Statistics

Once scientists have made careful observations, the collected data is then organized and interpreted. Many have been mislead by big round numbers that have not been statistically verified. Good statistics is essential to good research. Researchers must ask: how is the data distributed? What measure of central tendency should be used? How much variation is there in the data? How closely are two things related, is there a strong correlation? Finally, Are we confident in our generalizations made from the research on the representative sample and are our findings statistically significant?

Distributions

The researcher must take the data and organize it in a way that allows one to see how it is distributed such as by using a bar graph. Statistical graphs must be carefully interpreted however noting the range in scale. Researchers can easily make slight differences in data look much larger in a graph.

Percentile rank: the text defines this as the percentage of scores in a distribution that fall below a given score. For example, a students percentile rank of 88 on the first psychology test has a grade higher than 88% of the students in the class. A students percentile rank can never be 100 because it would mean that he scored higher than 100% of the class yet he could not have scored higher than himself- he is part of the 100%!

Central Tendencies (mean, median, mode)

Measures of central tendency allow us to summarize the data. When attempting to do this, the researcher must choose a method that allows for a true interpretation of the data. For example, if we were interested in finding out how students were generally doing in an AP math class we could get an average of their grades (the **mean**) but if the marks were very extreme such as a group with many low marks and many high marks and with very little in between, the mean would not give a true indication of the caliber of math student in the class. **The mean**, or arithmetic average, works well with a *symmetrical* distribution (little or no extreme data). Otherwise, when dealing with a *skewed* distribution in which the data is unevenly distributed (e.g. extreme numbers or clumps of numbers) two other measures of central tendency may be used such as **the median** or **the mode.**

Median: The *middle* score in a distribution. Take all the scores and arrange them from lowest to highest, half will be below the median and half will be above it.

Mode: The score that appears most frequently in a distribution. This is the simplest measure of central tendency.

For an illustration of this concept, see Myers 5E p.596 or Myers Modules p.31.

Variation

Although it is important to look at the central tendency of a population, it is also helpful to know how much an individual varies from it. For example if the average mark in the class was 74%, is your mark of 62% within the normal range of variation or is it extremely low compared to others in the class? To find this out we could look at the **range** of scores in the class (subtract the lowest score from the highest) but to get a more precise indication of the variation within a sample, we would calculate the **standard deviation** (how much scores deviate from each other). It will indicate whether the scores are close together or dispersed. This is extremely important because averages with low variability are more reliable than those with high variability. For instance, Ashley and Robert finish the psychology course with an 80% average. Ashleys marks never strayed below 75% or above 85%. Roberts marks were variable and included a couple of low fifties and yet also a couple of low nineties. Although their averages work out to be the same, Ashleys average is considered a more reliable indicator/reflection of her ability in this course than is Roberts average.

To calculate **standard deviation**:

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    1. Calculate the difference between the score and the mean for each individual score. This difference is called the *deviation* from the mean.
    2. Square each of those deviations.
    3. Calculate the average of these squared deviations (divide by the total number of scores).
    4. Find the square root of this number. This will give you the "standard deviation" from the mean.
    5. A large number would indicate that the scores are dispersed while a relatively smaller number would indicate that the scores are clumped together.

Using the above example, Ashleys scores would result in a smaller standard deviation than would Roberts scores.

Large samples of data such as heights, weights, intelligence scores, etc, usually form a normal bell-shaped curve called a "**normal curve**". You must commit to memory that

68% of the cases will fall within 1 standard deviation of the mean (above and below) while 95% will fall within 2 standard deviations.

Correlations

As described earlier, correlations are used to show how closely two things are related. For instance, in a situation where the question is whether there is a relationship between TV violence and aggression in children who view TV violence, a **correlation coefficient** would be calculated. This is a statistical measure that ranges from -1.00 to a +1.00.

-1.00: a coefficient close to or equal to 1.00 would indicate an *inverse*relationship. For instance, Children exposed to a lot of TV violence show little aggression.

0.00: a number close to or equal to 0 would indicate no relationship between the two items. For instance, watching TV violence has no relationship to aggression in children.

+1.00: a number close to or equal to +1.00 would indicate a *direct*relationship. Either as one goes increases the other also increases *or* as one decreases then the other decreases. For example, as the incidence of watching TV violence decreases, aggressive acts by children also decreases, or vice versa.

** **Important Note: Correlation does not prove causation.** Correlation simply *implies* a relationship that will need to be investigated further in order to determine cause. For the above example, perhaps it is not the TV violence that causes aggression in children but maybe more aggressive parents allow their children to watch more violent shows and the reason for the childs aggressive acts may be due to modeling their aggressive parents or perhaps aggression is hereditary.

Looking at the data in a graph called a **scatterplot** will allow us to see whether two sets of data are related.

Calculating the correlation coefficient will also allow us to prove that an *illusionary correlation*does not exist. An illusionary correlation would be when a person believes that there is a relationship between two things and is therefore more likely to notice and recall instances that support and confirm their belief. For instance, a person might feel that whenever they think of their favorite song they will turn on the radio and it will be playing. The odd time that it happens will stand out to them and it might appear that it always happens, they might feel that there is some kind of relationship between the two as if *they* can make this happen feeding the notion of an *illusion of control*. Rather, if they took note as to how many times it doesnt happen they probably wouldnt associate the two.

Regression toward the mean: This is described in the text as the tendency for things to return to their normal level after an extraordinary event has taken place. Behavior tends to regress from the unusual to the more usual. This is evident after "winning streaks" in sports or "crime waves" for example.

Statistical inference

It is important to be able to determine whether or not research findings are reliable, to know that you can confidently generalize from the sample population. A principle worth following is that "averages based on many cases are more reliable than averages based on only a few cases". The sample must be a good representative of the population we are studying and it should give us consistent data with low variability.

As the text suggests, when sample averages are reliable and the difference between them is large, this difference is said to have **statistical significance.** One may then assume that the difference is probably due to a real difference between the two conditions and not due to chance. A good example of this is when researchers are testing the efficacy of a drug. In a controlled experiment, one group of women with high blood pressure is given a new blood pressure medication while the control group is given a placebo. At the end of the trial, the difference in average blood pressure between the two groups must be great enough to be deemed statistically significant and thereby indicating that the difference was due to the experimental groups usage of the drug.