ME-573 Homework 4

(Note: Do all problems for full credit (20 points each))

Problem 1:

A random sample was taken of the lengths of positioning rods produced by a manufacturing firm with the inspection results being $\bar{\ell}_{obs}, s_{\ell_{obs}}$ (1575,0.005) in. The inspection process has been calibrated such that it is known to have an error of $\bar{e}, s_e$ (0.005, 0.0005) in. After correcting the length distribution for measurement error, determine the percentage of rejects if the acceptable range of lengths is 1.5622 to 1.5838 in. (assume a standard normal distribution and 100% confidence).

Problem 2:

A firm is manufacturing ball bearings for a precision tool maker who specifies that the individual balls are to be graded such that those he receives are 5.00 mm ± 0.05 mm diameters. The initial sample of several hundred balls shows $\bar{D}, s_D$ (5.00,0.0312) mm. **a)** What percentage of balls will be rejected? After several more samples of 100 balls have been taken, the results are $\bar{D}, s_D$ (5.02,0.05) mm. Now what percentage of balls will be rejected? (note that the second case is an unsymmetrical area)

Problem 3:

For a shaft to fit freely into the machine of the precision tool maker it has been specified that the maximum acceptable shaft diameter is 20.05 mm (no lower limit is specified). The 20 shafts produced by a certain, quasi-stationary process have been reviewed and the results are $\bar{d}, s_d$ (19.98,0.035) mm. With 95% confidence, what percentage of the shafts are acceptable?

Problem 4:

The variation of one of the critical dimensions in a part is studied by taking a random sample of 50 from the 10,000 parts produced per day with $\bar{X}, s_x$ (23.63,0.867) mm. **a)** How many parts would have dimensions between 22.76 and 24.50 mm at the end of one week's production (5 days)? **b)** If dimensions outside the range of 21.89 to 25.37 are not acceptable, how many parts would be rejected in one week's production? **c)** If the nominal dimension is to be 23.50 mm, what ± tolerance should be specified with 99% confidence to give a rejection of 100 per day? (Assume a sample of set of 50 is sufficient to describe the total production of the day.)

Problem 5:

A location constraint is illustrated for an offset crankshaft/connecting/rod piston arrangement as shown. The model for this system is a+((b+c) cos θ_{max})) and a-((b-c) cos θ_{min})). Using the dimensions shown determine **a)** the maximum dimension between the upper face of the piston and the crankshaft center line (95% confidence, and 99.99% probability). and **b)** the minimum distance with the same confidence and probability. At maximum and minimum extension θ_{max} =35° and θ_{min} =215° CW, respectively from the vertical as shown.