S1 Normal Distribution: exam questions

5 questions · 21 marks · full mark schemes

Name _____ Date _____ Score / 21

- The normal distribution N(μ, σ^2); standardising with Z; using tables for probabilities and inverse problems; finding μ and/or σ.
- Try every question before you look at the mark schemes. They start after the questions: M marks for method, A marks for accuracy, B marks for a correct result on its own.
- Online, with more practice: alevelmathrevision.com/alevel-frontend/units/s1/normal-distribution-questions

1. **2 marks · warm-up**

The random variable $X \sim N(30, 4^2)$. Find $P(X < 35)$.

2. **3 marks · standard**

$X \sim N(200, 100)$. Find the value of a such that $P(X < a) = 0.9$.

3. **4 marks · standard**

The diameters of bolts made by a machine are normally distributed with mean $12\ \text{mm}$ and standard deviation $0.2\ \text{mm}$. A bolt is rejected if its diameter is less than $11.7\ \text{mm}$ or more than $12.3\ \text{mm}$. Find the expected number of rejected bolts in a batch of 1000.

4. 3 marks · harder

The mass of an item is normally distributed with unknown mean and $\sigma = 5$. $P(X < 40) = 0.1$. Find μ.

5. 9 marks · harder

A machine fills bags of flour. The mass of flour in a bag is normally distributed with standard deviation 4 g. The machine is first set so that the mean mass is 502 g.

(a) Find the probability that a bag contains less than 500 g. (2)

(b) The mean is changed so that only 1% of bags contain less than 500 g. Find the new mean, to one decimal place. (3)

(c) With the new setting, three bags are chosen at random. Find the probability that all three contain at least 500 g. (2)

(d) Using a mean of 509.3 g, find the probability that a bag contains more than 515 g. (2)

Answers and worked solutions

Question 1

2 marks

Answer: 0.8944

$P\left(Z < \frac{35-30}{4}\right) = P(Z < 1.25)$ **M1**

$= 0.8944$ **A1**

Question 2

3 marks

Answer: 212.8

$z = 1.2816$ **B1**

$\frac{a-200}{10} = 1.2816$ **M1**

$a = 212.8$ **A1**

Answer: 212.8

Question 3

4 marks

Answer: 134 (133.6)

$z = \pm\frac{0.3}{0.2} = \pm 1.5$ **M1**

$P(Z > 1.5) = 1 - 0.9332 = 0.0668$ **A1**

$1000 \times 2 \times 0.0668$ **M1**

$= 133.6$, so about 134 bolts **A1**

Question 4

3 marks

Answer: $\mu \approx 46.4$

$z = -1.2816$ **B1**

$\frac{40-\mu}{5} = -1.2816$ **M1**

$\mu = 46.4$ **A1**

Answer: $\mu = 46.4$

Question 5

9 marks

Answer: (a) 0.3085 (b) $509.3\ g$ (c) 0.9703 (d) 0.0771

a. $P\left(Z < \frac{500-502}{4}\right) = P(Z < -0.5)$ **M1**

$= 1 - 0.6915 = 0.3085$ **A1**

b. $z = -2.3263$ **B1**

$\frac{500-\mu}{4} = -2.3263$ **M1**

$\mu = 509.3\ g$ **A1**

c. $P(X \geq 500) = 0.99$, so 0.99^3 **M1**

$= 0.9703$ **A1**

d. $z = \frac{515-509.3}{4} = 1.425$ **M1**

$P(Z > 1.425) = 0.0771$ **A1**

More normal distribution practice with instant feedback: alevelmathrevision.com/alevel-frontend/units/s1/normal-distribution-questions

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