

# Normal Distribution 1

Q1.

The random variable  $X$  is the length of time in minutes that Jannon takes to mend a bicycle puncture.  $X$  has a normal distribution with mean  $\mu$  and variance  $\sigma^2$ . It is given that  $P(X > 30.0) = 0.1480$  and  $P(X > 20.9) = 0.6228$ . Find  $\mu$  and  $\sigma$ . [5]

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Q2.

In the holidays Martin spends 25% of the day playing computer games. Martin's friend phones him once a day at a randomly chosen time.

- (i) Find the probability that, in one holiday period of 8 days, there are exactly 2 days on which Martin is playing computer games when his friend phones. [2]
  - (ii) Another holiday period lasts for 12 days. State with a reason whether it is appropriate to use a normal approximation to find the probability that there are fewer than 7 days on which Martin is playing computer games when his friend phones. [1]
  - (iii) Find the probability that there are at least 13 days of a 40-day holiday period on which Martin is playing computer games when his friend phones. [5]
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Q3.

The lengths of new pencils are normally distributed with mean 11 cm and standard deviation 0.095 cm.

- (i) Find the probability that a pencil chosen at random has a length greater than 10.9 cm. [2]
  - (ii) Find the probability that, in a random sample of 6 pencils, at least two have lengths less than 10.9 cm. [3]
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Q4.

The random variable  $X$  is normally distributed with mean  $\mu$  and standard deviation  $\sigma$ .

- (i) Given that  $5\sigma = 3\mu$ , find  $P(X < 2\mu)$ . [3]
  - (ii) With a different relationship between  $\mu$  and  $\sigma$ , it is given that  $P(X < \frac{1}{3}\mu) = 0.8524$ . Express  $\mu$  in terms of  $\sigma$ . [3]
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Q5.

The heights that children of a particular age can jump have a normal distribution. On average, 8 children out of 10 can jump a height of more than 127 cm, and 1 child out of 3 can jump a height of more than 135 cm.

- (i) Find the mean and standard deviation of the heights the children can jump. [5]
  - (ii) Find the probability that a randomly chosen child will **not** be able to jump a height of 145 cm. [3]
  - (iii) Find the probability that, of 8 randomly chosen children, at least 2 will be able to jump a height of more than 135 cm. [3]
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Q6.

The times taken by students to get up in the morning can be modelled by a normal distribution with mean 26.4 minutes and standard deviation 3.7 minutes.

- (i) For a random sample of 350 students, find the number who would be expected to take longer than 20 minutes to get up in the morning. [3]
  - (ii) 'Very slow' students are students whose time to get up is more than 1.645 standard deviations above the mean. Find the probability that fewer than 3 students from a random sample of 8 students are 'very slow'. [4]
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Q7.

The distance the Zotoc car can travel on 20 litres of fuel is normally distributed with mean 320 km and standard deviation 21.6 km. The distance the Ganmor car can travel on 20 litres of fuel is normally distributed with mean 350 km and standard deviation 7.5 km. Both cars are filled with 20 litres of fuel and are driven towards a place 367 km away.

- (i) For each car, find the probability that it runs out of fuel before it has travelled 367 km. [3]
  - (ii) The probability that a Zotoc car can travel at least  $(320 + d)$  km on 20 litres of fuel is 0.409. Find the value of  $d$ . [4]
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Q8.

- (i) State three conditions that must be satisfied for a situation to be modelled by a binomial distribution. [2]

On any day, there is a probability of 0.3 that Julie's train is late.

- (ii) Nine days are chosen at random. Find the probability that Julie's train is late on more than 7 days or fewer than 2 days. [3]
- (iii) 90 days are chosen at random. Find the probability that Julie's train is late on more than 35 days or fewer than 27 days. [5]
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Q9.

The times spent by people visiting a certain dentist are independent and normally distributed with a mean of 8.2 minutes. 79% of people who visit this dentist have visits lasting less than 10 minutes.

- (i) Find the standard deviation of the times spent by people visiting this dentist. [3]
- (ii) Find the probability that the time spent visiting this dentist by a randomly chosen person deviates from the mean by more than 1 minute. [3]
- (iii) Find the probability that, of 6 randomly chosen people, more than 2 have visits lasting longer than 10 minutes. [3]
- (iv) Find the probability that, of 35 randomly chosen people, fewer than 16 have visits lasting less than 8.2 minutes. [5]
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Q10.

- (a) The random variable  $X$  is normally distributed with mean  $\mu$  and standard deviation  $\sigma$ . It is given that  $3\mu = 7\sigma^2$  and that  $P(X > 2\mu) = 0.1016$ . Find  $\mu$  and  $\sigma$ . [4]
- (b) It is given that  $Y \sim N(33, 21)$ . Find the value of  $a$  given that  $P(33 - a < Y < 33 + a) = 0.5$ . [4]
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