



STATISTICS

parameters, variables, intervals, proportions

THE BASIC PRINCIPLES OF STATISTICS FOR INTRODUCTORY COURSES

DEFINITIONS

- STATISTICS** - A set of tools for collecting, organizing, presenting, and analyzing numerical facts or observations.
 1. **Descriptive Statistics** - procedures used to organize and present data in a convenient, useable, and communicable form.
 2. **Inferential Statistics** - procedures employed to arrive at broader generalizations or inferences from sample data to populations.
- STATISTIC** - A number describing a sample characteristic. Results from the manipulation of sample data according to certain specified procedures.
- DATA** - Characteristics or numbers that are collected by observation.
- POPULATION** - A complete set of actual or potential observations.
- PARAMETER** - A number describing a population characteristic; typically, inferred from sample statistics.
- SAMPLE** - A subset of the population selected according to some scheme.
- RANDOM SAMPLE** - A subset selected in such a way that each member of the population has an equal opportunity to be selected. *Ex. lottery numbers in a fair lottery*
- VARIABLE** - A phenomenon that may take on different values.

- MEAN** - The point in a distribution of measurements about which the summed deviations are equal to zero. *Average value of a sample or population.*

POPULATION MEAN SAMPLE MEAN

$$\mu = \frac{1}{N} \sum_{i=1}^N x_i \qquad \bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

Note: The mean is very sensitive to extreme measurements that are not balanced on both sides.

- WEIGHTED MEAN** - Sum of a set of observations multiplied by their respective weights, divided by the sum of the weights:

$$\frac{\sum_{i=1}^G w_i x_i}{\sum_{i=1}^G w_i}$$

WEIGHTED MEAN

where w_i = weight; x_i = observation; G = number of observation groups. Calculated from a population, sample, or groupings in a frequency distribution.

Ex. In the Frequency Distribution below, the mean is 80.3; calculated by using frequencies for the w_i 's. When grouped, use class midpoints for x_i 's.

- MEDIAN** - Observation or potential observation in a set that divides the set so that the same number of observations lie on each side of it. 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 the Frequency Distribution table below, the median is 79.5.

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- MODE** - Observation that occurs with the greatest frequency. *Ex. In the Frequency Distribution table below, the mode is 88.*

MEASURES OF DISPERSION

- SUM OF SQUARES (SS)** - Deviations from the mean, squared and summed.

$$\text{Population SS} = \sum (x_i - \mu_x)^2 \text{ or } \sum x_i^2 - \frac{(\sum x_i)^2}{N}$$

$$\text{Sample SS} = \sum (x_i - \bar{x})^2 \text{ or } \sum x_i^2 - \frac{(\sum x_i)^2}{n}$$

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

POPULATION VARIANCE SAMPLE VARIANCE

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^N (x_i - \mu)^2 \qquad s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$$

VARIANCES FOR GROUPED DATA

POPULATION SAMPLE

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^G f_i (m_i - \mu)^2 \qquad s^2 = \frac{1}{n-1} \sum_{i=1}^G f_i (m_i - \bar{x})^2$$

- STANDARD DEVIATION** - Square root of the variance.

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

GRAPHING TECHNIQUES

- BAR GRAPH** - A form of graph that uses bars to indicate the frequency of occurrence of observations.
 - **Histogram** - a form of bar graph used with interval or ratio-scaled variables.

- **Interval Scale** - a quantitative scale that permits the use of arithmetic operations. The zero point in the scale is arbitrary.

- **Ratio Scale** - same as interval scale except that there is a true zero point.

- **Frequency Curve** - A form of 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 in the adjacent higher class. It cannot have a negative slope.

• **Normal curve** - bell-shaped curve.

• **Skewed curve** - departs from symmetry and tails-off at one end.

FREQUENCY DISTRIBUTION

Shows the number of times each observation occurs when the values of a variable are arranged in order according to their magnitudes.

FREQUENCY DISTRIBUTION

Frequency Distribution of student scores on an exam

x	f	x	f	x	f	x	f
100	1	83	11	74	111	66	0
99	1	84	111111	75	1111	66	1
98	0	85	1	76	11	67	11
97	0	86	0	77	111	68	1
96	11	87	1	78	1	69	111
95	0	88	11111111	79	11	70	1111
94	0	89	111	80	1	71	0
93	1	90	11	81	11	72	11
92	0	91	1	82	1	73	111

x = observation f = frequency

- GROUPED FREQUENCY DISTRIBUTION** - A frequency distribution in which the values of the variable have been grouped into classes.

GROUPED FREQUENCY DISTRIBUTION

CLASS	f	CLASS	f
98-100	2	80-82	4
95-97	2	77-79	6
92-94	1	74-76	9
89-91	6	71-73	5
86-88	8	68-70	8
83-85	8	65-67	3

GROUPING OF DATA

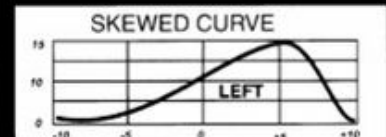
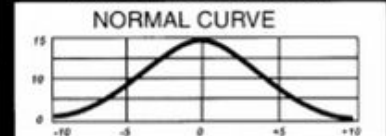
CUMULATIVE FREQUENCY / PERCENTAGE DISTRIBUTIONS

- CUMULATIVE FREQUENCY DISTRIBUTION** - A distribution which shows the total frequency through the upper real limit of each class.
- CUMULATIVE PERCENTAGE DISTRIBUTION** - A distribution which shows the total percentage through the upper real limit of each class.

CUMULATIVE FREQUENCY / PERCENTAGE DISTRIBUTION

CLASS	f	Cum f	%
65-67	3	3	4.84
68-70	8	11	17.74
71-73	5	16	25.81
74-76	9	25	40.32
77-79	6	31	50.00
80-82	4	35	56.45
83-85	8	43	69.35
86-88	8	51	82.26
89-91	6	57	91.94
92-94	1	58	93.55
95-97	2	60	96.77
98-100	2	62	100.00

FREQUENCY CURVES





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