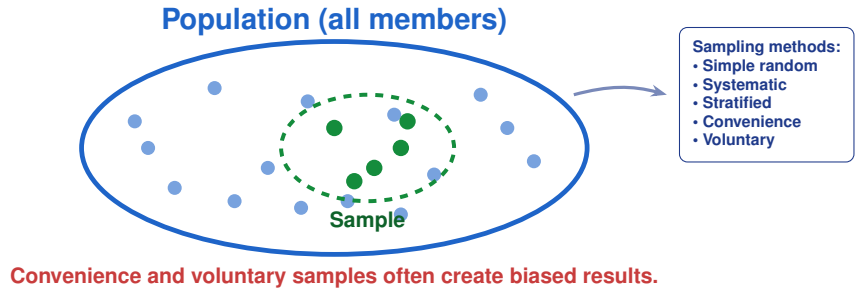
Populations, Samples, and Sampling Methods

Name: _____	Date: _____	Score: _____ / 17

In statistics, the **population** is the entire group you want to learn about, and a **sample** is the smaller group you actually study—because let's face it, you usually cannot ask *everyone*! The trick is making sure your sample represents the population fairly, and that is why sampling method matters so much. A good **random sample** reduces bias and gives you the best shot at trustworthy conclusions. Get this right and every other statistics topic builds on it!



Convenience and voluntary samples often create biased results.

Key Concepts & Quick Review

Population: the entire group of interest. **Sample:** a subset used to represent the population.

Unbiased methods: *Simple random* (every member equally likely); *Systematic* (every k-th member); *Stratified* (random within subgroups).
Biased methods: *Convenience* (whoever is nearest); *Voluntary response* (self-selected — those with strong opinions over-represented).

Examples

① A school wants to know students' favorite lunch option. They survey only the students in the cafeteria at noon. Identify the population and sample. Is this biased?

Think It Through: The population is the whole group the school wants information about, so here it is all students. The sample is only the group actually surveyed, which is the students in the cafeteria at noon. This sample is biased because it misses students who eat elsewhere, bring lunch from home, or are absent. Since the vice-principal is asking whoever is easiest to reach, this is a convenience sample.

Answer: *Biased convenience sample*

② A city has $4{,}000$ residents. A researcher numbers them 1–$4{,}000$ and uses a random number generator to select 200 names. Name this sampling method and explain why it is unbiased.

Think It Through: This is a simple random sample because the names are chosen by random number from the full list of residents. Every resident has the same chance of being selected, which is $\frac{200}{4000} = 5\%$. That equal chance is what makes the method unbiased: no part of the population is automatically favoured or left out.

Answer: *Simple random sample; every member equally likely*

Practice Problems

Identify the population, sample, and sampling method; state whether it is biased or unbiased.

1. A teacher chooses every 5th student from the class list. Identify the sampling method and state whether it is likely unbiased. _____
2. A radio station asks listeners to call in and vote for their favorite song. Identify the sampling method and explain whether bias is likely. _____
3. A phone company surveys $1{,}000$ customers chosen at random from its billing database. Identify the sampling method. _____
4. Researchers survey only students entering school on Monday morning. State whether the sample is biased and explain what group may be missed. _____
5. A mall uses a computer-generated list to randomly choose 50 shoppers to survey. Identify the sampling method. _____
6. A website asks visitors to rate its service. Identify the likely sampling method and the type of bias that may result. _____
7. A health clinic interviews every 10th patient on the appointment list. Identify the sampling method. _____
8. A student surveys only her friends about screen-time habits. State whether the sample is biased and explain why. _____
9. A national poll selects participants by random digit dialing. Identify the sampling method. _____
10. A teacher puts each student's name on a slip, shuffles the slips, and draws 8 names. Identify the sampling method. _____
11. A survey asks 500 Texas seventh graders about homework. Identify the population the survey wants to describe. _____
12. A supermarket surveys only customers leaving with a full cart. State whether the sample is biased and explain why. _____
13. Students are divided by grade level, then students are randomly selected within each grade. Identify the method and one advantage. _____
14. A voluntary response survey asks people to share opinions online. What kinds of opinions are most likely to be overrepresented? _____
15. A factory tests every 20th item from a production line. Identify the sampling method and one advantage of using it. _____

Study Tips

- Ask: **"Does every member of the population have a chance to be selected?"** If yes, the sample is likely unbiased.
- **Larger samples** are not automatically unbiased. A massive biased sample is still biased — size doesn't fix a flawed method.

☞ Real-world red flags: *only online respondents*, *only daytime phone calls*, *only students present that day* — all suggest important groups are missing.

✍ Word Problems

16. A school district wants to know what percentage of its $3{,}600$ students support a longer school day. A vice-principal surveys the 180 students who stay for after-school clubs. Identify the population and sample. Is this sample biased? Suggest a better sampling method. If possible, estimate how many survey participants would be a reasonable sample size (roughly 5%). _____

17. A city is deciding whether to build a new skate park. Method A: Survey 100 randomly selected residents from the voter roll. Method B: Place a comment box at the current skate park for one week. Which method is more likely to produce a representative result? _____

Answer Keys

1) systematic
2) voluntary response; biased
3) simple random
4) yes, biased
5) simple random
6) voluntary response bias
7) systematic
8) yes, biased
9) random digit dialing
10) simple random
11) Texas seventh graders
12) yes, biased
13) represents each grade level
14) strong opinions
15) systematic; efficient
16) Population: all $3{,}600$ students; sample: 180 after-school students; biased; better sample: random from full list; sample size about 180
17) Method A.

Step-by-Step Explanations

Strategy: For Nets and Surface Area of Prisms, use the net as a checklist for every outside face so no rectangle is missed or counted twice. A surface-area estimate should be reasonable for the size of the prism.

Practice 1: A rectangular prism has length 8, width 3, and height 5. Find its surface area. **Answer:** 158
In the first example, find the area of every outside face, using the net as a checklist so no face is counted twice.

Practice 15: A rectangular prism has surface area 94, length 5, and width 3. Find its height. **Answer:** 4
Toward the end, find the area of every outside face, using the net as a checklist so no face is counted twice.

Word-problem notes:

16. Answer: $SA = 2(40{\cdot}25{+}40{\cdot}15{+}25{\cdot}15) = 2(1000{+}600{+}375) = 3950\ cm^2$; daily cost $= 500 \times 3950 \times 0.004 = \$7{,}900$.
Use the rectangular prism surface area formula: $SA = 2(lw{+}lh{+}wh) = 2(40{\cdot}25{+}40{\cdot}15{+}25{\cdot}15)$. That becomes $2(1000 + 600 + 375) = 3950\ cm^2$ for one box. The paper cost for one box is $3950 \times 0.004 = \$15.80$. Since the company ships 500 boxes, multiply again by 500 to get a daily paper cost of $\$7{,}900$.

17. Answer: SA (no floor): $2(\frac{1}{2}{\cdot}1.8{\cdot}2.4) + 1.8(3) + 3.0(3) = 4.32 + 5.4 + 9.0 = 18.72\ m^2$; cost $= 18.72 \times 12 = \$224.64 \approx \$225$.
The two triangular ends are both canvas, so start with $2\left(\frac{1}{2} \cdot 1.8 \cdot 2.4\right) = 4.32\ m^2$. Since the $2.4\ m$ side is the floor, exclude the rectangle 2.4×3. That leaves only the other two side rectangles: $1.8 \times 3 = 5.4\ m^2$ and $3.0 \times 3 = 9.0\ m^2$. Add the canvas pieces: $4.32 + 5.4 + 9.0 = 18.72\ m^2$. Then multiply by $\$12$ per square metre to get $\$224.64$, which is about $\$225$.

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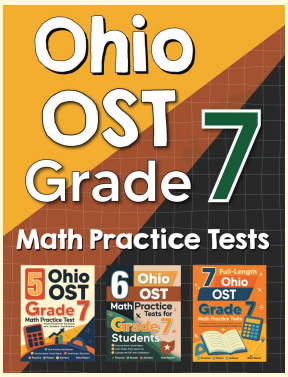

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