

# Lecture 17

## Chapter 15 Understanding and Reporting Trends over Time; Review

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



# Constructing & Summarizing a Time Series

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



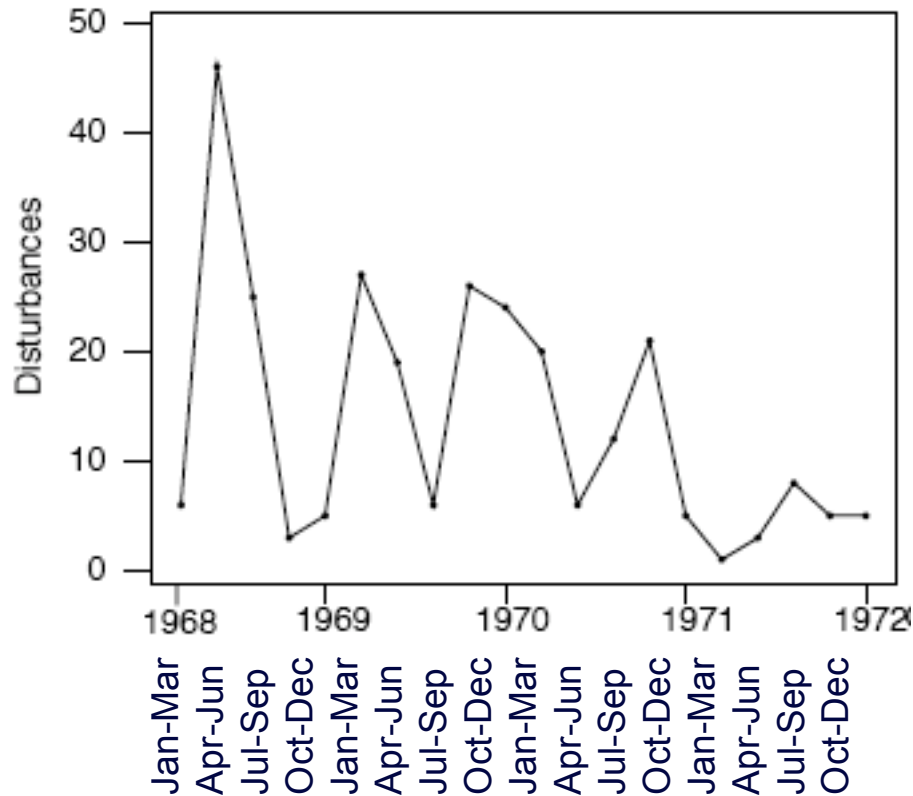
## **Example:** *Visualizing a Time Series*

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- **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., 1968-1972.
- **Question:** What does the time series plot show?





## **Example:** *Analyzing a Time Series*

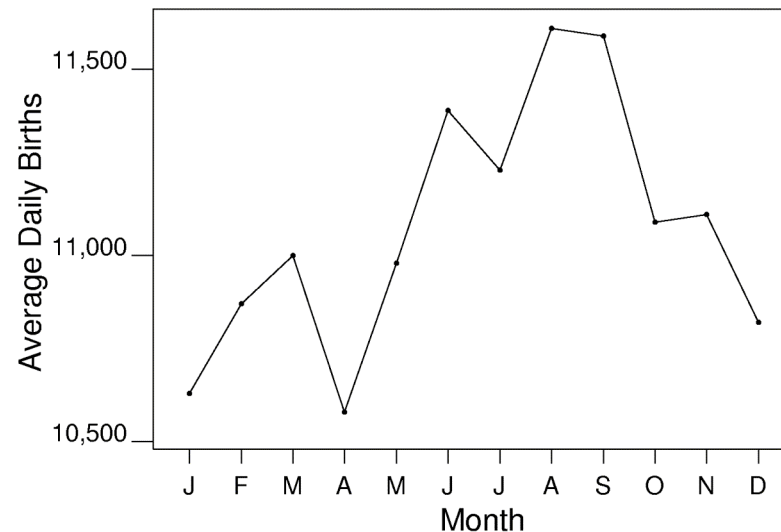
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- ❑ **Background:** Civil disturbances in U.S., 1968-1972:
- ❑ **Question:** What does the time series plot show?
- ❑ **Response:**
  - **Long-term trend:**
  - **Seasonal components:**
  - **Irregular cycles:**
  - **Random fluctuations:**

## Example: *Time Series: Lows and Highs*

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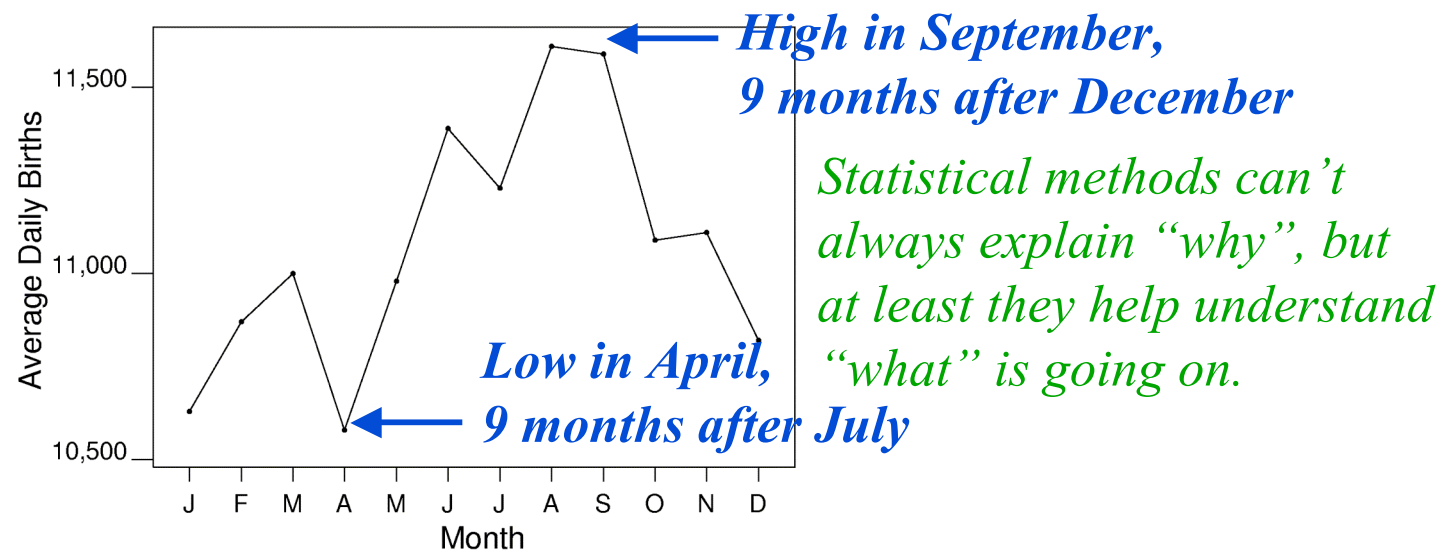
- **Background:** Time series plot shows average daily births each month in year 2000 in the U.S.:



- **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.:



- **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*)

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



## Example: *Comparing Proportions*

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- **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

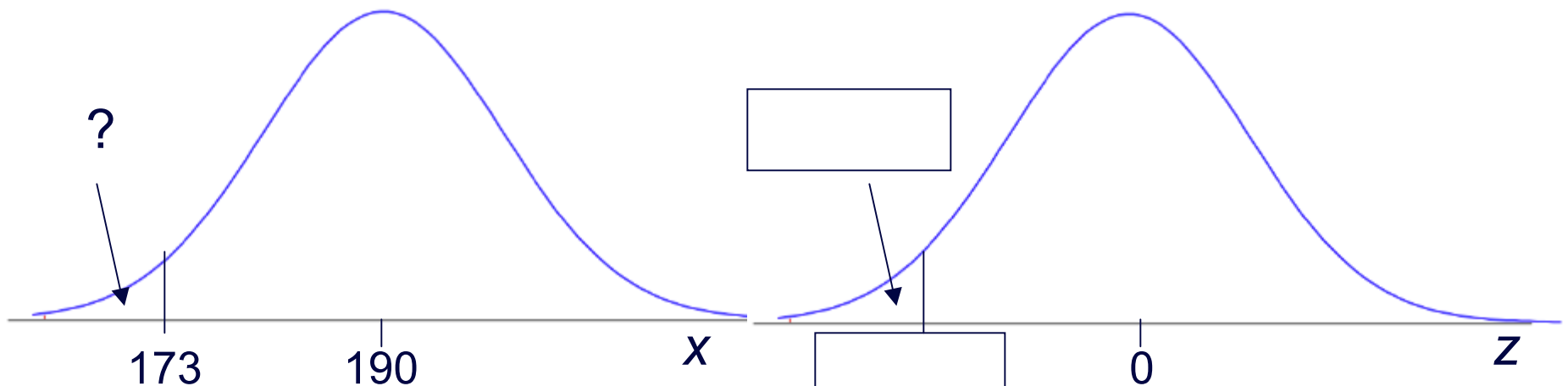
- **Question:** What is chi-square? Conclude?
- **Response:**

$$\frac{(16-20)^2}{20} + \frac{(15-11)^2}{11} + \frac{(24-20)^2}{20} + \frac{(7-11)^2}{11} = 4.50 > 3.84$$

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*

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- **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*

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- **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: *Gender and Attendance Related?*

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- **Background:** Data on gender and attendance...

Obs	A	NA	T
M			
F			
T			

Exp	A	NA	T
M			
F			
T			

- **Questions:** What are the expected counts and chi-square?  
What do we conclude?
- **Response:**

**EXTRA CREDIT (max 5 pts.)** Present a reasonable explanation for why in some countries (including the U.S.), there are fewer conceptions in July and more in December, whereas in other countries in comparable climate zones (including Canada) there are more conceptions in summer and fewer in winter.