36-303: Sampling, Surveys and Society

Components of a Survey

Brian Junker
132E Baker Hall
brian@stat.cmu.edu

Handouts

- Emailed to you:
  - Team Member Lists
- In Class:
  - Reading (538 and the Florida Primary)
  - Graded Quizzes
  - Today's Lecture Notes
- On http://www.stat.cmu.edu/~brian/303:
  - Topics Schedule
  - Project Schedule
  - HW01 – Due Jan 31!

Outline

- Quiz Results
- 538 and the Florida Primary
- Team Assignments; Project Schedule
- Process of Conducting a Survey
  - Defining Research Objectives
  - Mode of Data Collection; Target Population; Frame
  - Measurement; Errors of Observation
  - Sample; Errors of Non-Observation
  - Coding, Editing and Post-Survey Processing
  - Analyzing the Data, Writing the Report

Quiz Results

- Quiz scores:

```
4 | 2
4 |
5 |
5 | 7889
6 | 1
6 | 7
7 | 244
7 | 57
8 | 111122334
8 | 578
9 | 000111122244
9 | 6
```

median

- It was an easy quiz
  - 80 or above
    - Generally feel pretty good
    - Errors were sloppy or minor
  - Below 80 – a significant chunk is missing
    - Median/Outliers
    - Histogram/Boxplot
    - Confidence Interval
    - Scatterplot
    - Summation Notation
    - Expected Value
    - Binomial Distribution

Quiz Results (Cont'd)

- Most answers pretty obvious – ask your friends or check with us
- CI for Mean Test Performance…

```
N   Mean SE Mean StDev Minimum    Q1 Median    Q3 Maximum
93 82.61    1.06 10.21   58.00 77.00  84.00 91.00   99.00
```

$$\begin{aligned}
\text{StDev} &= \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i-\overline{x})^2} = 10.21 \\
\text{SE Mean} &= \text{StDev}/\sqrt{n} = 1.06 \\
95\%\ \text{CI} &= \text{Mean} \pm 1.96 \times (\text{SE Mean}) \\
&\approx (82.61 - 2 \times 1.06, 82.61 + 2 \times 1.06)
\end{aligned}$$

Quiz Results (Cont'd)

$$\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2}$$

- What is role of i?
- What is role of x_i?
- How do we calculate it?
- What is it?

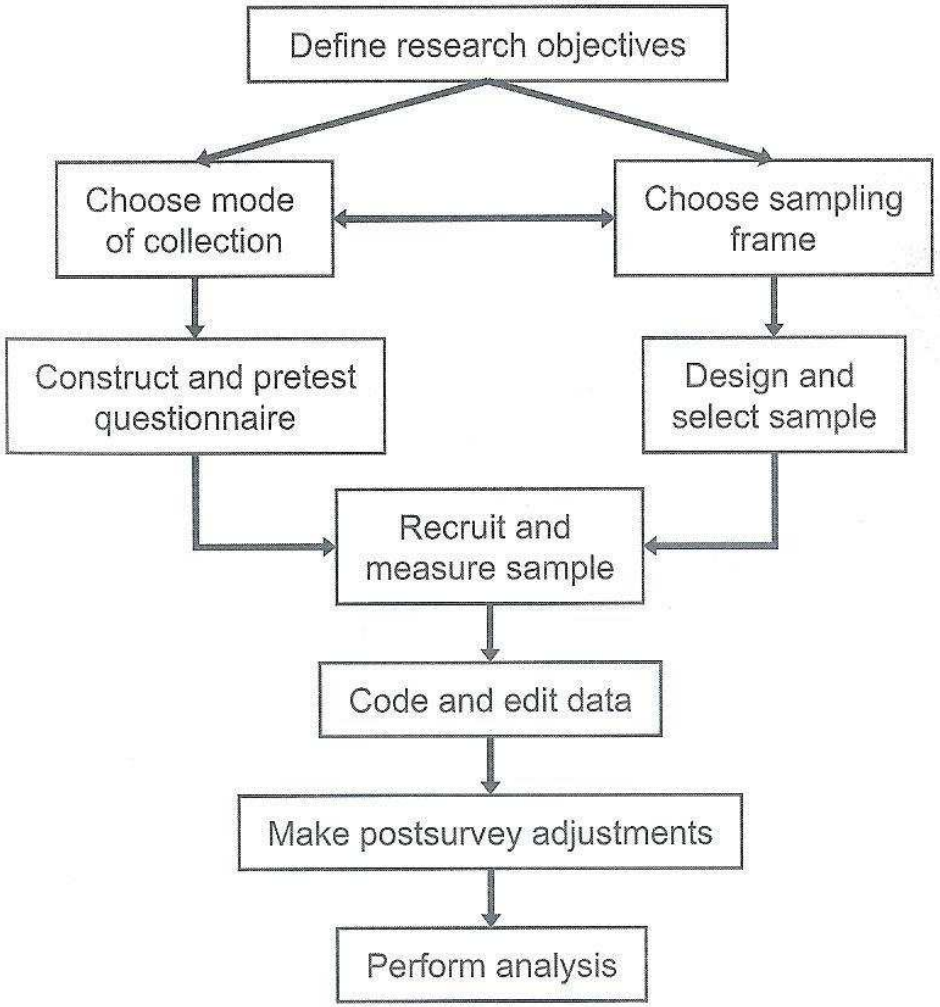
Team Assignments; Project Outline

- Team Member Lists – Emailed to You
  - As the projects get underway there may be some small adjustments in some teams
- Project Schedule – Posted on http://www.stat.cmu.edu/~brian/303
- Next deadline: Tue Jan 31: ***Propose two topics!***
- (HW01 is also due Tues Jan 31).

Wrapping up Previous Lecture

- Elements of a Sample
- Does Sample Represent Population?
- Non-sampling errors and Sampling Errors
- What can we say about
  - Population of Interest
  - frame/list
  - sampling technique
  - sample size
  - response rate
  - mode of interview
  - possible sources of selection bias and inaccuracy
  - other details of methodology relevant to our inferences

Process of Conducting a Sample Survey



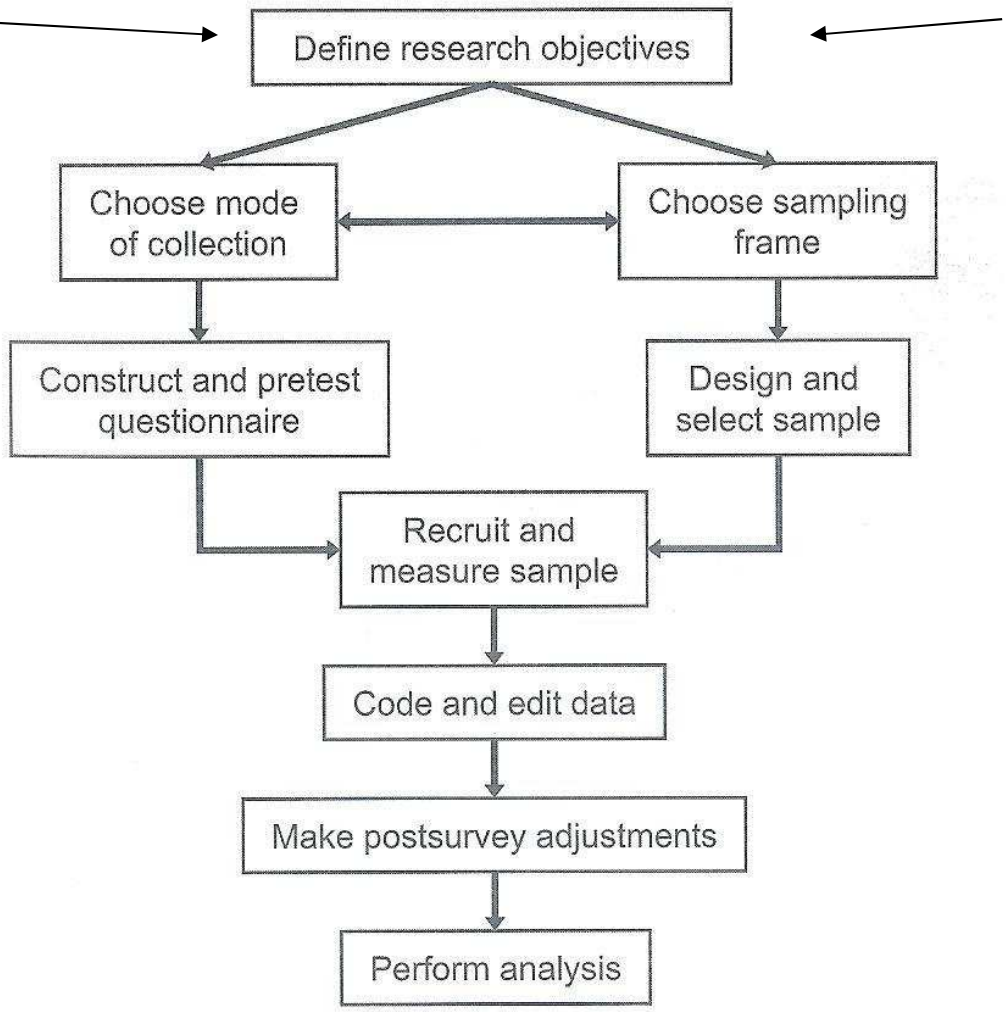
Defining Research Objectives

- **Research Question(s)**
  - Is it of interest? *(Who Cares??)*
  - Can it be answered with available methods?
  - Can a survey on it be conducted and analyzed within budget ($$, time, effort, irritation, …)?
  - Surveys are not well-suited to cause-effect questions (Why not? Think about 36-309…)
- **Target Population** *(This is harder than it sounds!)*
  - What population is relevant to the question?
  - What population can you construct a good sampling frame for?
- **Construct** *(What information do you seek?)*
  - *"Number of jobs created in last month"*
  - *"Consumption of beer in the last month"*
  - *"Knowledge in mathematics of eighth grade school children"*
  - *"Optimism about one's financial status"*

Process of Conducting a Sample Survey

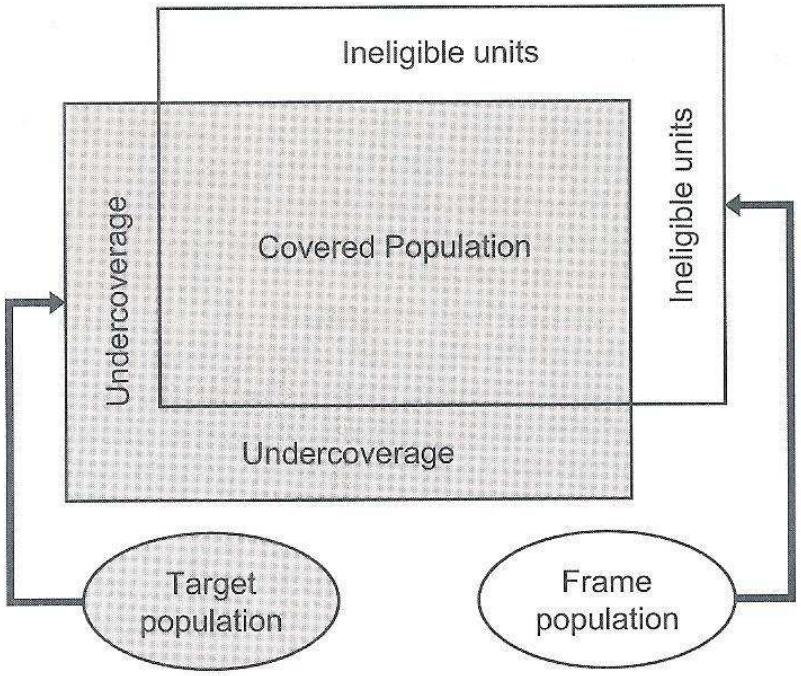
- Question
- Construct

- Target Population



Mode of Data Collection and Sampling Frame

- Why Sampling Frame ≠ Target Population?
  - Population may not have a natural frame
  - Mode of data collection may restrict frame
- Mode of Data Collection
  - Interview
    - Face to face?
    - Telephone?
  - Self-report
    - Face to face?
    - Internet?
  - Direct
    - Administrative records?
    - Observe prices, soil samples, type of nbhd, etc.



Coverage Error – *the extent to which the Sampling Frame does not cover the Target Population*

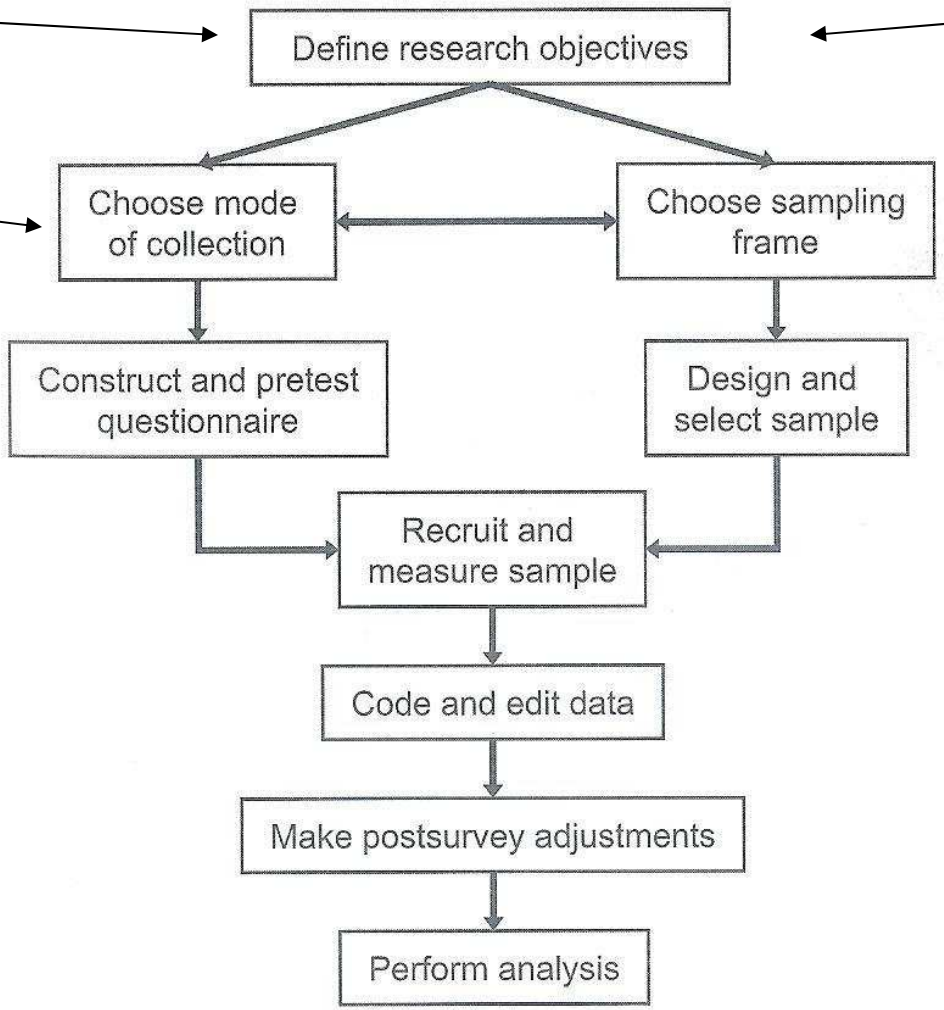
Process of Conducting a Sample Survey

- Question
- Construct

- Target Population

How does the mode of collection affect the Sampling Frame?

How is the Sampling Frame different from the target population?



Measurement; Response; Errors of Observation

- Measurement: How we gather information for constructs
  - Chemical analyses of soil samples
  - Electronic measures of traffic flow
  - Observations of classroom teaching
- Questions posed to respondent are common
  - Oral (face-to-face interview)
  - Visual (self-report or computer-assisted interview)
  - Based on some stimulus (reaction to watching a video, listening to music, reading a story)

Measurement; Response; Errors of Observation

- Responses depend on the form of the question
  - Multiple choice
  - Fill in the blank
  - Longer user-generated response
- Nonresponse
  - Didn't understand, didn't see, or refused question (item nonresponse)
  - Not home, not approached by interviewer, refused phone call, etc. (unit nonresponse)

Measurement; Response; Errors of Observation

- Errors of Observation (Measurement Error)
  - Deviations of measurement from underlying construct
  - Inaccurate measurements
    - Inaccurate administrative records
    - Poor chemical analysis of soil
    - Untrained interviewers/observers
    - Memory/attention/understanding/truthfulness of respondents
  - Item Nonresponse

Designing a Sample; Errors of Non-Observation

- We want to design a sample that is
  - Affordable (time, money, effort, accessibility…)
  - Representative (of the frame? Of the target population?)
- Simple populations with good frames
  - Simple sample designs and analyses suffice
- Complex populations or poor frames
  - Stratified sampling and Clustered sampling common
  - More complex designs require more complex analyses
- Followup for Unit Nonresponse?

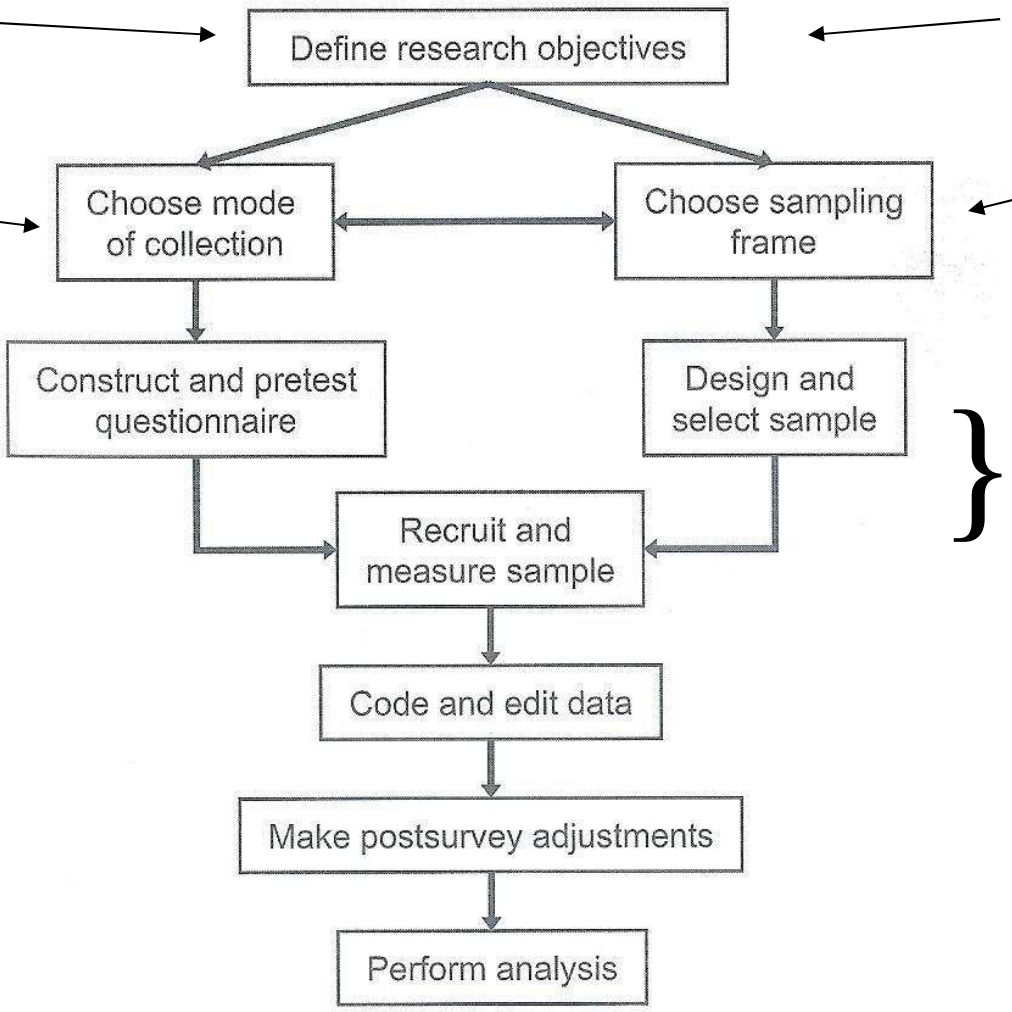
Designing a Sample; Errors of Non-Observation

- Errors of Non-Observation
  - Deviations between the sample and the target population.
  - How representative of the Sampling Frame is the Sample?
  - How representative of the Target Population is the Sampling Frame (Coverage Error…)
  - How do we followup unit nonresponders?
    - Sample more units to replace them?
    - Keep after them until they respond?

Process of Conducting a Sample Survey

- Question
- Construct

- Target Population



How does the mode of collection affect the Sampling Frame?

How is the Sampling Frame different from the target population?

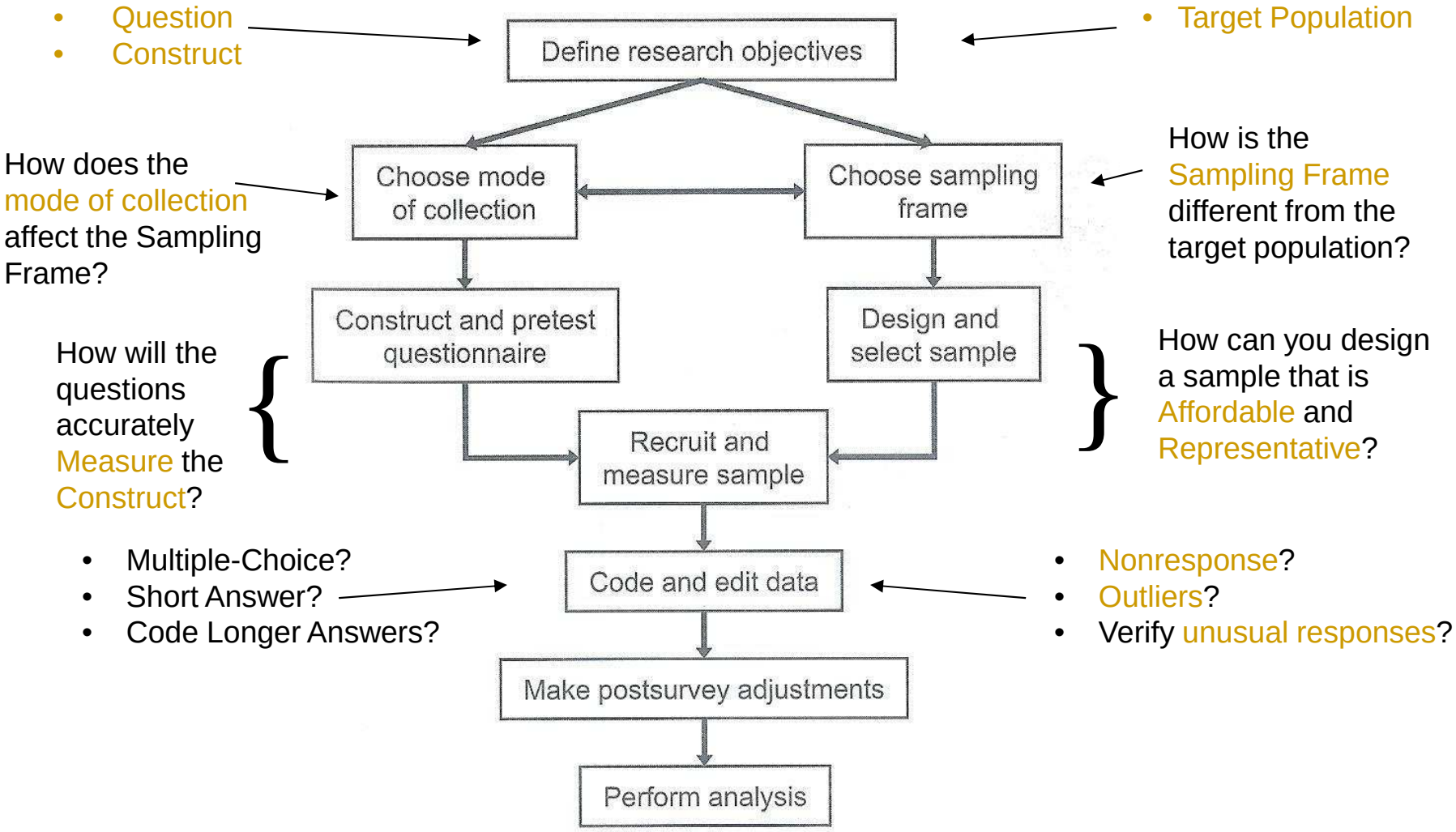
How will the questions accurately Measure the Construct?

How can you design a sample that is Affordable and Representative?

Coding and Editing Data

- Coding depends on measurements
  - Multiple choice?
  - Fill in the blank, long-answer, taped conversation?
  - Accuracy of chemical analysis?
- Nonresponse
  - Unit nonresponse? Successful Followups?
  - Item nonresponse? Refused? Not asked? Not reached? Not understood?
- Outliers
  - What is an outlier?
  - Include anyway? Drop?
  - Followup to verify value?
- Inaccurate Data
  - Detection? Followup? Correct value? Drop case?

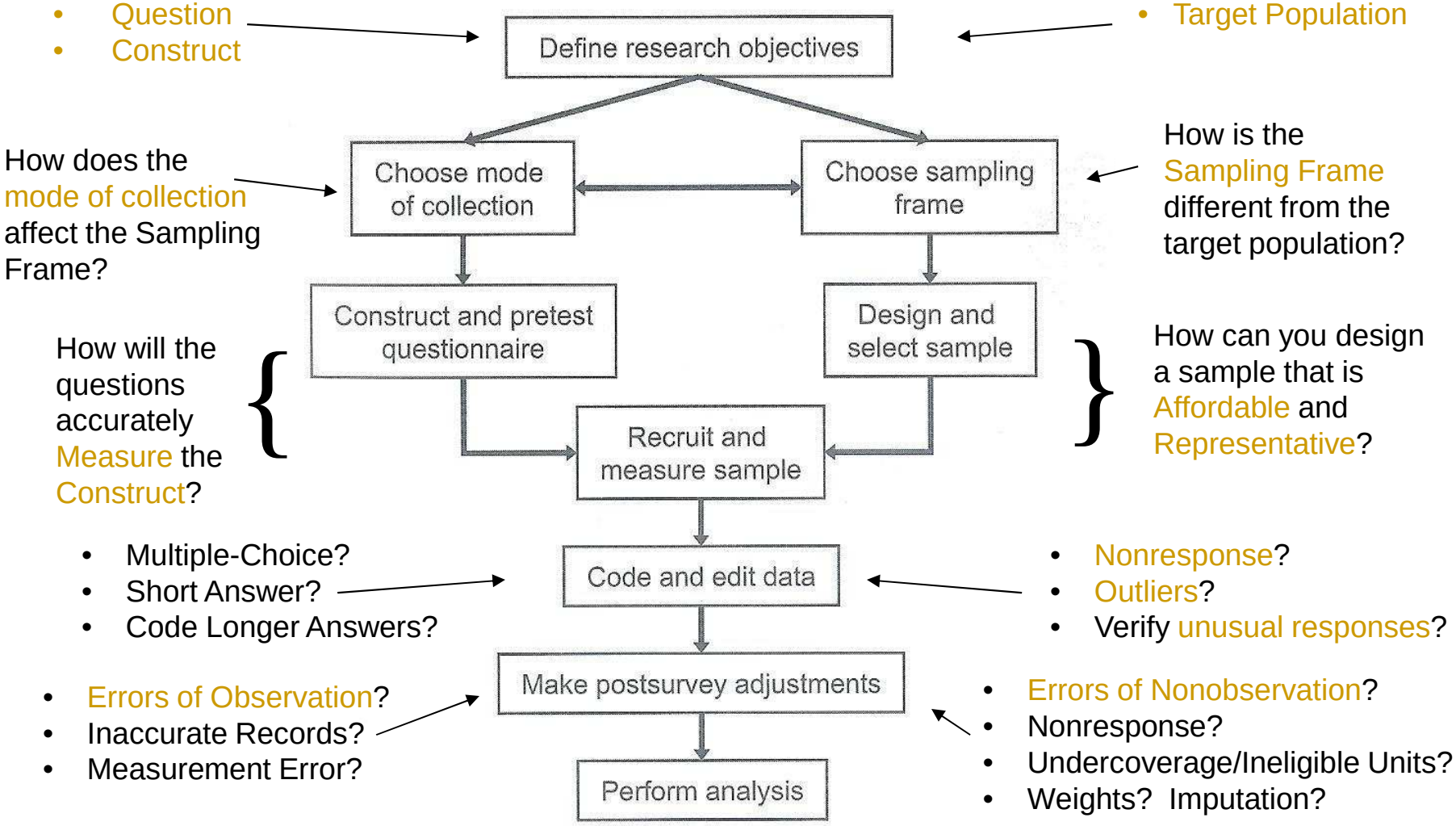
Process of Conducting a Sample Survey



Post-Survey Adjustments

- Adjustments for
  - Patterns of unit nonresponse (did women respond less than men?)
  - Under- or over-coverage of the sampling frame (no phone numbers for homeless men?)
  - Inaccurate or outlying data, …
- Weights (only 20% of sample was women but 50% of population are women, so “weight up” women by 5/2)
- Impute missing values (unit nonresponse and item nonresponse)

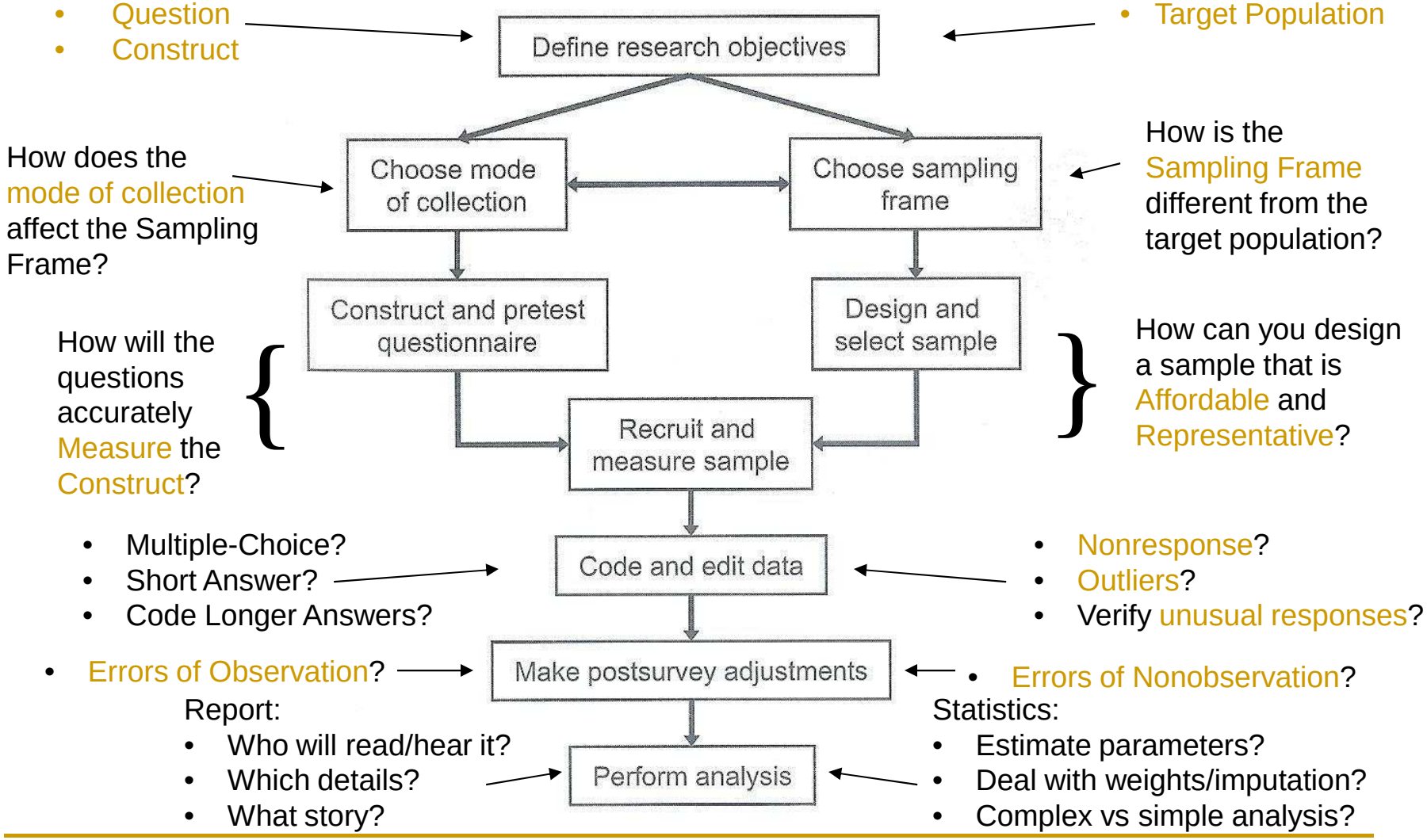
Process of Conducting a Sample Survey



Performing the Analysis

- Statistical analysis
  - What quantities should be estimated? How?
  - Do we have to deal with weights? Imputation?
  - Simple designs can use simple statistics; complex designs require complex statistics
  - Statistics cannot fix (or even quantify!) all errors
- Report writing
  - Who will read the report? ***How*** will they read it?
  - How much detail is needed? Where should it go?
  - What is the interesting story you are trying to tell?
    - Research objectives: Who Cares???

Process of Conducting a Sample Survey



Review

- Quiz Results
- Team Assignments
- Process of Conducting a Survey
  - What are the various components of a survey?