ECOR 2606 - Assignment #2

1. You are building a picnic table with legs in an X configuration. The beams are b-in wide, the legs are w-in apart and are h-in high. You need to calculate the cutoff angle θ in order to saw off the legs at the correct angle. You can show that:

$$w \sin\theta = h \cos\theta + b \qquad \text{....(1)}$$

   a) Write a Matlab function thetaone.m that, given w, h and b, calculates θ.

   b) There is an analytical solution to this problem:

$$\sin\theta = (2\,wb + \text{sqrt}(\,(2wb)^2 - 4(w^2+h^2)(b^2 - h^2)))/(2(w^2+h^2)) \qquad \text{....(2)}$$

   Write a Matlab function thetatwo.m that, given w, b and h, calculates theta in degrees using this equation.

   c) Demonstrate that thetaone.m and thetatwo.m give the same values of θ for b=10 in, h = 32-in and w varying between 36-in to 48-in. Use fzero to determine what value of w produces an angle of 60 degrees. Include all your commands in the script file q1.m.

   d) Not to be handed in for assessment, **but extremely useful to do for practice for the midterm and final examinations.** Using equation (1), use the Bisection and Newton's methods to find θ when b = 8-in, h=36-in and w =24-in. Choose two suitable boundaries, or starting point, as the method requires, and do three full iterations. Estimate the error after your last iteration.