Exercise walk-through

6.1
Planning a mathematical exploration

International Baccalaureate · IB Diploma · Mathematics: Applications and Interpret

6.1 Planning a mathematical exploration

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

KEY WORDS assumption

Objective

Planning a mathematical exploration. Original classroom practice for IB SL; not an official IB paper.

1 Key knowledge and worked examples

■ What makes an investigation mathematical?

- A student wants to predict queue waiting time at the school canteen. A useful exploration needs a question, data and mathematics the student can explain.
- This lesson studies **assumption** : A condition adopted to make a mathematical

model possible and whose effect should be evaluated.

The method

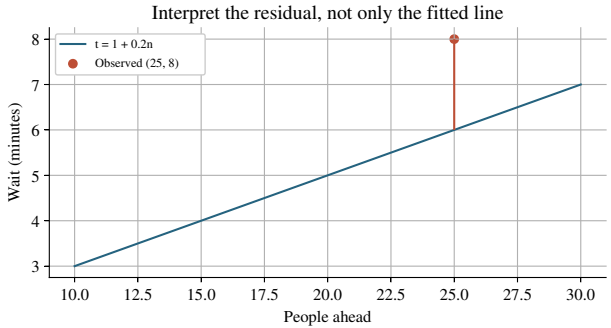
- Frame a focused question with measurable variables and a feasible method.
- Keep a dated record of decisions, sources and mathematical reasoning.
- Use technology to support analysis, and explain every important output in your own words.

A worked case

$$\widehat{t} = 1 + 0.2n, \qquad e = t - \widehat{t}$$

Example:

A pilot records mean waiting times of 3,5,7 minutes when 10,20,30 people are ahead. A first model is t=1+0.2n. At n=25 it predicts 6 minutes. An actual wait of 8 gives residual 2; investigate varying service rates rather than hiding the mismatch.



Where it goes wrong

- Do not copy a sample exploration, invent data or manufacture personal engagement.
- A prediction is not evidence until it is compared with observations.
- Consent and privacy matter when collecting school data.

Not true: The school-supervised mathematical exploration can be replaced by a timed written mock exam. The exploration is an extended piece of written work assessed on its own criteria; a timed exam tests something different.

Applying it

- The school supervises topic approval, checkpoints, authenticity and assessment.
- For the current 2021 course use the current school's guide and criteria; the 2029 inquiry criteria belong to a different assessment version.

In your course

- Applications and Interpretation SL, the course first assessed in 2021.
- Every paper allows a calculator, but method marks still need the expression or equation written before its value.

Key:

- **Assumption**: A condition adopted to make a mathematical model possible and whose effect should be evaluated.
- Frame a focused question with measurable variables and a feasible method.
- Watch for: do not copy a sample exploration, invent data or manufacture personal engagement.

Write from a predicted wait of 7

- The model $t = 4 + 0.5n$ predicts the wait at $n = 6$.
- An observed wait of 12 leaves a residual. A timed mock does not replace the exploration.

Exercises 2.1·2.3

2.1 For $t=1+0.2n$, find predicted wait at $n=25$. Show the relation, substitution and units. [2]

2.2 Find the residual for observed 8 and predicted 6. Show the relation, substitution and units. [2]

2.3 Three independent measurements are 4,6,8. Find their mean. Show the relation, substitution and units. [2]

Exercises 2.1·2.3

2.1 For t=1+0.2n, find predicted wait at n=25. Show the relation, substitution and units. [2]

2.1 Use n=25 in the model: 1+0.2×25=6 minutes.

2.2 Find the residual for observed 8 and predicted 6. Show the relation, substitution and units. [2]

2.2 Residual=8-6=2 minutes.

2.3 Three independent measurements are 4,6,8. Find their mean. Show the relation, substitution and units. [2]

2.3 Mean=(4+6+8)/3=6.

Exercises 2.4·2.5

2.4 Decide whether this claim is true and justify: Assumption means a condition adopted to make a mathematical model possible and whose effect should be evaluated. [2]

2.5 A pilot study gives t=1+0.2n, but an actual wait of 8 minutes at n=25 gives residual 2. What is the correct response? Choose one answer.

- **A** Investigate why - for example a varying service rate - and record the reasoning
- **B** Delete the observation and refit the model without mentioning it
- **C** Hide the mismatch, since the model fitted every other observation [1]

Exercises 2.4·2.5

2.4 Decide whether this claim is true and justify: Assumption means a condition adopted to make a mathematical model possible and whose effect should be evaluated. [2]

2.4 True. True: A condition adopted to make a mathematical model possible and whose effect should be evaluated.

2.5 A pilot study gives t=1+0.2n, but an actual wait of 8 minutes at n=25 gives residual 2. What is the correct response? Choose one answer.

- **A** Investigate why - for example a varying service rate - and record the reasoning
- **B** Delete the observation and refit the model without mentioning it
- **C** Hide the mismatch, since the model fitted every other observation [1]

2.5 A A residual is evidence about the model's limits. Investigating a better assumption, with dated records, is exactly the mathematical thinking the exploration rewards; hiding it is a failure of authenticity.

Exercise 3.1

3.1 Fictional wait times for n=10, 20, 30 are 4, 7, 11 minutes. A proposed model is t=1+0.3 n. Find residuals and propose a useful next investigation; do not write a learner's assessed exploration. [4]

Exercise 3.1

3.1 Fictional wait times for n=10, 20, 30 are 4, 7, 11 minutes. A proposed model is t=1+0.3 n. Find residuals and propose a useful next investigation; do not write a learner's assessed exploration. [4]

3.1 Predictions 4, 7, 10; residuals 0, 0, 1 minute. Collect repeated observations across a wider justified range, inspect curvature/variation and compare models. One residual pattern from three invented values does not validate causality or certify an IB exploration.