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SUPERVISOR'S USE ONLY

Level 3 Mathematics and Statistics (Statistics), 2013

91586 Apply probability distributions in solving problems

9.30 am Wednesday 20 November 2013
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply probability distributions in solving problems.	Apply probability distributions, using relational thinking, in solving problems.	Apply probability distributions, using extended abstract thinking, in solving problems.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Show ALL working.

Make sure that you have the Formulae and Tables Booklet L3–STATF.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

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You are advised to spend 60 minutes answering the questions in this booklet.

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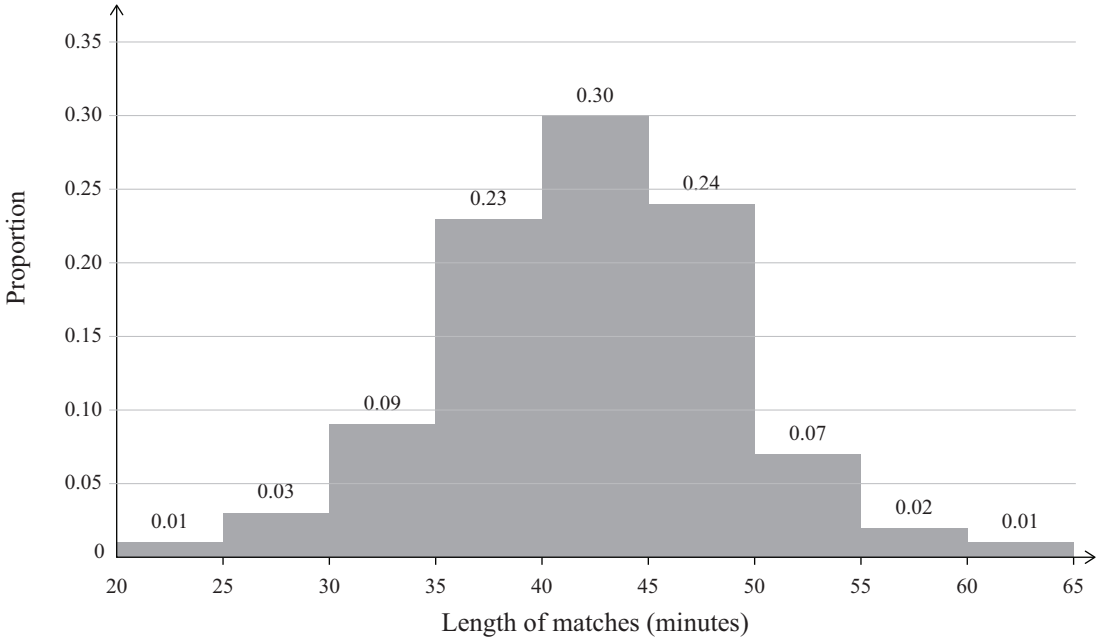
QUESTION ONE: SQUASH

(a) The lengths of squash matches for a particular high performance squash player can be modelled by the normal distribution, with a mean of 44.6 minutes and a standard deviation of 7.3 minutes.

Calculate the percentage of matches for this particular high performance squash player that could be expected to last less than 40 minutes or longer than 50 minutes.

(b) For another high performance player, data on the length of their matches was collected over a long period of time. The histogram below displays this information:



For this data, the mean length of matches is 42.2 minutes and the standard deviation is 6.8 minutes.

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Explain whether a normal distribution would be an appropriate model for the distribution of lengths of matches for the high performance player.

As part of your explanation, describe the features of the distribution and include at least one calculation.

(c) The number of calories a particular high performance player, B, burns during a training game can be modelled by a normal distribution, with mean 1 496 and standard deviation 7.81.

The number of calories another high performance player, C, burns during a training game can also be modelled by a normal distribution, with mean 1 496.

Player C is expected to burn more than 1 500 calories in 28% of training games.

Explain how the standard deviation of the distribution of calories burned by player C during a training game compares with the standard deviation of the distribution of the calories burned by player B during a training game.

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The examination continues on the following page.

QUESTION TWO: ICE HOCKEY

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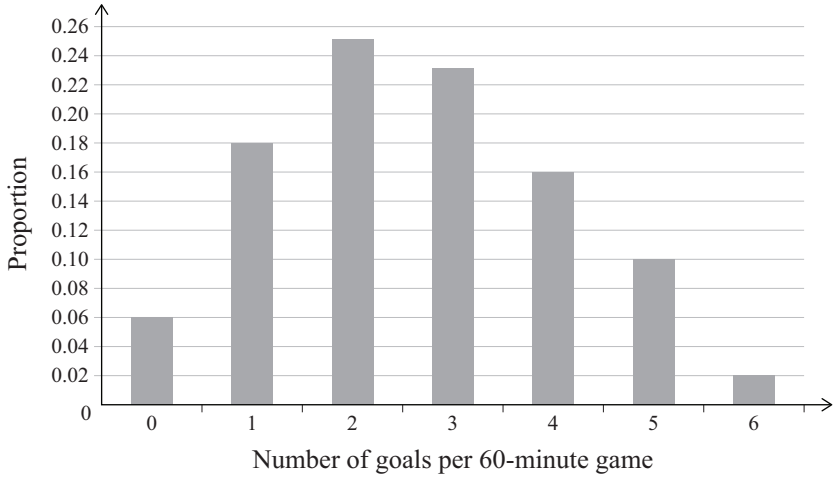
Ice hockey is a game where the puck (the round disk that is hit) is passed between the two teams very often, and the clock rarely stops during a 60-minute game. Goals are fairly rare, occur independently, and are approximately equally likely to happen during any minute of the game.

(a) The observations of the number of goals scored by a team during a 60-minute ice hockey game, over a large number of games, resulted in the following graph.



(i) Describe the key features of the distribution, and obtain an estimate for the mean number of goals scored per 60-minute game (rounded to one decimal place).

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(ii) After 30 minutes in an ice hockey game involving this team, the team had scored no goals.

Using your answer to part (i) and an appropriate probability distribution to model this situation, calculate the probability of the team scoring at least two goals by the end of the game.

In your answer, you should justify your choice of distribution, identify the parameter(s) of this distribution, and state any assumption(s) you make.

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(b) For another ice hockey team, the mean number of goals scored per 60-minute game is 0.8.

(i) Calculate the probability that during two different 60-minute games, the team scores fewer than three goals in each game.

State any assumption(s) you make.

(ii) Using an appropriate distribution, find the probability that the team will score at least three goals in at least two of the next five different 60-minute games.

In your answer, identify the distribution and its parameter(s), and state any assumption(s) you make.

QUESTION THREE: UNIFORMS AND EQUIPMENT

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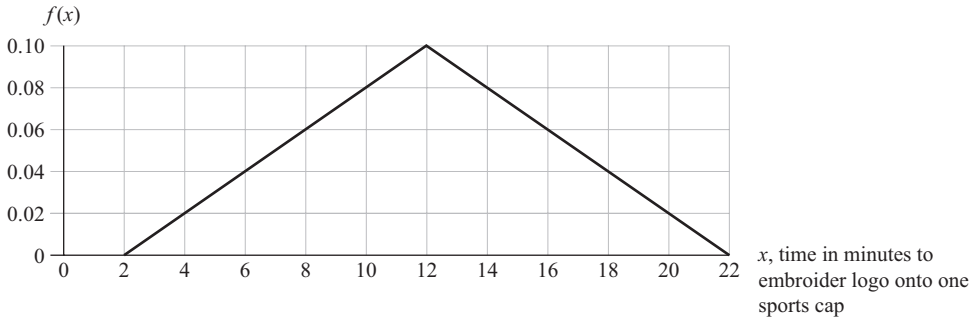
(a) A company that embroiders logos onto sports caps guarantees that this service will take no longer than 22 minutes for one cap.

The triangular distribution shown below models the time (in minutes) it takes the company to embroider a logo onto one sports cap.



(i) Calculate the probability that it will take the company more than 8 minutes to embroider a logo onto one sports cap.

(ii) After a year, the company collected data on the time that it took to embroider a logo onto one sports cap. The company found that it took less than 8 minutes to embroider a logo for 12% of the caps. The company also found that the minimum and maximum times to embroider a logo onto one sports cap were 2 and 22 minutes respectively.

Assuming a triangular distribution is still used to model the time it takes to embroider a logo onto one sports cap, find the mode for this distribution.

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(b) A manufacturer of sports uniforms makes shirts for sports teams. The manufacturer knows that the machine he currently uses to make the shirts will produce defective shirts 4% of the time.

The manufacturer has received an order for 20 shirts for a sports team.

Using an appropriate distribution to model this situation, calculate the probability there will be at least two defective shirts in the order.

In your answer, you should justify your choice of distribution, identify the parameter(s) of this distribution, and state any assumption(s) you make.

(c) The manufacturer of a brand of squash rackets has received a complaint about a particular racket it produced.

According to the complainant, the racket logo is more likely to be facing up than down after the racket is spun, suggesting that the racket is unbalanced.

The manufacturer states that it is equally likely for the logo to be facing up or down after the racket is spun.

The complainant has recorded data over 20 spins, which is shown in the table below:

	Racket logo	
	Facing up	Facing down
20 spins	13	7

Apply an appropriate probability distribution to investigate whether the complaint is justified.

You should support your answer with statistical reasoning and calculations.

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Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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