91586M

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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

3

SUPERVISOR'S USE ONLY

Te Pāngarau me te Tauanga (Tauanga), Kaupae 3, 2017

91586M Te whakahāngai i ngā tuari tūponotanga hei whakaoti rapanga

9.30 i te ata Rāhina 27 Whiringa-ā-rangi 2017
Whiwhinga: Whā

Paetae	Kaiaka	Kairangi
Te whakahāngai i ngā tuari tūponotanga hei whakaoti rapanga.	Te whakahāngai i ngā tuari tūponotanga mā te whakaaro whaipānga hei whakaoti rapanga.	Te whakahāngai i ngā tuari tūponotanga mā te whakaaro waitara hōhonu hei whakaoti rapanga.

Tirohia mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOA kei roto i tēnei pukapuka.

Tuhia ō mahinga KATOA.

Tirohia mēnā kei a koe te Pukapuka Tikanga Tātai me ngā Tūtohi L3–STATMF.

Mēnā ka hiahia whārangi atu anō mō ō tuhinga, whakamahia ngā whārangi wātea kei muri o tēnei pukapuka, ka āta tohu ai i ngā tau tūmahi

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–15 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

HOATU TE PUKAPUKA NEI KI TE KAIWHAKAHAERE HEI TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI

MĀ TE KAIMĀKA ANAKE

(a) Ka taea te rahinga wai mō te horoi hīrere te whakatauira mā tētahi taurangi matapōkere e whai uara ana i waenga i te 20 rita me te 200 rita. Me kī ko te rahinga wai ka tino whakamahia pea ina horoi hīrere ana he 50 rita.

(i) Mā te whakamahi i tētahi tauira tuari tūponotanga tōtika, tātaihia he whakatau tata mō te ōrau o ngā horoi hīrere he iti iho i te 50 rita te wai ka whakamahia.

(ii) Mā te whakamahi i tētahi tauira tuari tūponotanga tōtika, tātaihia he whakatau tata mō te ōrau o ngā horoi hīrere he nui ake i te 40 rita te wai ka whakamahia.

(b) Ka taea e ngā kaihautū waka ngā taupānga whakaterenga GPS waea pūkoro rerekē te whakamahi hei whiwhi whakatau tata mō te roa o te wā ki te tae ki tētahi wāhi. I whakahaerehia he rangahau hei tūhura he pēhea te tōtika o ngā whakatau tata wā haerenga mai i tētahi taupānga whakaterenga GPS ake. Mō ia haerenga i roto i te rangahau, i whakatauritea te wā haerenga whakatau tata ki te wā haerenga tika, ā, i tātaihia te rerekētanga pūrawa (tirohia te tūtohi i raro).

Haerenga	Wā haerenga whakatau tata	Wā haerenga tika	Te rerekētanga pūrawa i waenga i te wā haerenga whakatau tata me te wā haerenga tika
1	10.4 meneti	11.3 meneti	0.9 meneti
2	6.5 meneti	5.2 meneti	1.3 meneti
3	3.9 meneti	3.9 meneti	0 meneti
…	…	…	…

MĀ TE KAIMĀKA ANAKE

(i) Me kī, ko te 15% o ngā haerenga i tutuki i roto i te rangahau ka kīia "kāore i te tika" mā te whakamahi i te rerekētanga pūrawa.

Mēnā tekau ngā haerenga i tīpakohia matapōkerehia i te rangahau, mā te whakamahi i te tauira tōtika, tātaihia te tūponotanga e whā i te nui rawa o ngā haerenga i kīia "kāore i te tika".

(ii) Parahautia te whakamahi i te tuari tūponotanga mō tō tuhinga ki te wāhanga (i).

(iii) Ko te rerekētanga pūrawa tau toharite i waenga i te wā haerenga whakatau tata me te wā haerenga tika mō ngā haerenga i roto i tēnei rangahau he 3.5 meneti, me te ine mahora o te 2.8 meneti. I kitea anō e te rangahau e 87% o ngā haerenga he iti iho i te rima meneti ngā rerekētanga pūrawa.

Matapakitia ngā pūtake e RUA i kore ai e tika ki te whakamahi i tētahi tuari māori hei whakatauira i ngā rerekētanga pūrawa i waenga i te wā haerenga whakatau tata me te wā haerenga tika mō ngā haerenga.

1.

2.

QUESTION ONE

ASSESSOR'S USE ONLY

(a) The amount of water used when taking a shower can be modelled by a random variable that takes on values between 20 litres and 200 litres. The most likely amount of water used when taking a shower is 50 litres.

(i) Using an appropriate probability distribution model, calculate an estimate for the percentage of showers that use less than 50 litres of water.

(ii) Using an appropriate probability distribution model, calculate an estimate for the percentage of showers that use more than 40 litres of water.

(b) Car drivers can use various mobile phone GPS navigation apps to get an estimate of the time it will take to travel to a destination. A study was carried out to investigate how accurate the travel time estimates were from one particular GPS navigation app. For each trip in the study, the estimated travel time was compared to the actual travel time, and the absolute difference calculated (see the table below).

Trip	Estimated travel time	Actual travel time	Absolute difference between estimated travel time and actual travel time
1	10.4 minutes	11.3 minutes	0.9 minutes
2	6.5 minutes	5.2 minutes	1.3 minutes
3	3.9 minutes	3.9 minutes	0 minutes
…	…	…	…

ASSESSOR'S USE ONLY

(i) Suppose 15% of trips made during the study were classified as "not accurate" using the absolute difference.

If ten trips from the study were chosen at random, using an appropriate model, calculate the probability that at most four of the trips were classified as "not accurate".

(ii) Justify the use of the probability distribution for your answer in part (i).

(iii) The mean absolute difference between the estimated travel time and the actual travel time for trips in this study was 3.5 minutes, with a standard deviation of 2.8 minutes. The study also found that 87% of trips had absolute differences of less than five minutes.

Discuss TWO reasons why it would be inappropriate to use a normal distribution to model the absolute differences between the estimated travel time and the actual travel time for trips.

1.

2.

TŪMAHI TUARUA

MĀ TE KAIMĀKA ANAKE

(a) E whakaatu ana te tūtohi i raro nei i te tuari tūponotanga o te taurangi matapōkere, X.

x	0	1	2	3	4
$P(X = x)$	0.11	0.21	0.24	0.25	0.19

(i) $E(X) = 2.2$.

Tātaihia te $VAR(X)$.

(ii) Ko te taurangi matapōkere Y kua whai $VAR(Y) = 1.5376$.
$VAR(X + Y) = 5.5696$.

He wehe kē a X me Y?
Tautokona tō tuhinga ki ngā tauākī tauanga e tōtika ana.

(b) Ka taea te paemahana toharite o tētahi rūma noho i Aotearoa i tētahi pō takurua te whakatauira mā tētahi tuari māori, me te tau toharite o te 17.8°C me te ine mahora o te 2.1°C.

(i) Mā te whakamahi i tēnei tauira, i waenga i ēhea uara e rua ko tō tūmanako mō te 95% o waenganui o ngā paemahana toharite mō ngā rūma noho i Aotearoa i tētahi pō takurua?

(ii) Matapakitia kia KOTAHI te āhuatanga hei whakaaroaro ina whakatauirahia te paemahana toharite i tētahi rūma noho i Aotearoa i tētahi pō takurua?

MĀ TE KAIMĀKA ANAKE

(iii) Mē kī e rima ngā whare i tīpakohia matapōkerehia i Aotearoa, ā, i kitea i te whā o ēnei whare i raro te paemahana toharite o te rūma noho i tetahi pō takurua i te 16°C.

He iti pea te tūponotanga ka kitea e whā neke atu rānei ngā whare i roto i te rima he iti ake i te 16°C te paemahana toharite o te rūma noho, e ai ki te tauira tuari tūponotanga e whakaahuatia ana i runga?

Whakamahia he tātaitanga hei tautoko i tō whakautu.

QUESTION TWO

ASSESSOR'S USE ONLY

(a) The table below shows the probability distribution of the random variable X.

x	0	1	2	3	4
$P(X = x)$	0.11	0.21	0.24	0.25	0.19

(i) $E(X) = 2.2$.

Calculate $VAR(X)$.

(ii) The random variable Y has $VAR(Y) = 1.5376$.

$VAR(X + Y) = 5.5696$.

Are X and Y independent?

Support your answer with appropriate statistical statements.

(b) The average temperature in a New Zealand living room on a winter evening can be modelled by a normal distribution, with mean 17.8°C and standard deviation 2.1°C.

(i) Using this model, between what two values would you expect the middle 95% of average temperatures for New Zealand living rooms on a winter evening to be?

(ii) Discuss ONE factor that should be considered when modelling the average temperature in a New Zealand living room on a winter evening.

ASSESSOR'S USE ONLY

(iii) Suppose that five New Zealand houses were selected at random, and it was found that the average temperature of the living room on a winter evening was below 16°C for four of these houses.

Would finding four or more houses out of five with an average temperature of the living room below 16°C be unlikely under the probability distribution model described above?

Support your answer with a calculation.

TŪMAHI TUATORU

MĀ TE KAIMĀKA ANAKE

I kohia e tētahi rangahau ngā raraunga mō te whakamahi wai i roto i ngā kāinga i Aotearoa hei āwhina i ngā kaunihera, ngā tari kāwanatanga, me ngā kaiwhakarato wai ki te whakauru mai i ngā whakaritenga mō te whakamahi tōtika i te wai.

I mua i te rangahau, ko te whakatau tata he 4.7 ngā wā toharite e hīreretia ana te putunga para e ia tangata i Aotearoa i roto i tētahi wā 24 haora.

(a) (i) Mā te whakamahi i te tauira tuaritanga Poisson, tātaihia he whakatau tata mō te tūponotanga he iti iho i te 5 ngā wā e hīreretia ana e te tangata te putunga para i tētahi wā 24 haora.

(ii) Homai kia KOTAHI te pūtake he aha ai i kore e tika pea te whakamahi i tētahi tuaritanga Poisson hei whakatauira i te maha o ngā hīrere putunga para mō **tētahi wā 4 haora**.

(b) I kohia ngā raraunga mō te maha o ngā wā i hīreretia e ia tangata te putunga para i roto i tētahi wā 24 haora. Kua whakarāpopototia i raro i te tūtohi ngā raraunga mai i ngā tāngata 200 puta noa i ngā kāinga 84 i roto i te rangahau.

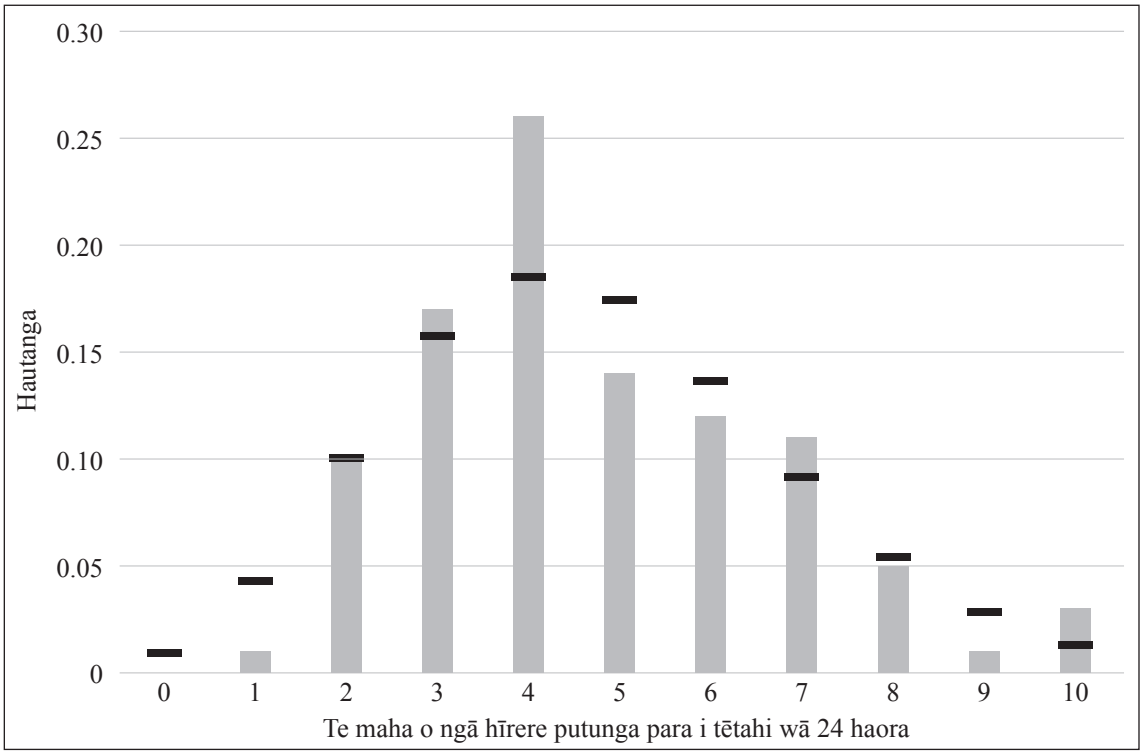
Te maha o ngā hīrere putunga para i tētahi wā 24 haora	0	1	2	3	4	5	6	7	8	9	10
Hautanga	0	0.01	0.1	0.17	0.26	0.14	0.12	0.11	0.05	0.01	0.03

(i) Tātaihia te tau toharite o ngā hīrere putunga para i oti i roto i tētahi wā 24 haora mō ngā tāngata i roto i tēnei rangahau.

MĀ TE KAIMĀKA ANAKE

(ii) He whā i te iti rawa te hīrere putunga para a te nuinga o ngā tāngata i roto i tēnei rangahau i tētahi wā 24 haora?
Whakamahia he tātaitanga hei tautoko i tō whakautu.

(iii) E whakaatu ana te kauwhata i raro i te tuaritanga whakamātautau (ngā pae kauruku) me tētahi tuaritanga Poisson o te $\lambda = 4.7$ (te tauira tuaritanga e whakaaturia ana ki te pango).



Matapakitia kia RUA ngā pūtake i kore ai pea te tuaritanga Poisson o te $\lambda = 4.7$ i te tauira pai mō te maha o ngā hīrere putunga para mō tētahi wā 24 haora.

1.

2.

QUESTION THREE

ASSESSOR'S USE ONLY

A study collected data on water use within New Zealand homes for the purpose of assisting councils, government agencies, and water suppliers to introduce water efficiency measures.

Prior to the study, it was estimated that each person in New Zealand flushes the toilet on average 4.7 times per 24-hour period.

(a) (i) Using a Poisson distribution model, calculate an estimate for the probability that a person flushes the toilet less than five times in any 24-hour period.

(ii) Give ONE reason why it may not be appropriate to use a Poisson distribution to model the number of toilet flushes for **any 4-hour period**.

(b) Data was collected on the number of times each person flushed the toilet during a 24-hour period. The data from 200 people from across 84 homes in the study is summarised in the table below.

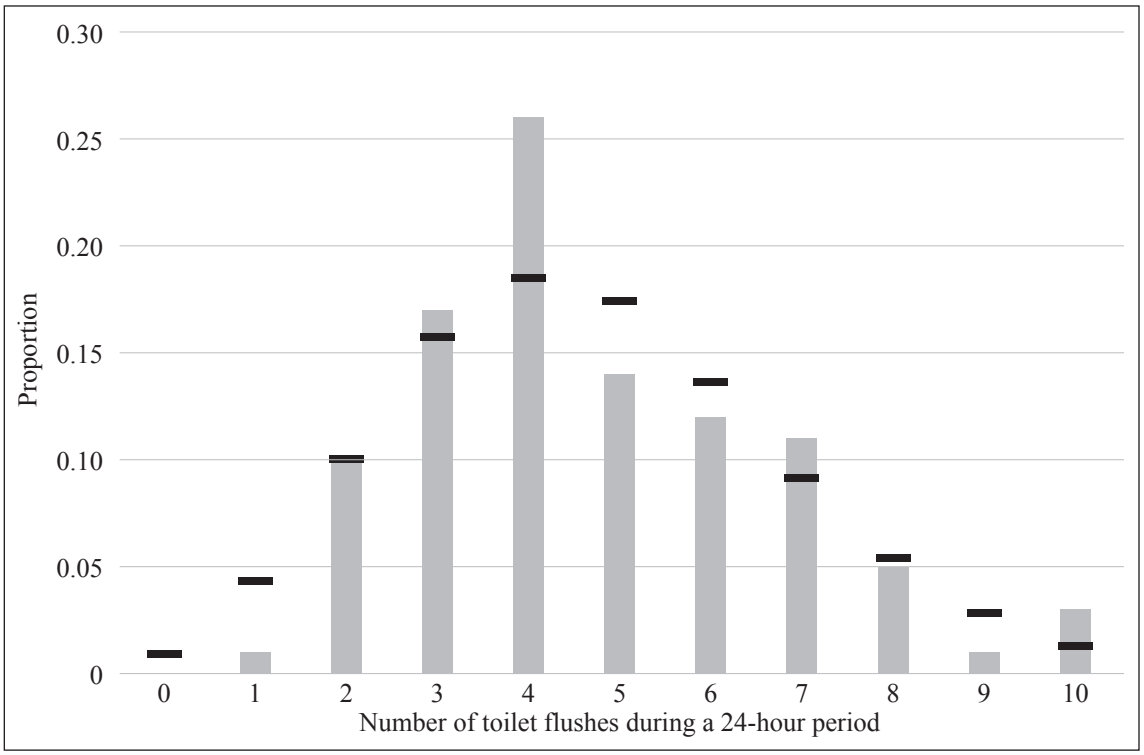
Number of toilet flushes during 24-hour period	0	1	2	3	4	5	6	7	8	9	10
Proportion	0	0.01	0.1	0.17	0.26	0.14	0.12	0.11	0.05	0.01	0.03

(i) Calculate the mean number of toilet flushes made per 24-hour period for people in this study.

ASSESSOR'S USE ONLY

(ii) Did most people in this study flush the toilet at least four times during a 24-hour period? Support your answer with a calculation.

(iii) The graph below shows the experimental distribution (shaded bars) and a Poisson distribution with $\lambda = 4.7$ (the model distribution shown in black).



Discuss TWO reasons why a Poisson distribution with $\lambda = 4.7$ may not be a good model for the number of toilet flushes for any 24-hour period.

1.

2.

He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.

TAU TŪMAHI

MĀ TE KAIMĀKA ANAKE

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

English translation of the wording on the front cover

Level 3 Mathematics and Statistics (Statistics), 2017

91586 Apply probability distributions in solving problems

9.30 a.m. Monday 27 November 2017
Credits: Four

91586M

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 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 2–15 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.