Problem 1. Consider a system for manufacturing spherical nanoparticles.

1. The following diameter measurements were obtained for 5 nanoparticles:
   \( x = \{0.12 \ 0.09 \ 0.11 \ 0.10 \ 0.08\} \). Compute the mean and variance from these samples. Compute the 90% confidence intervals on the mean and variance.

2. Test the hypothesis that the mean \( \mu = \mu_0 = 0.10 \) versus the alternative that \( \mu < \mu_0 \) at a significance level \( \alpha = 0.05 \). Determine the smallest value \( \mu_0 > 0.10 \) such that the hypothesis would be rejected.

Problem 2. Consider the following scaled data collected for the film thickness of a set of solar cells:

\[ x = \{2.0 \ 2.2 \ 1.7 \ 2.3 \ 2.5 \ 1.9 \ 2.1 \ 1.8 \ 2.2 \ 2.4 \ 2.0\} \]

1. Calculate the sample mean \( \bar{x} \) and the 99% confidence interval on the mean \( \mu \). Calculate the sample variance \( s^2 \) and the 90% confidence interval on the variance \( \sigma^2 \). Show your calculations.

2. Consider the hypothesis that the mean \( \mu_0 = 2.15 \) versus the alternative that the mean \( \mu_1 < \mu_0 \). Perform a hypothesis test to accept or reject the hypothesis.

3. Consider the problem of increasing the sample number \( n \) such that \( \text{CONF}_{0.90}\{\sigma^2 \leq 0.1\} \). Assume that the sample variance \( s^2 \) calculated in part 1 remains unchanged as \( n \) increases. What is the minimum number of samples are required?