

### Question 1

The percentage of carbon in a batch of steel produced using a particular method is normally distributed with mean 2 and variance 0.09.

- (a) Calculate the probability that the percentage of carbon in a batch is less than 2.15
- (b) The batch is high grade if the percentage of carbon is between 1.7 and 2.3. Calculate the probability that the batch is high grade.
- (c) Suppose that it is possible to control the variance. What is the maximum variance possible such that at least 95% of the batches are high grade?

### Question 2

The compressive strength of concrete for fresh-water exhibition tanks has mean 5000 psi and standard deviation 240 psi. Assuming that the compressive strength is normally distributed, calculate the probability that the compressive strength of a sample of concrete is less than 4900 psi.

### Question 3

IQ scores are assumed to have a normal distribution with mean 100 and standard deviation 15.

- (a) What IQ would you have if you were in the 80th percentile?
- (b) Estimate the threshold for the top 10 percent?
- (c) What is the probability of having an IQ above 142?
- (d) What is the probability of having an IQ below 97?

### Question 4

A machine produces components whose thicknesses are normally distributed with a mean of 0.40 cm and a standard deviation of 0.02 cm. Components are rejected if they have a thickness outside the range 0.38 cm to 0.41 cm.

- (a) What is the probability that a component will have a thickness exceeding 0.41 cm?
- (b) What is the probability that a component will have a thickness between 0.38 cm and 0.41 cm?
- (c) What is the thickness below which 25% of the components will be?

### Question 5

A charity believes that when it puts out an appeal for charitable donations the donations it receives will normally distributed with a mean 50 and standard deviation 6, and it is assumed that donations will be independent of each other.

- (a) Find the probability that the first donation it receives will be greater than 40.
- (b) Find the probability that it will be between 55 and 60.
- (c) Find the value  $x$  such that 5% of donations are more than  $x$ .

### Question 6

The diameter of a screw produced in a factory has a normal distribution with mean 8mm and standard deviation 0.05mm. A screw is defective if its diameter is less than 7.92mm or more than 8.08mm.

- (a) Calculate the probability that a screw is defective.
- (b) Suppose it is possible to control the variance of the diameter without changing the mean diameter. What is the maximum variance possible such that only 1% of screws are defective?

### Question 7

Assume that the number of weekly study hours for students at a certain university is approximately normally distributed with a mean of 22 and a standard deviation of 6.

- (a) Find the probability that a randomly chosen student studies less than 12 hours.
- (b) Estimate the percentage of students that study more than 37 hours.

### Question 8

Suppose an oil exploration company purchases drill bits that have a life span that is approximately normally distributed, with a mean equal to 80 hours and a standard deviation equal to 10 hours.

- (a) What is the probability that a drill bit will fail before 60 hours of use?
- (b) What is the probability that a drill bit will last between 70 hours and 90 hours?
- (c) The life span of 95% of drill bits is below what value?

### Question 9

The breaking strength of a certain type of plastic block is normally distributed with a mean of 1500kg and standard deviation of 50kg.

- (a) What is the probability that a block will have a breaking strength greater than 1570kg?
- (b) What is the probability that a block will have a breaking strength measuring between 1482kg and 1518kg?
- (c) Determine the maximum load such that no more than 5% of the blocks break?

### Question 10

The amount of beer in a bottle has a normal distribution with mean 500ml and variance  $25\text{ml}^2$ .

- (a) Calculate the probability that the amount of beer in the bottle is between 498ml and 504ml.
- (b) What volume is exceeded by 20% of the bottles?

### Question 11

A model of an on-line computer system gives a mean times to retrieve a record from a direct access storage system device of 200 milliseconds, with a standard deviation of 58 milliseconds. If it can assumed that the retrieval times are normally distributed:

- (i) What proportion of retrieval times will be greater than 75 milliseconds?
- (ii) What proportion of retrieval times will be between 150 and 250 milliseconds?
- (iii) What is the retrieval time below which 10% of retrieval times will be?

### Question 12

Assume that the number of weekly study hours for students at a certain university is approximately normally distributed with a mean of 22 and a standard deviation of 6.

- i. Find the probability that a randomly chosen student studies less than 12 hours.
- ii. Estimate the percentage of students that study more than 37 hours.

### Question 13

A scientific publishing house produces assembly manuals for kit cars. The number of manuals sold every year is known to be normally distributed with a mean of 500 and a standard deviation of 50.

- (a) What is the probability that the number of manuals sold will exceed 600?
- (b) What is the probability that the number of manuals sold will be less than 300?
- (c) What is the probability that the number of manuals sold will be between 450 and 550?
- (d) What is the minimum number of manuals that the company must print such that that 90% of the demand is satisfied?

### Question 14

A tyre manufacturer claims that under normal driving conditions, the tread life of a certain tyre follows a normal distribution with mean 50,000 miles and standard deviation 5000 miles.

- (a) If your tyres wear out at 45,000 miles, would you consider this unusual? Support your answer with an appropriate probability calculation using the normal curve.
- (b) If the manufacturer sells 100,000 of these tyres and warrants them to last at least 40,000 miles, about how many tyres will wear out before the warranty expires?

**Question 15**

Suppose  $X$  is a normally distributed random variable with mean  $\mu = 500$  and  $\sigma = 24$

- (a) Compute the value of  $P(X \geq 518)$
- (b) Compute the value of  $P(X \leq 482)$
- (c) Compute the value of  $P(482 \leq X \leq 518)$