

2.7 Calculate spread with an explicit quartile and variance convention

Name: _____ Class: _____ Date: _____

Total: 24 marks

KEY WORDS range 全距 • interquartile range (IQR) 四分位距 • standard deviation 标准差

Objective

Calculate spread with an explicit quartile and variance convention. Original GAC004-aligned practice, not an official assessment. Show the method as well as the result. All applied scenarios are invented classroom problems.

1 Key knowledge and worked examples

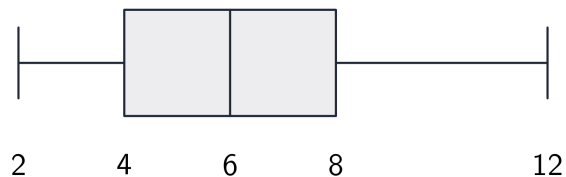
■ Key knowledge: equal means can conceal different distributions

The **range** 全距 is maximum minus minimum. The **interquartile range (IQR)** 四分位距 is $Q_3 - Q_1$. For this sheet, order the data, split an even-sized list into equal halves, and use each half's median for its quartile. For an odd list, exclude the overall median before finding half-list medians. Other software may use different conventions.

A box plot shows the median and quartiles; this sheet's whiskers run to minimum and maximum, not to an automatic outlier fence. **Standard deviation** 标准差 measures spread using squared deviations. Use population $\sigma = \sqrt{\sum(x - \mu)^2/n}$ for a complete supplied population; sample estimate $s = \sqrt{\sum(x - \bar{x})^2/(n - 1)}$ requires the stated sample convention. Standard deviation has the original units; variance has squared units.

■ Worked example: read a five-number summary rather than every observation

whiskers: minimum to maximum



Known five-number summary: minimum 2, $Q_1 = 4$, median 6, $Q_3 = 8$, maximum 12. The overall span and middle-half span are different.

$$R = x_{\max} - x_{\min} = 12 - 2 = 10$$

$$IQR = Q_3 - Q_1 = 8 - 4 = 4$$

The box does not identify every original value, the sample size or why the spread arose.

2 Practice

2.1 Find the range of 3, 5, 8 and 12. [2]

2.2 A five-number summary is minimum 4, first quartile 7, median 9, third quartile 13, maximum 20. Find its IQR and range. [2]

2.3 Using the stated half-list convention, find the median, first quartile and third quartile of 2, 4, 6, 8, 10, 12, 14, 16. [3]

2.4 The complete population is 2, 4, 6. Find its mean, population variance and population standard deviation, giving the latter to 3 significant figures. [3]

3 Exam-style questions

3.1 Two complete populations are A: 4, 5, 6 and B: 1, 5, 9. Find each mean and population standard deviation, to 3 significant figures. Compare their spread without claiming a cause. [6]

3.2 The ordered data are 2, 4, 6, 8, 10, 12, 14, 16. (a) Draw a minimum-to-maximum box plot using the stated quartile convention. (b) Find the range and IQR. (c) Replace 16 by 100 and find the new range and IQR. Explain why these two spread measures respond differently and whether the plot alone can establish the cause of the extreme value. [8]