



## Chapter 15

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# Understanding and Reporting Trends Over Time

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# Thought Question 1:



What do you think is meant by the term *time series*?

## Thought Question 2:



What do you think it means when a monthly economic indicator, such as new housing starts, is reported as having been *seasonally adjusted*?

# Thought Question 3:



If you were to plot number of ice cream cones sold versus month for 5 years, do you think the plot would show peaks and valleys, or would sales be relatively constant across all months?

Explain.

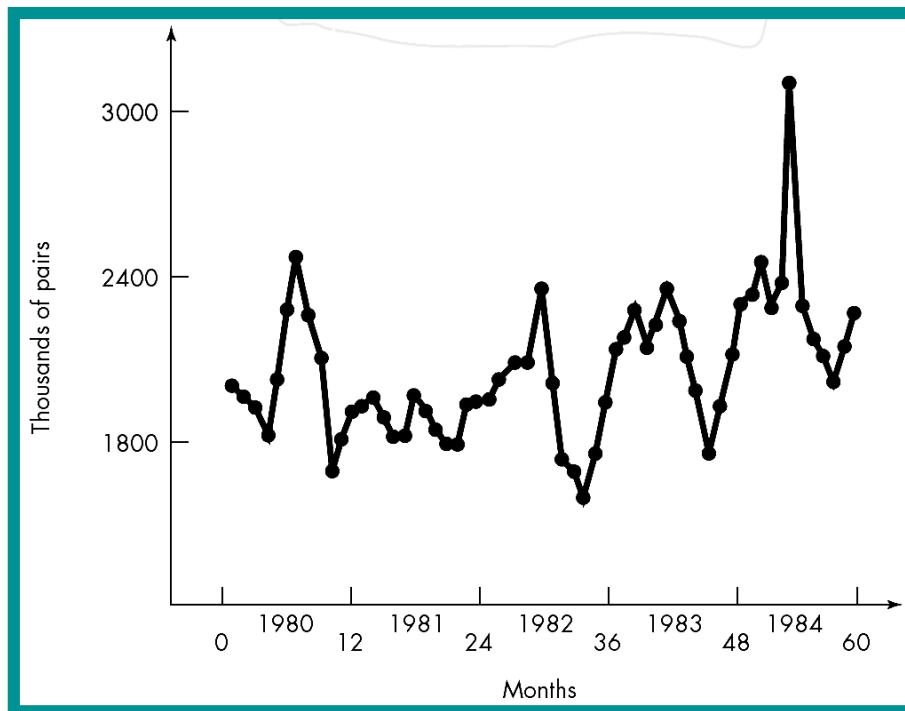
## Thought Question 4:



If someone is trying to get you to invest in his or her company and shows you a **plot of sales or profits** over time, **what features** of the picture do you think you **should critically evaluate** before you decide to invest?

# 15.1 Time Series

**Time series:** record of a variable across time, usually measured at equally spaced time intervals.



## **Time series plot:**

Jean sales in the United Kingdom from 1980 to 1984.

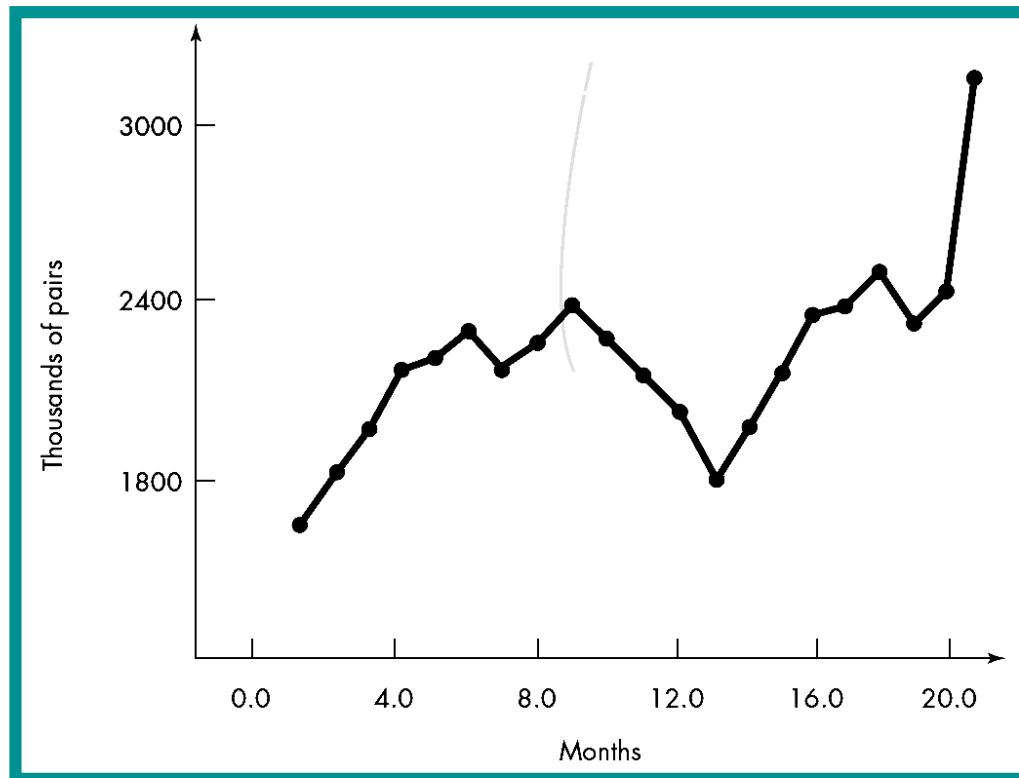
Data points connected so easier to follow ups and downs across time.

*Source:* Hand et al., 1994, p. 314.

# Improper Presentation of a Time Series



Using a subset of the data or starting the plot at an advantageous point.



**Jeans sales for  
21 months**

*Distortion caused by  
displaying only part  
of a time series.*

# 15.2 Components of Time Series

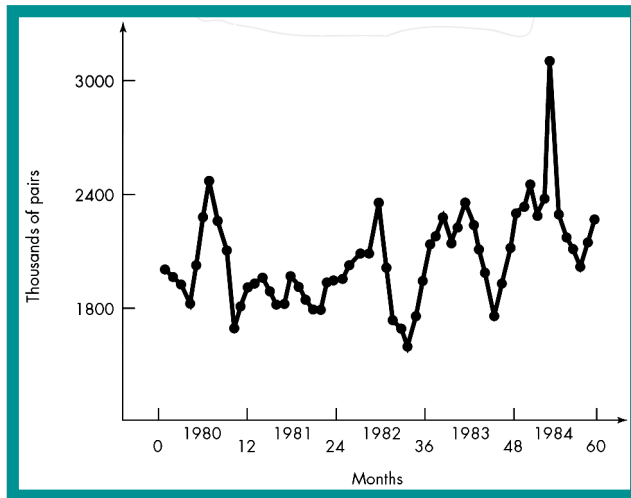


- 1. Long-term trend**
- 2. Seasonal components**
- 3. Irregular cycles**
- 4. Random fluctuations**



# Long-Term Trend

**Trend:** steady increase or decrease across time.



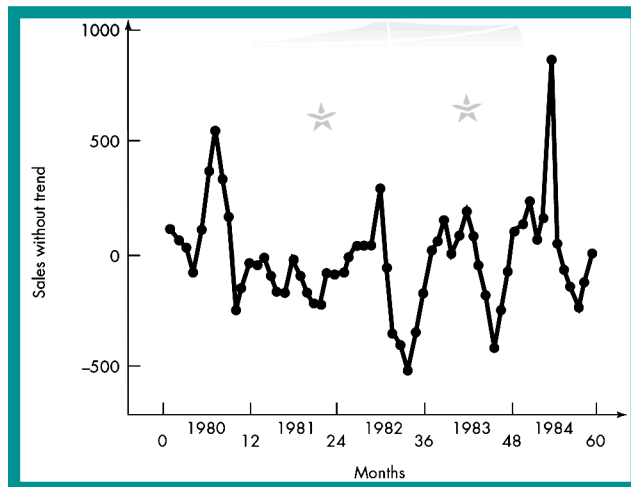
**Increasing trend for jean sales**

The regression line is:

$$\text{sales} = 1880 + 6.62 (\text{months})$$

where month 1 = Jan 1980

Expect sales to increase about 6.62 units (or 6620 pairs) per month.



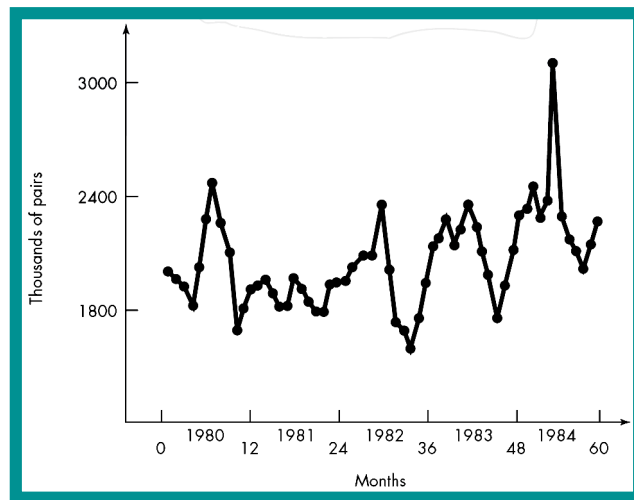
An example of a

**detrended time series:**

Jeans sales with trend removed

# Seasonal Components

**Seasonal components:** tend to be high in certain months or seasons and low in others every year.

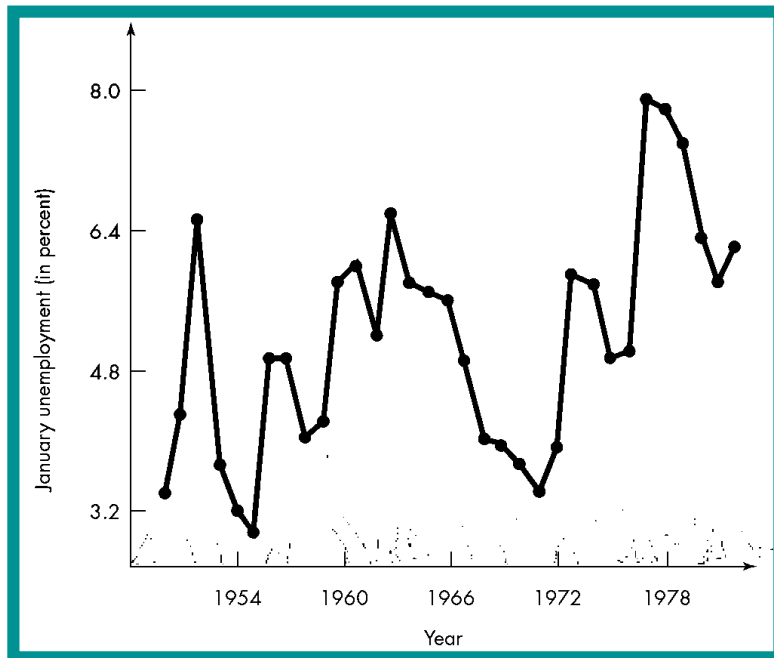


## Seasonal component for jean sales

Sales peak during June and July and reach a low in October every year.

Economists have sophisticated methods for seasonally adjusting time series using *seasonal factors* as multipliers.

# Irregular Cycles and Random Fluctuations



**U.S. unemployment rate, seasonally adjusted for each Jan from 1950-1982.**

**Irregular cycles** – some explained by social and political factors.

**Random fluctuations** – what is left over when the other three components have been removed. They are part of the natural variability present in all measurements.

# 15.3 Seasonal Adjustments: Reporting the CPI



Most news reports do not give the actual CPI – only the *change* from the previous month.

**Consumer Prices Rose 0.3% in June** *Washington, July 13—Consumer prices climbed three-tenths of 1 percent in June, as increases for cars, gasoline, air fares and clothing more than offset moderation in housing, the Labor Department reported today. (Hershey, 19 July 1994, p. C1)*

Also often missing is the statement: “Consumer prices—percent change, month to month, *seasonally adjusted*.”

Adjustments have already been made since certain items are expected to cost more during certain months of the year.

# Why Are Changes in the CPI Big News?



Financial markets are *extremely sensitive to changes* in the rate of inflation.

*Unlike Tuesday's surprisingly favorable report that prices at the producer level were unchanged last month, the C.P.I. data provided little comfort to the majority of analysts, who say that inflation—higher in June than in either April or May—has begun a gradual upswing, and that the Federal Reserve will need to raise short-term interest rates again by mid-August. (Hershey, 19 July 1994, p. C1)*

It is the *changes* that *attract concern* and attention, not the continuation of the status quo.

# 15.4 Cautions and Checklist

*Ask the following when reading time series data:*

1. Are the time **periods** equally spaced?
2. Is the series **adjusted for inflation**?
3. Are the values **seasonally adjusted**?
4. Does the series **cover enough of a time span** to represent typical long-term behavior?
5. Is there an **upward or downward trend**?
6. Are there other **seasonal components** that have not been removed? (E.g. sales of toys go up in December.)
7. Are there **smooth cycles**?

## Example: The Dow Jones Industrial Average

**Dow Jones Industrial Average (DJIA):** weighted average of price of 30 major stocks on NYSE.

But DJIA is *not adjusted for inflation*.

In 1970, high was \$842.00 (on Dec 29).

In 1993, high was \$3794.33 (also on Dec 29).

CPI in 1970 was 38.8, and in 1993 it was 144.5.

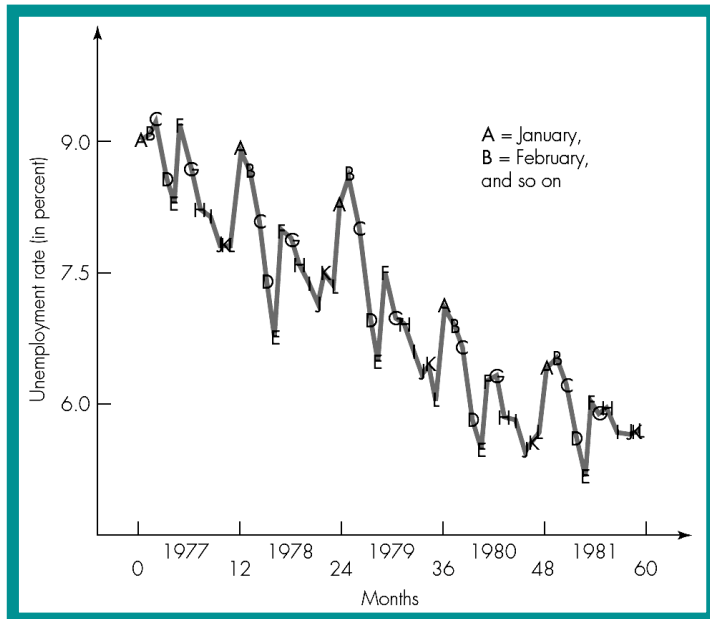
*Did DJIA rise faster than inflation?*

$$\begin{aligned}\text{Value in 1993} &= (\text{value in 1970}) \times (\text{CPI in 1993}) / (\text{CPI in 1970}) \\ &= (\$842.00) \times (144.5) / (38.8) = \$3135.80\end{aligned}$$

High of \$3794.33 cannot be completely explained by inflation.

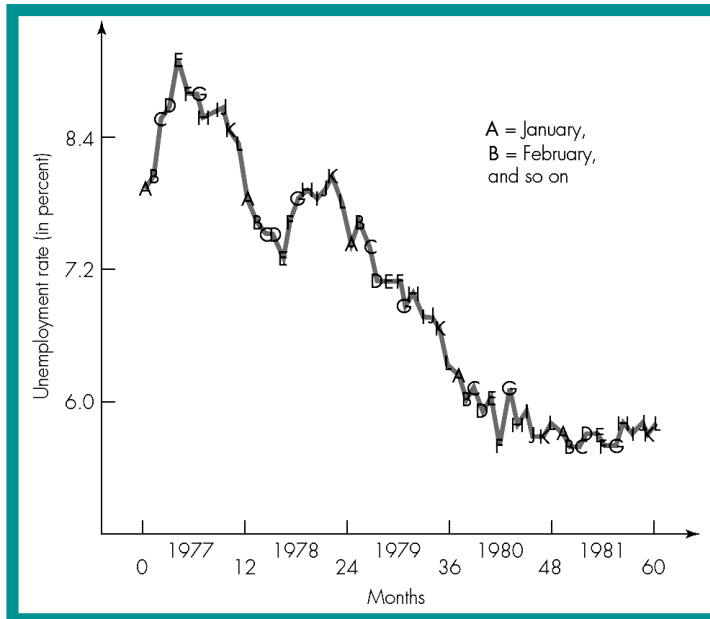
Ratio:  $\$3794.33 / \$3135.80 = 1.21 \Rightarrow$  increase in DJIA highs is 21% after adjusting for inflation using the CPI.

# Case Study 15.1: If You're Looking for a Job, Try May and October



*Unemployment rates for 1977–1981 before being seasonally adjusted.*

Sharp increases between Dec (L) and Jan (A) and between May (E) and June (F)



*Unemployment rates for 1977–1981 after being seasonally adjusted.*

Extremes have been removed. Series shows much less variability.

*Source: Miller, 1988.*