

## 2.8 Standardise values and interpret a stated normal model

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

Total: 24 marks

**KEY WORDS** normal distribution 正态分布 • z-score 标准分 • standard deviation 标准差

### Objective

Standardise values and interpret a stated normal model. Original GAC004-aligned practice, not an official assessment. Show the method as well as the result. All applied scenarios are invented classroom problems.

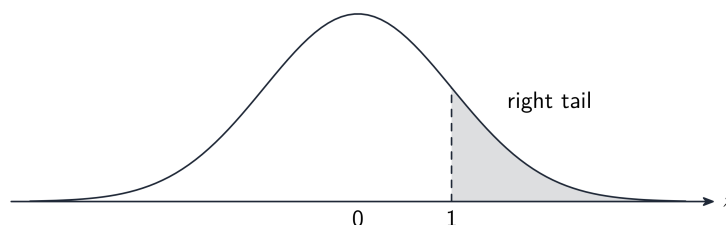
### 1 Key knowledge and worked examples

#### ■ Key knowledge: normal probabilities depend on the model and its parameters

A **normal distribution** 正态分布 is a continuous symmetric bell-shaped model with mean  $\mu$  and positive **standard deviation** 标准差  $\sigma$ . Standardising gives a **z-score** 标准分,  $z = (x - \mu)/\sigma$ . Total area is 1; individual exact values have zero probability in this continuous model.

Use the supplied standard-normal cumulative values  $\Phi(z) = P(Z \leq z)$ :  $\Phi(0) = 0.5000$ ,  $\Phi(1) = 0.8413$ ,  $\Phi(1.5) = 0.9332$ ,  $\Phi(2) = 0.9772$ . Symmetry gives  $\Phi(-z) = 1 - \Phi(z)$ . Interval probability is upper cumulative area minus lower cumulative area. These probabilities require a stated normal assumption; a mean and standard deviation alone do not prove that real data are normal.

#### ■ Worked example: a threshold is an area beyond a standardised value



Known: an invented measurement model has  $\mu = 50$  and  $\sigma = 10$ . For values above 60, standardise the threshold.

$$z = \frac{x - \mu}{\sigma} = \frac{60 - 50}{10} = 1$$

Use the complement of the supplied cumulative area.

$$P(X > 60) = 1 - \Phi(1) = 1 - 0.8413 = 0.1587$$

This is a model probability, not a guarantee that exactly 15.87% of a finite sample exceeds 60.

## 2 Practice

**2.1** A normal model has mean 100 and standard deviation 15. Find the z-score of 130.[2]

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**2.2** Using the supplied cumulative values, find the probability that a standard-normal value is greater than 1. [2]

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**2.3** Use symmetry and the supplied values to find the probability that a standard-normal value lies between negative 1 and 1. [3]

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**2.4** A normal model has mean 70 and standard deviation 8. Find the raw values corresponding to z-scores negative 1 and 1.5. Give the probability above the latter value. [3]

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### 3 Exam-style questions

**3.1** A stated normal model for completion time has mean 40 minutes and standard deviation 5 minutes. (a) Find the probability of completion between 35 and 50 minutes. (b) For 200 independently modelled tasks, find the expected number exceeding 50 minutes. Explain why that expectation is not a guaranteed observed count. [6]

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