4. (15%) A certain manufacturing process has been operating in control at a mean μ of 65.00 mm with upper and lower control limits on the $\bar{\bar{X}}$ chart of 65.225 and 64.775, respectively. The process standard deviation is known to be 0.15 mm, and specifications on the dimension are 65.00 ± 0.50 mm.
   (a) What is the probability of not detecting a shift in the mean to 64.75 mm on the first subgroup sampled after the shift occurs? The subgroup size is four.
   (b) What proportion of nonconforming product results from the shift described in part (a)? Assume a normal distribution of this dimension.
   (c) Calculate the process capability indexes C_p and C_{pk} for this process, and comment on their meaning relative to parts (a) and (b).

5. (20%) The specifications of the thickness of a low-alloy steel gear blank are 0.3000 ± 0.0015 centimeter.
   (a) If it is desired that the value of C_{pk} be at least 1.25, what would be the minimum σ_x of a centered process?
   (b) If the specifications change to 0.3000 ± 0.0010 centimeter, what would be the minimum σ_x for a centered process?
   (c) If it is desired for the process to have a C_p value of at least 1.25, what is the minimum σ_x if $\bar{\bar{X}} = 0.301$ centimeter? What if $\bar{\bar{X}} = 0.298$ centimeter?
   (d) What does this say about using C_p as a measure of capability?

6. (15%) A stipulated acceptance procedure calls for examining 25 articles from a lot of 1,000 articles. If none of the 25 articles is classified nonconforming, the lot is accepted; otherwise, it is rejected. Assume that a lot containing 10% nonconforming articles is submitted for acceptance.
   (a) Using hypergeometric probabilities, compute the probability of acceptance.
   (b) Using the binomial distribution as an approximation to the method that is correct in principle, compute the approximate probability of acceptance.
   (c) Using the Poisson distribution as an approximation to the binomial, compute the approximate probability of acceptance.