TUTORIAL SHEET 10

Confidence Intervals

1. A random sample of 25 ingots of nickel yielded a sample mean of $\bar{x} = 5.06$ pounds. The last five years' production records show that the standard deviation of the weight of nickel ingots is $\sigma = 0.06$ pounds. Find the 95% confidence interval for the mean weight of all such nickel ingots.

2. In a production process yielding lead sulphate as a by-product, the following amounts (in kg) were obtained by random sampling 10 days of production:

   22, 27, 26, 20, 29, 25, 31, 26, 23 and 26.

   Find a 90% confidence interval for mean daily production of lead sulphate. What assumption are you making here?

3. An article in the *Journal of Composite Materials* (December 1989, Vol. 23, p. 1200) describes the effect of delamination on the natural frequency of beams made from composite laminates. Five such delaminated beams were subjected to loads, and the resulting frequencies were as follows (in Hz):

   230.66, 233.05, 232.58, 229.48 and 232.58.

   Find a 99% confidence interval for the natural frequency of these beams.

4. Repeat questions 2 and 3 in Minitab to check your calculations. The relevant part of the menu is *Stat→Basic Statistics→(1-Sample Z...) or (1-Sample t...).* Just enter the column containing the data, the level of confidence required (default is 95%) and, for an interval using normal Z values, the value of σ.

5. The management of a lumber supply company would like to check a shipment of 1 million pine boards in order to determine the extent to which the boards are excessively warped. A sample of 50 boards resulted in the identification of 7 boards that were excessively warped. Find a 95% confidence interval for the proportion of boards warped in the entire shipment. What does this mean in terms of the **number** of boards warped in the entire shipment? Comment on this.

6. The machine breakdown data on page 11 of the lecture notes should be stored in the Minitab worksheet *br_time.mtw*. Use Minitab to construct a 99% confidence interval for the true mean time to breakdown. In the light of the shape of the histogram for this data, do you think this confidence interval is valid?

7. Retrieve the *camshaft.mtw* worksheet, which contains data on the lengths of camshafts from two suppliers. Construct 95% confidence intervals for the true mean lengths for each supplier separately and decide whether there really is a difference between the suppliers in terms of mean camshaft length.

8. Refer to question 5. How many pine boards should be included in a sample if it is required to estimate the proportion of excessively warped boards in the entire shipment to within ± 0.03 with 95% confidence? Treat the sample used in question 5 as a pilot study and use the corresponding sample proportion as a planning value.

   How large a sample would be needed if no such pilot study were available?

9. As part of a time and motion study, it is desired to estimate the mean time that a machine operator spends performing a particular task. How many times should the operator perform the task if the precision of the estimate is to be ± 2 minutes at a 95% level of confidence? How many observations would be required for a 99% level of confidence? Use a planning value of the standard deviation of 8 minutes.

10. Use the lifetimes of *Components B and E* contained in the *six_lifetimes.mtw* worksheet. The company manufacturing component B claims that it has a mean lifetime of 1000 hours, while the company manufacturing component E claims that their component has a mean lifetime of 350 hours. Use 95% confidence intervals to decide which, if either, of these two claims is reasonable.