Spline homework problem

Assume you are recently hired by TAOCO’s distillation division. This division uses distillation to produce high ethanol concentration beverages made from TAOCO’s whiskey product, which contains 30 mol% water. The whiskey feedstock has an ethanol concentration of 30 mol % water. It is to be distilled at 180 mm Hg to produce Knockout™, a higher ethanol composition product (see diagram below).

Assume the set of data below are measurements of vapor-liquid equilibrium values for binary mixtures of water and ethanol at the fixed distillation temperature. P is the total pressure (mm Hg), L is the liquid water mole fraction equilibrium composition data, and V is the vapor water mole fraction equilibrium composition data.







Distillation process

(separation)

Whiskey vapor

30 mol% water ? mol% water

20 moles ? moles

Knockout™ (liquid)

? mol% water

? moles

1. **(6 points)** Create cubic spline numerical models for the vapor-liquid equilibrium curves for this binary system and **provide an appropriate plot of P vs. water molar composition.**
2. **(6 points)** Using your models and a root finding method of your choice**, calculate the molar water composition of the azeotrope** that exists for this binary system.
3. **(3 points)** Using your models, **calculate the amount (moles) and compositions (water mole fraction)** of the equilibrium liquid (Knockout™ product) obtained at a pressure of 180 mm Hg resulting from separating 20 moles of whiskey.

Notes:

You may use pre-programmed computational programs to do this work. Please just specify what software/program you used.