Introduction to Data Visualization

Schoolyard Ecology Looking at Data Workshop for Teachers

Betsy A. Colburn
Harvard Forest

January 9, 2020
We use graphs of our data to tell a story and identify questions.

J. Mossman

J. Scanio

Choate Rosemary Hall
Our Changing Forests
Joseph Scanio
We use graphs of our data to tell a story and identify questions.
We use graphs of our data to tell a story and identify questions.

Global temperature anomaly, 1880-present

Atmospheric Carbon Dioxide (CO₂) levels, 1800–present

Temperature Anomaly w.r.t. 1800-2018

https://sealevel.info/co2.html

https://data.giss.nasa.gov/gistemp/graphs_v4
We use graphs of our data to tell a story and identify questions.

Data from Greenland ice cores through 1958, and subsequently from Mauna Loa Observatory, HI. Annual means of monthly measurements. 2019 data are from July, 2019 as estimate of annual average.

https://sealevel.info/co2.html

Temperature graph from weather stations and buoys worldwide; shows yearly average differences between measured land and ocean temperatures in a given year and a baseline average annual temperature (the temperature anomaly shown on the Y axis). Also shown is five-year running average, which is the average of the temperature anomalies for the current year and the four preceding years. The base period (0 point on Y axis) is 1951-1980.

https://data.giss.nasa.gov/gistemp/graphs_v4
We use graphs of our data to tell a story and identify questions.

Would this graph help you interpret year-to-year changes in tree growth, if that was the subject of the graph below?

What if this graph were showing changes in annual growth of trees relative to the previous year (biomass or diameter) what might you conclude?

https://data.giss.nasa.gov/gistemp/graphs_v4
Mean Date of 50% Leaf-fall in Four Species of Trees at the Harvard Forest, 1990-2018 (John O’Keefe Data)

- ACRUL50
- BEALL50
- QURUL50
- QUALL50

Day of Year vs. Year of Study

- $R^2 = 0.4322$
- $R^2 = 0.125$
- $R^2 = 0.1212$
- $R^2 = 0.1415$
a. Line graph – not appropriate

Date of last leaf fall in four trees, 2005

b. Bar graph – appropriate

Date of last leaf fall in four trees, 2005
Macroinvertebrate communities in a Cape Cod Vernal Pool, April and June, 1996. Data from EA Colburn

**April**
- Number of individuals collected: 376
- N = 376, 7%
- N = 68, 15, 22%
- N = 1, 2%

**June**
- Number of individuals collected: 68
- N = 376, 5,7%
- N = 68, 17, 10%
- N = 9, 13%

April, 376 organisms
June, 68 organisms
Density and Biomass of Trees and Shrubs in the Harvard Forest Megaplot
(Data from D. A. Orwig)

- **Density and Biomass (kg/ha):**
  - Red maple: 282, 16%
  - White pine: 109, 6%
  - Hemlock: 111, 6%
  - Yellow birch: 654, 38%
  - Beech: 61, 4%
  - Winterberry holly*: 4, 2%
  - Mountain laurel*: 0.4, 0%

- **Density (stems/ha):**
  - Red maple: 112, 7%
  - Red oak: 277, 16%
  - White pine: 109, 6%
  - Hemlock: 111, 6%
  - Yellow birch: 654, 38%
  - Beech: 61, 4%
  - Winterberry holly*: 4, 2%
  - Mountain laurel*: 0.4, 0%
Age and diameter of trees on Mt Wachusett. Data from DA Orwig.
Distribution of Six Tree Species and Six Shrub Species in the Harvard Forest Megaplot. (Data: D.A. Orwig)
We use graphs of our data to tell a story and identify questions.

Data from Greenland ice cores through 1958, and subsequently from Mauna Loa Observatory, HI. Annual means of monthly measurements. 2019 data are from July, 2019 as estimate of annual average.

https://sealevel.info/co2.html

Temperature graph from weather stations and buoys worldwide; shows yearly average differences between measured land and ocean temperatures in a given year and a baseline average annual temperature (the temperature anomaly shown on the Y axis). Also shown is five-year running average, which is the average of the temperature anomalies for the current year and the four preceding years. The base period (0 point on Y axis) is 1951-1980.

https://data.giss.nasa.gov/gistemp/graphs_v4
Steps in Preparing Visual Presentations of (Schoolyard) Data

• Collecting the Data

• Organizing Data and Inputting data to a Data base

• Preparing data for analysis
  – Transformations (e.g., change numbers to percent, date to Julian Day, etc.)
  – Extracting additional information
    • (e.g., biomass accrual for the whole plot, length of growing season)

• Carrying out data analysis

• Data analysis through visual presentations of data
  – Looking at Data – Graphing considerations
  – Kinds of graphs – what is appropriate for your data and questions?

Level 1 – STEP 1 IN DATA ANALYSIS
Levels 2 and 3 also need to do this

Level 2 teachers – Creating graphs by hand or by using graphics programs with structured exercises
  Looking at graphs and answering questions about them.

Level 3 teachers – Organizing your students’ data and creating and interpreting graphs of the data, or otherwise working with data to meet your individual goals for today. We hope graph INTERPRETATION will be part of your work!

Everyone – wrapping up
• Sharing graphs, ideas, questions
• Workshop evaluation and feedback