Section #9

1. A distance measurement is repeated 9 times independently. The results (in m) are as follows:

   8.054 8.042 8.063 8.050 8.030 8.046 8.058 8.070 8.037

   The standard deviation of the instrument error is known to be 0.0010 m. Assuming that the population of X is approximately normal, determine the 90% confidence limits for this distance.

2. Given a normal random variable X with mean 20 and variance 3, and a random sample of size n taken from the distribution, what sample size n is necessary in order that $P(19.9 \le \overline{X} \le 20.1) = 0.95$?

3. Annual maximum lake levels X have been observed (in m) for the last 10 years as follows:

   714.4 714.8 715.6 715.2 712.4 717.7 713.4 713.9 716.6 716.0

   The annual maxima are assumed to be normally distributed.

   (a) Calculate the sample mean and the sample standard deviation.

   (b) Calculate the 95% confidence limits for the true mean.

   (c) Calculate the 95% confidence limits for the true standard deviation.

4. Two different formulations of lead-free gasoline are being tested to study their road octane numbers. The population variances of road octane number are 1.5 (formulation 1) and 1.2 (formulation 2). Two samples of size n_1=15 and n_2 = 20 were tested to reveal mean road octane numbers of $\bar{x}_1$ = 89.6 with S_1 = 1.8 and $\bar{x}_2$ = 92.5 with S_2 = 1.5. Construct a 99% confidence interval for the difference ($\mu_2 - \mu_1$) if the populations X_1 and X_2 are approximately normal.

   (a) $-2.9 \pm 2.330 \times 0.400$
   (b) $2.9 \pm 2.330 \times 0.268$
   (c) $-2.9 \pm 2.575 \times 0.268$
   (d) $2.9 \pm 2.575 \times 0.400$
   (e) none of the above

5. Application of coats of paint to cars manufactured by the Little Red Car Company is performed by a robot. The following sample has been collected on the coating thickness (in mm) applied:

   0.83 0.88 0.88 1.04 1.09 1.12 1.29 1.31 1.48 1.49 1.59 1.62 1.65 1.71 1.76 1.83

   Assuming that the measurements represent a random sample from a normal population, find the 95% confidence interval for the mean coating thicknesses.

6. A particular brand of diet margarine was analyzed to determine the level of polyunsaturated fatty acid (in percentages). Given that a sample of six packages selected from a normal population resulted in the following data, determine the 98% confidence interval on the population mean.

   16.8 17.2 17.4 16.9 16.5 17.1

   (a) $17.0 \pm 2.330 \times 0.130$
   (b) $17.0 \pm 3.365 \times 0.130$
   (c) $17.0 \pm 2.330 \times 0.047$
   (d) $17.0 \pm 3.365 \times 0.047$
   (e) none of the above

7. The derailment of a freight train due to the catastrophic failure of a traction motor armature bearing provided the impetus for research into this problem. A sample of 17 high-mileage traction motors was selected and the amount of cone penetration (mm/10) was determined both for the pinion bearing and for the commutator armature bearing, resulting in the following data.

Motor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Commutator	211	273	305	258	270	209	223	288	296	233	262	291	278	275	210	272	264
Pinion	226	278	259	244	273	236	290	287	315	242	288	242	278	208	281	274	268

   Calculate the 95% confidence interval on (μ_1 - μ_2) in which subscript 1 refers to the penetration for the commutator armature bearing and subscript 2 refers to the penetration for the pinion bearing. Note that the assumption of normality applies to both populations of cone penetration.

8. To test the claim that the resistance of electric wire can be reduced by alloying, 25 values obtained for standard wire yielded a mean of 0.136 ohm and a standard deviation of 0.004 ohm. Another sample of 16 wires obtained for alloyed wire produced a mean of 0.083 ohm and a standard deviation of 0.005 ohm. Find the 90% CI on the ratio $\sigma^2_{s\tan ndard} / \sigma^2_{alloyed}$. The two populations are normally distributed.

   (a) 0.303, 1.466
   (b) 0.682, 3.299
   (c) 0.279, 1.350
   (d) 0.741, 3.578
   (e) none of the above

9. The engineer responsible for the production of MP3 players is concerned that an extensive number of these units are defective. A sample of 500 units contained 5 defectives. What is the 95% confidence interval for the true proportion of defectives produced?