1.4 Problems and Solutions (last update 27 August 2024)

1. Give one possible sample of size 3 from each of the following populations. In other words, list 3 of the units that constitute the population described.

a) All the large cities in the United States;

b) All the cities in Louisiana;

c) All TV or movie streaming services;

d) All companies listed on the New York Stock Exchange.

Solution

a) All the large cities in the United States: New York City, Houston, and Denver.

b) All the cities in Louisiana: Lafayette, Baton Rouge, and Shreveport.

c) All TV or movie streaming services: Hulu, Peacock, and Netflix.

d) All companies listed on the New York Stock Exchange: General Motors, Chase Bank, and Exxon–Mobil.

2. Identify the unit on which each of the following variables is measured. For example, for the variable "the age of a person", a person is a unit since this variable is a characteristic of the person.

a) The number of people in a household;

b) The size of the screen of a laptop computer (measured in inches);

c) The number of credit hours a student is registered for;

d) The manufacturer of an automobile;

e) The color of the front entrance door of a house;

f) The classification (grade level) of a student in a high school. *Solution*

a) The number of people in a household: This is a characteristic of the household. Therefore, a household is a unit.

b) The size of the screen of a laptop computer (measured in inches): This is a characteristic of the laptop computer. Therefore, a laptop computer is a unit.

c) The number of credit hours a student is registered for: This is a characteristic of the student. Therefore, a student is a unit.

d) The manufacturer of an automobile: this is a characteristic of the automobile. Therefore, an automobile is a unit.

e) The color of the front entrance door of a house: This is a characteristic of the entrance door (or the house). Therefore, an entrance door (or a house) is a unit.

f) The classification (grade level) of a student in a high school: This is a characteristic of the student. Therefore, a student is a unit.

For questions 3 through 5 classify each **blue, bold faced number or description of a number** (there are two such descriptions in each problem) as a parameter or statistic (there is one of each in each problem). Carefully explain your reasoning (include a clear description of the population and the sample).

3. The receiving department of a company inspects a truckload of ball bearings to determine whether the bearings are within specified size limits. It is known, by the shipper but not by the receiving department, that the average diameter of the bearings in this truckload is **2.50**cm. The receiving department obtains a random sample of 100 ball bearings from this truckload and finds that the average diameter of these bearings is **2.55**cm.

Solution

In this scenario, the truckload of ball bearings is the population and the 100 bearing selected at random from the truckload is the sample. Therefore, the average diameter of the bearings in this truckload, **2.50**cm, is the parameter and the average diameter of the 100 bearings in the sample, **2.55**cm, is the statistic.

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4. A telephone sales outfit in Los Angeles uses a device that dials residential phone numbers in the city at random. Of the first 200 numbers dialed, **47%** are unlisted numbers. This is not surprising since **52%** of all Los Angeles residential phone numbers are unlisted.

Solution

In this scenario, the all of the residential phone numbers in Los Angeles form the population and the first 200 numbers dialed form the sample. Therefore, the percentage of unlisted numbers among all Los Angeles residential phone numbers, **52%**, is the parameter and the percentage of unlisted numbers among the first 200 dialed, **47%**, is the statistic.

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5. It might be of interest to determine **the percentage of all personal vehicles registered in the United States that are more than 10 years old**. It would probably be easier to determine **the percentage of all personal vehicles registered in Louisiana that are more than 10 years old**.

Solution

In this scenario, the collection of all personal vehicles registered in the United States forms the population and the collection of all personal vehicles registered in Louisiana forms the sample. Therefore, **the percentage of all personal vehicles registered in the United**

States that are more than 10 years old is the parameter and **the percentage of all personal vehicles registered in Louisiana that are more than 10 years old** is the statistic.

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6. A medical researcher wants to study the effects of a particular regimen of radiotherapy on the survival time (time until death) of patients suffering with a particular type of cancer.

a) What is a unit?

b) What is the variable of primary interest to the medical researcher?

c) What is the population of interest to the medical researcher.(*i.e.*, What is the target population?)

In parts d and e you will need to describe what you believe would be a plausible sampled population and how it might differ from the target population of part c.

d. Describe how the researcher could select a sample from the population and describe the sampled population determined by your method of obtaining a sample.

e. What problems might arise in sampling from this population?

Solution

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a) What is a unit?
In this example, the unit or experimental unit is a patient. This is the basic entity which is being manipulated and evaluated in this study.

b) What is the variable of primary interest to the medical researcher?
The variable of primary interest to the medical researcher (a.k.a. as the response variable) is the survival time of the patient, which is defined as the time that the patient lives after receiving the regimen of radiotherapy.

c) What is the population of interest to the medical researcher.(*i.e.*, What is the target population?)
The target population is the collection of all patients suffering with the particular type cancer of interest to the researcher. There may also be some restrictions on this population that are not mentioned here, such as the age of the patient.

In parts d and e you will need to describe what you believe would be a plausible sampled population and how it might differ from the target population of part c.

d. Describe how the researcher could select a sample from the population and describe the sampled population determined by your method of obtaining a sample.

Question parts d and e are open ended and many answers are possible. The description of the sampled population which follows indicates the types of restrictions which enter into selecting patients for such a study.

Basic medical and scientific ethics require that patients used in an experiment of this sort must be informed of all risks associated with the study and must sign a formal consent form. Therefore, the pool of potential patients is restrict to volunteers who are willing to consent to the procedure. In addition, the patient must be available to the researcher! Hence, the sampled population consists of all patient volunteers with the appropriate type of cancer who meet all of the requirements of the study, such as age and current medical condition, who are available to the experiments. In short, the sampled population consists of all available volunteers.

To select a random sample of patients from this collection of "all available volunteers" a list would be formed by assigning a code number to each volunteer and randomly selected the appropriate number of patients from this list.

e. What problems might arise in sampling from this population?

Based on my answer to part d, the main problem here is that the sampled population of "all available volunteers" may differ in some systematic way from the target population described in part c. The researchers will need to measure all relevant characteristics, such as age, medical condition, sex, socio–economic status, and race or genetic background, which might conceivably be related to how the treatment might affect the patient. This information would then be included in the discussion of the experiment and its outcome to help the reader understand relevant restrictions on the scope of the conclusions.

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7. Ten vehicles were selected at random from a partial listing of all the vehicles that have been issued campus parking permits, and the data tabulated below were recorded. Note: The list that the sample was selected from was created a few weeks before the semester

began and does not include all vehicles with campus parking permits.

Vehicle	**Type**	**Make**	**Color**	**Age of vehicle (years)**	**commute distance (miles)**
1	car	Honda	blue	8	12
2	car	Ford	white	7	30
3	truck	Chevy	brown	2	18
4	car	Toyota	white	3	6
5	truck	Toyota	black	9	4
6	motorcycle	Harley	black	3	28
7	car	Honda	green	6	45
8	truck	Ford	silver	10	10
9	motorcycle	Honda	red	1	4
10	car	Nissan	white	3	18

a) What is a unit?

b) What is the population of interest? (*i.e.*, What is the target population?)

c) What is the population we have information about? (*i.e.*, What is the sampled population?)

Solution

a) What is a unit? Here we have a sample of 10 vehicles selected at random from a partial listing of all the vehicles that have been issued campus parking permits. Therefore, a unit is a personal vehicle.

b) What is the population of interest? (*i.e.*, What is the target population?) Based on this description the target population is all the personal vehicles that have been or will be issued campus parking permits for a particular semester.

c) What is the population we have information about? (*i.e.*, What is the sampled population?) Since the sample of 10 vehicles was selected from a partial listing of all the vehicles that have been issued campus parking permits, the sampled population is the collection of personal vehicles on this partial listing of all the vehicles that have been issued campus parking permits.