

## 2.7 Residuals

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

Total: 9 marks

### Objective

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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

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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

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2.1 Write the formula for a residual. [1]

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2.2 An observed value is 18 and the model predicts 15. Find the residual. [2]

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

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### 3 Exam-style questions

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3.1 A residual equals [1]

- **A**  $\hat{y} - y$
  - **B**  $y - \hat{y}$
  - **C**  $y + \hat{y}$
  - **D**  $y \times \hat{y}$
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3.2 A residual plot showing random scatter suggests the linear model is [1]

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

### 4 Go further

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- work through the **2.7 Residuals** lesson on the **Learn** page;
- read the **Exploring Two-Variable Data** section of the AP Statistics handout on the **Know** page.

## Solutions

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**2.1** residual =  $y - \hat{y}$ .

**2.2**  $18 - 15 = 3$ .

**2.3** a linear model is not appropriate for the data.

**3.1 B.**

**3.2 B.**

**3.3** (a)  $46 - 40 = 6$ . (b) above the line (positive residual).