WEB PAGE FOR CHAPTER 6

SPSS ACTIVITY

Load Chapter 7 SPSS Data File A and undertake the following tasks.

(a) Create a total score, mean score and percentage for variables *q13 – q18* inclusive for all 80 cases.
(b) Using the frequencies menu, check for input errors on the variables *gender, age, the workload is too heavy* and *I am not given clear instructions*. Obtain appropriate tables and graphs, etc.

Print out your results and compare your results with those of other class members.

QUESTIONS

1 What type of scale is used (a) in a list of the order of finish in a marathon, and (b) when describing the sex of the runners in that marathon.

2 Is calendar time counted in months equal interval data?

3 What scale of measurement is most appropriate for each of the following?
   (a) attitudes towards currency exchange controls
   (b) numbering of houses along a road
   (c) scores on an accountancy test
   (d) annual income in dollars
   (e) government departments
   (f) Janice is the most popular member of the group
   (g) results of a beauty contest
   (h) time taken to complete a task
   (i) nationality

4 In a study investigating the role of practice in improving performance the IV is which variable?

5 What level of measurement is each of the following DV's:
   (a) Employees are divided into those who have blue eyes and those who have brown eyes.
   (b) These two groups are then measured on the time required for their eyes to adjust to a sudden change in light intensity.
   (c) Each employee is also classified as a heavy smoker, moderate smoker, light smoker or non-smoker.
   (d) Each is also classified as having either normal vision or better, or below normal vision.

Additional material – *VARIABLES AND LEVELS OF MEASUREMENT*

The term *variable* refers to a characteristic that varies from person to person or case to case. If we are interested in the time commuters in Vancouver must spend on their drive to work each morning, the variable is *time spent.* In a study concerning the income of wage earners, the variable is *income.* These measurements need not correspond very well with everyday notions of measurement such as weight, distance, and temperature. For example, eye colour is a variable (because a set of people will include some with brown, some with blue and others with green eyes), as are types of vehicle and political parties. Thus measurement of a variable can involve merely categorization. Companies may use different categories such as department manager, supervisor, and administrative assistant, for classifying staff. These categories constitute a variable since they are different positions to which people can be allocated. Such categorization techniques are an important type of measurement in statistics. Variables may be classified as quantitative or qualitative.

Variable. A variable is the characteristic of the population that can take on more than one value and demonstrates variation from one observation, event or person to another.

Qualitative and quantitative variables

Qualitative variables

Qualitative variables are classified into categories according to the characteristics by which they differ rather than by 'how much'. The data obtained with qualitative variables are limited to counting and classifying. For example, the marital status of credit applicants, the gender of students in the statistics class, ethnicity, political affiliation, the makes of car used by the Melbourne police force are all examples of qualitative variables. In every case, the observations are measured non-numerically as categories.

Qualitative variables such as sex, ethnic group, branches of a company, and so on, are usually recorded through the use of code numbers, e.g. male = 1; female = 2, rather than by verbal labels. Of course these numbers have no mathematical significance!

Quantitative variables

These are those which vary in quantity and are thus recorded in numerical form, for example, age, price, items sold per day. Q*uantitative variables* differ in terms of *how much* individuals, objects, or events possess a given characteristic. Thus, the numbers we use to deal with quantitative variables can be added, subtracted, multiplied and divided. The incomes of all wage earners is an example of a quantitative variable. Other examples include the heights of all people we might be interested in if we are in the business of manufacturing clothes, scores students receive on the final examination in statistics, or the time spent in minutes in the queue at the supermarket. In each case, the observations are measured numerically.

Discrete and continuous variables

Discrete variables

A *discrete variable* is one that is restricted to whole numbers and can therefore take on only a specific set of values. They are characterized by gaps in which no real values exist. For example, the number of foreign born workers in a factory is a discrete variable. There might be 14 or 15 of these individuals but never 14.7. A person is either a male or female and cannot be assigned any value between the two. The number of companies in the country making bicycles and the number of computers in stock at a dealership are all discrete too. Typically, the data accumulated with discrete variables result from the process of counting. There may be 15 companies making bicycles, 12 computers in stock, and 34 immigrant employees. Discrete variables may, of course, be either qualitative (sex, marital status, country of birth) or quantitative (number of books in a library, number of items repaired this year under warranty)

A discrete variable. *Consists of separate indivisible categories so that no values can exist between two neighbouring categories.*

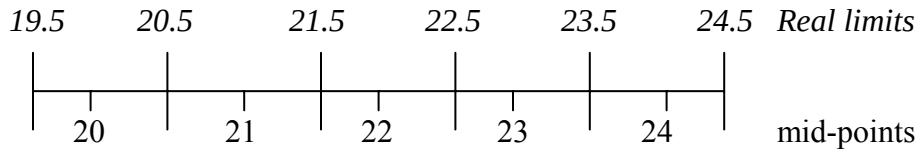
Continuous variables

A *continuous variable* is one that can assume any value, including fractional ones, within a range of values. Weight of content of tins of beans, temperature for baking different types of bread, tread wear on car tyres, distances on various delivery routes, scores on a stress test, daily calorie intake, and so on, are examples of continuous variables. An individual can be described as 25.5 years old and weighing 75.2 kilos.

To go from one unit to the next on a continuous variable, one must pass, theoretically at least, through a large number of fractional parts. For example, as the temperature increases it does not suddenly go from 24C to 25C or even from 24C to 24.1C but rather passes gradually through a succession of infinitesimally small changes as it increases. Therefore the measurement of continuous variables is always an approximation of the true value. No matter how accurately one measures, it is not possible to measure and record all the possible values of a continuous variable. As a result, continuous variables are measured to the nearest convenient unit and the recorded values of these variables are, in practice, discrete with definite predetermined points along the continuum chosen to report the variable values.

A continuous variable. *Is one that can take on an infinite number of intermediate values between any two identified values.*

Because a continuous variable is in real terms measured in specified intervals like millimetres, or seconds, we consider each interval to have a midpoint that represents the score or measure and bounded by upper and lower limits (often termed the real limits) which link it to the next interval. Thus as Figure 2.1 illustrates, the upper boundary or limit of one interval on a continuous scale falls at the lower limit of the next defined interval.



Lower and upper limits of each score are indicated by the longer lines.

Figure 1 Illustration of real limits and midpoints of a continuous variable.

Because of this limitation in accuracy with continuous data, the distinction between continuous and discrete variables is not always clear-cut and unambiguous. Take currency as an example. The money we carry on our persons and with which we pay our bills is discrete. However, in the world of finance, in which actual money may never change hands, money is frequently expressed in fractional terms. For example, exchange rates are expressed to four decimal places and, in the field of cost accounting, the cost per unit may be stated to several decimal places. In this context then, money is continuous. Alternatively, in some research studies, we often find variables that are inherently continuous being treated as though they were discrete. For example, age is a continuous variable, but subjects in a study may be placed into length of work experience categories, such as 0–5 years, 6–10 years, 11–15 years and so on, rather than using actual years and months. Salary is often placed into categories too.

ANSWERS TO QUESTIONS

1 ordinal; nominal

2 no; as months vary in days

3 a = interval; b = nominal; c = interval; d = ratio ; e = nominal; f = ordinal; g = ordinal; h = ratio; i = nominal

4 practice

5 a = nominal; b = ratio; c = ordinal; d = nominal