1. A confidence interval (CI) is desired for the true average stray-load loss $\mu$ (watts) for a certain type of induction motor when the line current is held 10 amps for a speed of 1500 rpm. Assume that stray-load loss is normally distributed with $\sigma = 3.0$. [5+5+5+5 points]
   a. Compute a 95% CI for $\mu$ when $n = 25$ and $\bar{x} = 58.3$.  
   b. Compute a 95% CI for $\mu$ when $n = 100$ and $\bar{x} = 58.3$.  
   c. Compute a 99% CI for $\mu$ when $n = 100$ and $\bar{x} = 58.3$.  
   d. Compute a 90% CI for $\mu$ when $n = 100$ and $\bar{x} = 58.3$.  
   a. How large must $n$ be if the width of the 99% interval for $\mu$ is to be 1.0. 

2. The article “Evaluating Tunnel kiln Performance” (Amer. Ceramic Soc. Bull., Aug. 1997: 59-63) gave the following summary information for fracture strengths (Mpa) of $n=169$ ceramic bars fired in a particular kiln: $\bar{x}=89.10$, $s=3.73$. [10+10 points]
   a. Calculate a (two-sided) confidence interval for true average fracture strength using a confidence level of 95%.  
   b. Suppose the investigators had believed a priori that the population standard deviation was about 4 Mpa. Based on this supposition, how large a sample would have been required to estimate $\mu$ to within 0.5 Mpa with 95% confidence?

3. The Associated Press (October 9, 2002) reported that in a survey of 4722 American youngsters aged 6 to 19, 15% were seriously overweight. Calculate and interpret a confidence interval using a 99% confidence level for the proportion of all American youngsters who are seriously overweight. [10 points]

4. A sample of 14 joint specimens of a particular type gave a sample mean proportional limit stress of 8.48 Mpa and a sample standard deviation of 0.79 Mpa. Calculate and interpret a 95% confidence interval for the true average proportional limit stress of all such joints. [10 points]

5. The amount of lateral expansion (mils) was determined for a sample of $n=9$ pulsed-power gas metal arc welds used in LNG ship containment tanks. The resulting sample standard deviation was $s=2.81$ mils. Assuming normality, derive a 95% CI for $\sigma^2$ and for $\sigma$. [10 points]

6. A melting point of each of 16 samples of a certain brand of hydrogenated vegetable oil was determined, resulting in $\bar{x}=94.32$. Assume that the distribution of melting point is normal with $\sigma=1.20$. [5+5+5 points]
   a. Test $H_0 : \mu = 95$ versus $H_a : \mu \neq 95$. Use $\alpha = 0.01$  
   b. If a level 0.01 test is used, what is $\beta(94)$, the probability of a type II error when $\mu = 94$.  
   c. What value of $n$ necessary to ensure that $\beta(94)=0.1$ when $\alpha = 0.01$. 

7. The amount of shaft wear (0.0001 in.) after a fixed mileage was determined for each of $n = 8$ internal combustion engines having copper lead as a bearing material, resulting in $\bar{x}=3.72$ and $s=1.25$. Assuming the distribution of shaft wear is normal with mean $\mu$, use the $t$ test at level 0.05 to test $H_0 : \mu = 3.50$ versus $H_a : \mu > 3.50$. [10 points]