Time Series: Introduction

- Data are collected sequentially are time.

Examples

- Weekly interest rates
- Daily temperatures
- Improvement in condition throughout clinical trial
  (longitudinal study - added degree of difficulty
  - uneven time periods).

Purposes of Time Series

1. Understand stochastic (random) process that gives rise to our data.
2. Predict/forecast future values of the response variable.

Key Difference from Regression

- Observations are not usually independent.

Examples

1. Rainfall in LA

Time Series plot tells us about overall pattern if there is one.

- Can we gain information from previous years?
  - Plot inches of rain vs. year
- No clear pattern - Can't really tell much about this year's rainfall from last year's.

② Chemical Process

- Measure color property based on consecutive batches.
  - Time series plot - neighbors tend to be similar in size (related?)
  - Scatterplot of current color property versus previous batch property.
  - somewhat linear - suggests a relationship

③ Abundance of Canadian Hare

Time series plot - neighbors are quite closely related.
- Scatterplot of Abundance of hare this year vs. abundance in previous year.
  - somewhat linear - low values with low.

④ Monthly Average Temperatures - Dubuque, IA

- Plot shows seasonality - still have variation in January values, in June values.

- Models have to incorporate this variation while also accounting for seasonality.

⑤ Monthly Oil Filter Sales

- Time series plot shows seasonality.
  - Specify plotting symbols for each month.
  - Easier to see with plotting symbols.

A Strategy For Model-Building

3 Steps
1. Model Specification
2. Model fitting
3. Model Diagnostics

Specification
- Propose a model that may be appropriate for observed series
  - Can revise later
- Principle of Parsimony: Obtain/use simplest model (fewest parameters) that explain behavior of series adequately (in some sense).

Fitting
- Find "best" (in some sense) possible estimates of model parameters
  - Typically maximum likelihood or least squares.

Diagnostics
- Assess quality of model.
- Assess validity of model assumptions
- If there are problems, start over or transform data. Otherwise, model-building is complete.

- Cycle through these until model-building is complete.