Chapter 2: Overview

Statistical Literacy 2009
Chapter Summaries

by

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2009StatLitTextHandoutCh2.ppt

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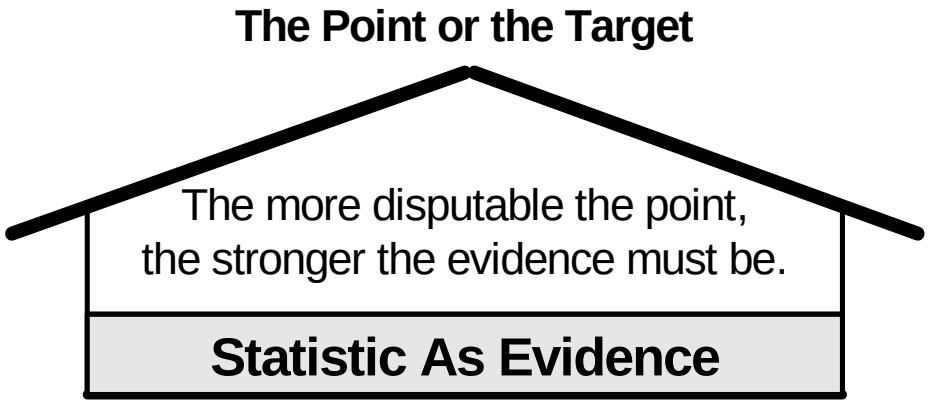
Ch 1. Review

Statistics are generally used as evidence to support an argument.

The influences on a statistic are of four kinds: Context, Assembly, Randomness or Error.



"All Statistics are Socially Constructed"
So, "Take CARE"!!
Statistics may be influenced by:

C	A	R	E
Confounding	Assembly	Randomness	Error

Review of C.A.R.E.

Context: Related factors taken into account; the confounders not taken into account.

Assembly: Choice in definition, measurement or presentation.

Randomness: Influence of chance.

Error: Systematic deviation of statistics from the underlying reality.

Association: Arithmetic Comparisons

1. **Simple Difference:**

_____ is ___ more/less/*er **than** _____.
{test} # [T-B] {base}

2. **Simple Ratio:**

_____ is __ times as much/many **as** _____.
{test} # [T/B] {base}

‘*er’ indicates comparative: bigger, smaller…

Association: Arithmetic Comparisons

3. **Relative Difference:**

- **Percent difference:**

  _____ is __ % more/less/*er **than** _____.

  {test} # [100(T-B)/B] {base}

- **Times difference:**

  _____ is __ times more/less/*er **than** _____.

  {test} # [(T-B)/B] {base}

Association: Percentage Points

Compare 15% with 10%.

- Simple Difference: 15% is 5% more than 10%.
- Simple Ratio: 15% is 1.5 times [as much as] 10%.
- Percent difference: 15% is 50% more than 10% .

First and last statements cannot both be true.

Percentage points for a simple difference in two %.

- 15% is 5 percentage points more than 10%

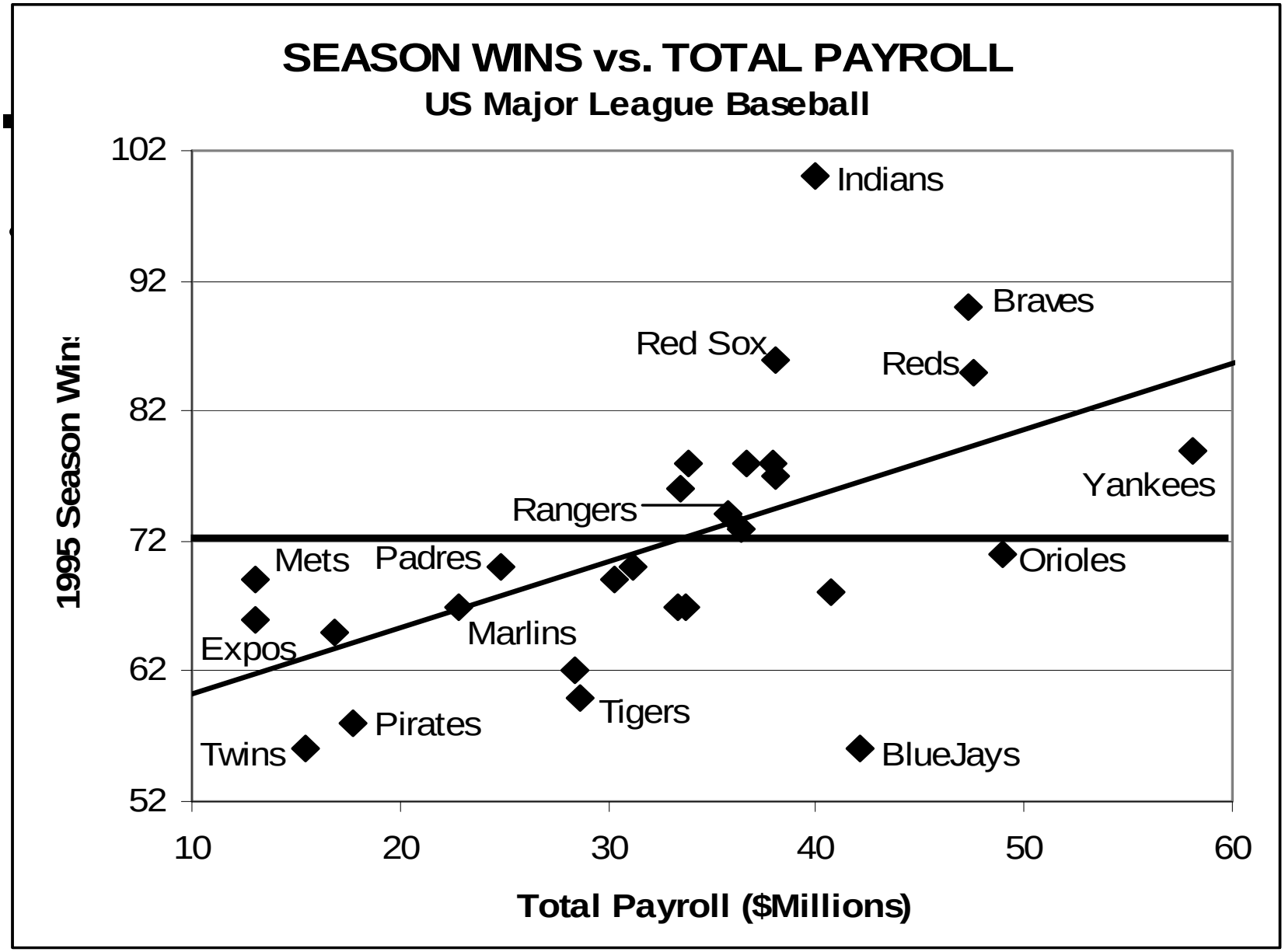
Assembly: Choice of Base

Suppose 99% of married men (90% of married women) are happy with their spouse.

Minimizes the difference: "Men are **10% more likely to be happy** with their spouse than are women." [99% is 10% more than 90%]

Maximize the difference: "Women are **10 times as likely to be unhappy** with their spouse as are men." [10% is 10 times 1%]

Context


SEASON WINS vs. TOTAL PAYROLL
US Major League Baseball
1995 Season Wins
102
92
82
72
62
52
10
20
30
40
50
60
Total Payroll ($Millions)
Indians
Braves
Red Sox
Reds
Yankees
Rangers
Mets
Padres
Orioles
Expos
Marlins
Tigers
Pirates
Twins
BlueJays

Context: Study Design

Experiment: "Study in which the researcher intentionally alters one or more factors under controlled conditions in order to study the effects of so doing."

Observational study: "A study where the investigator observes without intervening."

Most studies are observational – even in medical journals.

Context: Study Design

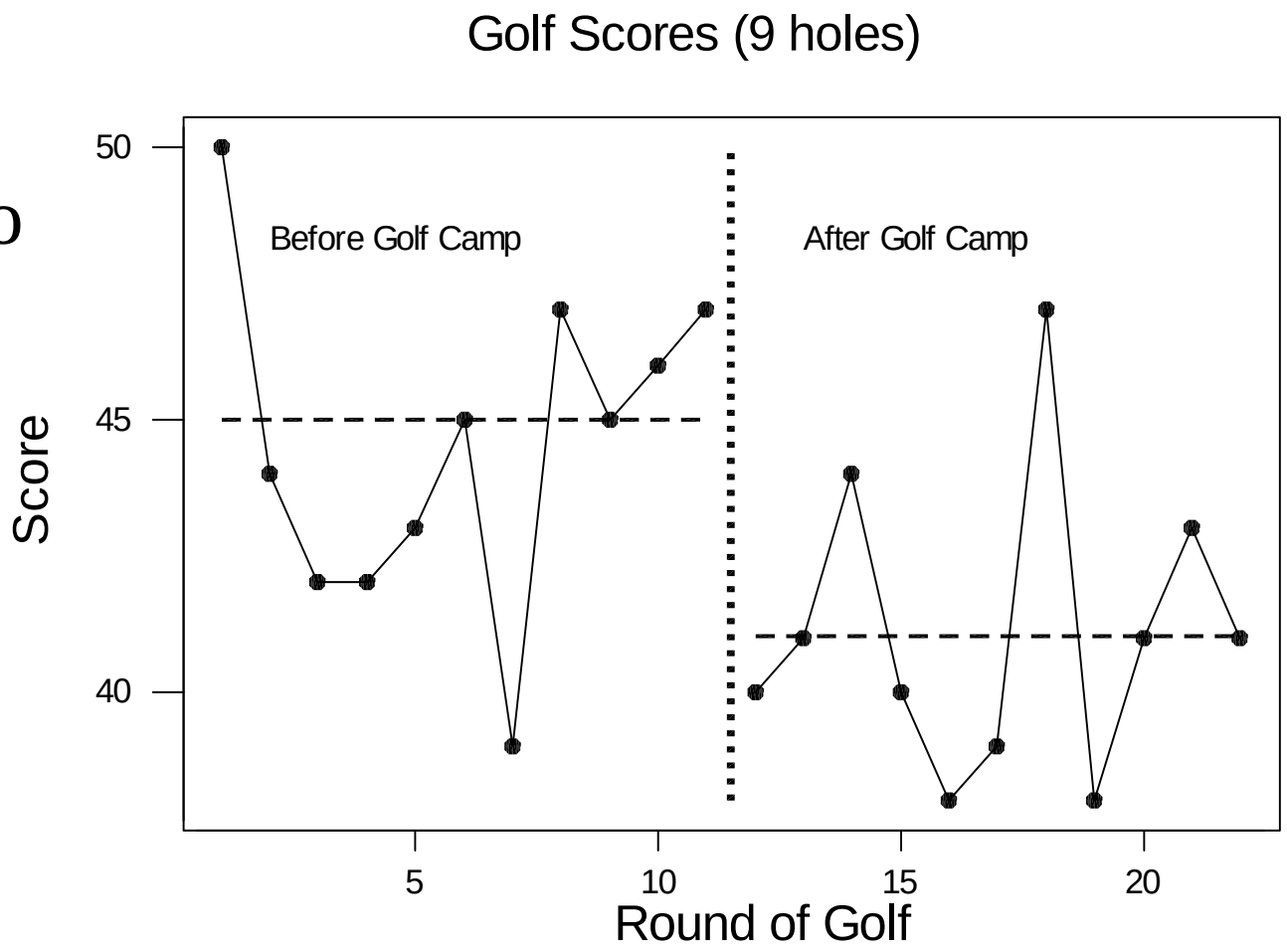
Longitudinal study involves repeated measures: measurement of the outcome at two different times (before and after a treatment or exposure).

Cross-sectional study involves counts and measures at one time: a single moment in time (unemployment) or a time interval (death rate).

Cross sectional studies are cheaper, more common than longitudinal.

Context: Longitudinal Studies

Longitudinal study is still susceptible to influence of time-varying confounders.



Context: Controlled Study

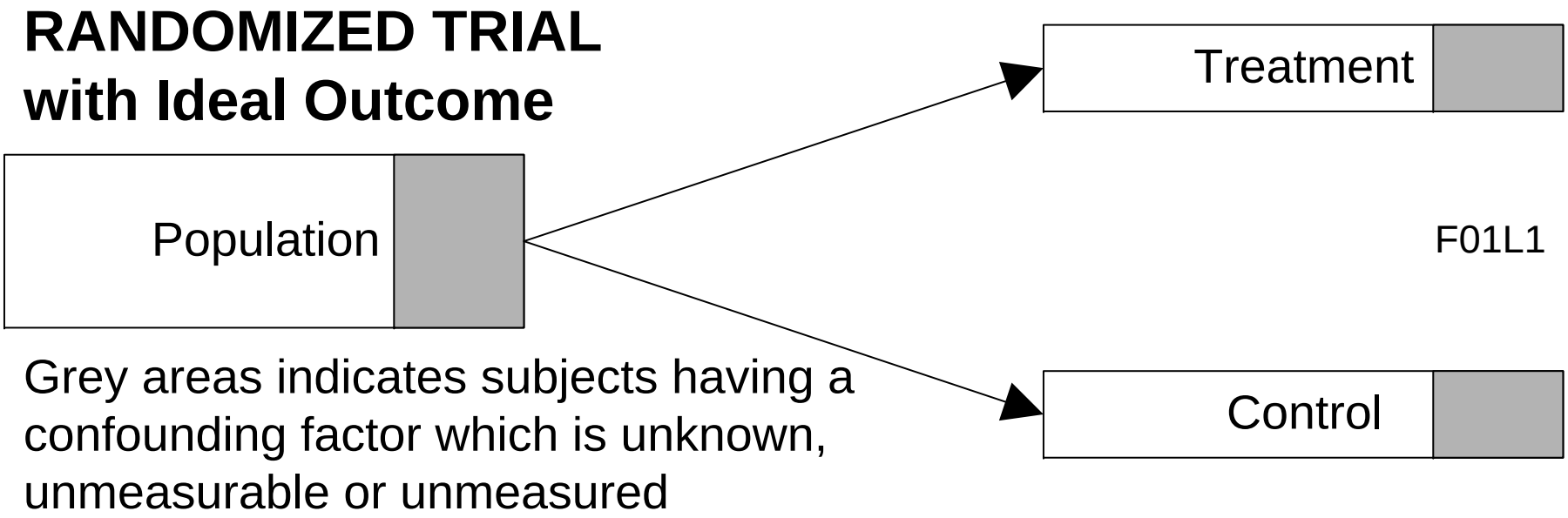
Controlled study involves at least two groups or subgroups at the same time.

A controlled study is not always an experiment. Most controlled studies are observational.

A single measurement, count or percentage is often from an uncontrolled study or survey.
E.g., 25% of those ages 25-29 have had only one sex partner since age 18.

Context: Random Assignment

Random assignment *statistically* nullifies all pre-existing confounders. Same mix in both groups. Random assignment is the "gold standard".



Context: Benefits of Study Design

A *longitudinal study* controls for confounders that don't change over time.
E.g., race, gender, etc.

A *cross-sectional study* controls for confounders that involve a change over time.
E.g., change in age, in prices, etc.

Randomized assignment controls for any (all) pre-existing confounders.

Random: Best Representative

A **population** is any group of interest.

A **sample** is any part of the population.

- **Representative samples** are samples similar to the whole population. *Problem*: Getting a representative sample is very difficult with people.
- **Random samples** are samples where each member of a population is equally likely to be selected. *Benefit*: Most likely to yield a representative sample on all factors—known and unknown.
- **Convenience samples** are non-random.

Randomness: Margin of Error

The **margin of error (ME)** is the variability due to random sampling. The smaller the sample, the larger the margin of error.

A tell-tale sign is the ± followed by an amount.

Margin of error only measures sampling error.

A 95% **confidence interval** is the range that contains the population statistic – with 95% confidence.

Confidence intervals range from low (statistic minus margin of error) to high (statistic plus margin of error).

Randomness: Statistical Significance

Being **"statistically significant"** means that something (a value, a difference, a ratio or an association) is very unlikely if due just to chance.

Getting all 13 cards in one suit in a random deal of card would be statistically significant!

A small study found a statistically-significant difference between men and women in the percentage who dream in color .

Randomness: Non-Overlap Rule

If a two sample statistics have overlapping confidence intervals, then their difference is not *statistically significant*.

If the intervals do not overlap, then the difference in sample statistics is *statistically significant*.

An increase from 8% last year to 10% this year would not be *statistically significant* if the margin of error was 1 percentage point.

1) Respondent Bias:

Three common forms:

Placebo Effect: A health-improvement in subjects getting a placebo: an inert medication or procedure.

Hawthorne effect: A systematic change in response when the subjects know they are the subject of attention (e.g., being watched).

Safety Effect: An increase in risky behavior because the subject knows they have safer equipment.

2) Measurement Bias:

Researcher bias: A change in outcome due to a researcher's knowledge of who is in which group.

A researcher with this knowledge may generate biased evaluations or may communicate that knowledge to the subject and generate subject bias.

Halo effect: when the researcher's optimism influences the data so it supports their optimism.

Devil/Horns effect: the opposite.

3) Sampling Bias:

Two common causes of non-representative samples:

Non-response bias: Subjects who select out by not participating in a survey are different from those who do participate.

Completion/dropout bias: The outcome is different for those who complete a survey or study than for those who do not.

Minimizing Bias

A single-blind study blinds subjects as to whether they are in the treatment or control group; it minimizes respondent bias.

A double-blind study blinds the researcher as well as the subject from knowing which group a subject is in. This minimizes both respondent bias and researcher measurement bias.

Summary: Defaults

Media stories often omit details. If the story does

- not say random assignment, assume non-random.
- not say experiment, assume observational study.
- not say longitudinal, assume cross-sectional.
- not give exact definitions, assume opportunism.
- not say random selection, assume convenience.
- not indicate large sample size, assume small.
- not give the questions in a survey, assume bias.

Conclusion

Take CARE in evaluating statistics used as evidence in arguments.

Statistics can be influenced by context, assembly, randomness and error/bias.

Comparisons, study design and random selection can block or nullify some of these influences.