91586M

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NZQA

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

Tohua tēnei pouaka mēnā kāore he tuhituhi i roto i tēnei pukapuka

Te Pāngarau me te Tauanga (Tauanga), Kaupae 3, 2020

91586M Te whakahāngai i ngā tuari tūponotanga hei whakaoti rapanga

9.30 i te ata Rāapa 18 Whiringa-ā-rangi 2020
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 koe mō ō tuhinga, whakamahia ngā whārangi wātea kei muri o tēnei pukapuka, ka āta tohu ai i te tau tūmahi.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–23 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

ME HOATU RAWA KOE I TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

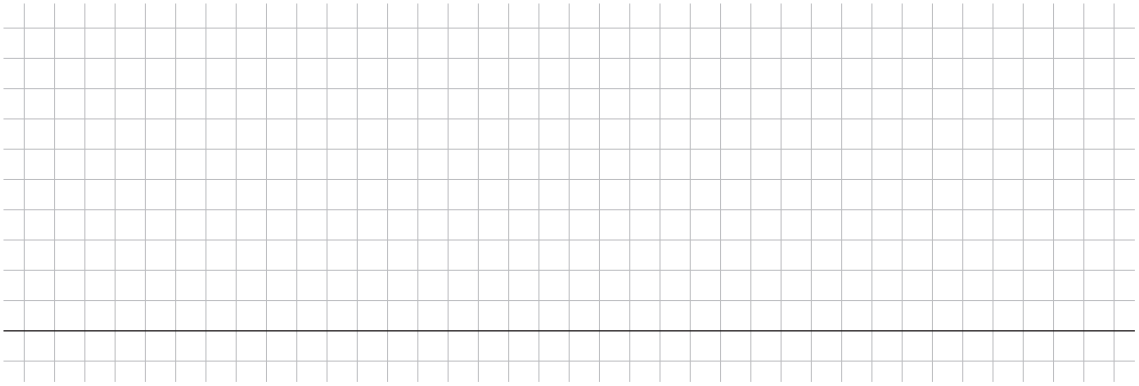
TŪMAHI TUATAHI

MĀ TE KAIMĀKA ANAKE

(a) Ko te whāinga o te hōhipera he tuku tina ki ngā tūroro mai i te 5 ki te 25 meneti i muri i te wehenga o te kai i te kīhini. E whai ana anō rātou ki te tuku i te kai ahiahi ki ngā tūroro mai i te 5 ki te 30 meneti i muri i te wehenga o te kai i te kīhini.

(i) Tātuhia ngā tauira tuari tūponotanga e rua mō te tina me te kai ahiahi ki tēnei tukutuku.

Me āta tautohu ko tēhea te tina ko tēhea te kai ahiahi.



Ki te hiahia koe ki te tuhi anō i ō tauira, whakamahia te tukutuku i te whārangi 20.

(ii) Ka makariri ngā kai mēnā kua neke atu i te 20 meneti te taenga atu i muri i te wehenga mai i te kīhini.

Mā te whakamahi i ngā tauira tuari tūponotanga tōtika, tātaihia he whakatau tata mō te tūponotanga he makariri te tina me te kai ahiahi a tētahi tūroro i te rā kotahi.

(iii) Whakaaroarohia tētahi whakapae pūtake i oti i a koe i tō tātaitai i tō tuhinga ki te wāhanga (a)(ii).

Matapakitia mēnā kei te tika pea (kāore rānei) tēnei whakapae pūtake.

(b) I Aotearoa, e tūtohu ana Te Manatū Hauora kia toru ngā tohanga huawhenua i te iti rawa i ia rā mō ngā pakeke katoa. Me kī ko te maha o ngā tohanga huawhenua ka kainga i ia rā e ngā pakeke o Aotearoa ka taea te whakatauira mā te tuari Poisson me te $\lambda = 3.2$.

(i) Whakamahia tēnei tauira Poisson hei tātai i tētahi whakatau tata mō te ōwehenga o ngā pakeke o Aotearoa e kai ana i te maha o ngā tohanga huawhenua i te iti rawa e tūtohua ana i ia rā.

(ii) He aha he uara mō λ, i raro i te tauira Poisson, kia taea ai e te 95% i te iti rawa o ngā pakeke o Aotearoa te kai tētahi tohanga huawhenua i te iti rawa i ia rā?

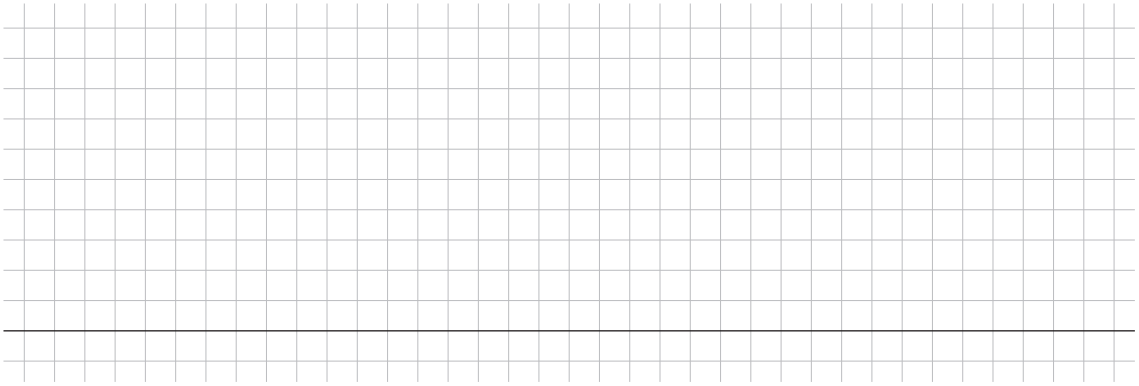
QUESTION ONE

ASSESSOR'S USE ONLY

(a) A hospital aims to deliver lunch (the midday meal) to patients anywhere between 5 and 25 minutes after the meal has left the kitchen. They also aim to deliver dinner (the evening meal) to patients anywhere between 5 and 30 minutes after the meal has left the kitchen.

(i) Sketch the two probability distribution models for lunch and dinner on this grid.

Clearly identify which is lunch and which is dinner.



If you need to redraw your models, use the grid on page 21.

(ii) Meals are cold if they arrive more than 20 minutes after leaving the kitchen.

Using appropriate probability distribution models, calculate an estimate for the probability that a patient has both a cold lunch and a cold dinner on the same day.

(iii) Consider an assumption you made when you calculated your answer to part (a)(ii).

Discuss whether (or not) this assumption is likely to be valid.

ASSESSOR'S USE ONLY

(b) In New Zealand, the Ministry of Health recommends that all adults eat at least three servings of vegetables each day. Suppose that the number of servings of vegetables eaten by New Zealand adults each day can be modelled by a Poisson distribution with $\lambda = 3.2$.

(i) Use this Poisson model to calculate an estimate for the proportion of New Zealand adults who eat at least the recommended number of vegetable servings each day.

(ii) What would the value of λ need to be so that, under a Poisson model, at least 95% of New Zealand adults ate at least one serving of vegetables each day?

(iii) Homai kia RUA ngā pūtake kāore pea e tika te whakamahi i te tuaritanga Poisson hei whakatauira i tēnei āhuatanga.

MĀ TE KAIMĀKA ANAKE

(iii) Give TWO reasons why the use of the Poisson distribution may not be appropriate to model this situation.

ASSESSOR'S USE ONLY

TŪMAHI TUARUA

MĀ TE KAIMĀKA ANAKE

(a) Ko te whakatau tata ka kainga te parakuihi i ia rā e ngā taiohi 49.9% o Aotearoa (ngā tāngata 15–18 tau).

(i) Me kī i tangohia he tīpako matapōkere o ngā taiohi e 8 o Aotearoa.

Mā te whakamahi i tētahi tauira tuari tūponotanga tōtika, tātaihia he whakatau tata mō te tūponotanga ka iti iho i te haurua o ēnei taiohi e 8 he kai parakuihi i ia rā.

(ii) E kī ana tētahi ākonga Tau 13, "tata ki te 50% o ngā taiohi ka parakuihi i ia rā, nō reira e 5 o ngā taiohi 10 ka tīpakohia ka kai parakuihi i ia rā."

Me kōrero mēnā kei te tika tēnei tākupu mō tēnei whakaaro.

(iii) Mō ngā tamariki o Aotearoa (2-14 tau), ko te whakatau tata mō te ōwehenga he kai parakuihi i ia rā he 85%.

I kite tētahi kaimahi hauora mō ngā rōpū taiohi 10, ko te rerekētanga mō te maha o ngā taiohi i kai parakuihi i ia rā he tino nui ake ki te rerekētanga i kitea e ia mō ngā rōpū tamariki 10.

Me tuku kōrero mēnā ka taea te parahau ngā kitenga a te kaimahi hauora mā te tauanga.

Tautokona tō tuhinga ki ngā tātai tauanga.

QUESTION TWO

ASSESSOR'S USE ONLY

(a) It has been estimated that breakfast is eaten daily by 49.9% of New Zealand youths (people aged 15–18 years).

(i) Suppose that a random sample of 8 New Zealand youths was taken.

Using an appropriate probability distribution model, calculate an estimate for the probability that less than half of these 8 youths ate breakfast daily.

(ii) A Year 13 student says, "approximately 50% of youths eat breakfast daily, so 5 of the next 10 youths sampled will eat breakfast daily."

Comment on whether this student is correct in this reasoning.

(iii) For New Zealand children (aged 2–14 years), the proportion who eat breakfast daily is estimated to be 85%.

A health worker observed that for groups of 10 youths, the variation in the number of youths who ate breakfast daily was much greater than the variation they observed for groups of 10 children.

Comment on whether the health worker's observation can be justified statistically.

Support your answer with statistical calculations.

MĀ TE KAIMĀKA ANAKE

(b) Me kī ka whakatauiratia te whakapeto pūngao a ngā taiohi tāne o Aotearoa he parakuihi i ia rā mā te tuari māori, me te tau toharite o te 11 200 kJ me te ine mahora o te 2230 kJ.

(i) Mēnā kei runga ake te whakapeto pūngao i te 12 800 kJ mō te parakuihi ko te mutunga atu i te nuinga o te wā he pukukai mō te roanga atu o te rā.

Whakatau tatatia te tūponotanga kei runga ake te whakapeto pūngao i te 12 800 kJ i te parakuihi mō tētahi taiohi tāne ka tīpakohia matapōkeretia. ā, he kai parakuihi i ia rā.

(ii) E mōhiotia ana tata ki te haurua o ngā taiohi tāne o Aotearoa he kai parakuihi i ia rā kei waenga tā rātou whakapeto pūngao i te 9500 me te 12 000 kJ.

Matapakitia mēnā e tōtika ana te tauira tuari māori e whakaaturia ana i runga ake mō te whakatauira i te whakapeto pūngao i te parakuihi mō ngā taiohi tāne o Aotearoa he kai parakuihi i ia rā.

Tautokona tō tuhinga ki ngā tātai tauanga.

ASSESSOR'S USE ONLY

(b) Suppose the energy intake at breakfast for New Zealand male youths who eat breakfast daily is modelled by a normal distribution, with a mean of 11 200 kJ and standard deviation of 2230 kJ.

(i) Energy intake at breakfast above 12 800 kJ often leads to overeating for the rest of the day.

Estimate the probability that a randomly chosen male youth who eats breakfast daily has an energy intake above 12 800 kJ at breakfast.

(ii) It is known that approximately half of New Zealand male youths who eat breakfast daily have an energy intake at breakfast of between 9500 and 12 000 kJ.

Discuss whether the normal distribution model presented above appears to be appropriate for modelling the energy intake at breakfast of New Zealand male youths who eat breakfast daily.

Support your answer with statistical calculations.

(iii) Ka kohia ngā raraunga mai i ngā ākonga i whakauru ki tētahi kura tāne. I tēnei kura, 15% o ngā taiohi he kai parakuihi i ia rā he nui ake i te 12 800 kJ te whakapeto pūngao i te parakuihi.

Tūtohutia ngā uara tōtika o ngā tawhā o tētahi tauira tuari māori ka taea te whakamahi hei whakatauira i te whakapeto pūngao i te parakuihi mō ngā taiohi tāne he kai parakuihi i ia rā i tēnei kura.

Whakamahia ngā tātai tauanga me te whakaaro whaitake hei tautoko i tō tuhinga.

MĀ TE KAIMĀKA ANAKE

(iii) Data is collected from students enrolled at a single-sex boys' school. At this school, 15% of youths who eat breakfast daily have an energy intake above 12 800 kJ at breakfast.

Suggest suitable values of the parameters of a normal distribution model that could be used for modelling energy intake at breakfast for male youths who eat breakfast daily at this particular school.

Support your answer with statistical calculations and reasoning.

ASSESSOR'S USE ONLY

TŪMAHI TUATORU

MĀ TE KAIMĀKA ANAKE

(a) Ko tētahi tino wharanga mō ngā kaitākaro, otirā me hāparapara i te nuinga o te wā, ko te tīhae o te nape o te turi (ACL). Ko te tikanga kei waenga i te 120 meneti me te 150 meneti te roa o te hāparapara ACL, ā, ko te roa i te nuinga o te wā he 130 meneti.

(i) Mā te whakamahi i tētahi tuari tūponotanga tōtika, tātaihia tētahi whakatau tata mō te tūponotanga he poto ake i te 130 meneti te roa o tētahi hāparapara ACL.

Whakaaturia ngā tātaitanga hei tautoko i tō tuhinga.

(ii) Ina ko te roa o tētahi hāparapara ACL he poto ake i te 140 meneti, tātaitia he whakatau tata mō te tūponotanga ka roa ake te hāparapara i te 130 meneti.

QUESTION THREE

ASSESSOR'S USE ONLY

(a) A common injury for sports players, which often requires surgery, is a ruptured anterior cruciate ligament (ACL). ACL surgery usually takes between 120 and 150 minutes, with the most common time being 130 minutes.

(i) Using an appropriate probability distribution, calculate an estimate for the probability that an ACL surgery takes less than 130 minutes.

Show working to support your answer.

(ii) Given that an ACL surgery takes less than 140 minutes, calculate an estimate for the probability that the surgery takes more than 130 minutes.

MĀ TE KAIMĀKA ANAKE

(b) Kei te whiriwhiri tētahi hōhipera ki te tiki i tētahi mīhini hihi-x hou. E whakaatu ana te papatau i raro i te tuari tūponotanga o te taurangi matapōkere N, arā, te maha o ngā tapitapi e hiahiatia ana mō tētahi mīhini hihi-x i roto i tētahi wāhanga wā toru tau.

n	0	1	2	3
$P(N = n)$	0.11	0.34	0.35	0.2

(i) Tātaitia te tau toharite me te ine mahora o te maha o ngā tapitapi i roto i te toru tau.

Tau toharite: _____

Ine mahora: _____

(ii) E whiriwhiri ana te hōhipera ki te rīhi i tētahi mīhini hihi-x mai i Kamupene A, i Kamupene B rānei.

Ka tukuna e Kamupene A tētahi utu motuhake kotahi o te $69 500, me te $350 tāpiri i ia marama.

Ka tukuna e Kamupene B tētahi utu motuhake kotahi o te $65 000, me te $10 000 tāpiri mō ia tapitapi.

Matapakitia ko tēhea te kamupene he nui ake te taurangitanga i roto i ngā utu rīhi tapeke i roto i te toru tau.

Ka haere tonu te Tūmahi Tuatoru i te whārangi 18.

ASSESSOR'S USE ONLY

(b) A hospital is considering sourcing a new x-ray machine. The table below shows the probability distribution of the random variable N, the number of repairs needed for an x-ray machine over any three-year period.

n	0	1	2	3
$P(N = n)$	0.11	0.34	0.35	0.2

(i) Calculate the mean and standard deviation of the number of repairs over the three-year period.

Mean:

Standard deviation:

(ii) The hospital is considering leasing an x-ray machine from Company A or Company B.
Company A charges a one-off fee of $69 500, plus an additional $350 per month.
Company B charges a one-off fee of $65 000, plus an additional $10 000 per repair.

Discuss which company has the higher variation in total lease costs over the three-year period.

Question Three continues on page 19.

(iii) Ka rīhitia e te hōhipera tētahi mīhini hihi-x mō te toru tau.

Ko tēhea te kamupene ka tūtohua e koe ki te hōhipera mō te rīhi i te mīhini hihi-x? Whakamahia te whakaaro whaitake o te tauanga hei tautoko i tō whakautu.

MĀ TE KAIMĀKA ANAKE

(iii) The hospital will lease an x-ray machine for three years.

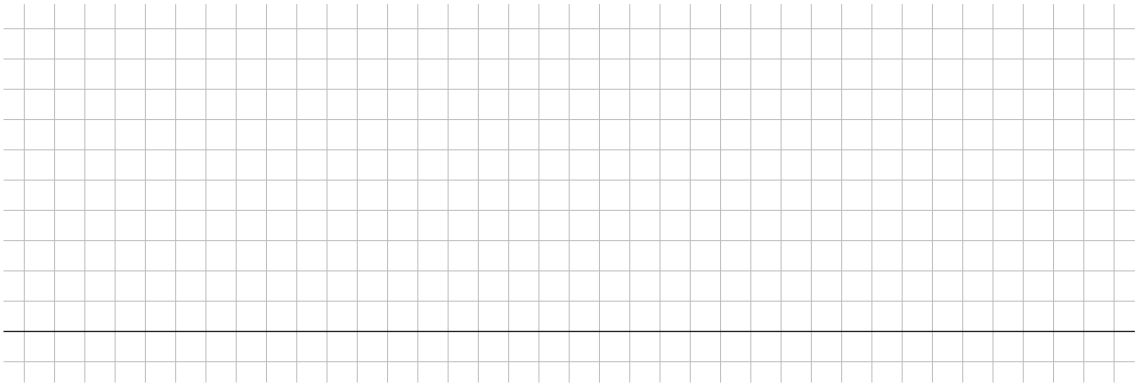
From which company would you recommend the hospital lease the x-ray machine? Support your answer with statistical reasoning.

ASSESSOR'S USE ONLY

HOAHOA WĀTEA

MĀ TE KAIMĀKA ANAKE

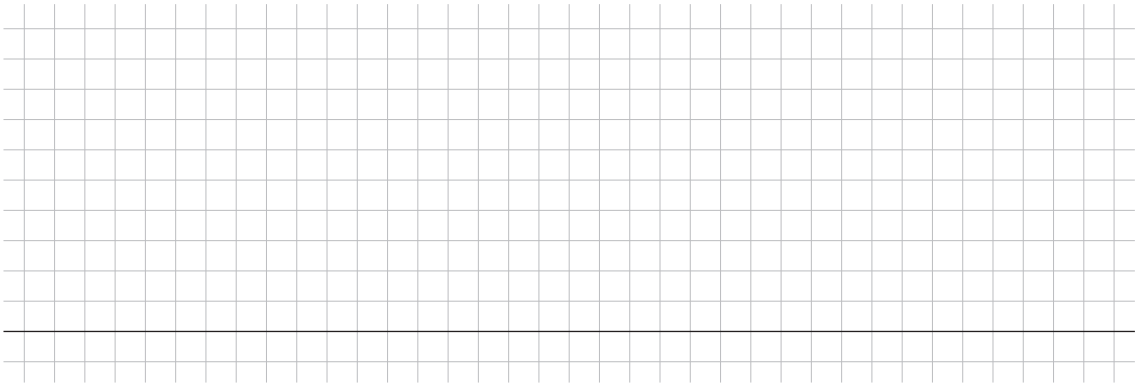
Ki te hiahia koe ki te tuhi anō i ō tauira tuari tūponotanga mai i te Tūmahi Tuatahi (a)(i), tuhia ki te tukutuku o raro. Kia mārama te tohu ko tēhea te tuhinga ka hiahia koe kia mākahia.



SPARE DIAGRAM

ASSESSOR'S USE ONLY

If you need to redraw your probability distribution models from Question One (a)(i), draw them on the grid below. Make sure it is clear which answer you want marked.



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) 2020

91586 Apply probability distributions in solving problems

9.30 a.m. Wednesday 18 November 2020
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–STATMF.

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 2–23 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.