

## 2.7 Residuals

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 9 marks

KEY WORDS residual 残差 • residual plot 残差图

### Objective

Build the skills to answer exam questions on **residuals**.

You must be able to:

- calculate a **residual** 残差 as  $y - \hat{y}$  (observed minus predicted)
- construct and interpret a **residual plot** 残差图
- use a residual plot to judge whether a **linear model** is appropriate

### 1 Worked examples

Study these first. Each one shows the method for a question type used later.

#### ■ Residuals

$$\text{residual} = y - \hat{y} = \text{observed} - \text{predicted}.$$

A **positive** residual means the point lies **above** the line.

#### ■ Residual plots

Plot the residuals against  $x$  (or  $\hat{y}$ ):

- **random scatter** with no pattern  $\rightarrow$  the linear model is appropriate;
- a **clear pattern** (e.g. a curve)  $\rightarrow$  a linear model is **not** appropriate.

### 2 Practice

2.1 Write the formula for a residual.

[1]

2.2 An observed value is 18 and the model predicts 15. Find the residual.

[2]

**2.3** State what a residual plot with a clear pattern suggests. [1]

---

### 3 Exam-style questions

---

**3.1** A residual equals [1]

- |   |   |
|---|---|
| A | B |
| C | D |
- A**  $\hat{y} - y$   
**B**  $y - \hat{y}$   
**C**  $y + \hat{y}$   
**D**  $y \times \hat{y}$

**3.2** A residual plot showing random scatter suggests the linear model is [1]

- |   |   |
|---|---|
| A | B |
| C | D |
- A** inappropriate  
**B** appropriate  
**C** curved  
**D** wrong

**3.3** A prediction is  $\hat{y} = 40$ , but the actual value is  $y = 46$ .

(a) Find the residual. [2]

(b) State whether the point is above or below the line. [1]