

Exercise walk-through

Variation ■ 17.1

eXercise

You must be able to

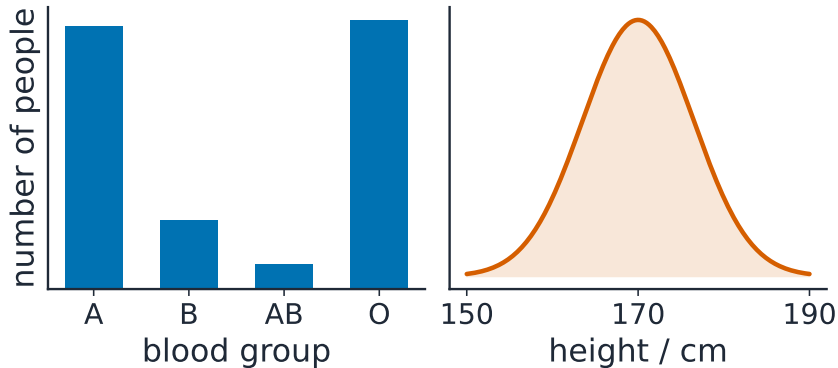
- explain genetic, environmental and combined causes of phenotypic variation
- explain continuous and discontinuous variation and their genetic basis
- use a t-test to compare the means of two samples

Method — Causes and patterns of variation

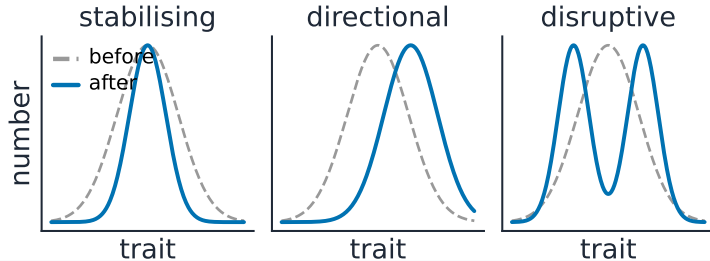
- **genetic only** — set by alleles (e.g. blood group); **environmental only** — set by surroundings (e.g. a scar); most features are a **combination** (e.g. height).
- **discontinuous**: separate categories, controlled by one or a few **genes** 基因, little environmental effect.
- **continuous**: a smooth range, controlled by **many genes** plus the environment.

Method — Causes and patterns of variation

discontinuous: discrete classes · continuous: smooth range (often polygenic)



Method — Causes and patterns of variation



directional: favors one extreme · stabilising: favors mean · disruptive: favors both extremes

Variation is acted on by the types of selection

Method — The t-test

The **t-test** compares the **means** of two samples to see whether their difference is real or just chance. A large t (beyond the critical value) means the difference is significant; a small t means it could be due to chance.

Practice 2.1 ■ 2 marks

State whether each is continuous or discontinuous variation: human height; ABO blood group.

Solution 2.1

Method: Causes and patterns of variation

Worked steps

height — continuous; ABO blood group — discontinuous **B1** *each*.

Practice 2.2 ■ 1 mark

Give **one** example of a feature caused by both genes and the environment.

Solution 2.2

Method: Causes and patterns of variation

Worked steps

e.g. height / body mass / skin colour **B1**.

Exam-style 3.1 ■ 1 mark

Which feature shows discontinuous variation?

A body mass

B ABO blood group

C height

D skin colour

Solution 3.1

Method: Causes and patterns of variation

A body mass

B ABO blood group



C height

D skin colour

Worked steps

B. ABO blood group falls into separate categories.

Exam-style 3.2 ■ 1 mark

Continuous variation is usually caused by:

- A** a single gene only
- B** many genes together, plus the environment
- C** the environment only
- D** a chromosome mutation

Solution 3.2

Method: Causes and patterns of variation

- A a single gene only
- B many genes together, plus the environment 
- C the environment only
- D a chromosome mutation

Worked steps

B. Continuous variation is polygenic and affected by the environment.

Exam-style 3.3 ■ 1 mark

A student measures the heights of plants grown in sun and in shade and wants to know if the difference in mean height is significant.

- (a) Name a statistical test the student should use.
- (b) The calculated t value is greater than the critical value at $p = 0.05$. State what this tells the student.

Solution 3.3

Method: The t-test

Worked steps

(a) the t-test **B1**.

(b) the difference between the means is significant **M1**; it is unlikely (less than 5% probability) to be due to chance **A1**.

Exam-style 3.4 ■ 2 marks

Explain why two genetically identical plants can still differ in height.

Solution 3.4

Worked steps

the environment differs (e.g. light, water, minerals) **M1**; environmental factors affect the phenotype as well as the genes **A1**.