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1 What is a Statistics?

Statistics are part of our everyday life.

Science fiction author **H. G. Wells** in **1903** stated, "Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write. "

Kuzma (1984) provides a formal definition:

A body of techniques and procedures dealing with the collection, organization, analysis, interpretation, and presentation of information that can be stated numerically.

2 Variables

A characteristic that varies with an individual or an object, is called a variable. For example, **age** is a variable as it varies from person to person.

There are two types of variables: **Quantitative** and **qualitative** variables.

2.1 Quantitative Variables

A variable called quantitative variable when a characteristic can be expressed numerically. **I.e.** Age, weight, income or number of children. Quantitative variables are reported in interval or ratio scales.

In Quantitative variable there are two types of variables **Discrete & continuous** variables.

2.1.1 Discrete variables

A discrete variable represents count data such as the number of persons in a family, the number of rooms in house, and the income of an individual.etc.

2.1.2 Continuous variables

A continuous variable represents measurement data such as the age of a person, the height of a plant, temperature at a plant, etc.

2.2 Qualitative Variables

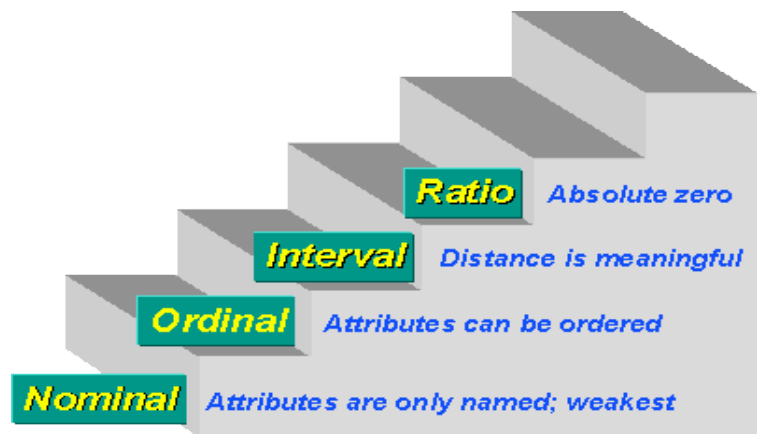
A variable called qualitative variable when a characteristic can not be expressed numerically.

I.e. education, gender, eye-color, quality, intelligence, poverty, satisfaction etc.

3 Scales of Measurement in Statistics

The Level of measurement of a variable is a critical factor in determining what kinds of tools may be used to describe the variable, and what means of analysis may be used for inference about the variable. In short, the level of measurement determines or constrains the types of descriptive and inferential statistics that may be applied to the variable.

- A. Nominal Scale
- B. Ordinal Scale
- C. Interval Scale
- D. Ratio scales.



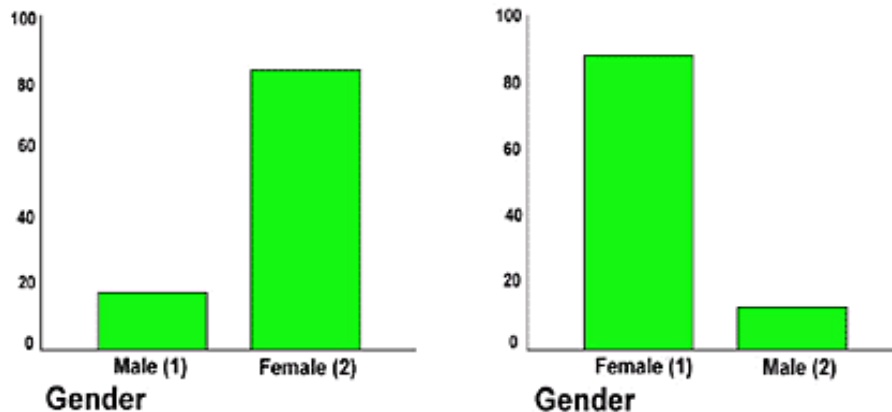
3.1 Properties of Measurement Scales

Each scale of measurement satisfies one or more of the following properties of measurement.

- **Identity.** Each value on the measurement scale has a unique meaning.
- **Magnitude.** Values on the measurement scale have an ordered relationship to one another. That is, some values are larger and some are smaller.
- **Equal intervals.** Scale units along the scale are equal to one another. This means, for example, that the difference between 1 and 2 would be equal to the difference between 19 and 20.
- **Absolute zero.** The scale has a true zero point, below which no values exist.

3.2 Nominal Scale of Measurement

The nominal scale of measurement only satisfies the identity property of measurement. Values assigned to variables represent a descriptive category, but have no inherent numerical value with respect to magnitude. Categorical data and numbers that are simply used as identifiers or names represent a nominal scale of measurement.



EXAMPLES

1. Gender is an example of a variable that is measured on a nominal scale. Individuals may be classified as "male" or "female", but neither value represents more or less "gender" than the other.
2. Birthplace They may code the seasons of birth as 1, 2, 3, and 4 for spring, summer, fall, and winter, respectively.
3. Goods: Fan, computer, speakers, mobile, watch etc.)
4. Meal Preference: Breakfast, Lunch, Dinner
5. Religious Preference: 1 = Buddhist, 2 = Muslim, 3 = Christian, 4 = Jewish, 5 = Other
6. Political Orientation: Republican, Democratic, Libertarian, Greens.
7. Counting how many people help someone else in a set-up scene (e.g., someone pretending to be blind cross the street).
8. Favouritism : Favourite (player, Actor, Teacher, Students, Friend, etc.)
9. Counting the number of people out of a group of 30 who are relieved from their depression three months after treatment.

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- 10.Examining whether extroverts or introverts are more likely to engage in altruistic behavior.
- 11.Asking whether females or males have higher self-esteem.
- 12.In a medical test, a lab animal may be either dead or alive. Every animal under study is in one of the two states and there is no animal that cannot be described by these two states.
- 13.In Quantum mechanics, the measured spin of an electron is either $+1/2$ or $-1/2$. The measurement cannot yield any other value and this is true for any electron under study.
- 14.Race (Caucasian, African-American, Hispanic, Asian, etc)
- 15.Linguistic Group
- 16.Mode of transportation (Automobile, bus, subway, bicycle, other)
- 17.Marital Status (Married, Single, Divorced)
- 18.Your social security number
- 19.Cricket Match(Pakistan, Australia, New-ze-land, Bangladesh)
- 20.Eye color, Hair color etc.
- 21.Favourite pizza topping.
- 22.Choice of residence (house, apartments, condominium, other)
- 23.Water and Tree is an example of nominal scale.
- 24.Psychiatric disorders (Schizophrenic, Paranoid, Manic-depressive)
25. Education types of people (Public School or Private School.)
26. Style of automobile (measured as sedan, sports car, SUV, and so forth).
27. If a university wants to classify its students into groups based on their major, they can express the information by labeling the groups with their respective major names (business, communications, health care, etc).
- 28.Jersey numbers in basketball are measures at the nominal level. A player with number 30 is not more of anything than a player with number 15, and is certainly not twice whatever number 15 is.
29. On a survey you might code Educational Attainment as 0=less than H.S.; 1=some H.S.; 2=H.S. degree; 3=some college; 4=college degree; 5=post college. In this measure, higher numbers mean more education
- 30.Either you are a smoker or not a smoker,
31. you attended college or you didn't
- 32.A subject has some experience with computers, an average amount of experience with computers, or extensive experience with computers.
- 33.On a continuum from one to ten. Coding of nominal scale data can be accomplished using numbers, letters, labels, or any symbol that represents a category into which an object can either belong or not belong.

34. This, the crudest of measurement scales, classifies individuals, companies, products, brands or other entities into categories where no order is implied.
35. Product which you bought on daily basis (Okra, Palm Oil, Milled Rice, Peppers, Prawns, Pasteurized milk.)
36. I'm partial to brown and may feel that brown should always be listed first, but you may like green and feel it should go first.
37. Ice cream flavor preference.
38. The language background of the householders (English, Mandarin, Greek, Italian);
39. Your Nationality (Pakistan, England, USA, Australia, etc.)
40. For example, a nominal scale dealing with household pets might include the categories dogs, cats, birds, and fish.
41. Suppose the numbers 1, 2, and 3 represent 3 measurements on any one of those scales. On a nominal scale, the numbers could have been replaced equally by the same numbers in a different order such as 3, 1, 2 or three arbitrarily chosen different numbers such as 6, 4, 8.
42. ZIP codes (0423, 0413, etc) , zip code of the boater's principal place of residence.
43. To 'numbering' of football players for the identification of the individuals.
44. 1 is not 2. 3 is not 9. It really makes more sense to think of things like apples and oranges, or cookies with green sprinkles vs. cookies with red sprinkles. There is no reason to assign apples to the number 1 or 3 nor does it make any sense to assign oranges to the number 2 or 9.
45. Name of your school, College, University,
46. Type of car you drive
47. Favorite breakfast cereal
48. Another example is blood groups where the letter A, B, O and AB represent the different classes
49. Just names. Consider Accounting Staff, Sales Staff, and Supervisors, and Clerical Staff,
50. The presence vs. absence of something is a form of nominal measurement

3.3 Ordinal Scale of Measurement

The ordinal scale has the property of both identity and magnitude. Each value on the ordinal scale has a unique meaning, and it has an ordered relationship to every other value on the scale.



Pepsi 1
Coke 2
Sprite 3
Surge 4



Sprite 1
Pepsi 2
Surge 3
Coke 4



Surge 1
Sprite 2
Pepsi 3
Coke 4

EXAMPLES

1. An example of an ordinal scale in action would be the results of a horse race, reported as "win", "place", and "show". We know the rank order in which horses finished the race. The horse that won finished ahead of the horse that placed, and the horse that placed finished ahead of the horse that showed.
2. Level of agreement Between the Parties(A & B): No, Maybe, Yes
3. Political Orientation: Left, Center, Right
4. High school class rankings. (one class to metric class)
5. In an Olympic race, the participants are ranked according to the ascending order of the time taken to finish the race. In this, the number tells us something about the relative performance of an **Athlete**.
6. The grading system used in university is a measurement scale of the type ordinal because there is a hierarchy involved.
7. Grades in govt. post (14 scale 16 scale 18 scale 20 scale)
8. Evaluations: Hi, Medium, Low
9. Liker Scales: 5 pt (Strongly Agree, Agree, Neither Agree nor Disagree, Disagree, Strongly Disagree)
10. Liberalism Scale: 7 pt liberalism scale (Strongly Liberal, Liberal, Weakly Liberal, Moderate, Weakly Conservative, Conservative, Strongly Conservative)
11. "On a scale of 1 to 10, with one being no pain and ten being high pain, how much pain are you in today?")
12. Many measures (e.g.,. personality, intelligence, psychosocial, etc.).

13. IQ scales should theoretically be treated as ordinal data.
14. Students Position holder's ranking : 1st position, 2nd position, 3rd position.
15. Brand Ranking: 1st D&G, 2nd Boss ,3rd Vercese.
16. Do you like the taste of Pepsi: Yes/No, Do you like the fast food: yes/ No
17. Winner of the Car racer awarded as: 1st (Cash, Cup), 2nd (Cup),3rd (Medal)
18. Income can b measure as (Below 10000=Below average, 10000-25000=average, above 25000= above average.
19. Socioeconomic status of a person (Upper, Middle, Lower)
20. One cookie is simply bigger than the other cookie
21. Size of Automobile (subcompact, compact, mid size, large)
22. Appraisal of company's inventory level (too low, about right, too high)
23. Diagnosis of weather patient has multiple sclerosis (certain, probable, unlikely, defiantly not)
24. Education level (grammar school, high school, college and post graduate)
25. Medical condition (measured as satisfactory, fair, poor, guarded, serious, and critical)
26. Socioeconomic status (measured as lower class, lower-middle class, middle class, upper-middle class, upper class)
27. Military officer rank (measured as lieutenant, captain, major, lieutenant colonel, colonel, general) Major is higher than captain, but we cannot measure the exact difference in numerical terms.
28. If a school wants to classify its students based on the year of schooling that they are in, they could label the groups as freshman, sophomore, junior, etc.
29. Suppose you are conducting a study on cigarette smoking and you capture how many packs of cigarettes three smokers consume in a day. It turns out that the first subject smokes one pack a day, the second smokes two packs a day, and the third smokes ten packs a day.
30. For example, if a researcher asked farmers to rank 5 brands of pesticide in order of preference he/she might obtain responses like 1=Rambo. 2=R.I.P. 3=Kill lot, 4=D.O.A, 5=Bug death.
31. Movies on a certain TV show are classified as 2 thumbs up, 1 thumb up, or 0 thumbs up. There is an order here. A movie that receives 2 thumbs up is better that a movie that receives 1 thumb up (supposedly anyway).
32. Voters are classified as low-income, middle-income, or high-income.
33. Students classified by their reading ability : Above average, Below average, Normal.

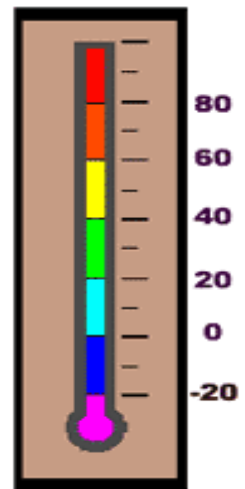
- 34.If we are told that Janet has a rank of 1 and Frank has a rank of 2, we do not know if Janet's appearance is greatly superior to Frank's or only slightly superior.
- 35.If you think of some type of competition or race (swimming, running), it is possible to rank order the finishers from first place to last place
- 36.A researcher might ask people to rank their preference for types of household pets, with 1 as the most preferred and 4 as the least preferred (resulting in, perhaps, 1-dogs, 2-cats, 3-birds, 4-fish).
- 37.What sort of scale is used to describe rain / no rain?
- 38.Numbers can be used to represent measurements on any of the four scales mentioned in this section On an ordinal scale, the order of the numbers 1, 2, 3 is important, but the order tells us nothing about the magnitude of difference between 1 and 2 and 2 and 3.
39. To rank job applicants from the best to the worst,
- 40.Examples of ordinal scales include finishing order in a competition, education level, and rankings. These scales only indicate that one value is greater or less than another, so differences between ranks do not have meaning..
- 41.A classic example of an ordinal scale is the scale of hardness of minerals.
- 42.Grade or quality of leather (1st class, 2nd class, 3rd class)
- 43.Stages in development (Developed country, under-developed country...etc)
- 44.Similarly if Jerry Seinfeld is ranked 1st for funniness, and David Letterman is ranked 15th we have no way of knowing how much funnier Seinfeld is than Letterman
- 45.You can tell which group scored highest or did best on your test; but you couldn't say by how much, just that one group of trainees did better than the others
- 46.One example is shoe size. Shoes are assigned a number to represent the size, larger numbers mean bigger shoes we know that a shoe size of 8 is bigger than a shoe size of 4.
- 47.House numbers 1,3,5...2,4,6
- 48.Observations may be classified into categories such as taller and shorter, greater and lesser, faster and slower, harder and easier, and so forth.
- 49.Meats are categorized as regular, choice, or prime
50. Here you should think of things like a list of the top ten cities to live. The data, here ten cities, are ranked from one to ten.

3.4 Interval Scale of Measurement

The interval scale of measurement has the properties of identity, magnitude, and equal intervals. Interval scales provide information about order, and also possess equal intervals.

EXAMPLES

1. A perfect example of an interval scale is the Fahrenheit scale to measure temperature. The scale is made up of equal temperature units, so that the difference between 40 and 50 degrees Fahrenheit is equal to the difference between 50 and 60 degrees Fahrenheit.
2. Time of Day on a 12-hour clock
3. Political Orientation: Score on standardized scale of political orientation.
4. IQ Scores. (The difference between an IQ of 92 and 98 is the same as the difference between 130 and 136. Using 100 as the average is arbitrary.)
5. Thermometer readings on a Fahrenheit scale. (The difference between 98.6 and 99.6 is the same as the difference between 101.8 and 102.8 -- 1 degree. The value of zero doesn't mean "the absence of heat.")
6. The number system that we use is another example of a uniform measurement scale.
7. Measurement of Sea Levels.
8. In Celsius system the starting point is (freezing point) zero and terminating point is (boiling point) 100° C. the gap between freezing and boiling point is divided into 100 equal space know as degree.
9. Blood pressure level of a person.
10. Functional life length of television set.
11. Length of prison term.
12. Money
13. People
14. Education (in years)



- 15.If a school is classifying students based on the results of their ACT scores, then they could say that student A scored a 25 and student B scored a 30. After stating that, they could see that student B scored 5 points higher then student A.
- 16.Suppose you are near the shore of a lake and you see three tree stumps sticking out of the water. In this way, you can create a relative measure of the height of the stumps from the surface of the water. the first stump may breach the water by twenty-four centimeters, the second by twenty-six centimeters, and the third by twenty-eight centimeters.
- 17.

Please indicate your views on Balkan Olives by scoring them on a scale of 5 down to 1 (i.e. 5 = Excellent; = Poor) on each of the criteria listed						
Balkan Olives are:						Circle the appropriate score on each line
Succulence	5	4	3	2	1	
Fresh tasting	5	4	3	2	1	
Free of skin blemish	5	4	3	2	1	
Good value	5	4	3	2	1	
Attractively packaged	5	4	3	2	1	
(a)						

Please indicate your views on Balkan Olives by ticking the appropriate responses below:					
	Excellent	Very Good	Good	Fair	Poor
Succulent					
Freshness					
Freedom from skin blemish					
Value for money					
Attractiveness of packaging					
(b)					

18. A brownie recipe calls for the brownies to be cooked at 400 degrees for 30 minutes. Would the results be the same if you cooked them at 200 degrees for 60 minutes? How about at 800 degrees for 15 minutes? I think we would get 3 different types of brownies : just right, awful gooey, and awful crunchy. The problem is that 200 degrees is not half as hot as 400 degrees, and 800 degrees is not twice as hot as 400 degrees.
19. When we say that Jill weighs 120 pounds and Sally weighs 130 pounds, we know by *how much* the two subjects differ
20. Multiple-choice tests of achievement. It is widely assumed that each multiple-choice test item measures a single point's worth of the trait being measured and that all points are equal to all other points
21. Thermometer, you can say that 88 degrees is 2 degrees higher than 86 degrees, but you cannot accurately say that 88 degrees is twice as hot as 44 degrees because there is never a situation of no heat at all. (The zero on a thermometer doesn't indicate a complete lack of heat, only one more unit on the scale, which continues downward.)
22. For instance, the amount of space between 1 and 2 is the same as the amount of space between 6 and 7. Or, the difference between 1 and 2 cookies is the same as the difference between 2 and 3 cookies. The difference in both cases is exactly one cookie
23. For example, one mistaken entry, two mistaken entries, three mistaken entries. With this data you can tell whether each trainee did better than others, and by how much.

3.5 Ratio Scale of Measurement

The ratio scale of measurement satisfies all four of the properties of measurement: identity, magnitude, equal intervals, and an absolute zero.



EXAMPLES

1. The weight of an object would be an example of a ratio scale. Each value on the weight scale has a unique meaning, weights can be rank ordered, units along the weight scale are equal to one another, and there is an absolute zero.
2. A person who is 40-year of age is twice as old as a 20-year old.
3. Ruler: inches or centimeters
4. Years of work experience of a person.
5. Income: Money earned last year
6. Number of children per family
7. GPA: grade point average
8. A speedometer.
9. Walking speed (see [Dr. Levine's](#) Pace of Life research by clicking on 'Geography of Time' excerpt).
10. Any time or length measurement would be on a ratio scale. since 0 time is meaningful
11. The cost of a cup of coffee. cool drink, Price of Pizza etc.
12. For example, when we say that the mass of a body is 2kg, it means that it is twice as heavy as a 1kg object that is defined in some scientific way.
13. The ratio measurement reflects our physical world and is thus very common in science and engineering. On the other hand, it is very rare in social sciences and surveys.
14. A person earning \$60000 per year earn three times the salary of a person earning \$ 20000

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15. Measuring the length of a piece of wood in centimeters, there is quantity, equal units, and that measure cannot go below zero centimeters. A negative length is not possible.
16. Height of a student, teacher, etc.
17. Items sold (500 computers, 100 T.V sets etc.)
18. Examples of ratio scale measurement in the behavioral sciences are all but non-existent. Luce (2000) argues that an example of ratio scale measurement in psychology can be found in rank and sign dependent expected utility theory..
19. Examples of variables which are ratio scaled include weights, lengths and times. Ratio scales permit the researcher to compare both differences in scores and the relative magnitude of scores. For instance the difference between 5 and 10 minutes is the same as that between 10 and 15 minutes, and 10 minutes is twice as long as 5 minutes.
20. Four people are randomly selected and asked how much money they have with them. Here are the results : \$21, \$50, \$65, and \$300.
21. Scores on exams of Graduate (graded from 0 to 100)
22. Hours of study for a test.
23. Percentage scores on a Math exam.
24. Time duration for exams or test.
25. The number of minutes of overtime work that employees perform is an example of Ratio scale of measurement.
26. Weight of cake measured in pounds is an example of ratio scale of measurement.
27. If you're measuring the height of two trees and tree A is 36 inches tall and tree B is 72 inches tall, you can accurately say that B is twice as tall as A. There is a condition of zero height.
28. Ratio scale is used for the measurement described in the statement 31mm of rain fell in the 6 hours to 3pm?
29. Another example of a ratio scale measurement is cash money, which has an absolute zero. You cannot hold in your hand anything less than a five cent coin (the smallest legal coin)!
30. 40° C does not represent a temperature which has twice the heat of 20° C because the zero on the Celsius scale is arbitrary, and does not represent an absence of heat. However, when we consider the metric system for temperature (known as 'degrees Kelvin'), then there is a true zero (called 'absolute zero'). Therefore, a measure of 40K (i.e. 40 degrees Kelvin) is twice as hot as 20K.

31. A measurement such as 0 feet does make sense, as it represents no length.
Furthermore 2 feet is twice as long as 1 foot
32. Weight of eatable goods (Rice, Oil, Sugar, etc..)
33. Counted values like numbers of people who attend the test session.
34. Area in square feet of the football ground
35. Speed of the car which u drive.
36. **Velocity** is measured on a ratio level scale.
37. In public policy and administration, budgets and the number of program participants are measured on ratio scales.
38. Number of cows, horse, in a field
39. Number of Mobile you own.
40. Your bank balance is also measure on ratio scale.
41. Number of people watching a movie.
42. Goals scored by Brazil in the World Cup.
43. When you are measuring your height, you are counting the number of inches off the ground to the top of your head
44. Total Candidates who votes to the parties
45. Number of complain by the customer for the poor services.
46. Number of units produce to accomplished the order of 3000 plastic bottles.
47. Number of cars in a show-room.
48. Course design for the Students who do I.Com.
49. Total shirts in your bukets.
50. Number of awards u win.