Grade 7 · Unit 8 · Assessment Guide

Probability and Sampling

For the Parent or Teacher — What to look for

Unit 8 builds probability and sampling intuition. THE classic errors: confusing experimental and theoretical probabilities, treating small samples as definitive evidence, and biased sampling (asking only your friends what their favorite movie is). The deeper questions are: when is a sample 'good enough'? And when is a difference 'meaningful'? Watch for whether students compare differences to variability (MAD).

Problem 1 — Likelihood vocabulary

- (a) Impossible. (b) Equally likely as not. (c) Certain (in most places). (d) Equally likely as not (26/52 = 1/2).
- ★ Strong students give precise vocabulary. (b) and (d) should both = 1/2.

Problem 2 — Spinner

- (a) 3/8 = 37.5%. (b) 4/8 = 1/2. (c) 7/8. (d) about 10 times.
- ★ Strong: confident with fraction-to-percent conversion. (d) tests expected value reasoning.

Problem 3 — Marble bag

- Total = 10. P(red) = 5/10 = 1/2. P(blue) = 3/10. P(red or blue) = 8/10 = 4/5.
- All add to 1 because every draw MUST be one of those colors (complete sample space).
- ★ The 'must equal 1' insight is the key sampling-completeness idea.

Problem 4 — Two coins

- Sample space: HH, HT, TH, TT. 4 outcomes.
- P(HH) = 1/4. P(at least one tail) = 3/4.
- ★ Watch for students who only list HH, HT, TT (3 outcomes) — forgetting that order matters.
- Or who say P(at least one tail) = 1/2 (the mistake of treating HT and TH as one outcome).

Problem 5 — Two dice

- Total: 36 outcomes (6 × 6).
- P(sum = 7): 6/36 = 1/6. (1+6, 2+5, 3+4, 4+3, 5+2, 6+1.)
- P(sum = 12): 1/36 (only 6+6).
- P(sum > 9): 6/36 = 1/6 (sums 10, 11, 12: combinations 4+6,5+5,6+4, 5+6,6+5, 6+6 → 6 outcomes).
- ★ Strong: enumerates systematically (table or tree). Weak: misses outcomes or double-counts.
- ★ THE classic mistake: treating sums as equally likely (says P(sum=2)=P(sum=7) — wrong).

Problem 6 — Lin's 13 heads in 20 flips

- (a) Experimental P = 13/20 = 0.65.
- (b) Theoretical = 0.5.
- (c) NOT yet evidence of unfairness. 20 flips is a small sample; getting 13 heads is well within normal variation. With many more flips, the experimental probability should approach 0.5.
- ★ This is the key idea: small samples are noisy. Strong: explicitly mentions sample size.
- Weak: 'yes, it's unfair' or 'definitely fair' — both are too definitive.

Problem 7 — Sampling bias

• The first 50 students are NOT representative — students who walk likely live closer and arrive earlier; students who drive or bus arrive later.

• Better methods: random sample (e.g., pick 50 random student IDs), stratified sample (sample equally from each grade), or sample at different times of day.

• ★ Strong: identifies that the SAMPLING METHOD creates bias (not just 'it's a small sample').

Problem 8 — Estimating population

• Sample: 45/60 = 75%.

• Estimate: 75% of 1200 = 900 students.

• ★ Strong: scales proportionally. Weak: just gives 45 as the answer (forgetting that 60 ≠ 1200).

Problem 9 — Meaningful difference?

• Difference of means: 84 − 78 = 6.

• MAD is about 4.5 (average of 5 and 4).

• Difference (6) is bigger than MAD but not 2× MAD (which would be 9).

• Likely meaningful but not strongly so.

• ★ Strong: explicitly compares the difference to the variability. Weak: 'yes, 6 is a lot' with no comparison.

• The rule of thumb in IM: difference > 2 × MAD suggests meaningful.

Problem 10 — Han's 'rigged die'

• P(5) = 1/6. Expected: 10/6 ≈ 1.67 fives in 10 rolls.

• Han got 6 — far more than expected. Suggestive but NOT proof.

• ★ With only 10 rolls, even rare events happen. Need many more rolls to confidently conclude the die is rigged.

• Strong: probability of 6+ fives in 10 rolls is very small, but possible. Acknowledges both surprise AND uncertainty.

• Weak: 'yes the die is rigged' or 'no Han is silly' — both too extreme.

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