

STATISTICS LAMINATE REFERENCE CHART: PARAMETERS, VARIABLES, INTERVALS, PROPORTIONS (QUICKSTUDY: ACADEMIC) BY INC. BARCHARTS

THE BASIC PRINCIPLES OF STATISTICS FOR INTRODUCTORY COURSES

STATISTICS

BASIC DEFINITIONS

STATISTICS: The study of methods for collecting, organizing, and analyzing data.

- **Descriptive Statistics:** Procedures used to organize and present data in a convenient and meaningful form.
- **Inferential Statistics:** Procedures employed to arrive at broader conclusions or inferences about populations on the basis of sample.

POPULATION: The complete set of actual or potential elements about which inferences are made.

SAMPLE: A subset of the population selected using some sampling method.

Sampling methods:

- **Cluster sample:** A population is divided into groups called clusters; some clusters are randomly selected and every member in them is observed.
- **Stratified sample:** The population is divided into strata and a fixed number of elements of each stratum are selected for the sample.
- **Simple random sample:** A sample selected so that each possible sample of the same size has an equal probability of being selected; used for most elementary inference.

VARIABLE: An attribute of elements of a population or sample that can be measured, or height, weight, IQ, hair color and pulse rate are some of the many variables that can be measured for people.

DATA: Values of variables that have been observed.

Types of data

- **Qualitative (or "nonnumerical") data:** are descriptive but not numeric; ex: sport grades, your hair color, the color of an automobile.
- **Quantitative data:** take numeric values.
- **Discrete data:** take on a finite number of values, usually representing things that can be counted; ex: the number of stars in a data set, the number of times a professor is late in a semester.
- **Continuous data:** can take a range of numeric values; ex: just counting marbles on the height of a child, the weight of a bag of beans, the amount of time a professor is late.

Levels of measurement

- **Qualitative data:** can be measured in two.
- **Nominal level:** Values are just names, without any order; ex: color of a car, major in college.
- **Ordinal level:** Values have some natural order; ex: high school class (freshman > sophomore > junior > senior), military rank.
- **Quantitative data:** can be measured in three.
- **Interval level:** Numeric data with no natural zero point; intervals (differences) are meaningful, but ratios are not; ex: temperature in Fahrenheit degrees, IQ's > 200' is not twice as high as IQ's > 100' is not.
- **Ratio level:** Numeric data for which there is a true zero; both intervals and ratios are meaningful; ex: weight, length, distance, most physical properties.

STATISTIC: A numeric measure computed from sample data, used to describe the sample and to estimate the corresponding population parameter.

PARAMETER: A numeric measure that describes a population; parameters are usually not computed, but are inferred from sample statistics.

FREQUENCY DISTRIBUTION

Provides the frequency (number of times observed) of each value of a variable.

Table #1: Students in a diving class are polled regarding a number of accidents they've had.

x	f	RP
2	3	0.0528
4	3	0.0541
7	9	0.1578
7	11	0.2042
1	16	0.2907
0	12	0.2160

GROUPED FREQUENCY DISTRIBUTION: Values of the variable are grouped into classes.

Table #2: The scores on a midterm exam are grouped into classes.

class	f	relative freq.
60-69	4	30
70-79	11	76
80-89	19	27
90-99	3	8
100-109	1	7

RELATIVE FREQUENCY DISTRIBUTION: Each frequency is divided by the total number of observations to produce the proportion or percentage of the data set having that value; ex: third column of Table 1.

CUMULATIVE FREQUENCY DISTRIBUTION: Frequencies (and all other statistics) in previous column are added all the way down; ex: third column of Table 2.

MEASURES OF CENTRAL TENDENCY

MEAN: Most commonly used measure of central tendency; usually meant by "average"; sensitive to extreme values.

POPULATION MEAN: $\mu = \frac{1}{N} \sum_{i=1}^n x_i$

SAMPLE MEAN: $\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$

- **Trimmed mean:** Computed discarding some number of the highest and lowest values, less sensitive than ordinary mean.
- **Weighted mean:** Computed with a $\sum_{i=1}^n w_i x_i$, weight implied to each value, making some values influence the mean more heavily than others.

MEDIAN: Value that divides the set so the same number of observations lie on each side of it; less sensitive to extreme values; for an odd number of values, it is the middle value; for an even number, it is the average of the middle two; ex: in Table 1, the median is 7.

MODE: Observations that appear with the greatest frequency; a distribution may have one or more modes.

MEASURES OF DISPERSION

SUM OF SQUARES (SS): The sum of squared deviations from the mean.

• **Population SS:** $\sum_{i=1}^n (x_i - \mu)^2 = \sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{N}$

• **Sample SS:** $\sum_{i=1}^n (x_i - \bar{x})^2 = \sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{n}$

VARIANCE: The average of square differences between observations and their mean.

• **Population variance:** $\sigma^2 = \frac{1}{N} \sum_{i=1}^n (x_i - \mu)^2$

• **Sample variance:** $s^2 = \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2$

• **Variances for grouped data:**

- **Population:** $\sigma^2 = \frac{1}{N} \sum_{i=1}^k f_i (m_i - \mu)^2$
- **Sample:** $s^2 = \frac{1}{n} \sum_{i=1}^k f_i (m_i - \bar{x})^2$

STANDARD DEVIATION: The square root of the variance; ex: the standard deviation is the square root of the original data and is more commonly used.

ex: Pop. S.D.: $\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^n (x_i - \mu)^2}$

STANDARD SCORES: Also known as Z-scores; the standard score of a value is the directed number of standard deviations from the mean at which the value is found; that is, $z = \frac{x - \mu}{\sigma}$.

- A positive z-score indicates a value greater than the mean; a negative score indicates a value less than the mean; a score of zero indicates the mean value.
- Centering every value in a data set to distribute in a normal (bell) distribution; zero is placed at distribution has been standardized; if it is a non-zero $\mu = 0$, and a non-standard deviation $\sigma = 1$.

GRAPHING TECHNIQUES

HISTOGRAM: A graph that uses bars to show the frequency of occurrence of observations.

• **Histogram:** A bar graph used with quantitative, continuous variables.

FREQUENCY CURVE: A graph representing a frequency distribution in the form of a continuous line that traces a histogram.

- **Continuous frequency curve:** A continuous line that traces a histogram where, but in all the lower classes are marked up to the adjacent higher class, cannot have a negative slope.
- **Stair-step curve:** The frequency curve is composed of joined vertical and horizontal segments.
- **Normal curve:** Bell-shaped curve, symmetric.
- **Skewed curve:** Deviates from symmetry; frequency curve is shifted with a longer "tail" to the left (mean < median) or to the right (mean > median).

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- Descriptive Statistics:** Procedures used to organize and present data in a convenient and meaningful form.
- Inferential Statistics:** The analysis employed to arrive at broader conclusions or inferences about populations on the basis of samples.

POPULATION: The complete set of actual or potential elements about which inferences are made.

SAMPLE: A subset of the population selected using some sampling method.

Sampling methods:

- Cluster sample:** A population is divided into groups called clusters; some clusters are randomly selected, and every member in them is observed.
- Stratified sample:** The population is divided into strata, and a fixed number of elements of each stratum are selected for the sample.
- Simple random sample:** A sample selected so that each possible sample of the same size has an equal probability of being selected; used for most elementary inference.

VARIABLE: An attribute of elements of a population or sample that can be measured, ex: height, weight, IQ, hair color and pulse rate are some of the many variables that can be measured for people.

DATA: Values of variables that have been observed.

Types of data:

- Qualitative (or "categorical") data:** are descriptive but not numeric, ex: your gender, your birthplace, the color of an automobile.
- Quantitative data take numeric values:**
- Discrete data take counting numbers (0, 1, 2, ...) as values,** usually representing things that can be counted, ex: the number of fleas on a dog, the number of times a professor is late to a semester.
- Continuous data can take a range of numeric values,** not just counting numbers, ex: the height of a child, the weight of a bag of beans, the amount of time a professor is late.

Levels of measurement:

- Qualitative data can be measured at the:**
- Nominal level:** Values are just names, without any order, ex: color of a car, major in college.
- Ordinal level:** Values have some natural order, ex: high school class (freshman / sophomore / junior / senior), military rank.
- Quantitative data can be measured at the:**
- Interval level:** Numeric data with no natural zero point; intervals (differences) are meaningful, but ratios are not, ex: temperature in Fahrenheit degrees, IQ (is 200% better than 100), but it is not 150% as hot.
- Ratio level:** Numeric data for which there is a true zero; both intervals and ratios are meaningful, ex: weight, length, duration, most physical properties.

STATISTIC: A numeric measure computed from sample data, used to describe the sample and to estimate the corresponding population parameter.

PARAMETER: A numeric measure that describes a population; parameters are usually not computed, but are inferred from sample statistics.

FREQUENCY DISTRIBUTION

Provides the frequency (number of times observed) of each value of a variable.

Table #1: Students in a driving class are polled regarding number of accidents they had.

# of accidents	Frequency	Relative frequency
2	3	0.0526
4	2	0.0351
1	9	0.1579
3	15	0.2632
1	16	0.2807
0	12	0.2105

GROUPED FREQUENCY DISTRIBUTION: Values of the variable are grouped into classes.

Table #2: The scores on a midterm exam are grouped into classes.

class	f	cumulative freq.
90-99	4	4
80-89	18	22
70-79	31	53
60-69	19	72
50-59	7	79
40-49	1	80

RELATIVE FREQUENCY DISTRIBUTION: Each frequency is divided by the total number of observations to produce the proportion or percentage of the data set having that value; ex: third column of Table 1.

CUMULATIVE FREQUENCY DISTRIBUTION: Frequencies count all observations at a particular value or class and all those less; Ex: third column of Table 2.

MEASURES OF DISPERSION

SUM OF SQUARES (SS): The sum of squared deviations from the mean.

- Population SS:** $\sum (x_i - \mu)^2 = \sum x_i^2 - \frac{(\sum x_i)^2}{N}$
- Sample SS:** $\sum (x_i - \bar{x})^2 = \sum x_i^2 - \frac{(\sum x_i)^2}{n}$

VARIANCE: The average of square differences between observations and their mean.

- Population variance:** $\sigma^2 = \frac{1}{N} \sum (x_i - \mu)^2$
- Sample variance:** $s^2 = \frac{1}{n-1} \sum (x_i - \bar{x})^2$

Variances for grouped data:

- Population:** $\sigma^2 = \frac{1}{N} \sum f_j (m_j - \mu)^2$
- Sample:** $s^2 = \frac{1}{n-1} \sum f_j (m_j - \bar{x})^2$

STANDARD DEVIATION: The square root of the variance (or the variance, if the same unit as the original data and to more commonly used).

ex: Pop. S.D. = $\sqrt{\frac{1}{N} \sum (x_i - \mu)^2}$

STANDARD SCORES: Also known as Z-scores, the standard score of a value is the directed number of standard deviations from the mean at which the value is found; that is, $z = \frac{x - \mu}{\sigma}$.

- A positive z-score indicates a value greater than the mean; a negative z-score indicates a value less than the mean; a z-score of zero indicates the mean value.
- Converting every value in a data set or distribution to a z-score is called **standardization**; once a data set or distribution has been standardized, it has a new mean $\mu = 0$, and a new standard deviation $\sigma = 1$.

MEASURES OF CENTRAL TENDENCY

MEAN: Most commonly used measure of central tendency, usually mean by "average"; sensitive to extreme values.

POPULATION MEAN: $\mu = \frac{1}{N} \sum x_i$

SAMPLE MEAN: $\bar{x} = \frac{1}{n} \sum x_i$

- Trimmed mean:** Computed discarding some number of the highest and lowest values; less sensitive than ordinary mean.
- Weighted mean:** Computed with a weight multiplied to each value, making some values influence the mean more heavily than others.

MEDIAN: Value that divides the set so the same number of observations lie on each side of it; less sensitive to extreme values; for an odd number of values, it is the middle value; for an even number, it is the average of the middle two, ex: in Table 1, the median is the average of the 20th and 20th observations, or 1.5.

MODE: Observation that occurs with the greatest frequency; **uniquely determined**.

GRAPHING TECHNIQUES

BAR GRAPH: A graph that uses bars to indicate the frequency of occurrence of observations.

- Histogram:** A bar graph used with quantitative, continuous variables.

FREQUENCY CURVE: A graph representing a frequency distribution in the form of a continuous line that traces a histogram.

- Cumulative frequency curve:** A continuous line that traces a histogram where bars in all the lower classes are stacked up; the adjacent higher class cannot have a negative slope.
- Smooth the curve:** The line away curve is smoothed if rounded around its center; median = mean.
- Normal curve:** Bell-shaped curve; symmetric.
- Skewed curve:** Deviates from symmetry; frequency curve is shifted with a longer "tail" to the left (mean < median) or to the right (mean > median).

The figure shows two graphs. The top graph is a bell-shaped normal curve centered at 0 on the x-axis, with y-axis values from 0 to 15. The bottom graph is a skewed curve with a longer tail to the left, also centered at 0 on the x-axis, with y-axis values from 0 to 15. The x-axis for both graphs ranges from -10 to 10.

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This guide is a perfect overview for the topics covered in introductory statistics courses.

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Statistics a Foreign Language?

By Hopekat

The Graduate School I attend has a mandatory requirement- all students must register and pass (with a B or better) Introductory and Advanced Statistics.

Intro Statistics was "instructed" by a gentleman who wanted to be anywhere else but the classroom. (Read: Taught myself Intro Stats). There are many texts that review statistical concepts and provide a step-by-step illustrations of the never-ending list of formulas. Having read a stack of textbooks, not one provides a condensed summary of all the procedural and conceptual explanations. This chart is the "missing link" . If for nothing else, you can use it as a placemat.

5 of 5 people found the following review helpful.

Good for class.

By Technology Instructor

I bought this for a college stats class. I did not need that expensive textbook after this. Wish I would have purchased this first. It has examples for everything you use in a college stats class. Homework was never easier and it was handy to have. I resold it to people taking the class after me for 100% of the price because it is easy to use and well worth it. The other student took one look at it and did not try to haggle or anything, just handed me the money and said thanks.

2 of 2 people found the following review helpful.

I hate math

By iLikeBigBooks

For a math challenged person as myself, this chart is excellent as a quick resource for statistics when working on a dissertation. Formulas and examples are provided that cover the content of a \$100 book, conveniently hole-punched and laminated for quick reference. I wish it also gave a brief description of how each statistic is used to come to certain conclusions why the measures are used, such as what conclusions can be made in reference to educational measurement. But, for a quick reference guide, it has everything covered in basic statistics and then some (such as ANOVA and linear regression).

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