Box Plots

Box plots: Mistakes and missing information

Name _____ **Date** _____ **Score** _____ / 6

QUICK REVIEW

A box plot uses minimum, Q_1, median, Q_3, maximum. Sort data, find the median, then find medians of the lower and upper halves; omit the overall median for an odd count. For $2, 4, 6, 8, 10, 12$, the summary is $2, 4, 7, 10, 12$. IQR $= 10 - 4 = 6$; the box covers the middle half, not the full range.

Worked example

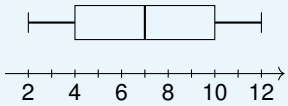
Construct a box plot. Data: $2, 4, 6, 8, 10, 12$. Draw the box plot and state the five-number summary, IQR, and range.

1. Sort: $2, 4, 6, 8, 10, 12$. Average positions 3 and 4: $(6 + 8)/2 = 7$.

2. Lower half $2, 4, 6$ gives $Q_1 = 4$; upper half $8, 10, 12$ gives $Q_3 = 10$.

3. The whiskers end at $2, 12$; box width $= 10 - 4 = 6$ and full range $= 12 - 2 = 10$.

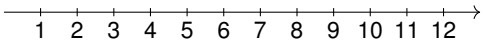
Answer: Min 2, $Q_1 = 4$, median 7, $Q_3 = 10$, max 12; IQR 6; range 10.



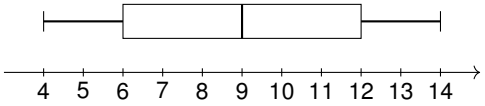
Practice Problems

Show your thinking.

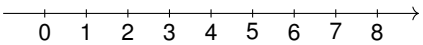
1. A student includes 6 in both halves. Construct the corrected plot. Data: $1, 2, 4, 6, 8, 10, 12$. Draw the box plot and state the five-number summary, IQR, and range.



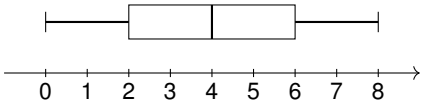
2. Recover all five markers from the display. Read the five-number summary, IQR, and range from the box plot.



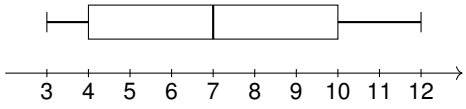
3. A student puts the median at the midpoint of the whiskers. Draw the corrected plot. Data: $0, 2, 2, 4, 6, 8$. Draw the box plot and state the five-number summary, IQR, and range.



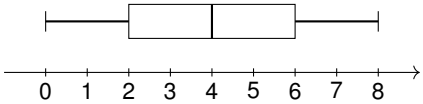
4. A box plot has five-number summary $0, 2, 4, 6, 8$. Add 3 to every observation. Recover the new five-number summary and IQR.



5. Explain why unequal whisker lengths are allowed. Read the five-number summary, IQR, and range from the box plot.



6. Can the exact six observations be recovered uniquely from five-number summary $0, 2, 4, 6, 8$? Give two different six-value lists with that summary.



Answer Key

1. Min 1, $Q_1 = 2$, median 6, $Q_3 = 10$, max 12; IQR 8; range 11.
2. Min 4, $Q_1 = 6$, median 9, $Q_3 = 12$, max 14; IQR 6; range 10.
3. Min 0, $Q_1 = 2$, median 3, $Q_3 = 6$, max 8; IQR 4; range 8.
4. $3, 5, 7, 9, 11$; IQR 4.
5. Min 3, $Q_1 = 4$, median 7, $Q_3 = 10$, max 12; IQR 6; range 9.
6. No. Examples: $0, 2, 3, 5, 6, 8$ and $0, 2, 4, 4, 6, 8$.

Step-by-Step Solutions

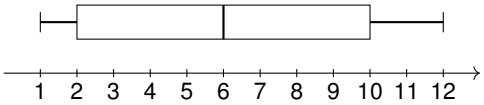
Follow each calculation, then check your own work.

Problem 1

1. Sort: $1, 2, 4, 6, 8, 10, 12$. The middle position 4 gives median 6. Leave it out of the halves.

2. Lower half $1, 2, 4$ gives $Q_1 = 2$; upper half $8, 10, 12$ gives $Q_3 = 10$.

3. The whiskers end at $1, 12$; box width $= 10 - 2 = 8$ and full range $= 12 - 1 = 11$.



Problem 2

1. The whisker tips mark minimum 4 and maximum 14. Read the median line at 9.

2. The left box edge is $Q_1 = 6$; the right edge is $Q_3 = 12$.

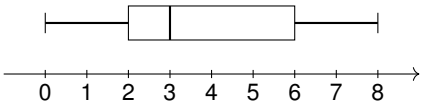
3. IQR $= 12 - 6 = 6$. Full range $= 14 - 4 = 10$.

Problem 3

1. Sort: $0, 2, 2, 4, 6, 8$. Average positions 3 and 4: $(2 + 4)/2 = 3$.

2. Lower half $0, 2, 2$ gives $Q_1 = 2$; upper half $4, 6, 8$ gives $Q_3 = 6$.

3. The whiskers end at $0, 8$; box width $= 6 - 2 = 4$ and full range $= 8 - 0 = 8$.



Problem 4

1. Add 3 to the markers: $0 + 3 = 3$, $2 + 3 = 5$, $4 + 3 = 7$, $6 + 3 = 9$, $8 + 3 = 11$.

2. Original IQR $= 6 - 2 = 4$; new IQR $= 9 - 5 = 4$, so a common shift changes location but not spread.

Problem 5

1. The whisker tips mark minimum 3 and maximum 12. Read the median line at 7.

2. The left box edge is $Q_1 = 4$; the right edge is $Q_3 = 10$.

3. IQR $= 10 - 4 = 6$. Full range $= 12 - 3 = 9$.

4. Left whisker length $= 4 - 3 = 1$; right whisker length $= 12 - 10 = 2$. Each spans from its box edge to its extreme, so lengths can differ.

Problem 6

1. For $0, 2, 3, 5, 6, 8$, median $= (3 + 5)/2 = 4$, $Q_1 = 2$, and $Q_3 = 6$.

2. For $0, 2, 4, 4, 6, 8$, median $= (4 + 4)/2 = 4$, $Q_1 = 2$, and $Q_3 = 6$.

3. Both have minimum 0 and maximum 8 but different central observations, so the summary does not identify one unique list.

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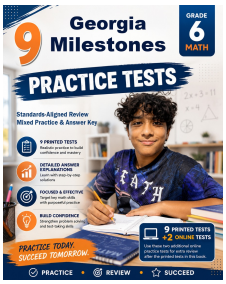

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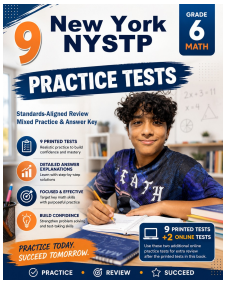

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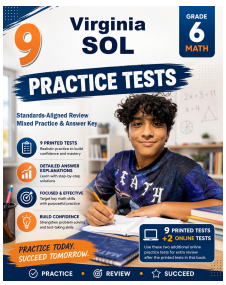

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