Visualization

- Displaying information in a meaningful fashion
Visualization Should…
(Tufte, 1983)

- Show the data
- Induce the viewer to think about the substance
- Avoid distorting what the data have to say
- Make large data sets coherent
- Encourage the eye to compare different pieces of data
- Reveal the data at several levels
- (And other stuff too)
Visualization

- A big area
- Worthy of a course in its own right
- Rather than discussing standard visualizations
- I’ll discuss a few visualizations that are particularly important with educational data
Learning Curves

- One of the most important visualizations in education
- Briefly discussed in Week 4
- I’ll go into more depth today
The Classic Learning Curve
Assumptions

- The student is practicing the same skill several times in (approximately) the same fashion

- Completing a physics problem set

- Reading the same word in several stories

- Learning to complete an assembly line procedure
  - Early application! (Crossman, 1959)
Assumptions

- Similar methods and considerations apply to situations where the student is recalling the same knowledge several times.
Assumptions

- We have some way to measure student performance over time
  - Speed or accuracy
Learning LISP programming in the LISP Tutor (Corbett & Anderson, 1995)
Learning in Cognitive Tutor Geometry (Ritter et al., 2007)

![Graph showing time to solution vs. number of problems](image-url)
A certain characteristic pattern
Power Law of Learning*

- Performance (both speed and accuracy) improves with a power function

* -- May actually be an exponential function rather than a power function (Heathcote, Brown, & Mewhort, 2000)
Called Power Law

- Because speed and accuracy both follow a power curve

- Radical improvement at first which slows over time towards an asymptote

- Passing the asymptote usually involves developing entirely new strategy
Passing the Asymptote

- Famous example: Fosbury Flop

  - http://www.youtube.com/watch?v=Id4W6VA0uLc
Power Law of Learning proven to apply across many domains

- Simple domains
  - Pressing correct button on stimulus

- Complex problem-solving domains
  - Math
  - Programming

- Real-world domains
  - Cigar-making in factories (Crossman, 1959)
Real-world data

- Are rarely perfectly smooth…
- (At least not without hundreds of students or more)
Example from a minute ago
Making inference from learning curves
Making inference from learning curves

- Via visual inspection of the curve form
“Normal learning”
No learning going on
What might this graph mean?
Student has already learned skill for the most part
What might this graph mean?
Student learned a new strategy and “broke through” the asymptote.
What might this graph mean?
Two skills treated as the same skill
(Corbett & Anderson, 1995)
Uses

- To understand how (and whether) a skill is being learned across students
Uses

- To study and refine item-skill mappings in educational software

- As discussed in week 4, Pittsburgh Science of Learning Center DataShop (Koedinger et al., 2010) is a common tool for doing this
Week 6 Video 1

Visualization

Learning Curves