Achievement Standard 91267 (Mathematics and Statistics 2.12)

Apply probability methods in solving problems

Practice assessment

1. Chocco bars are produced by a machine in a factory. The weights of the bars are normally distributed with a mean of 46 grams and a standard deviation of 0.7 grams.

a. What is the probability that a Chocco bar weighs between 45 and 47.3 grams?

b. What percentage of Chocco bars weight more than 46.5 grams?

c. In one production run, 24 000 Chocco bars are produced. What is the expected number of Chocco bars in this production run that weigh less than 45 grams? Give your answer to 2 sig fig.

d. i. 5% of the Chocco bars weigh more than what weight (to 3 sig fig)?

ii. Between what weights will the middle 90% of Chocco bars lie?

e.   Jamie, the production control manager, wonders if the machine is working properly and producing Chocco bars whose weights are normally distributed. Jamie takes a random sample of 200 bars from the production line, weighs each bar and draws a graph of the results.

Weights of Chocco bars

Compare the distribution of the weights of Jamie's sample of Chocco bars with the expected distribution of the weights if the machine is working properly.

Use statistical terms to explain your answer.

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2. a. In a school, the Principal attends 75% of staff meetings and the Deputy Principal attends 86% of staff meetings. Their attendances are independent of each other.

Some of this information is shown on the probability tree below.

    i. Calculate the probability that both the Principal and the Deputy Principal will be present at a staff meeting.

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    ii. Calculate the probability that at least one of the Principal and the Deputy Principal will be present at a staff meeting.

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    iii. If the Deputy Principal is absent there is a 80% chance that he is doing other work in the school. Calculate the probability that the Principal is absent and the Deputy Principal is absent but not doing other work in the school.

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b. Customers at a gym take out annual membership. The gym keeps track of how often its customers attend. A customer is given a 'very poor attendance' rating if they visit the gym on average fewer than 3 times per month.

The gym calculates that 18% of its customers had 'very poor attendance' in the year of their membership.

The gym notices that $\frac{2}{3}$ of these 'very poor attendance' customers will not renew their membership the following year.
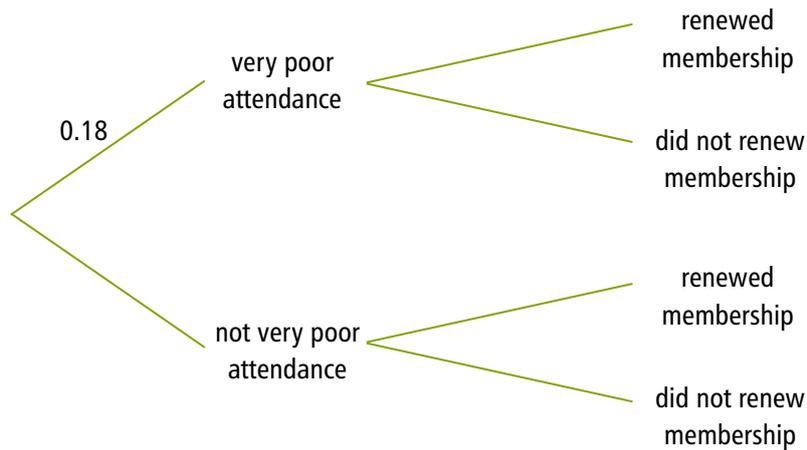
    i. What proportion of customers had very poor attendance and did not renew their membership?

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    ii. There were 4 580 customers at the gym at the beginning of a year. How many would be expected to have had very poor attendance but renewed their membership?

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    iii. The overall probability that a customer does not renew their membership at this gym is 0.325. Find the probability that a customer who did not have very poor attendance did not renew their membership.

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3. A shop sells two brands of vacuum cleaner, *VacMax* and *Turboclean*. Each vacuum cleaner has two different models: A and B. Each cleaner comes with a guarantee, giving free repair in case of faults within the first year. Sales figures for 2011 are shown in the table below.

2011 sales of vacuum cleaners			
	VacMax	**Turboclean**	**Totals**
Model A	135	153	288
Model B	109	281	390
	244	434	678

Some machines were faulty and needed to be returned for repair within the first year of ownership. The table below shows returns for vacuum cleaners purchased in 2011.

Returns of vacuum cleaners (purchased in 2011)			
	VacMax	**Turboclean**	**Totals**
Model A	9	14	23
Model B	9	13	22
	18	27	45

Use the above 2011 sales and returns data to answer the following questions.

a. What proportion of vacuum cleaners were returned for repair?

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b. What proportion of *Turboclean* Model B vacuum cleaners did not need repair?

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c. In 2012, 184 *Turboclean* Model A vacuum cleaners were sold. How many of these would be expected to be returned for repairs within a year? Explain your reasoning.

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d. What is the probability that a *VacMax* vacuum cleaner that was returned was Model A?

e. **i.** What is the risk that a *Turboclean* vacuum cleaner is returned?

  ii. What is the risk per 100 vacuum cleaners that a *VacMax* Model B machine is returned?

  iii. What is the risk that a *VacMax* vacuum cleaner is returned?

f. **i.** What is the relative risk of a *Turboclean* vacuum cleaner being returned, using the overall risk of a vacuum cleaner being returned as the base-line risk.

  ii. Explain in words what this means.

g. A shop assistant claims that, for the *VacMax* brand of vacuum cleaner, both models are equally reliable, as the same numbers were returned for repairs. Comment on this claim, justifying your answer.