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SUPERVISOR'S USE ONLY

91585

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NZQA

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Level 3 Mathematics and Statistics (Statistics), 2016

91585 Apply probability concepts in solving problems

2.00 p.m. Thursday 24 November 2016
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply probability concepts in solving problems.	Apply probability concepts, using relational thinking, in solving problems.	Apply probability concepts, 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 room for any answer, use the space 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.

Achievement

TOTAL 11

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QUESTION ONE

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(a) A product demonstrator for a confectionary company approaches shoppers and asks them if they would like to taste the product. Of the last 528 female shoppers approached, 288 tasted the product. Of the last 31 male shoppers approached, 14 tasted the product.

Suppose one of these shoppers approached by the product demonstrator is selected at random.

(i) What is the probability that they tasted the product?

	approached	tasted	total
Female	528	288	528
Male	31	14	31
Total	559	302	

$\frac{288}{528} = 0.5455$

$\frac{14}{31} = 0.4516$

$P = \frac{302}{559}$ $P = 0.5403$

(ii) How many times as likely is it that a female shopper tasted the product compared to a male shopper?

Support your answer with appropriate statistical statements.

The probability of a women tasting the food when approached is 0.5455 and the probability of men tasting food when approached is 0.4516, making women approximately 1.2 times more likely to try a product when approached, than men.

1.2

(iii) The product demonstrator claims that, in general, female shoppers are more likely to taste the product than male shoppers.

Discuss why the product demonstrator should be careful about using this data to make this claim.

This claim can not be made as a lot more females were approached than males, meaning that there was a higher probability of females tasting the product than men as 497 more females were approached than men

56.6% do ~~not~~ have Shopping day

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(b) At a particular supermarket, 43.4% of shoppers do not have a regular shopping day.

For shoppers who **do not** have a regular shopping day, 28.9% of these shoppers buy most of their groceries for the week on a weekend.

For shoppers who **do** have a regular shopping day, 41.2% of these shoppers buy most of their groceries for the week on a weekend.

$P(A) \times P(B) = P(A \cap B)$

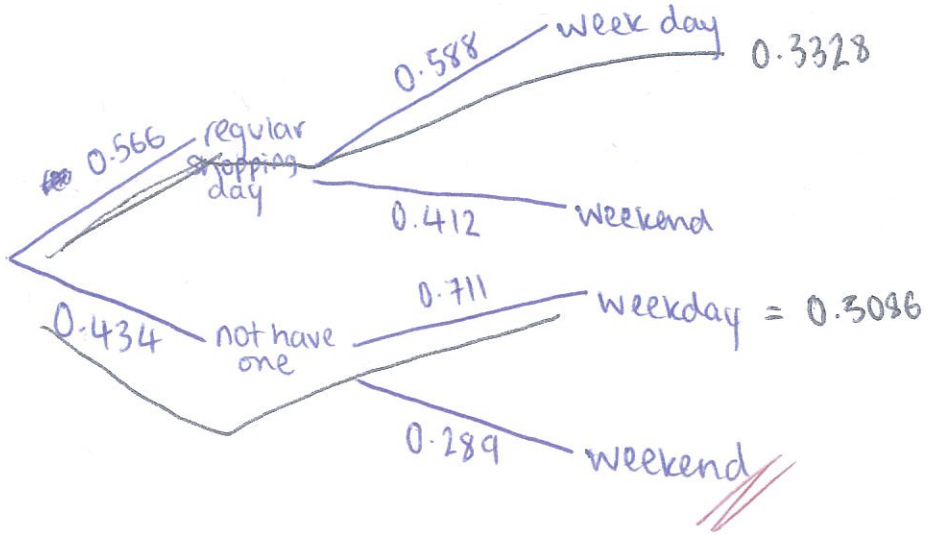
(i) Without performing any additional calculations, explain why the events "has a regular shopping day" and "buys most of their groceries for the week on a weekend" are not independent.

independent means that one event does ~~not~~ rely on the other for it to occur and people with a regular shopping day do not have to only shop on a weekend their shopping day can be any day of the week therefore it is not independent

(ii) Suppose one of the shoppers at this supermarket is chosen at random.

Calculate the probability that this shopper buys most of their groceries for the week on a weekday.

$P = 0.6414$



(iii) Suppose three shoppers at this supermarket are chosen at random.

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Calculate the probability that all three shoppers have a regular shopping day, and buy most of their groceries for the week on a weekend.

Support your answer with statistical statements and reasoning, including any assumption(s) made.

~~0.566 × 0.588 = 0.3328~~ $0.566 \times 0.412 = 0.2332$

$0.2332^3 = 0.0127$

Probability all three shoppers have regular shopping day and buy their groceries on the weekend is 0.0127.

Assumptions is that the three random shoppers were chosen on a weekend otherwise the probability of them all having a regular day on a weekend and be chosen on a ~~thursday~~ weekday makes the probability a lot smaller.

M6

	Male	female	
Stopped	29.6	70.4	
didn't			

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QUESTION TWO

A market research company employs five different "observers" to watch how shoppers at a supermarket interact with products displayed on a particular shelf of an aisle of a supermarket. Each observer records the gender of the shopper, the shopper's estimated age band (e.g. 20 – 29 years), and whether the shopper stops to look at the products on this shelf.

(a) In the most recent study of shoppers at this supermarket, the market research company found that 42.1% of the shoppers observed stopped to look at the products displayed on this shelf. The company also found that 70.4% of the shoppers observed were female.

(i) One of the observers has used this information to predict that 17.1% of shoppers will be male and will not stop to look at products displayed on this shelf.

Show how the observer made this prediction, including stating any assumption(s) that were made.

He made this assumption as the data shows females are 2.4 more times likely to stop

(ii) It is also known that 38.7% of shoppers in the most recent study were female and stopped to look at the products displayed on this shelf.

Use this information to predict how many shoppers out of every 300 shoppers at the supermarket will be male and will not stop to look at products displayed on this shelf.

	female	male	total
Stopped	116.1	10.2	126.3
didn't	95.1	78.6	173.7
total	211.2	88.8	300

116.1 were female and stopped

126.3 stopped

211.2 were female

Out of every 300 shoppers 78.6 males will not stop to look at the products displayed.

$$P = \frac{78.6}{300}$$

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(b) Every 10th shopper observed in the recent study took a survey. One of the questions in this survey asked the shopper to select their actual age band. The market research company compared each shopper's estimated age band with their actual age band, and, based on these comparisons, calculated that each observer has an 86% accuracy rate for estimating the shopper's age band.

(i) Give ONE reason why this "accuracy" rate is only an estimate for the true probability that an "observer" will record each shopper's actual age band correctly.

It is only an estimate as would not have done enough trials for it to be the true probability and the true Probability would take into account that some people just naturally look older or younger. And is not affected by human error.

(ii) One of the observers has recorded the correct age band for 30 of the 42 shoppers they observed.

Discuss how carrying out a simulation would help the market research company consider whether this observer has a lower than 86% accuracy rate.

You do not need to design the simulation.

As they would be able to see when he made mistakes with guessing ages.

(c) Each observer also records whether each shopper has young children with them, buys any products on this shelf, and how long the shopper spends at the supermarket.

Of the 435 shoppers observed in the most recent study:

- 60 shoppers had young children with them, bought products on this shelf, and spent more than 30 minutes at the supermarket
- 86 shoppers had young children with them, and bought products on this shelf
- 62 shoppers bought products on this shelf, and spent more than 30 minutes at the supermarket
- 129 shoppers bought products on this shelf

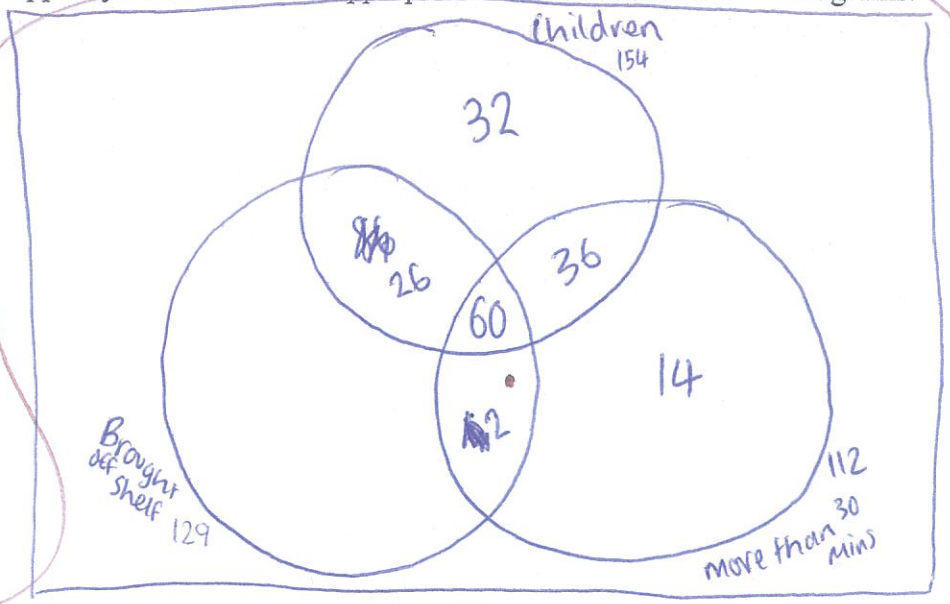
Child

- 32 shoppers had young children with them, but did not buy any products from this shelf, and did not spend more than 30 minutes at the supermarket
- 154 shoppers had young children with them
- 14 shoppers spent more than 30 minutes at the supermarket, but did not have young children with them, and did not buy products on this shelf.

A shopper from this study is selected at random.

Calculate the probability that the shopper did not have young children with them, did not buy any products on this shelf, and did not spend more than 30 minutes at the supermarket.

Support your answer with appropriate statistical statements or diagrams.



129 + 154 + 112 = 395

$\frac{395}{435} = 0.9080$

P = 0.9080

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A3

QUESTION THREE

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(a) A certain supermarket has self-service checkout machines. Customers scan each item and then place the item into a shopping bag, which is then weighed by the machine. The machine then uses this weight to check that the item scanned is the same item that was placed in the shopping bag.

doesn't match red light

If the weight of the product stored on the machine (obtained from the barcode scanned) does not match the weight of the item measured by the machine, the machine flashes a red light; otherwise the machine flashes a green light. The self-service checkout machine does not always flash the correct coloured light.

In cases where the item scanned actually is the same item placed in the shopping bag, the machine will incorrectly flash a red light 3% of the time. In cases where the item scanned is not the same as the item placed in the shopping bag, the machine will correctly flash a red light 98% of the time.

(i) Give ONE possible reason why the self-service checkout machine does not have a 100% accuracy rate when using item weights to check whether the correct item has been placed into the shopping bag.

as there can be variations in products and sometimes products can weigh more than their meant to, or if the coustomer had already eaten some then it would weigh less than its suppossed to.

(ii) At this supermarket, it is estimated that in 4% of the scans, the item scanned is not the same as the item placed in the shopping bag.

Suppose that an item is scanned and the machine flashes a red light.

Estimate the probability that the item scanned is not the same as the item placed in the shopping bag.

$P = 0.04$

N2

Achievement exemplar 2016

Subject:	Statistics	Standard:	91585	Total score:	11

Q	Grade score	Annotation
1	**M6**	The candidate correctly modelled a situation using contingency table and found the correct probability. The calculation of the relative risk was completed and interpreted with a minor error. Should have stated “it was 1.2 times as likely”, rather than “it was 1.2 times more likely”. Although the candidate realised that there were a lot more females than males in the sample, they didn’t comment on how this would cause greater sampling variability for the males. The calculation from a tree diagram constructed by the candidate was done accurately. The candidate failed to get an E7 or E8 in part b iii because they didn’t go on to explain about either the assumption of independent shopper habits or the assumption that the sample size was sufficiently large so as not to alter the probability.
2	**A3**	The contingency table was formed correctly and the required expected number was calculated. However, this result was not rounded to the nearest shopper (whole number). The candidate failed to find a reason why the accuracy rate gained from the sample may not be a good estimate for the true probability. Because the Venn Diagram was only partially completed, the required probability could not be found.
3	**N2**	They also recognised that any product will have a variety of weights, and it could fall outside the machine’s tolerance level. The candidate failed to interpret the requirements of the conditional probability part of the last question.