Chapter 4.4 Mean, variation, standard deviation and coefficient of variation

In statistical terms continuous variables are described by a mean and measures of variation. To describe the variation, standard deviation, variance and coefficient of variation can be used.

The mean is calculated as follows:

The "mean" of a sample is the sum the sampled values divided by the number of items in the sample:

\[ \bar{x} = \frac{x_1 + x_2 + \cdots + x_n}{n} \]

For example, the arithmetic mean of five values: 4, 36, 45, 50, 75 is

\[ \frac{4 + 36 + 45 + 50 + 75}{5} = \frac{210}{5} = 42. \]

The variance is calculated as follows:

\[ s^2 = \frac{\sum (x_i - \bar{x})^2}{N-1} \]

The standard deviation is calculated as follows:

\[ s_N = \sqrt{\frac{1}{N} \sum_{i=1}^{N} (x_i - \bar{x})^2} \]

For example the standard deviation is the square root from the variance and in this case for the five values: 4, 36, 45, 50, 75 is to be calculated as:

N=5 and the mean for x = 42

<table>
<thead>
<tr>
<th>( x_i )</th>
<th>( x_i - \bar{x} )</th>
<th>( (x_i - \bar{x})^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-38</td>
<td>1444</td>
</tr>
<tr>
<td>36</td>
<td>-6</td>
<td>36</td>
</tr>
<tr>
<td>45</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>50</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>75</td>
<td>33</td>
<td>1089</td>
</tr>
</tbody>
</table>

\[ \sum \frac{(x_i - \bar{x})^2}{N} = 2642 \]

In this case the variance is 2642/4 =660.5 and the standard deviation is 2642/5 = 32.5

The coefficient of variation is the standard deviation divided by the mean and is calculated as follows:

\[ C_v = \frac{\sigma}{\mu} \]

In this case \( \mu \) is the indication for the mean and the coefficient of variation is: 32.5/42 = 0.77. This means that the size of the standard deviation is 77% of the size of the mean. This implies that you see a lot of differences among animals when the five values above are the value of a trait of five animals.