

## Topic assessment

1. A factory manager is specifying a new storage tank for a particular chemical. In routine use, the tank will be filled to capacity each weekend. There should be enough chemical to last until the next weekend, as emergency deliveries are very expensive. On the other hand, money is wasted if an excessive amount of the chemical is stored.

The volume of chemical varies from week to week and is modelled by a Normally distributed random variable  $X$ . The manager is investigating the mean of  $X$ . Data are available for a random sample of 15 weeks, giving the volumes of the chemical used in each week. These are as follows (in litres).

1962	1928	1943	1939	1866	1964	1942	1996
1909	1940	1897	1924	1978	1944	1992	

The standard deviation of  $X$  is taken from long experience to be 28 litres.

A 2000-litre tank will be specified if the mean of  $X$  is no more than 1930 litres. Carry out a 5% significance test to examine whether a 2000-litre tank should be specified, stating clearly the null and alternative hypotheses and the conclusion. [8]

2. A craftsman makes hand-made souvenirs. The time taken to make a souvenir is a Normally distributed random variable with mean 34 minutes and standard deviation 2.6 minutes.

The craftsman undertakes a training course to improve his skill. Afterwards, a random sample of 8 times taken to make souvenirs is as follows (in minutes).

35.4	32.3	26.6	30.4	31.9	33.8	29.6	28.4
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Assuming that the underlying standard deviation has not changed, test at the 0.1% level whether the mean time taken to make a souvenir has decreased after the training course. [8]

3. Psychologists are developing a new index of overall intelligence for 11-year old children. It is assumed that the index is Normally distributed over the whole underlying population and that the standard deviation of this distribution is 12. If the index has been created correctly, its mean over the population should be 50.

The index is measured for a random sample of 100 11-year old children. It is found that the sample mean value is 47.8. Test the hypothesis that the true mean of the index is 50, against the alternative that it is not 50, at the 1% level of significance. [8]

4. A sports scientist wishes to test whether those who are good at sprinting are also good at long jump. For a sample of 30 athletes, she records the time,  $t$ , taken for them to run 100 m, and the distance,  $d$ , jumped at long jump. She calculates the correlation coefficient,  $r$ , for  $d$  against  $t$ , and finds that  $r = -0.35$ .
- (i) Write down the null and alternative hypotheses for her test. Explain why the alternative hypothesis takes the form that it does. [3]
- (ii) Carry out the hypothesis test at the 5% significance level. Explain whether or not there is evidence for correlation in the population. [3]

**Total 30 marks**