MTH-326 MATH MODELING SPRING 2025
Homework 4 Due Friday 02/28/2025

1. Reconsider the color TV problem of Example 2.1, but now use numerical methods instead of the analytic methods we employed in Chapter 2.

(a) Determine the production levels x and y that maximize the objective function $y = P(x, y)$. Use the two-variable version of Newton's method.

(b) As in Section 2.1, let a denote the price elasticity for 19-inch sets. In part (a) we assumed $a = 0.01$. Now assume that a increases by 10% to $a = 0.011$ and repeat the optimization problem in part (a). Use your results to obtain a numerical estimate of the sensitivities $S(x; a)$, $S(y, a)$, and $S(P, a)$. Compare to the results obtained analytically in Section 2.1.

(c) Let b denote the price elasticity for 21–inch sets. Currently, $b = 0.01$. As in part (b), use numerical methods to estimate the sensitivities of x, y, and P to the parameter b.

2. A manufacturer of lawn furniture makes two types of lawn chairs, one with a wood frame and one with a tubular aluminum frame. The wood-frame model costs \$18 per unit to manufacture, and the aluminum-frame model costs \$10 per unit. The company operates in a market where the number of units that can be sold depends on the price. It is estimated that in order to sell x units per day of the wood-frame model and y units per day of the aluminum-frame model, the selling price cannot exceed $10 + 31x^{-0.5} + 1.3y^{-0.2}$ \$/unit for wood-frame chairs, and $5 + 15y^{-0.4} + 0.8x^{-0.08}$ \$/unit for aluminum-frame chairs.

(a) Find the optimal production levels.

(b) Plot the surface plot of the profit function.

(c) Plot the contour plot of the profit function.