

Surveys & Sampling: Getting Reliable & Valid Data

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Session Objectives

- After attending this session, learners will be able to:
 - Critique a written survey
 - Write appropriate survey questions
 - Administer a survey to get optimal results
 - Design appropriate sampling plans
 - Evaluate potential threats to reliability and validity

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Survey Attributes & Limitations

- **Survey Attributes**
 - Many ways to collect data
 - Can measure very simple or very complex things
 - Can be customized to fit the exact needs of the situation
 - Sampling can be utilized
 - Large quantities of data can be obtained quickly
- **Survey Limitations**
 - Sometimes people won't admit to certain things
 - Can be costly in terms of time, effort, and money
 - Even when correctly done, results may be inconclusive

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Why Surveys Fail

Sampling error (PEOPLE SAMPLED)
+ Measurement error (SURVEY CONTENT)

= Total error

- Most people attempt to minimize sampling or measurement errors, but seldom work to minimize both
- If either error source is ignored, total error will be substantial

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Failure from Measurement Error

- **Failure to assess survey's reliability**
 - Is the data source trustworthy and dependable?
 - Can we expect to get the same or similar results each time the survey is used in the given circumstances?
 - Are respondents consistent in their responses?
- **Failure to assess survey's validity**
 - Does the scale or survey measure what it intends to measure?
 - Do the respondents interpret the questions the same way as the researcher?

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Failure from Measurement Error

- **Treating perceptions as objective measures**
 - Customer satisfaction ≠ product quality
 - Satisfaction is a complex phenomenon
 - An individual's perceptions / opinions can vary over a short time

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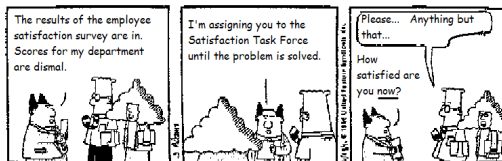
Perception is not Objective



Failure from Measurement Error

- Treating surveys as an event, not a process
 - Power in surveys when satisfaction monitored over time
 - Cannot separate out influencing factors in a one time survey
 - Seasonality
 - Environmental issues
 - Corporate restructuring

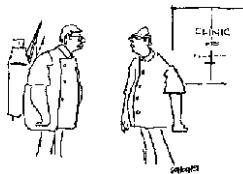
Mistreating Surveys as an Event



Failure from Measurement Error

- Using incorrect or incomplete data analysis methods
 - Go beyond frequency distributions and pie charts
 - Summary statistics only identify what is in the data
 - Avoid the overuse of averages on ordinal satisfaction scales
 - Measure *percent satisfied*

Incorrect Analysis



"Sure, your patients have 50% fewer cavities. That's because they have 50% fewer teeth."

Questionnaire Design Tips

- Keep it simple
- It should appear not to take too long
- It should be eye-appealing / allow plenty of "white space"
- Start with easy questions / save sensitive issues and demographics for last
- Organize question by topic or scale type
- Order the survey topics in a sequence meaningful to respondents
- Limit the number of branches
- Include clear instructions
- Be sure it flows smoothly
- Pretest questionnaire and revise as necessary

Sensitive or Threatening Issues

- Financial facts: income, property, investments
- Challenges to mental or technical skill or ability
- Revelation of shortcomings, personal deficits
- Socio-economic status indicators or symbols
- Sexuality: sexual preference, behavior, history
- Alcohol or drug consumption or addiction
- Undesirable habits: smoking, overeating, etc.
- Mental, emotional or psychological disturbances
- Aging and cosmetic means to conceal age
- Infirmity: disability or adverse health conditions
- Morbidity: death of self or person's loved one

Three Types of Questions

- Attitude question
 - Measures agreement or satisfaction
 - How customers think or feel about something in particular
- Knowledge question
 - Only one correct answer
 - Does customer know the specifics about a product/service
- Behavior question
 - How often / how much / when
 - Measures frequency of a behavior

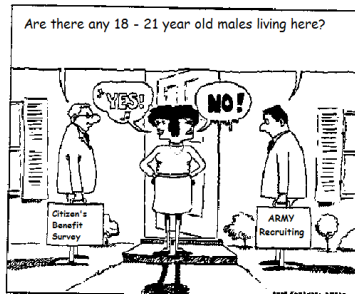
Writing Effective Survey Questions

- Focus
 - Every question on a questionnaire should focus directly on a single specific issue or topic.
 - Can help trigger memory or suggestions.
 - Examples:
 - WRONG: How would you improve the hotel?
 - RIGHT: How would you improve the check-in process at the hotel?

Writing Effective Survey Questions

- Clarity
 - Demands that virtually everyone interprets the question in exactly the same way.
 - Examples:
 - WRONG: Where are you from?
 - RIGHT: In what city were you born?
 - WRONG: When do you usually go to work?
 - RIGHT: What time do you ordinarily leave home for work?

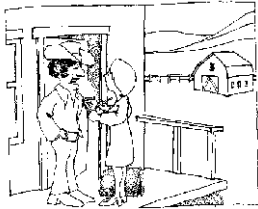
Clarity for Effectiveness



Writing Effective Survey Questions

- Core Vocabulary
 - Use words in the core vocabulary of virtually all respondents.
 - Limit vocabulary to words the least sophisticated respondent will know.
 - Examples:
 - WRONG: Are you cognizant of all the concepts to be elucidated?
 - RIGHT: Do you know about all the ideas that will be explained?

Core Vocabulary for Effectiveness



"Do I own any stock, Ma'am?
Why I've got 10,000 head out there."

Multi-Meaning Problem Words

• Dead Giveaway Words

- **All**
 - Are we doing all we can for our students?
- **Always**
 - Do you always read your classmates' postings?
- **Ever**
 - Have you ever listened to a Chipmunk song?

Multi-Meaning Problem Words

• Slang Words/Idioms

- **Go**
 - When did you last go to town?
- **Heard**
 - Have you heard about the latest terrorist threat?
- **Less**
 - Compared to last year, are you more or less happy in your job?

Multi-Meaning Problem Words

• Biasing Words

- **Like**
 - Do you think leafy vegetables like spinach should be in your diet?

Multi-Meaning Problem Words

• Confusing Words

- **About**
 - 48% is about half, while 52% is over half?
- **And**
 - Is there a rivalry among companies who sell PCs and printers?
- **Any**
 - Do you think any product is better than ours?
- **You**
 - How many calls did you take last month?

Instrumentation Bias and Error

• Inapplicable questions

- The questions must be applicable to all respondents based on their own situation.
- Examples:
 - WRONG: How long does it take you to get an e-mail response from us?
 - RIGHT: If you send e-mails to us, how long does it take for you to get a response from us?

Instrumentation Bias and Error

- Examples in questions
 - Don't use actual response alternatives as examples or respondents will over select them.
 - Examples:
 - WRONG: What groceries, such as apples and oranges, have you purchased in the last week?
 - RIGHT: What groceries have you purchased in the last week?

Instrumentation Bias and Error

- Over-demanding recall
 - Don't assume respondents will recall their behavior or feelings over an extended period.
 - Examples:
 - WRONG: How many times had you accessed the Internet last year?
 - RIGHT: For how many months in the prior year did you have Internet access?

Instrumentation Bias and Error

- Over-generalizations
 - Seek generalizations only if they represent *policies, strategies, or habitual* behavior patterns.
 - Examples:
 - WRONG: When you visit the courseroom, what percentage of the time do you post a comment?
 - RIGHT: Of the last 10 times you visited the courseroom, how many times did you post a comment?

Instrumentation Bias and Error

- Over-specificity
 - Don't ask for a precise answer unless respondents will be able to express it exactly.
 - Examples:
 - WRONG: When you visit our web site, how many times do you read the advertisements?
 - RIGHT: When you visit our web site, how often do you read the advertisements? (choose one) (1) almost always, (2) sometimes, (3) rarely, or (4) never

Instrumentation Bias and Error

- Over-emphasis
 - Avoid dramatic terms and lean toward understatement, rather than overstatement.
 - Examples:
 - WRONG: Would you favor increasing taxes to cope with the current fiscal crisis?
 - RIGHT: Would you favor increasing taxes to cope with the current problem?

Instrumentation Bias and Error

- Ambiguous words
 - Every word or phrase must have a plain, common meaning for everyone in the sample.
 - Examples:
 - WRONG: About what time do you ordinarily eat dinner?
 - RIGHT: About what time do you ordinarily dine in the evening?

Instrumentation Bias and Error

- Double-barreled questions
 - Split or modify compound questions, especially those asking an *action* and a *reason* for it..
 - Examples:
 - WRONG: Do you regularly take vitamins to avoid getting sick?
 - RIGHT: Do you regularly take vitamins? Why or why not?

Instrumentation Bias and Error

- Leading questions
 - Avoid leading words such as "*don't you ...*" or in favor of "*do you ...*" or "*would you ...*"
 - Examples:
 - WRONG: Don't you see anything wrong with your dissertation?
 - RIGHT: Do you see anything wrong with your dissertation?

Instrumentation Bias and Error

- Loaded questions
 - Never use questions asking a *preference* or *opinion* and including a *socially desirable* reason.
 - Examples:
 - WRONG: Do you advocate a lower speed limit to save human lives?
 - RIGHT: Does traffic safety require a lower speed limit?
 - WRONG: (*Actual question sent by Congressmen*) Do you feel that anyone should be forced to pay a union boss for permission to earn a living?
 - RIGHT: *Your thoughts???*

Sources of Response Bias

- Acquiescence
 - Response based on perception of what would be desirable to the sponsor
 - Assure respondents that candid, honest answers are most helpful
 - Cooperation requires honesty, not flattery

Sources of Response Bias

- Mental set
 - Perceptions based on previous items influence response to later ones
 - Frame of reference is often developed
 - If you ask about a specific purchasing experience, all questions about this relationship may imply that specific transaction

Sources of Response Bias

- Extremity
 - Clarity of extremes and ambiguity of mid-range options encourage extreme responses
 - Respondents tend to choose extreme options
 - Easier to think in black and white
 - Can result from having too many choices/too large a scale
 - People cannot distinguish a 75 from a 76 out of 100

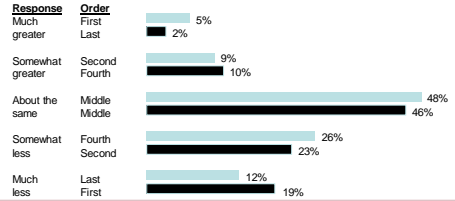
Sources of Response Bias

- Order
 - The routine and fatigue biases later response
 - People's feelings about one issue may contaminate future issues
 - Order of responses for a given question biases in favor of what is seen first

Sources of Response Bias

- How the order in which the alternatives are listed affects the distribution of replies

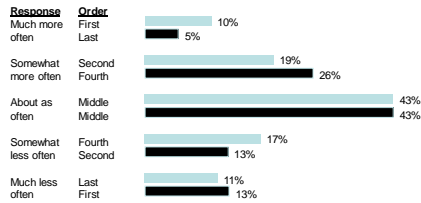
Compared to a year ago, the amount of time spent watching television by my household is:



Sources of Response Bias

- How the order in which the alternatives are listed affects the distribution of replies

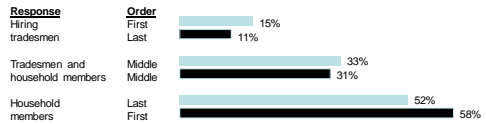
Compared to a year ago, my household eats out at restaurants:



Sources of Response Bias

- How the order in which the alternatives are listed affects the distribution of replies

Most home repair or improvement projects completed in my home during the past years have been completed by:



Survey Misuse in Election Polls

- Wording of questions or statements can drive results
- Two November 1997 Election Day polls asked how people would vote for proposal
 - 1st Poll: The City of Houston shall not discriminate against or grant preferential treatment to any individual or group on the basis of race, sex, ethnicity or national origin in the operation of public employment and public contracting.
 - 2nd Poll: Shall the Charter of the City of Houston be amended to end the use of preferential treatment (affirmative action) in the operation of the City of Houston employment and contracting?

Survey Misuse in Election Polls

- Results of two polls:

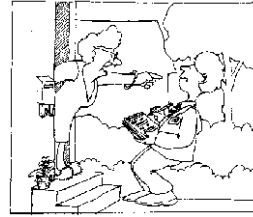
Wording	For	Against	Not sure	Other
Nondiscrimination	68%	16%	15%	1%
Affirmative action	47%	34%	18%	1%

- Same political action but different levels of support
- "Affirmative action" wording was actually used and was rejected by 55-45 vote

Points for More Useful Surveys

- You have only one chance and maybe 30 minutes
 - There is no second chance to get missing data
 - Time is precious and surveys are not productive time for customers
 - Open-ended questions take more time, so budget accordingly

Make Each Opportunity Count



"Have you ever thought of adding an indicator of how people feel about having their opinions asked every other day?"

Points for More Useful Surveys

- The more time you spend in survey development, the less time you will spend in data analysis and interpretation
 - Open-ended questions are easier to write, but take longer to analyze
 - Specific unbiased questions are hard to write, but easy to analyze
 - "Do you plan to return to our hotel as a result of the check-out process?" (*What's wrong with this question?*)

Points for More Useful Surveys

- Before the data are collected, you should know how you want to analyze and use the data
 - Begin with the end in mind
 - What will you do with the information?
 - Decide how reports will look to address critical issues
 - Then, decide the data needed to get to the desired report
 - Then, write questions that get the desired data
 - Finally, arrange questions for minimal bias / maximum response

How to Be a Pollster

- ✓ Write a question for a public opinion survey that is likely to produce results in favor of building a nuclear reactor in your hometown.
- ✓ Write a question for a public opinion survey that is likely to produce results showing most people are against building a nuclear reactor in your hometown.
- ✓ Write a fair question that attempts to accurately measure public opinion about whether or not to build a nuclear reactor in your hometown.

Mock Survey

1. What is your current income? _____
2. How many times have you visited your bank in the past five years? _____
3. Don't you agree that gambling should be legalized in your hometown to help raise money for underprivileged children?
 - a) Yes
 - b) No

Mock Survey

4. The bills from this hotel were timely and accurate.
strongly agree agree disagree strongly disagree
5. Rate your satisfaction with this hotel's golf course on a scale of 1 - 50. ____
6. Evaluate the following: "I support the efforts of the NRA."
strongly agree agree disagree strongly disagree

Mock Survey

7. Why do you enjoy beating your spouse / significant other?
a) it's fun
b) it's a job
c) why not?
d) I don't enjoy it
8. What is the most important subject offered at Capella?
a) Statistics
b) Statistics
c) Statistics
d) All of the Above

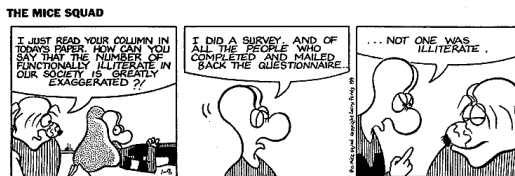
Failure from Sampling Error

- Whom you ask is as important as what you ask
 - Sample should be representative and random
 - Exit surveys don't address why employees stay
 - If you only study the 10% bad apples, your results will infer that all apples are bad
 - Internet voting, text messaging, 900 & 800 numbers, etc.

Survey Misuse Due to Self-Chosen People

- Most polls get data by people voluntarily submitting responses
- Results should not be projected onto population
- Self-selection hierarchy for respondents:
 - must have necessary equipment (TV, Internet, phone, cable)
 - must have selected the channel & program
 - must have felt issue was important enough
- Results are only valid for population who meet these criteria
- Results of Presidential Debates are often scored by costly telephone votes (not representative of U.S.)
- Web-based surveys

Always Trust Your Sample???



Sampling Terminology

- **Population** – A complete group of entities sharing some common set of characteristics.
- **Population Element** – An individual member of a specific element.
- **Census** – An investigation of all the individual elements making up a population.
- **Sample** – A subset or some part of a larger population.
- **Sampling** – The process of using a small number of items from a larger population to draw conclusions about the whole population.

Zikmund, W. G. (2000). *Business research methods* (6th ed.). Ft. Worth, TX: The Dryden Press.

Why Sample?

Populations have all of the data. If we have the population, we have everything we need. Then why do we take samples?

-
-
-
-
-

Why Sample?

- Lower cost
- Greater speed of data collection
- Greater accuracy of results
- Availability of population elements
- Destructiveness of observations

Stages In Sample Selection

1. Define the target population
2. Select a sampling frame
3. Choose probability or non-probability sampling method
4. Determine sample size
5. Choose a data collection technique
6. Select sample

Zikmund, W. G. (2000). *Business research methods* (6th ed.). Ft. Worth, TX: The Dryden Press.

Defining the Target Population

- **Target Population** – The specific group relevant to the research project; the group that the sample truly represents.
- Consider the following questions:
 - “What is the relevant population?”
 - “To whom do we want to talk?”
- Tangible characteristics must be used to define the population
 - Demographic
 - Behavioral

Selecting the Sampling Frame

- **Sampling Frame** – The list of elements from which a sample may be drawn
 - A complete and correct list of population members
 - Ideally, the source should be representative of the population
 - The source should not bias the results

QUESTION: Can a phone book be a valid sampling frame?

Probability vs. Non-probability Samples

- **Probability Sample** – A sample in which each and every item in the population has a known and non-zero chance for inclusion in the sample (aka **Random Samples**)
- **Non-probability Sample** – A sample in which items are selected on the basis of judgment or convenience (aka **Non-Random Samples**)

Non-probability Sampling

- **Convenience Sample** – A sample of items most readily available
 - Mall surveys
 - Surveys using students
- **Judgment Sample** – A sample selected by an experienced researcher based upon some appropriate characteristic
 - “Market basket” items upon which the CPI is based
 - The Dow Jones Industrial Average

Non-probability Sampling

- **Quota Sample** – A sample that ensures that certain characteristics of the population will be represented to the exact intended extent
 - Getting a sample of 100 residents of a specified metro area
 - Deciding that 59% of study participants must be male
 - Often starts out randomly, but once a quota is met, respondents are turned away
- **Snowball Sample** – A sample in which initial respondents are selected using probability methods, and then additional respondents are obtained from information provided by the initial respondents
 - Surveying 10 shoppers selected at random and asking each of them for the names of five friends

Non-Probability Sampling

Advantages

- Lower cost
- Less time
- May be the only feasible alternative

Disadvantages

- Greater opportunity for bias
- Results not generalizable
- Lack of objectivity

Probability Samples

- **Simple Random Sample** – A sampling procedure that ensures that each element of the population has an equal chance of being included in the sample
 - Random drawing (e.g. Lotto)
 - Random numbers
- **Systematic Sample** – A sample in which every n th number is selected
 - Selecting every 25th name from a list of company employees
 - Selecting every 50th number in the phone book
 - Selecting every employee whose ID number ends with 2

Probability Samples

- **Stratified Sample** – A subsample drawn from samples within different strata that are essential equal on some characteristic
 - Randomly selecting 20% of the automobile dealers from 10 randomly-selected states (strata)
 - If 40% of the population is male, and you want a sample of 1000, then you would choose 400 males and 600 females from their respective sub-populations.
- **Cluster Sample** – A sample in which the primary sampling unit is not an individual element in the population but a large cluster of elements
 - Most common type of cluster sample is an “area” sample, in which the primary sampling unit is a geographic area
 - Can also randomly select several small clusters and choose all elements in the clusters

Probability Sampling

Advantages

- Minimization of bias
- Generalizability of results

Disadvantages

- More costly
- More time consuming

Determining Sample Size

- A sample does not have to be large to be useful, as long as it's representative
- What is the "right" sample size?
 - Is it a percentage of the population?
 - Is population size a factor?
 - Is there a magic minimum?

Sample Size

- How much sampling error will you allow?
 - **Sampling error** is the difference between the actual population value and the results of the sample
 - As tolerable error decreases, sample size increases exponentially
 - Increasing sample size from 1000 to 2000 reduces sampling error by 1%
 - Increasing sample size from 2000 to 4000 reduces sampling error by ½%

Sample Size

- How confident must you be?
 - **Confidence** is the likelihood that the actual population value is within the tolerable error range
 - As confidence level increases, sample size increases

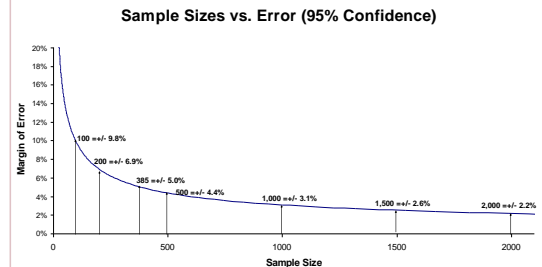
Estimating Sample Size

- Estimate the standard deviation of the population (S)
 - Prior information
 - Pilot study
 - Rule-of-thumb estimate that standard deviation is 1/6 of the response range

Estimating Sample Size

- Make a judgment about the desired magnitude of error (E)
 - How much "wiggle" room do you want?
 - For responses with a 5-point Likert response scale, you may determine that you can live with an error of 0.50
- Determine a confidence level (Z_{CI})
 - For 95% confidence level, $Z = 1.96$

Sample Sizes vs. Error



Estimating Sample Size

$$n = \left(\frac{ZS}{E} \right)^2$$

Estimating Sample Size

For a study using a 5-point Likert response scale

- $S = 5/6 = .8333$
- $Z = 1.96$
- $E = 0.5$

$$n = \left(\frac{ZS}{E} \right)^2$$

$$n = \left(\frac{1.96 \times .8333}{.5} \right)^2$$

$$n = 10.67 \approx 11$$

Estimating Sample Size

For a study using a 5-point Likert response scale

- $S = 5/6 = .8333$
- $Z = 1.96$
- $E = 0.1$

$$n = \left(\frac{ZS}{E} \right)^2$$

$$n = \left(\frac{1.96 \times .8333}{.1} \right)^2$$

$$n = 266.75 \approx 267$$

A Big, Big Warning!

- The n calculated in the previous formula is the number of questionnaires you need to get back completed
- You will probably not (ever) get back all of the questionnaires you distribute
- Adjust sample size upward to compensate for anticipated response rate
- For a typical mailed survey, a 10-20% response is likely, so you will need to distribute 5 to 10 times more surveys than needed

Using Excel to Compute Sample Sizes

Sample Size Determination for Proportion	
Estimate of True Proportion* =	0.50
Sampling Error =	0.03
Confidence Level =	95.00%
	Sample Size Needed = 1068
Finite Population Size =	1000
	Sample Size Needed = 517
*Use .50 for the "estimate of true proportion" when unknown.	
Sample Size Determination for Mean	
Population Standard Deviation =	0.8333
Sampling Error =	0.1
Confidence Level =	95.00%
	Sample Size Needed = 267
Finite Population Size =	1000
	Sample Size Needed = 211

Taken from <http://www.DrJimMirabella.com/resources>

Choose a Data Collection Technique

	In-Person	Phone	Mail	E-Mail	Internet
Costs	High	Med	Low	Very low	Very low
Time required	Medium	Low	High	Low	Low
Data quantity per respondent	High	Med	Low	Med	High
Reaches widespread sample	No	Maybe	Yes	Yes	Yes
Reaches special locations	Yes	Maybe	No	Yes	Yes
Interaction with respondents	Yes	Maybe	No	No	No
Degree of interviewer bias	High	Med	Low	Low	Low
Severity of non-response bias	Low	Low	High	High	High
Presentation of visual stimuli	Yes	No	Maybe	Yes	Yes

Select the Sample

- Get your sampling frame
- Choose your sampling technique
- Choose your sample as planned
- Contact sample as planned
- Follow through if at all possible to get your desired sample

Pitfalls Throughout the Sampling Hierarchy

1. Start with Total Population
2. Select Sampling Frame
 - **Sampling Frame Error** – Certain elements of the population are not included in the sampling frame
 - Include unwanted units OR exclude desired units
 - Using a telephone book to define the sample frame for residents of a particular neighborhood

Pitfalls (continued)

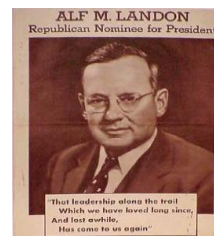
3. Select Sample
 - **Random Sampling Error** – The difference between the result of a sample and the result of a census due solely to observations chosen
 - 75% of a selected sample might be male when only 40% of the population is male
 - Caused by bad luck
 - Caused by sampling bias (i.e., *tendency to favor selection of certain data*)

Pitfalls (continued)

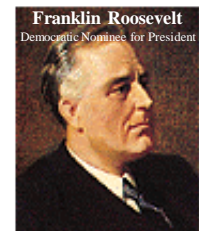
4. Gather Responses
 - **Non-Response Error** – Errors that cause the sample to be less than representative of the population
 - A disproportionately large group of males responds to a questionnaire
 - Respondents unavailable OR refuse to cooperate
 - Most serious limitation of surveys
 - Don't confuse *response rate* with *sample size*

Sampling Bias in Action: The 1936 Presidential Election

Sampling Bias: The 1936 Presidential Election



Literary Digest predicts Landon win



Gallup poll predicts Roosevelt win

Sampling Bias: The 1936 Presidential Election

Literary Digest Sample

- Sample Size: 2,400,000
- Sampling Frame: 10,000,000
 - Magazine subscribers
 - Telephone directories
 - Club and association rosters
- Estimated Sampling Error: +/- 0.06%

Gallup Sample

- Sample Size: 3,000
- Sampling Frame: N/A
 - Quota sample
- Estimated Sampling Error: +/- 1.8%

Sampling Bias: The 1936 Presidential Election

The Outcome ... Roosevelt Wins!

So, What Went Wrong?

What Went Wrong?

Sampling Frame Error

- Sources of sample lists represented middle- and upper-income voters
 - They had phones
 - They subscribed to magazines
 - They belonged to clubs
 - They tended to vote Republican

Nonresponse Error

- Low response rate
 - 10,000,000 million ballots
 - 2,400,000 responses
- Respondents tended to be:
 - Better educated
 - Higher income
 - Republican

Final Lesson: Beware of Voluntary Samples

- 900 number surveys
- 800 number surveys
- Text message responses
- “Opinions” site at malls
- News / sports polls on Web
- Talk shows

➤ Voluntary surveys may bring large response totals (*not the same as response rate*), but don't be satisfied with a large sample size. If it is not representative of the population, size will not compensate.

Designing a Sampling Plan

- If you were planning to do a study on the satisfaction of Capella PhD learners, how would you design the sample?
- What factors would you want to consider?
- How would you select the learners?
- Can you do the survey at a colloquia?
- What assumptions would you have to make?

Lessons Learned

- Writing surveys is not as easy as it seems
- Pilot test your survey (even if you didn't write it)
- Don't assume too much about your respondents
- Plan on how to get the largest possible response rate
- Keep your survey as short and simple as possible
- Remember that analysis comes next, so plan ahead
- Choose your sample with care
- Watch for the pitfalls of sampling / keep track of them as you go
- Constrain your conclusions to the target population
- Take a lesson from your survey for the next time and keep getting better at it.