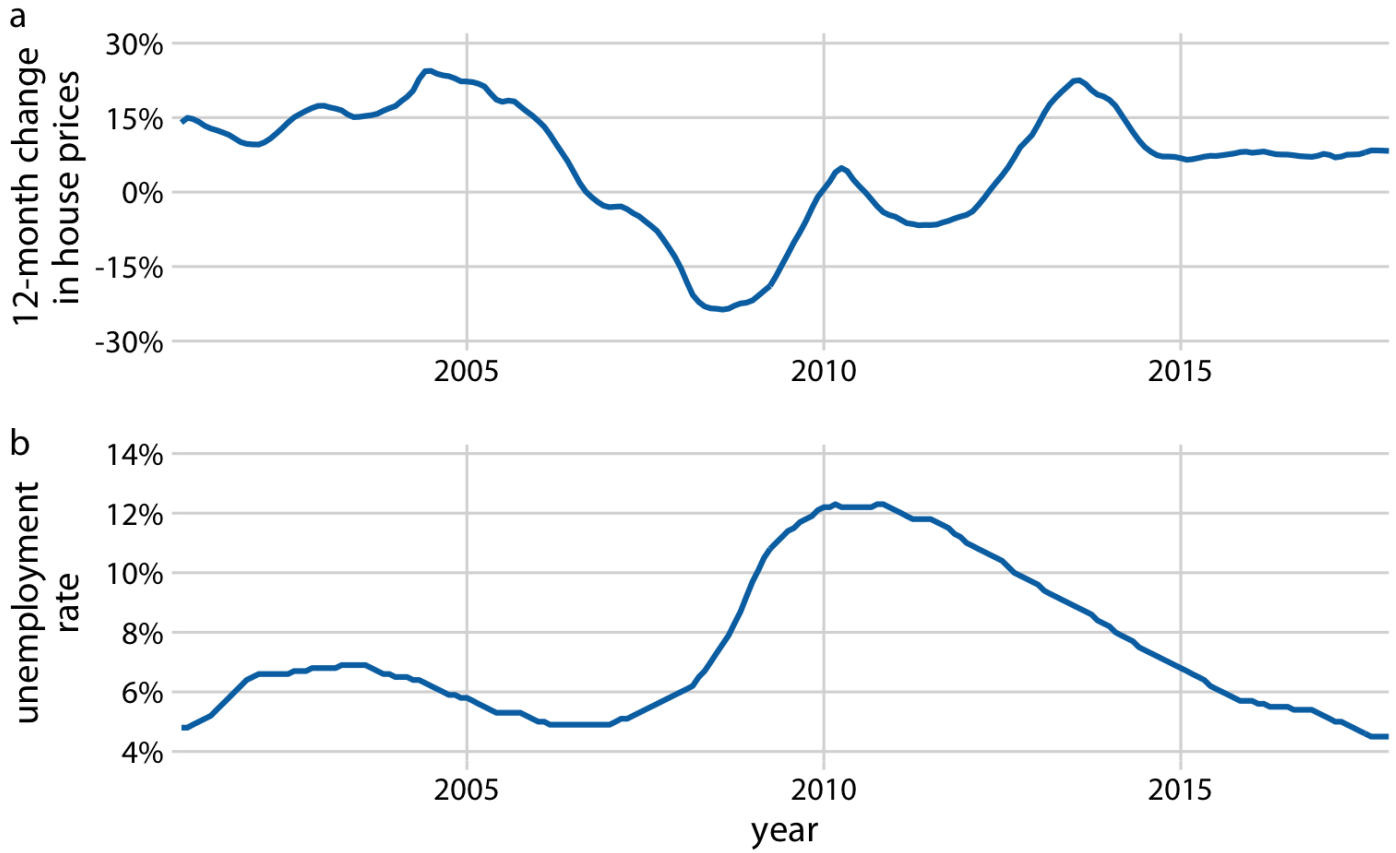
# Multiple Time Series



# Dose–response curves



# Time Series of Two or More Response Variables



# Time Series of Two or More Response Variables

# Time Series of Two or More Response Variables