



For Supervisor's use only

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90642



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA



National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TĀEA

Level 3 Statistics and Modelling, 2005

90642 Calculate confidence intervals for population parameters

Credits: Three

9.30 am Thursday 24 November 2005

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

Make sure you have a copy of the Formulae and Tables Booklet L3–STATF.

You should answer ALL the questions in this booklet.

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 2–8 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.

<i>For Assessor's use only</i>		Achievement Criteria	
Achievement	<input type="checkbox"/>	Achievement with Merit	<input type="checkbox"/>
		Achievement with Excellence	<input type="checkbox"/>
Calculate confidence intervals for population parameters.	<input type="checkbox"/>	Demonstrate an understanding of confidence intervals.	<input type="checkbox"/>
		Analyse estimates of population parameters.	<input type="checkbox"/>
Overall Level of Performance		<input type="checkbox"/>	

You are advised to spend 35 minutes answering the questions in this booklet.

Show **ALL** working.

A quality analyst is undertaking her 2005 survey of batteries that her company produces.

QUESTION ONE

A random sample of 40 'super' model batteries was tested by placing the batteries in torches and running them until the batteries were flat.

The sample mean for the lifetime of these batteries was 9.35 hours and the sample standard deviation was 0.65 hours.

Find a 95% confidence interval for the mean lifetime of all 'super' batteries when they are run in the same type of torch as the ones used in the test.

QUESTION TWO

A random sample of 60 'super' model batteries was tested by placing the batteries in a computer game device and running it until the batteries were flat.

The sample mean for the lifetime of these batteries was 3.72 hours and the sample standard deviation was 0.43 hours.

Find a 90% confidence interval for the mean lifetime of all 'super' batteries when they are run in the same type of computer game device as the one used in the test.

QUESTION THREE

- (a) The company produces two different models of batteries: 'power' and 'super'.

The quality analyst interviewed a random sample of 95 people who have used both 'power' and 'super' batteries, to find out which of the two models these people prefer to use in their torches.

Of the 95 people, 63 said that they prefer to use the 'power' model in their torches.

Find a 95% confidence interval for the proportion of all people who have used both 'power' and 'super' batteries and prefer to use the 'power' model of battery in their torches.

- (b) The quality analyst's manager asked her to explain to him the meaning of the confidence interval that was found in Question 3(a).

Write a clear description that gives the meaning of this confidence interval.

QUESTION FOUR

The quality analyst is asked if there is a significant difference between the lifetimes of 'power' batteries and 'super' batteries when they are used in torches.

In order to answer this question, she collects data from a random sample of each model. The results are shown in the following table:

	'Power'	'Super'
Sample size	40	40
Sample mean (lifetime in hours)	10.73	9.35
Sample standard deviation (hours)	1.09	0.65

Let μ_1 be the mean lifetime of all 'power' batteries and let μ_2 be the mean lifetime of all 'super' batteries.

- (a) Find a 99% confidence interval for $\mu_1 - \mu_2$.

- (b) Do the quality analyst's results suggest that there is a significant difference between μ_1 and μ_2 ?

Use statistical reasoning to justify your answer.

QUESTION FIVE

The quality analyst's supervisor tells her that when she is estimating $\mu_1 - \mu_2$ (the difference in the mean lifetimes for the two models of battery) in her 2006 survey:

- she can use standard deviations obtained in 2005 as estimates of population standard deviations (see the table of data in Question Four)
- that, rather than taking a random sample of 40 of each type of battery, she might be able to reduce the width of the confidence interval by taking a larger sample from one model of battery and a smaller sample from the other model
- that the total number of batteries sampled (both 'super' and 'power' combined) must still be 80
- that, for each model, the number of batteries sampled must be a multiple of 10.

Perform calculations to establish the number of each model of battery that the quality analyst should sample (when she calculates her 99% confidence interval for $\mu_1 - \mu_2$) in order to obtain a minimum width for the interval.

Justify your answer.
