Design a Carnival Game: Fair or Fundraiser? — Teacher Guide

Financial Algebra · Unit 15: Probability & Expected Value

3 class periods | Small groups (3–4) | Skills: Skill 1, Skill 2, Skill 3, Skill 4

Overview

Your class runs a booth at the school fair to raise money for a trip. Your team will analyze three sample games, run a simulation, then design your own game with a target expected profit, and convince the student council it is honest and fun.

Skills covered

- Compute probabilities of events (probability-skill-01)
- Use compound probability and counting (probability-skill-02)
- Calculate expected value of decisions (probability-skill-03)
- Evaluate games, warranties and lotteries (probability-skill-04)

Required materials

- Student packet
- Dice, spinners or a spreadsheet with RAND()

Suggested pacing

Session	Focus
Day 1	Tasks 1–2
Day 2	Tasks 3–4
Day 3	Pitches

Implementation guidance

- Make sure students count the $2 cost in the player's EV.
- Expected winners = plays × P(win), useful for buying prizes.

Worked calculations

Task 1

1. Lucky Six: P(win) = 16.7%; player EV = −$0.67; class profit ≈ $266.67.
2. Double Trouble: P(win) = 16.7%; player EV = −$0.33; class profit ≈ $133.33.
3. Big Spin: P(win) = 5%; player EV = −$0.50; class profit ≈ $200.00.

Task 4

1. Lucky Six: expect about 67 winners → buy that many prizes plus a few extra.
2. Double Trouble: expect about 67 winners → buy that many prizes plus a few extra.
3. Big Spin: expect about 20 winners → buy that many prizes plus a few extra.

Sample student responses

> “Lucky Six returns $1.33 per $2 play, so the class expects $266.67 from 400 plays, and players win 1 time in 6, which meets the council’s rule.”

Common misconceptions

- Forgetting to subtract the cost of a play.
- Expecting a 50-play simulation to match the expected value exactly.

Differentiation

Support

- Provide an EV table template.

Extend

- Design a game with two prize levels and compute its variance.

Extension opportunities

- Research how a state lottery sets its prizes and payout percentage.

100-point rubric

Category (points)	Exemplary (100%)	Proficient (~80%)	Developing (~60%)	Beginning (~30%)
Financial understanding	Uses vocabulary precisely and	Mostly accurate	Partial understanding;	Little evidence of

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(20)	explains every financial concept involved, including assumptions.	explanations with minor vocabulary gaps.	some concepts misapplied.	understanding.
Mathematical accuracy (25)	Probabilities, expected values and expected profit correct.	1–2 minor errors that do not change conclusions.	Several errors or missing work.	Calculations largely missing or incorrect.
Analysis & comparison (20)	Compares every option on the same basis and tests at least one changed assumption.	Compares options with small gaps.	Comparison superficial or uneven.	Little analysis.
Justification (15)	Recommendation is supported by specific numbers and weighs non-financial factors and risks.	Mostly supported.	Mostly opinion.	No justification.
Communication & presentation (10)	Clear, organized, well-labeled tables, charts, and writing.	Minor clarity issues.	Hard to follow in places.	Disorganized.
Completion (10)	Every checklist item complete.	One item missing.	Two or three items missing.	Most items missing.

Total: 100 points. Alternative recommendations earn full credit when supported by accurate evidence.

Student documents (reference)

Sample games

Game	Rules	P(win)	Prize
Lucky Six	Roll one die; a 6 wins $8.	16.7%	$8
Double Trouble	Roll two dice; doubles win $10.	16.7%	$10
Big Spin	Spin a 20-section wheel; 1 section wins $30.	5%	$30