**Specialist Unit 3&4 Test 6 2016**

**Calculator Section**

**Time limit = 40 minutes.**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Score: \_\_\_\_\_\_\_\_\_\_ / 40**

**Calculators allowed**

**Access to approved Sample Mathematics Specialist formulae sheet is permitted.**

**Answers should be in 4 decimal places.**

**Q1. [3,3,2]** [8 marks]

The standard deviation of the durability of Performance Racing tyres is 410 kilometres. Racing experts plan to estimate, the mean lifetime of these tyres, using the mean lifetime of a random sample of the tyres.

1. The experts would like to be 95% confident that the mean lifetime of tyres in the sample is within 50 kilometres of . How large a sample should they take?

1. Suppose that a random sample of 80 tyres is taken, and the mean lifetime of these tyres is 1245 kilometres. Based on this sample, determine a 90% confidence interval for .

1. The manufacturer claims that the mean lifetime of Performance Racing tyres is at least 1250 kilometres. Does the sample in part (b) provide a strong reason to doubt this claim? Justify your answer.

**Q2. [2, 3, 3, 4]** [12marks]

The thickness, x microns, of a protective coating applied to electrical components for use in wet conditions is known to follow a uniform distribution with minimum and maximum values of 350 and 600 microns respectively.

The mean thickness is 475 microns and the standard deviation of x is 72.2 microns.

1. Sketch the graph of the density function of x

f(x)

x

1. Determine the probability that the thickness of the protective coating of a component
2. is at least 425 microns.
3. is no more than 550 microns, given that it is at least 425 microns.
4. Determine the probability that in a box of 48 components, no more than six have a coating less than 425 microns.
5. A random sample of 144 components was selected and the mean thickness of these components was calculated to be 464 microns, less than the expected value of 475 microns.

Assuming the standard deviation of the coating thickness is still 72.7 microns, calculate a 95% confidence interval for the mean thickness of the coating for all components and explain whether this suggests that the mean thickness is not 475 microns.

**Q3. [2,2 ]**  [4 marks]

A machine is designed to produce ball bearings. The quality control officer sampled 400 items and calculated a mean radius of 16 mm and standard deviation of 0.2 mm.

1. Calculate the 99% confidence interval for the population mean of the radii of the ball bearings,
2. The company was asked to make ball bearings with radii accurate to within 0.05mm with a 95% confidence. What size sample must be taken to satisfy this request?

**Q4. [2,2,1]**  [5 marks]

A survey was conducted via the internet. It asked participants who logged onto a football website; “what fine should a football player receive for major indiscretion?” The statistics of the population resulted in a mean of $4212 and a standard deviation of $1004.

Using a sample of 1256 respondents, the website supervisor calculated the 95% confidence interval to be $4156.47 to $4267.53.

1. Is the confidence level correct? Explain.
2. Does this sample represent the view of the population? Explain.
3. Describe the effect on the length of confidence interval if the confidence level were to be increased to 99%

**Q5. [1,3,3]**  [7 marks]

If the numbers 1 to 100 form the population, them the mean and standard deviation of the population are 50.5 and 28.87 respectively.

1. Show clearly why the mean of the population is 50.5.
2. If all possible samples of size 9 were taken from this population, what does the Central Limit theorem tell us about the distribution of the means of these samples?
3. The diagram below shows 3 lists of 9 randomly generated counting numbers from 1 to 100 generated by the calculator

Edit Calc SetGraph

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|  |  |  |  |
| --- | --- | --- | --- |
|  | List 1 | List 2 | List 3 |
| 1 | 49 | 15 | 75 |
| 2 | 3 | 20 | 70 |
| 3 | 89 | 45 | 72 |
| 4 | 76 | 7 | 19 |
| 5 | 72 | 16 | 74 |
| 6 | 45 | 6 | 81 |
| 7 | 36 | 48 | 83 |
| 8 | 43 | 46 | 27 |
| 9 | 86 | 8 | 11 |
| 10 |  |  |  |
| 11 |  |  |  |
| Calc= randList (9,1,100) | | | |
| Deg Auto Decimal | | | |

Given that the 95% confidence interval for the population mean is 31.64 69.36

Indicate whether these lists above are representative samples, giving your reasons.

Q6. [2,2] [4 marks]

1. A company wishes to estimate the average age of its employees. From past information it was found the standard deviation was 3.5 years. A sample of 60 employees is selected and the mean is calculated as 32.5 years. Find the 95% confidence interval of the population mean.



1. How large a sample should the company use to be 95% sure that the sample is within 1 year of the sample mean of 32.5 years,