MATH2019 – Statistics for Civil and Environmental Engineering

Worksheet 5 – Confidence intervals and hypothesis tests

First answer each question by hand and then check your answers using MINITAB.

1. The breaking strength of Portland cement is tested for the same basic mix with the following results, units in Newtons per square millimetre:

   57.4 59.5 62.1 53.0 56.5 64.5 56.6 55.6 58.2 59.6 57.5 60.3

   Determine a 95% confidence interval for the mean μ of the distribution of breaking strength for this kind of concrete. What assumptions have you made?

2. Samples of cotton strips are cut from sheets and subjected to breaking-strength tests, in order to investigate the effect of a waterproofing treatment on strength. One sample of 8 strips was left untreated and the remaining 6 strips were treated.

   The results for breaking strength (kg wt) were as follows:

Untreated	169	115	138	167	138	150	131	142
Treated	135	149	116	126	137	161		

   Calculate a 95% confidence interval for the true difference in mean strength due to the treatment, and test the hypothesis that the treatment has zero effect. State any assumptions used.

3. To 'confirm' the result established in the experiment described in Question 2, a second experiment was conducted in which 6 strips were chosen at random and cut in halves, so that 6 pairs of test-pieces were available. For each pair, one half was left untreated and tested for breaking strength, and its other half was tested after waterproofing treatment. The results are shown below.

Test-piece	1	2	3	4	5	6
Untreated	159	133	144	148	127	166
Treated	151	137	122	130	120	158

   Carry out a paired t-test on the differences and calculate a 95% confidence interval for the true mean difference in strength due to the treatment. What conclusion can be made? What advantage does the second experiment have over the first?

4. For the following data on Temperature, x, in ^oF and the number of pounds of steam (per 10000), y, used by a chemical plant, obtain the least square estimates of the slope β and intercept α for the linear regression model $y = \alpha + \beta x + \epsilon$ using a calculator. Check your answers using Minitab.

Temperature (x)	21	24	32	47	50	59	68	74
Usage (y)	18.6	21.4	28.8	42.5	45.4	53.9	62.2	67.5

Temperature (x)	62	50	41	30
Usage (y)	56.2	45.3	37.0	27.4