Mean and Standard Deviation -- Univariate Statistics for Quantitative Variables

Application: To obtain a summary of the distribution of scores (center and spread) for a quantitative variable**.**

The data: The researcher is interested in describing the data about the number of fish displayed in the Pet stores. Specifically, the researcher wants to tell what is the typical number of fish displayed. The data from the 12 stores are displayed below.

32 41 31 38 21 13 17 22 24 11 17 20

Computing the Mean

Step 1 Arrange the data into a column. The variable is referred to as X, to simplify the presentation and use of the formulas below.

fishnum

X

32
41
31
38
21
13
17
22
24
11
17
20

Step 2 Compute the sum of the scores

$\Sigma X = 32 + 41 + 31 + 38 + 21 + 13 + 17 + 22 + 24 + 11 + 17 + 20 = 287$

Step 3 Determine the sample size

$N = 12$

Step 4 Compute the mean (always compute and report 2 decimal places)

$$\bar{X} = \frac{\Sigma X}{N} = \frac{287}{12} = 23.92$$

Computing the Standard Deviation

Step 5 Compute the square of each score and place it in an adjacent column.

fishnum

X	X^2
32	1024
41	1681
31	961
38	1444
21	441
13	169
17	289
22	484
24	576
11	121
17	289
20	400

Step 6 Compute the sum of the squared scores

$$\Sigma X^2 = 32^2 + 41^2 + 31^2 + 38^2 + 21^2 + 13^2 + 17^2 + 22^2 + 24^2 + 11^2 + 17^2 + 20^2 = 7879$$

Step 7 Compute the sum of squares

$$SS = \Sigma X^2 - \frac{(\Sigma X)^2}{N} = 7879 - \frac{(287)^2}{12} = 7879 - \frac{82369}{12} = 7879 - 6864.08 = 1014.91$$

Step 8 Compute the variance

$$s^2 = \frac{SS}{N-1} = \frac{1014.91}{12-1} = \frac{1014.91}{11} = 92.26$$

Step 9 Compute the standard deviation

$$s = \sqrt{s^2} = \sqrt{92.26} = 9.61$$

Computing the Standard Error of the Mean

The standard error of the mean (SEM) is closely related to the standard deviation. Specifically, the standard deviation tells how much scores from a sample will vary from the mean of that sample. The SEM tells how much the means of several samples taken from the same population will vary from each other.

Step 10 Compute SEM

$$SEM = \frac{s}{\sqrt{N}} = \frac{9.61}{\sqrt{12}} = \frac{9.61}{3.46} = 2.78$$