Thought Question 1:

Want to find out what people felt to be the most important problem facing society today. Better to give a fixed set of choices from which they must choose or an open-ended question that allowed them to specify whatever they wished? What would be the advantages and disadvantages of each approach?
Thought Question 2:

Newsletter distributed by politician to his constituents gave results of nationwide survey on Americans’ attitudes about educational issues. One question: “Should your legislature adopt a policy to assist children in failing schools to opt out of that school and attend an alternative school—public, private, or parochial—of the parents’ choosing?”

From wording of question, can you speculate on what answer was desired? Explain.
3.1 Simple Measures Don’t Exist

- Important to understand how the information was collected and what was measured or asked.

- Many measurements are complex and difficult.

- Component 4 in the Seven Critical Components.
3.2 It’s All in the Wording

Simple changes of words can lead to big changes in answers.

Example 1: How Fast Were They Going?
Students asked questions after shown film of car accident.

• About how fast were the cars going when they contacted each other?
  Average response = 31.8 mph
• About how fast were the cars going when they collided with each other?
  Average response = 40.8 mph
Example 2: Is Marijuana Easy to Buy But Hard to Get?

Results:

<table>
<thead>
<tr>
<th>Response</th>
<th>&quot;buy&quot; version</th>
<th>&quot;obtain&quot; version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cigarettes</td>
<td>35%</td>
<td>39%</td>
</tr>
<tr>
<td>Beer</td>
<td>18%</td>
<td>27%</td>
</tr>
<tr>
<td>Marijuana</td>
<td>34%</td>
<td>19%</td>
</tr>
<tr>
<td>The Same</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Don’t know/no response</td>
<td>9%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Note: Beer is easier to ‘obtain’ than marijuana, but marijuana is easier to ‘buy’ than beer.
Pitfalls when asking questions …

1. Deliberate bias
2. Unintentional bias
3. Desire to please
4. Asking the uninformed
5. Unnecessary complexity
6. Ordering of questions
7. Confidentiality and anonymity
Deliberate Bias

- Questions can be worded to support a certain cause
- The questions should not contain the desired response.
- “Do you agree that abortion, the murder of innocent beings should be outlawed?”

Unintentional Bias

- Questions are worded such that the meaning is misinterpreted by many.
- **Do you use drugs?** --- need to specify if you mean prescription drugs, illegal drugs, etc.
Desire to Please

- Respondents have a desire to please the questioners.
- People tend to understate responses about undesirable social habits.
- Estimate of prevalence of cigarette smoking based on surveys do not match those based on cigarette sales.

Asking the Uninformed

- People do not like to admit they don’t know what you are talking about.
- 30% of the respondents in a study had an opinion about the fictional Wisians ethnic group.
Unnecessary Complexity

If questions are to be understood, they must be kept simple.

Ordering of Questions

The order in which questions are presented can change the results.
Confidentiality and Anonymity

People answer differently based on degree to which they are anonymous.

- **Confidentiality**: researcher promises not to release identifying information about respondents.
- **Anonymity**: researcher doesn’t know identity of respondents.

Surveys on issues like sexual behavior and income are hard to conduct accurately.
3.3 Open or Closed Questions: Should Choices Be Given?

- **Open question**: respondents allowed to answer in own words.
- **Closed question**: respondents given list of alternatives from which to choose answer. Often an ‘other’ choice is provided.
- **Problems**: closed questions may not include preferred answer while open questions are difficult to summarize.
3.4 Defining What is Being Measured

• Important to be specific on how the variable of interest is to be measured

• Different measurement techniques can lead to different conclusions

• Some non-quantitative variables can be hard to define
Measuring Attitudes and Emotions

How to measure self esteem or happiness?

Common Method: respondents read statements and determine extent to which they agree with statement.

Example for happiness:

“I generally feel optimistic when I get up in the morning.”

Indicate level of agreement from: ‘strongly disagree’ to ‘strongly agree’.
Case Study 3.2: Questions in Advertising

Example 6: Levi Strauss
Levi’s 501 Report, a fall fashion survey conducted annually on 100 U.S. campuses …

“90% of college students chose Levi’s 501 jeans as being ‘in’ on campus.”

List of choices:

- Levi’s 501 jeans
- 1960s-inspired clothing
- Overalls
- Decorated denim
- Long-sleeved, hooded T-shirts
- T-shirts with graphics
- Lycra/spandex clothing
- Patriotic-themed clothing
- Printed, pull-on beach pants
- Neon-colored clothing

Levi’s 501 jeans were ONLY blue jeans on the list!
Case Study 3.2: Questions in Advertising

Example 7: Triumph Cigarettes

“TRIUMPH BEATS MERIT – an amazing 60% said Triumph tastes as good as or better than Merit.”

There were actually three choices …

- 36% preferred Triumph
- 40% preferred Merit
- 24% said the brands were equal

Ad is not false, but it is also true that 64% said Merit tastes as good as or better than Triumph!

Which brand do you think wins?
3.5 Defining a Common Language

Categorical versus Measurement Variables

Categorical Variables: those you can place into a category. Categorical variables whose categories have a natural ordering are called *ordinal*, while categorical variables whose categories do not have a natural ordering are called *nominal*.

Measurement Variables: those for which we can record a numerical value and then order respondents according to those values -- also called *quantitative variables*. Sometimes we further distinguish between *discrete* (can count the possible responses) versus *continuous* (can be anything within a given range).
Validity, Reliability and Bias

Valid Measurement: actually measures what it claims to measure.
Example = IQ test not a valid measure of happiness.
Key = need to know exactly what was measured.

Reliable Measurement: will give you or anyone else approximately the same result time after time, when taken on the same object or individual.
Example = physical measurements with precise instrument.
Key = watch for degree of precision being reported.

Biased Measurement: systematically off the mark in the same direction.
Example = time on clock that’s fast
Variability across Measurements

**Variability:** used when we talk about 2 or more measurements in relation to each other.

**Measurement Error:** amount by which each measurement differs from the true value.

**Natural Variability:** results from changes across time in the individual or system being measured.
The Importance of Natural Variability

Three Reasons Variability Occurs …

1. Measurement error: measurements are imprecise.
2. Natural variability across individuals at any given time.
3. Natural variability in a characteristic of the same individual across time.

Heart of Modern Statistics:

*Comparing natural variability to the variability induced* by different treatments or group memberships.

- If there were **no variability** within two groups, it would be **easy to detect differences** between the two groups.
- The **more variability** there is within each group, the **more difficult it is to detect differences** between groups.
How to Get a Good Sample
Thought Question 1:

Suppose a properly chosen sample of 1600 people across the United States was asked if they regularly watch a certain television program, and 24% said yes. How close do you think that is to the percentage of the entire country who watch the show? Within 30%? 10%? 5%? 1%? Exactly the same?
Thought Question 2:
Many television stations conduct polls by asking viewers to call one phone number if they feel one way about an issue and a different phone number if they feel the opposite.

Do you think the results of such a poll represent the feelings of the community?
Do you think they represent the feelings of all those watching the TV station at the time or the feelings of some other group? Explain.
Thought Question 3:

Suppose you had a telephone directory listing all the businesses in a city, alphabetized by type of business. If you wanted to phone 100 of them to get a representative sampling of opinion on some issue, how would you select which 100 to phone?

Why would it not be a good idea to simply use the first 100 businesses listed?
4.1 Common Research Strategies

Sample Surveys

- A subgroup of a large population is questioned on a set of topics.

Observational Studies

- Can’t assume the *explanatory variable* is the only one responsible for any observed differences in the *response variable*.

- *Case-control study* attempts to include an appropriate control group.
Randomized Experiments

• Measures the effect of manipulating the environment in some way.
• Randomized experiment = manipulation is assigned to participants on a random basis.
• Explanatory variable = the feature being manipulated.
• Response variable = outcome of interest.
• Randomization helps to make the groups approximately equal in all respects except for the explanatory variable.
Meta-Analyses

• Quantitative review of a collection of studies all done on a similar topic.

• Combining information can lead to emergence of patterns or effects not readily seen in the individual studies.

Case Studies

• In-depth examination of one or a small number of individuals

• Descriptive and do not require statistical methods.
4.2 Defining a Common Language

- A **unit** is a single individual or object to be measured.
- The **sampling frame** is a list of units from which the sample is chosen. Ideally, it includes the whole population.
- In a **sample survey**, measurements are taken on a subset, or sample, of units from the population.
- A **census** is a survey in which the entire population is measured.
4.3 The Beauty of Sampling

With proper sampling methods, based on a sample of 1500 adults we can almost certainly estimate, to within 3%, the percentage of the entire population who have a certain trait or opinion.

This result does not depend on how large the (large) population is.
Accuracy of a Sample Survey: Margin of Error

For a properly conducted sample survey: The sample proportion differs from the population proportion by more than the margin of error less than 5% of the time, or in fewer than 1 in 20 surveys.

Margin of error \( \approx \frac{1}{\sqrt{n}} \)
4.4 Simple Random Sampling

Probability sampling plans: everyone in the population has a specified chance of making it into the sample.

Simple Random Sample: every conceivable group of people of the required size has the same chance of being the selected sample.

Need: (1) List of units in the population.
   (2) Source of random numbers.
Example 4: How to Sample From Your Class

Background:
Population = 200 students in your class.
Plan to take a simple random sample of size \( n = 25 \) students.

Margin of error: \( \frac{1}{\sqrt{25}} = \frac{1}{5} = 0.20 \) or about 20%.

Step 1: Obtain a list of students in the class, numbered 1 to 200.

Step 2: Obtain 25 random numbers between 1 and 200. Write 1 to 200 on same-sized slips of paper, put in bag, mix well, draw out 25; or Use computer or calculator program (e.g. Minitab).

Step 3: Locate and interview the people on your list whose numbers were selected.
4.5 Other Sampling Methods

- Stratified Random Sampling
- Cluster Sampling
- Systematic Sampling
- Random Digit Dialing
- Multistage Sampling
Stratified Random Sampling

Divide population into groups (strata) and take a simple random sample from each.

Advantages:
1. Have **individual estimates** for each stratum.
2. If variable measured gives more consistent values within each strata than within population, can get **more accurate estimates** of population values.
3. If strata are geographically separated, may be **cheaper** to sample them separately.
4. May use different interviewers within each strata.
Cluster Sampling

*Divide population into groups (clusters), take a random sample of clusters and measure only the selected clusters.*

**Advantage:** need only a list of clusters, not a list of all individual units.

**Example:** Sample students living in a dorm at a college

College has 30 dorms, each dorm has 6 floors

→ 180 floors form the clusters.

Take a random sample of floors and measure everyone on those floors.
Systematic Sampling

*Divide population list into as many consecutive segments as you need, randomly choose a starting point in the first segment, then sample at that same point in each segment.*

**Example:**

- List of 5000 names, want a sample of 100.
- Divide the list into 100 consecutive segments of 50.
- Randomly choose a starting point in the first 50 names.
- Then sample every 50th name after that.
Random Digit Dialing

*Results in a sample that approximates a simple random sample of all households in the U.S. that have telephones.*

**Steps:**

- List all possible *exchanges* (area code + next 3 digits).
- Use white pages to approximate proportion of all households in country that have each exchange.
- Use computer to generate a sample with approximately the same proportions.
- Repeat above to sample *banks* (next 2 digits)
- Computer randomly generates last two digits to complete the phone number.
Multistage Sampling

*Sampling plan that uses a combination of sampling methods in various stages.*

**Example:**

- Stratify by region of the country; then
- stratify by urban, suburban, and rural; then
- choose a random sample of communities within those strata.
- Divide those communities into city blocks or fixed areas, as clusters, and sample some of those.
- Everyone on the block or within fixed area may then be sampled.
4.6 Difficulties and Disasters in Sampling

Difficulties
1. Using the wrong sampling frame
2. Not reaching the individuals selected
3. Having a low response rate

Disasters
4. Getting a volunteer or self-selected sample
5. Using a convenience or haphazard sample
Disasters in Sampling

Getting a Volunteer or Self-Selected Sample

Relying on volunteer responses presents difficulties, but relying on a volunteer sample is a waste of time.

Example 7: A Meaningless Poll

Television poll vs. properly conducted study

<table>
<thead>
<tr>
<th>Q: Do you support the president’s economic plan?</th>
<th>TV Poll (volunteer sample)</th>
<th>Survey (random sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>42%</td>
<td>75%</td>
</tr>
<tr>
<td>No</td>
<td>58%</td>
<td>18%</td>
</tr>
<tr>
<td>Not sure</td>
<td>0%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Such ‘volunteer polls’ are just a count of who bothered to go to the telephone and call.
Case Study 4.1: The Infamous Literary Digest Poll of 1936

Election of 1936: Democratic incumbent Franklin D. Roosevelt and Republican Alf Landon

Literary Digest Poll:
• Sent questionnaires to 10 million people from magazine subscriber lists, phone directories, car owners, who were more likely wealthy and unhappy with Roosevelt.
• Only 2.3 million responses for 23% response rate. Those with strong feelings, the Landon supporters wanting a change, were more likely to respond.
• (Incorrectly) Predicted a 3-to-2 victory for Landon.
Case Study 4.1: The Infamous Literary Digest Poll of 1936

Election of 1936: Democratic incumbent Franklin D. Roosevelt and Republican Alf Landon

Gallup Poll:

• George Gallup just founded the American Institute of Public Opinion in 1935.

• Surveyed a random sample of 50,000 people from list of registered voters. Also took a random sample of 3000 people from the Digest lists.

• (Correctly) Predicted Roosevelt the winner. Also predicted the (wrong) results of the Literary Digest poll within 1%.