Lecture 17
Chapter 15 Understanding and Reporting Trends over Time; Review

- Time Series
- 4 Features of Time Series
- Review of Part Two

Constructing & Summarizing a Time Series

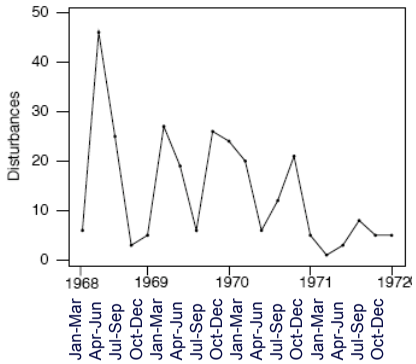
- Horizontal axis for time, vertical for responses
- Connect the dots
- Consider main features:
  - Long-term trend
  - Seasonal components
  - Irregular cycles
  - Random fluctuations

Example: *Visualizing a Time Series*

- **Background**: Suppose you recorded the number of hours spent on homework each week over 4 years.
- **Question:** What would the time series plot show?
- **Response:**
  - **Long-term trend:**
  - **Seasonal components:**
  - **Irregular cycles:**
  - **Random fluctuations:**

Example: *Analyzing a Time Series*

- **Background**: Civil disturbances in U.S., 1968-1970.

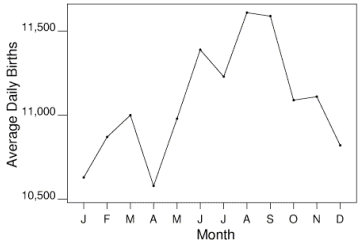


Example: *Analyzing a Time Series*

- **Background**: Civil disturbances in U.S., 1968-1972:
- **Question:** What does the time series plot show?
- **Response:**
  - **Long-term trend:**
  - **Seasonal components:**
  - **Irregular cycles:**
  - **Random fluctuations:**

Example: *Time Series: Lows and Highs*

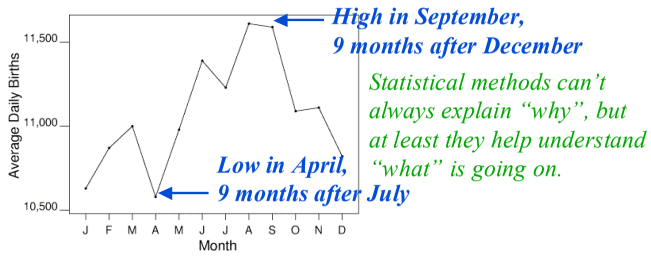
- **Background**: Time series plot shows average daily births each month in year 2000 in the U.S.:



- **Question:** Where do you see a low and a high?
- **Response:**

Example: *Time Series: Lows and Highs*

- **Background**: Time series plot shows average daily births each month in year 2000 in the U.S.:



Statistical methods can't always explain "why", but at least they help understand "what" is going on.

- **Questions:** How can we explain why there are…
  - Conceptions in U.S.: fewer in July, more in December?
  - Conceptions in Europe: more in summer, fewer in winter?
- **Response:**

Significant Relation in 2 Cat. Vars. *(Review)*

1. Compute each expected count $= \dfrac{\textit{Column total} \times \textit{Row total}}{\textit{Table total}}$
2. Calculate each component $= \dfrac{(\text{observed} - \text{expected})^2}{\text{expected}}$
3. Find chi-square = sum of $\dfrac{(\text{observed} - \text{expected})^2}{\text{expected}}$
4. If chi-square > 3.84, there is a statistically significant relationship. Otherwise, we don't have evidence of a relationship.

Example: *Comparing Proportions*

- **Background**: An experiment considered if wasp larvae were less likely to attack an embryo if it was a brother:

	Attacked	Not attacked	Total
Brother	16	15	31
Unrelated	24	7	31
Total	40	22	62

- **Question:** What are the relevant proportions to compare?
- **Response:**
  - Brother:
  - Unrelated:
  - → _____ likely to attack a brother wasp

Example: *Expected Counts*

- **Background**: Kinship and aggression in wasps…

	Attacked	Not attacked	Total
Brother	16	15	31
Unrelated	24	7	31
Total	40	22	62

- **Question:** If kinship and aggression were not related, what counts would we expect?
- **Response:** Overall 40/62 attacked→ expect _____brothers, _____ unrelated to be attacked, remaining _____ brothers unattacked, _____ unrelated unattacked

Example: *Comparing Counts*

- **Background**: Tables of observed and expected counts in wasp aggression experiment:

Obs	A	NA	T
B	16	15	31
U	24	7	31
T	40	22	62

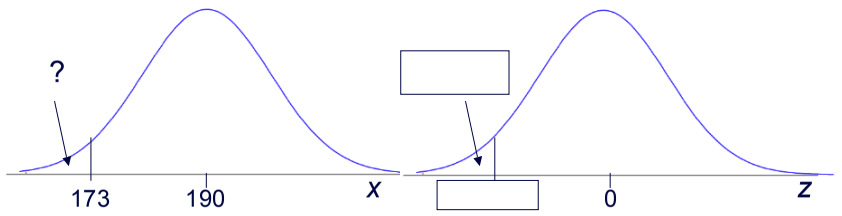
Exp	A	NA	T
B	20	11	31
U	20	11	31
T	40	22	62

- **Question:** What is chi-square? Conclude?
- **Response:**

Conclude kinship and aggression _____

Example: *Normal Exercise #1*

- **Background**: Healthy cholesterol levels *x* are normal with mean 190, sd 10.
- **Question:** What % are below 173?
- **Response:**



Example: *Normal Exercises #2*

- **Background**: Healthy cholesterol levels x are normal with mean 190, sd 10.
- **Questions:** What % are (a) > 182 (b) <234 (c) >192
- **Responses:**

Example: *Normal Exercises #3*

- **Background**: x is normal with mean 190, sd 10.
- **Questions:** (a) The lowest 5% are below what level? (b) The top 20% are above what level?
- **Responses:**

Example: *Smoking and Alcohol Related?*

- **Background**: Overall proportion alcoholic is $\frac{40}{1000} = 0.04$

Obs	D	ND	T
V	14	18	32
P	15	7	22
T	29	25	54

- **Questions:** What counts do we expect if no relationship?
- **Response:** Expect…
  - _____ smokers to be alcoholic
  - _____ non-smokers to be alcoholic
  - _____ smokers not alcoholic
  - _____ non-smokers not alcoholic

Example: *Smoking & Alcohol (continued)*

- **Background**: Observed and Expected Tables:

Obs	A	NA	Total
S	30	200	230
NS	10	760	770
Total	40	960	1000

Exp	A	NA	Total
S	9.2	220.8	230
NS	30.8	739.2	770
Total	40	960	1000

- **Question:** Find components & chi-square; conclude?
- **Response:** chi-square

The relationship is significant, because