# Measurement

- ***Example 1:*** **A local health club is doing a survey to see if there is a relationship between strength and fitness.**
- **They want to measure the strength and fitness of a sample of 100 members of the club.**
- **Which of these two attributes do you think will be easier for them to measure?**

# Measurement (Continued)

- ***Example 2:*** **A study on customer service found there were more customer complaints registered at a large local grocery store in the past year than at a small local market.**
- **Is it fair to conclude that the local market had better customer service?**
- **What would be a fairer way to present the numbers?**

- ***Measurement*: Assigning a number to represent some property or characteristic.**
- **We must be aware of the *units of measurement* (1999 Mars Climate Orbiter example).**
- **What is the correct definition of our variable of interest?**
- **Knowing this will help us make the right *measurement*.**

- ***Example 3*: Bureau of Labor Statistics calculates unemployment rate.**
- **This rate defined as:**

  **(# of people unemployed) / (# of people in labor force)**
- **What does it mean to be unemployed?**
- **What does it mean to be in labor force?**
- **What about workers on temporary strike?**
- **What about people without a job but not actively looking for one?**

  **People too discouraged to look?**

# Clicker Quiz 1

**How would the unemployment rate probably be measured?**

**A. Interviews with a random sample of employers.**

**B. Interviews of a random sample of U.S. adults.**

**C. Reviews of U.S. tax returns filed in the previous year.**

# Clicker Quiz 2

**What could cause bias or variation in the measurement of the unemployment rate?**

**A. Response error**

**B. Changes in the wording of the questionnaire**

**C. Nonresponse**

**D. All of the above**

**E. None of the above**

# Validity

- **A variable is a *valid* measure of a characteristic if it is relevant or appropriately represents that property.**
- ***Example 1:* Would "body weight" be a valid measure of strength? Would "bodyfat percentage"?**
- **Would either of these be a valid measure of fitness?**
- **Would performances of certain exercises be more valid measures of strength and/or fitness?**

# Rates vs. Counts

- **A *rate* is given as a fraction, proportion or percentage.**
- **A rate measures how regularly something occurred.**
- **It is often more useful than a raw *count* of the number of times something occurred.**
- **Recall customer complaint example: Variable studied was number of complaints in a year.**
- **What would be a more appropriate measure to compare levels of customer dissatisfaction?**

# Clicker Quiz 3

**Based on the concepts of rates and counts, which is the LEAST valid measure of annual highway safety?**

**A. Yearly rate of deaths per accident**

**B. Yearly rate of accidents per licensed driver**

**C. Yearly rate of deaths per total mile traveled**

**D. Number of accidents in a year**

# Clicker Quiz 4

**A study found that in a particular month, there were 30 accidents from driver fatigue between 5 p.m. and 6 p.m. and 25 accidents from driver fatigue between 1 p.m. and 2 p.m. Which conclusion is most certain to be true?**

**A. Drivers are more tired in the late afternoon.**

**B. More cars are on the road in the late afternoon.**

**C. People drive faster in the late afternoon.**

**D. Traffic lights work poorly in the late afternoon.**

# Predictive Validity

- **A measurement has good *predictive validity* if it can be used to predict success on relevant tasks.**
- **Do IQ tests measure intelligence? What do we mean by intelligence?**
- **Does the SAT score of a student predict college success well?**
- **Do high school grades predict college success better?**
- **Statistical methods can answer the last two questions using sample data.**

# Errors in Measurement

- **The measured value we get is not always the "truth."**
- **If a measurement process has any systematic overstatement or understatement of the truth, this is called *bias*.**
- **If the measured value tends to fluctuate randomly when repeated measurements are taken on the same individual, this is *random error*.**
- **So actually, the measured value = true value + bias + random error.**
- ***Example:* Timing a 100-meter dash by hand. Bias? Random Error?**
- **A process with very small random error is called *reliable*.**

# Errors in Measurement (continued)

- **Ideally we want a measurement with no bias and very little random error.**
- **The only way to reduce *bias* is to get a better measuring *instrument*.**
- **We can reduce *random error* by using the average of many repeated individual measurements.**
- **Bureau of Weights and Measures averages the times from 200 atomic clocks to get a very reliable measurement of time.**
- **What if ordinary wall clocks were used instead of atomic clocks?**

# Clicker Quiz 5

**The website IMDB.com tries to determine the quality of films by allowing a large number of viewers choose to log on and rate the movies and averaging the ratings of each movie. This measurement process likely has:**

**A. High bias and good reliability.**

**B. Low bias and good reliability.**

**C. High bias and poor reliability.**

**D. Low bias and poor reliability.**

# Psychological Studies

- **Measuring personality traits like “optimism” or “authoritarian personality” is difficult to do objectively.**
- **Often this is done via long personality questionnaires (Myers-Briggs)**
- **Items rated on a scale of “Strongly Agree” to “Strongly Disagree” (Likert)**
- **How well to these answers reflect underlying personality traits?**
- **Understanding the properties of the measurements is an important aspect in psychological studies.**