Chapter 1
Data Spread, Standard Deviations

1 General Purpose

Repeated measures have a central tendency (averages, two averages, regression lines), and a tendency to depart from the expected central values. In order to estimate the magnitude of the departures from the averages an index is needed. Why not simply add-up departures? However, this does not work, because generally the values higher and lower than the averages tend to even out, and the results would be zero. A pragmatic solution was taken by statisticians around the world. They decided to square the departures first, and then add-up. The add-up sum of the squared departures is called the variance. The square root of the variance is called the standard deviation. This chapter shows how pocket calculators can be used for computation of standard deviations.

2 Schematic Overview of Type of Data File

Outcome
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T.J. Cleophas, A.H. Zwinderman, *Clinical Data Analysis on a Pocket Calculator*,
DOI 10.1007/978-3-319-27104-0_1

3 Primary Scientific Question

Is the standard deviation an adequate index for spread in the data?

4 Data Example

Standard deviations (SDs) are often used for summarizing the spread of the data from a sample. If the spread in the data is small, then the same will be true for the standard deviation. Underneath the calculation is illustrated with the help of a data example.

55
54
51
55
53
53
54
52+

Mean . . .. => . . ./8 = 53.375

SD=

55	$(55-53.375)^2$
54	$(54-53.375)^2$
51	$(51-53.375)^2$
55	$(55-53.375)^2$
53	$(53-53.375)^2$
53	$(53-53.375)^2$
54	$(54-53.375)^2$
52	$(52-53.375)^2$+

SD= . . .. => . . ... / (n-1) => √. . ..=> 1.407885953

5 Calculate Standard Deviations

Each scientific pocket calculator has a mode for data-analysis. It is helpful to calculate in a few minutes the mean and standard deviation of a sample.

Calculate standard deviation: mean = 53.375 SD = 1.407885953

The next steps are required:

```
Casio fx-825 scientific
On  ...  .mode....shift....AC....55....M+....54....M+....51....M+....55....
M+....53....M+....53.....M+....54....M+....52....M+....shift...[x]....shift....
σxn-1
-----------------------------------------------------------------
Texas TI-30 scientific
On....55....Σ+....54....Σ+....51....Σ+....55....      Σ+....53....Σ+....53....Σ
+....54....  Σ+....52....Σ+....2nd....x....2nd....σxn-1
-----------------------------------------------------------------
Sigma AK 222 and Commodoor
On ... 2ndf ... on ... 55 ... M+ ... 54 ... M+ ... 51 ... M+ ... 55 ... M+ ...  53 ... M+
... 53 ... M+ ... 54 ... M+ ... 52 ... M+ ... x=>M ... MR
-----------------------------------------------------------------
Calculator: Electronic Calculator
On....mode....2....55....M+....54....M+....51....M+....55....M+....53....M
+....53....M+....54....M+....52....M+....Shift....S-var....1....=....
(mean)....Shift....S-var....3....(sd)
```

6 Conclusion

Repeated measures have a central tendency and tendency to depart from the expected central values. In order to estimate the magnitude of the departures from the averages an index is needed. The add-up sum of the squared departures is used for the purpose, and is called the variance. The square root of the variance is called the standard deviation. This chapter shows how pocket calculators can be used for computation of standard deviations. Sometimes, data files are skewed, and mean values do not mean too much. Instead the modus (the frequentest value) or the median (the value in the middle) are more meaningful (see Chap. 27).

Example:

What is the mean value, what is the SD?

5
4
5
4
5
4
5
4

7 Note

More background, theoretical and mathematical information of means, variances, standard deviations, and standard errors (of the mean) is given in Statistics applied to clinical studies 5th edition, Chap. 1, Springer Heidelberg Germany, 2012, from the same authors.