The mathematical exploration

Internal assessment · SL and HL

The holes that were not there

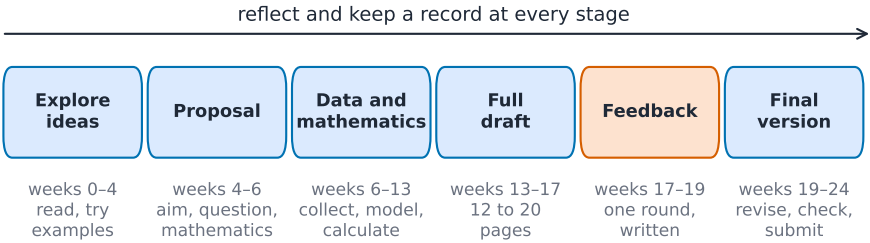
> Ask how the data were collected, and who is missing.

- Returning bombers had few holes in the engines.
- Planes hit there never came back.
- This unit: topic $\to$ data $\to$ model $\to$ test $\to$ reflection.

The five criteria

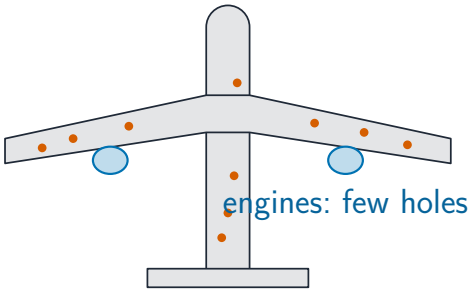
Criterion	Marks
A **Presentation**	4
B **Mathematical communication**	4
C **Personal engagement**	3
D Reflection	3
E Use of mathematics	6

Plan the time



- One round of written feedback on a draft.
- Collect data early; a second round is often needed.

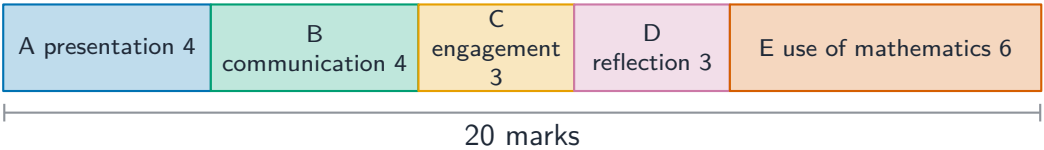
Survivorship bias



data come only from planes that returned: hits to the engines brought planes down, so armour the engines

> Armour the engines

How the exploration is marked



Use of mathematics carries the most: 6

From topic to question

Weak

Sleep and students

Bus delays

Phone prices

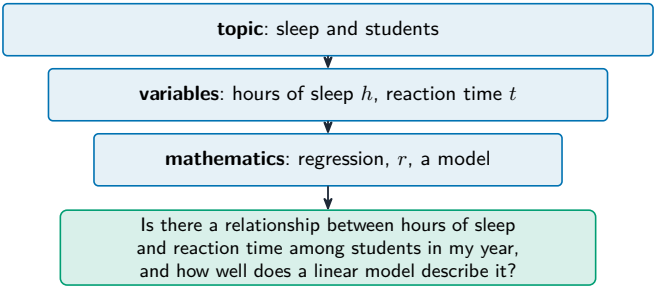
Better

How well does a linear model link sleep and reaction time?

Are bus delays normal, and when should I leave?

Linear, exponential or power model for price and age?

Narrowing to a research question

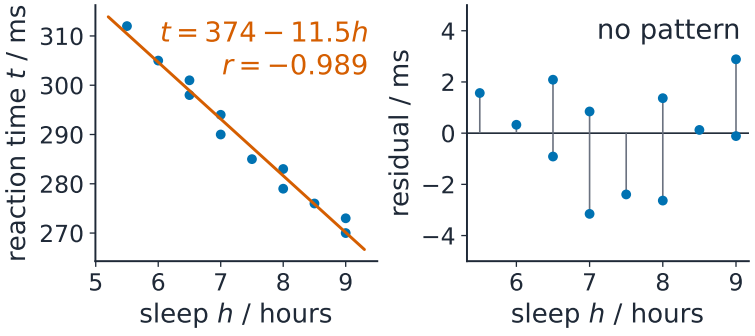


End with a focused **research question**

Correct notation

Not this	**This**
0.0012	1.2×10^{-3}
sqrt(x), x*y	$\sqrt{x}$, xy
p = 3.9E-4	p-value $= 0.00039 < 0.05$

Sleep and reaction time



- $t = 374 - 11.5h$, $r = -0.989$.
- Residuals within 3.2 ms, no pattern.

Critical reflection

Descriptive	Critical
Sleep makes you faster.	Correlation only; caffeine may affect both.
My sample was small.	One class of volunteers, not a random sample.

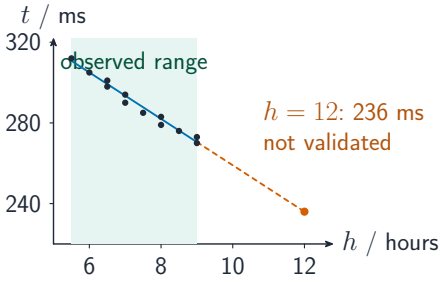
Check: which criterion?

Your turn

A student explains that self-reported sleep may be inaccurate and how to check it. Which criterion does this mainly earn?

A. D Reflection
B. A Presentation
C. B Mathematical communication
D. E Use of mathematics

The danger of extrapolation



Outside the observed range, the model is untested

Integrity

> If you cannot explain a step, it should not be in the exploration.

- Cite data, images, software and AI tools.
- Never invent or alter data; get consent.

Criterion E at HL

1. **Test.** $H_0 : \rho = 0$, $H_1 : \rho < 0$
2. **Conditions.** check normality and spread before a t-test
3. **Compare.** $t = a + \frac{b}{h}$ against the line, by R^2 and context

Decision

Mathematics that answers the question

Exam tips

> Choose a question you care about that needs course mathematics.

- Label every graph; define every variable.
- Look at residuals, not only r.
- Ask who is missing from your data.

Check yourself

Try these

Rewrite “Statistics in basketball” as a focused research question.

Predict t for $h = 7.5$ from $t = 374 - 11.5h$, and find the residual for $t = 285$.

Turn “I could have used more data” into critical reflection.