



EduTrend Contents

EDUTECH · MATHEMATICS · HIGH SCHOOL

Modelling Decay with Dice

Build and test an exponential model from a dice experiment

Ages 15–18

Level: Advanced

75 minutes

Teams of 3

Activity 05

Inside: activity at a glance · step-by-step session plan · facilitator notes · 3 student worksheets · assessment checklist

ACTIVITY 05 · AT A GLANCE

Modelling Decay with Dice

Teams start with 100 dice. Each round they roll them all and remove any that show a six, then record how many remain. They plot the data, notice the curve, fit an exponential model $N = 100 \times (5/6)^n$, estimate a “half-life” and evaluate how well the model fits. Links are made to radioactive decay.

Learning outcomes

By the end of the session students can:

- collect and plot data;
- recognise exponential decay;
- fit and test a model;
- evaluate model limitations.

KEY WORDS

exponential · decay · model · half-life · logarithm · residual

CURRICULUM LINKS

Physics: radioactive decay. Biology: population models. Finance: depreciation.

1**NOTICE**

What do we see?

2**REPRESENT**

Concrete, picture, symbol

3**EXPLORE**

Try and look for patterns

4**CONJECTURE**

What might always be true?

5**JUSTIFY**

Explain why

6**CONNECT**

Where else does it apply?

Materials (per team)

- 100 dice (or a simulation)
- Tray
- Graph paper or spreadsheet
- Worksheets 1, 2 and 3

Before the session

- Collect dice or prepare a spreadsheet simulation.
- Print worksheets.
- Prepare axes.
- Plan teams.

SAFETY

Roll dice in trays to keep them contained and off the floor.

ACTIVITY 05 · SESSION PLAN

Step by step

Pooling several teams' data gives a smoother curve closer to the model.

Time	What happens	Say or ask
0–10 min Hook	Predict rounds until none remain.	<i>"How fast will they go?"</i>
10–30 min Collect	Roll, remove sixes, record.	<i>"What fraction remains each round?"</i>
30–45 min Plot	Graph remaining dice.	<i>"What shape is it?"</i>
45–62 min Model	Fit $N = 100 \times (5/6)^n$.	<i>"How close is it?"</i>
62–75 min Evaluate	Half-life and limitations.	<i>"Where does the model break down?"</i>

CHALLENGE CARD (print or copy onto the board)

Collect decay data with dice, fit an exponential model, estimate the half-life and evaluate how well the model describes the data.

ACTIVITY 05 · FACILITATOR NOTES

The maths know-how in brief

Each die has a $1/6$ chance of showing a six, so on average $5/6$ remain each round. This gives exponential decay: $N = N_0 \times (5/6)^n$, which falls by the same fraction each step.

The half-life is the number of rounds for half the dice to remain. Solving $(5/6)^n = 1/2$ gives $n = \ln 2 \div \ln 1.2$, about 3.8 rounds. Small numbers of dice make the data noisy.

Common ideas to listen for

- “The same number are removed each round.” The same fraction is.
- “The model predicts exactly.” It predicts averages.
- “Exponential means fast growth.” It can describe decay too.

Adapting the activity

Support

Provide a spreadsheet with the model column set up.

Stretch

Plot $\ln N$ against n and find the gradient.

WORKSHEET 1

Data

Name: _____

Class: _____ Date: _____

Record each round.

Data

Round	Dice remaining	Model value
0		
1		
2		
3		
4		
5		
6		
8		
10		

WORKSHEET 2

Model fit

Compare data and model.

Model fit

Measure	Value
Fraction remaining per round	
Observed half-life	
Model half-life	
Largest difference	

WORKSHEET 3

Evaluation

Evaluate the model.

How well the model fits and its limitations

FOR THE TEACHER

Assessment checklist

Use during the session. One sheet covers up to eight students; copy as needed.

Student	Collects data accurately	Fits an exponential model	Evaluates limitations

Suggested codes: W = working towards · E = expected · G = greater depth

ABOUT THIS ACTIVITY

Modelling Decay with Dice is a sample activity from the EduTrend Contents Edutech Mathematics programme (high school, level: advanced). Every activity in the programme follows the same format: a practical challenge, a clear session plan, facilitator notes and ready-to-print worksheets, so that teachers, club leaders and parents can run it without extra preparation.

Full 15-, 20- and 32-week programmes are available from EduStore at edutrend.org.

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