BarCharts, Inc.

Quick Study ACADEMIC

Statistics EQUATIONS & ANSWERS™

Essential Tools for Understanding Statistics & Probability — Rules, Concepts, Variables, Equations, & Solved Problems, Helpful Hints, & Common Pitfalls

DESCRIPTIVE STATISTICS

Methods used to simply describe data set that has been observed

KEY TERMS & SYMBOLS

quantitative data: data variables that represent some numeric quantity (is a numeric measurement).

categorical (qualitative) data: data variables with values that reflect some quality of the element; one of several categories, not a numeric measurement.

population: "the whole"; the entire group of which we wish to learn or that we intend to measure.

sample: "the part"; a representative subset of the population.

simple random sampling: the most commonly assumed method for selecting a sample; samples are chosen so that every possible sample of the same size is equally likely to be the one that is selected.

N: size of a population.

n: size of a sample.

x: the value of an observation.

f: the frequency of an observation (i.e., the number of times it occurs).

frequency table: a table that lists the values observed in a data set along with the frequency with which it occurs.

(population) parameter: some numeric measurement that describes a population, generally not known, but **estimated** from sample statistics.
EX: population mean: μ; population standard deviation: σ; population proportion: p (sometimes denoted π)

(sample) statistic: some numeric measurement used to describe data in a sample; used to estimate or make inferences about population parameters.
EX: sample mean: $\bar{x}$; sample standard deviation: s; sample proportion: $\hat{p}$

Descriptive Statistics Definitions

1. A student receives the following exam grades in a course: 67, 89, 75, 82, 79

a. Compute the mean: $\bar{x} = \frac{\sum x}{n} = \frac{67 + 89 + 75 + 82 + 79}{5} = \frac{392}{5} = 78$

b. What is the median exam score?
In order, the exam scores are: 67, 75, 79, 82, 89; middle element = 79

c. What is the range? range = maximum − minimum = 89 − 67 = 22

d. Compute the standard deviation:

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}} = \sqrt{\frac{(67-78)^2 + (89-78)^2 + (75-78)^2 + (82-78)^2 + (79-78)^2}{5-1}} = \sqrt{\frac{234}{4}} = \sqrt{58.5} = 7.65$$

e. What is the z-score for the exam grade of 89? $z = \frac{x - \bar{x}}{s} = \frac{89 - 78}{7.65} = \frac{11}{7.65} = 1.44$

2. The residents of a retirement community were surveyed on the home viewing times they've been married; the results are given in the following frequency tables:

Viewing Time	0	1	2	3	4	Totals
x = # of viewings	0	1	2	3	4	
f = # of observations	120	460	270	110	40	1000 = n
xf	0	460	540	330	160	1490

a. Compute the mean: $\bar{x} = \frac{\sum xf}{n} = \frac{1490}{1000} = 1.49$

b. Compute the median: Since $n = 1000$, an even number, the median is the average of the observations with ranks $\frac{n}{2} = 500$ and $\frac{n}{2} + 1 = 501$ (i.e., the 500th and 501st observations).

While we could count from either side of the distribution (from 0 or from 4), it is easier here to count from the bottom. The first 120 observations in rank order are all 0; the next 460 (the 121st through the 580th) are all 1; the 581st through the 850th are all 2; since the 500th is a 1 and the 501st is a 2, the median is the average: $(1 + 2) / 2 = 1.5$

c. Compute the IQR: To find the IQR, we must first compute Q1 and Q3; if we divide n in half, we have a lower 50 and an upper 50 observations; the "median" of each would have rank 25; the 25th observation in the lower half is a 1, so Q1 = 1 and the 25th observation in the upper half is a 2, so Q3 = 2; therefore, IQR = Q3 − Q1 = 2 − 1 = 1

Commonly Hypothesized Parameters

Type	Statistic	Formula	Important Properties
measures of central (clustering) or central tendency: indicate which value is typical for the data set	mean	Simple case (data): $\bar{x} = \frac{\sum x}{n}$ — Frequency table: $\bar{x} = \frac{\sum xf}{n}$	sensitive to extreme values; why outlier will influence the mean; **more useful for symmetric data**
	median (the middle value when data is ordered in order and each)	n odd: median has rank $\frac{n+1}{2}$; n even: median is the average of values with ranks $\frac{n}{2}$ and $\frac{n}{2}+1$	not sensitive to extreme values; **more useful when data are skewed**
	mode	the observation with the highest frequency	only measure of center **appropriate for categorical data**
	mid-range	$\frac{\text{maximum} + \text{minimum}}{2}$	most often used; highly sensitive to unusual values; **easy to compute**
measures of variation (measures of dispersion): indicate how scattered the data is; how different the values are from each other?	sample variance	$s^2 = \frac{\sum (x - \bar{x})^2}{n-1}$	most often used; units are the **square** of those for the data
	sample standard deviation	$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$	square root of variance; **sensitive to extreme values**; most commonly used
	interquartile range (IQR)	IQR = Q3 − Q1 (see **quartile**, below)	less sensitive to extreme values
	range	maximum − minimum	**most often used; highly sensitive to unusual values**; easy to compute
measures of relative standing (measures of relative position): indicate how a given/stated value compares to the others in the same data set	percentile	data divided into 100 equal parts by rank (i.e., the k^{th} percentile is that value greater than $k\%$ of the others)	important to apply to **normal distributions** (see **probability distributions**)
	quartile	data divided into 4 equal parts by rank; Q2 (third quartile) is the value greater than ¾ of the others; Q1 (first quartile) is greater than ¼; Q2 is identical to the median	used to compute IQR (see **IQR**, above); Q2 is often viewed as the "median" of the upper half; and Q1 as the "median" of the lower half; Q2 is the median of the data set
	z-score	$z = \frac{x - \bar{x}}{s}$ — my find the value of some observation, x, when the z-score is known: $x = \bar{x} + zs$	measures the distance from the mean in terms of standard deviation

Statistics Equations Answers Quickstudy Academic

JG Myers

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