

Random Sampling and Comparing Populations: practice solutions, Grade 7 – download the PDF

Written solutions to the chapter problems. Check each step, then correct yourself.

1 Population or sample?



- a. Population: it is the entire group of interest.
- b. Sample: 60 residents are only part of the 1,200.
- c. Sample: 24 cars are only part of the 300 cars. (The 300 cars would be the population.)

2 Which method is random?



Methods (a) and (c) are random: every student has the same chance, and chance alone decides.

Method (b) favors students who come early, and method (d) favors students who like the library. In both, a person's convenience decides, so those samples may be biased.

3 True or false?



- a. False. A sample is a part of the population, so it cannot be larger than the population.
- b. True. This is exactly the definition of a random sample.
- c. False. Surveying every member gives the whole population, not a sample.

4 Mean, median, and range



Sum: $8 + 9 + 6 + 10 + 7 + 9 + 7 = 56$, so the mean is $56 \div 7 = 8$.

Ordered data: 6, 7, 7, 8, 9, 9, 10. The middle (fourth) value is 8, so the median is 8.

Range: $10 - 6 = 4$.

The mean is 8 points, the median is 8 points, and the range is 4 points.

5 Reading a dot plot



- a. The tallest stack has 5 dots, so 5 students own 2 pets.
- b. The most common value is 2 pets.
- c. Two students own 3 pets, one owns 4, and one owns 5: $2 + 1 + 1 = 4$ students.
- d. Range: $5 - 0 = 5$ pets.

6 Estimating a count



Sample proportion: $\frac{30}{120} = 0.25$.

Estimate: $0.25 \times 800 = 200$.

About 200 students at the school play soccer.

7 Which set is more spread out?



Set P: $18 - 10 = 8$. Set Q: $17 - 13 = 4$.

Set P has the larger range, so it is more spread out.

8 MAD of daily temperatures



Mean: $\frac{62 + 65 + 66 + 68 + 69}{5} = \frac{330}{5} = 66^\circ\text{F}$.

Distances from 66: 4, 1, 0, 2, 3. Their sum is 10.

$\text{MAD} = \frac{10}{5} = 2$. The temperatures are on average 2°F from the mean.

9 Five-number summary



The data are already ordered, and there are 12 values.

Median: the mean of the 6th and 7th values, $\frac{9 + 10}{2} = 9.5$.

Lower half: 3, 5, 5, 6, 8, 9, so $Q_1 = \frac{5 + 6}{2} = 5.5$. Upper half: 10, 12, 12, 13, 15, 16, so $Q_3 = \frac{12 + 13}{2} = 12.5$.

Minimum 3, maximum 16, and $\text{IQR} = 12.5 - 5.5 = 7$ laps.

10 Spot the bias



- Students at a basketball clinic probably like basketball more than the average student, so the sample is not representative, and the results would favor basketball.
- Use the school roster, number all the students, and pick the sample with a random number generator (or draw names from a bin). Then every student has an equal chance to be included.

11 Defective light bulbs



a. $\frac{6}{50} = 0.12$ and $0.12 \times 4000 = 480$ defective bulbs.

b. $\frac{9}{50} = 0.18$ and $0.18 \times 4000 = 720$ defective bulbs.

c. The two samples suggest that the number is probably between about 480 and 720 bulbs. The estimates differ because samples vary.

12 Fish in two lakes



Median of Lake A: 10 in. Median of Lake B: 13 in. Range of Lake A: $11 - 8 = 3$ in. Range of Lake B: $15 - 12 = 3$ in.

The ranges are equal, so the variability is the same. The median of Lake B is 3 inches greater, so the fish in Lake B are typically longer. The two sets of data do not overlap at all.

13 An unusual value



Sum: $10 + 12 + 12 + 13 + 13 + 14 + 45 = 119$, so the mean is $119 \div 7 = 17$ minutes.

The median (4th value) is 13 minutes.

The value 45 is far from the others and pulls the mean up. Six of seven students took 14 minutes or less, so the median of 13 minutes describes the typical time better.

14 Gap in MADs



Difference of the means: $27 - 21 = 6$ points.

$6 \div 2 = 3$, so the gap is 3 MADs.

A gap of 3 MADs is large, so the two distributions overlap very little: Team B usually scores clearly more than Team A.

15 Three samples, one claim



a. Sample 1: $\frac{14}{40} \times 1200 = 420$. Sample 2: $\frac{17}{40} \times 1200 = 510$. Sample 3:
 $\frac{11}{40} \times 1200 = 330$.

b. All three estimates (330 to 510) are well below 600, so the samples do *not* support the claim. It is more reasonable to say that fewer than half of the members support the schedule.

16 Design a sampling plan



Sample plan:

1. Get the list of all 600 students and number them from 1 to 600.
2. Use a random number generator to produce numbers from 1 to 600. If a number repeats, skip it.
3. Continue until 30 different numbers are chosen, and survey the students with those numbers.

Every student has the same chance of being selected, and no person decides who is included, so the plan avoids bias. The sample also includes students of every kind, which makes it representative.

17 Two box plots



- a. Class X: range $92 - 55 = 37$, IQR $80 - 65 = 15$. Class Y: range $85 - 60 = 25$, IQR $78 - 70 = 8$.
- b. The median of Class Y (75) is higher than the median of Class X (72), so Class Y has the higher typical score. Class Y also has the smaller range and the smaller IQR, so its scores are more consistent.

18 Two sprinters



a. Anna: $\frac{72.0}{5} = 14.4$ s. Ben: $\frac{72.0}{5} = 14.4$ s. Both have the same mean.

b. Anna: distances 0.2, 0.2, 0, 0.4, 0.4, sum 1.2, so **MAD** = $\frac{1.2}{5} = 0.24$ s. Ben:
distances 0.5, 0.3, 0.1, 0.3, 0.2, sum 1.4, so **MAD** = $\frac{1.4}{5} = 0.28$ s.

c. Anna is slightly more consistent because her MAD is smaller. Her times stay a little closer to the mean.

19 Does fertilizer help?



a. With fertilizer: sum 196, mean $196 \div 8 = 24.5$ cm. Distances from 24.5: 3.5, 1.5, 0.5, 0.5, 0.5, 1.5, 1.5, 2.5, sum 12, so **MAD** = $12 \div 8 = 1.5$ cm. Without fertilizer: sum 160, mean $160 \div 8 = 20$ cm. Distances from 20: 3, 2, 1, 0, 0, 1, 2, 3, sum 12, so **MAD** = 1.5 cm.

b. Difference of means: $24.5 - 20 = 4.5$ cm. $4.5 \div 1.5 = 3$, so the gap is 3 MADs.

c. A gap of 3 MADs means the distributions hardly overlap. The plants with fertilizer were clearly taller in this experiment. (To be sure about all plants, we would need more plants chosen at random.)

20 Find the two mistakes



Mistake 1: her sample is not random. Her teammates are likely to prefer basketball, so the sample is biased and not representative of the school.

Mistake 2: a sample of 10 students is very small, so a different sample could give a very different percentage. Her estimate of 400 students should not be trusted. She should draw a larger random sample from the whole school roster.

21 Sleep and age



- a. Seventh graders: sum 90, mean 9 hours; distances 2, 1, 1, 0, 0, 0, 0, 1, 1, 2 sum to 8, so **MAD** = **0.8** hour. Older students: sum 75, mean 7.5 hours; distances 2.5, 1.5, 0.5, 0.5, 0.5, 0.5, 0.5, 1.5, 2.5 sum to 11, so **MAD** = **1.1** hours.
- b. Difference of the means: $9 - 7.5 = 1.5$ hours. $1.5 \div 1.1 \approx 1.4$, so the gap is only a little more than 1 MAD. The distributions overlap quite a lot: many older students sleep as much as seventh graders. The seventh graders sleep more on average, but the difference is moderate, not huge.



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