36-315: Statistical Graphics and Visualization

Handout 21
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Dynamic graphics (movies)

So far, we have encoded data using "still" representations like position, length, area, angle, and color. We have used 3D perspective to move beyond two-dimensions. But another dimension that we can use is **time**.

Graphics that represent a variable using time are known as `dynamic graphics` or simply `movies`. This variable could actually be time, as in the mumps data, or it could be some other variable that we have chosen to represent using time. Thus we have to distinguish between the variable `time` (in a dataset) and a time variable (a variable represented by time in a movie).

The mumps data has four dimensions: `latitude`, `longitude`, `incidence rate`, and `time`. The movie encodes these in the most direct way, using color for `incidence rate` and time for `time`. But you could instead use longitude to represent `time`, and time to represent `longitude`. This movie would show the time behavior of mumps in different slices of the country.

Movies are really just **slice plots**, with slices shown one at a time. Thus the variable represented using time should be the one which is most useful to slice on. By definition, this is the variable which can best predict the response.

Making movies

Twenty years ago, statistical movies on videotape required specialized and expensive hardware to produce, and a single movie meant a large investment. Today, a laptop can produce digital MPEG movies en masse.

Movies are made in R by writing a function that takes a frame number and draws the corresponding frame. R then loops through the frames and collects the results into an MPEG file.

Time interpolation is almost always required to get a visually pleasing movie. In practice, this is done by mixing consecutive movie frames (a "fade").

To fill in missing or uncertain values, data can be smoothed in time, just as in space. Time just represents another variable in the dataset. Since the time variable is usually the best predictor (see above), this can be quite important.

Choosing the color breaks:

Time-varying Color breaks are optimized for each movie frame. Maximizes spatial contrast—the distribution of mumps at a given time.

Space-varying Each state has its own breaks, fixed over all time. Emphasis is on temporal shape of each state, via color change with time. Good for showing the correlation of states.

Fixed for all space and time Maximizes temporal contrast of maps—the change of mumps over time.

The mumps movie:

- Smoothed in space and time
- Interpolated in time to give 24 frames per second (the standard video rate)
- Colormap fixed for all space and time
- Three sub-movies: choropleth, area smoothing, residuals from the trend