**ENGS203P: Mathematical modelling and analysis II**

**Questions**

Week 7: Data analysis and decision statistics

1. A traffic engineer collected 1296 samples of vehicle speeds. It is found that the mean speed is 58.86 kmph while the standard deviation is 5.5 kmph. Assuming that the speed follow normal distribution, construct the 95% confidence interval on speed.

**[Answer]:**

**The 95% C.I. can be determined as**



**The result indicates that there is a 95% chance that the *true* value of mean speed lies within** .

1. Based on a number of strength tests, it is found from the test results that the average strength of a material is 60 N/mm2, and the standard deviation of the measured strength is 10 N/mm2.

Assuming the strength follows normal distribution, determine the minimum number of tests we would have to perform such that we can construct a 95% confidence interval on the expected strength of the material with a width less than 6 N/mm2 (i.e. 10% of the average measured strength 60 N/mm2).

**[Answer]:**

The 95% confidence interval on the true strength  can then be determined as:

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**Hence, the width of the 95% confidence interval is:**

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**And it is required that:**

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**Hence, the minimum number of tests is 43.**

3. The table below summarises the test results obtained from a set of strength tests on the concrete produced by two laboratories. Formulate a two-sample t-test to determine whether the products produced by them are different at a significance level 5%.

|  |  |
| --- | --- |
| 28 day strength (MPa) | |
| Laboratory 1 | Laboratory 2 |
| 47.4 | 48.1 |
| 53.0 | 48.8 |
| 36.9 | 45.4 |
| 46.0 | 45.0 |
| 35.4 | 46.2 |
| 51.6 | 51.5 |
| 40.3 | 47.0 |
| 38.3 | 46.8 |
| 52.1 | 49.7 |
| 45.7 | 48.5 |
| 39.6 | 52.8 |
| 55.5 | 48.1 |

**[Answer]:**

**We set up a two-tail test of hypotheses where the hypotheses are formulated as:**

**Null hypothesis (Ho): the strengths of the concrete produced by the two labs are equal**

**Alt. hypothesis (Ha): the strengths of the concrete produced by the two labs are *not* equal**

**Mean of concrete produced by Lab 1:** 

**Mean of concrete produced by Lab 2:** 

**Standard dev. of concrete produced by Lab 1:** 

**Standard dev. of concrete produced by Lab 2:** 

**Sample sizes** 

**Calculate the two-sample *t* statistics as:**



**At 5% significance level, the critical value of *t* (with degree of freedom: 12-1 = 11) for rejecting the null hypothesis is** **.**

**Hence, the null hypothesis cannot be rejected.**