Lesson 14. Production Process Models, Revisited

Problem 1. Yobro Co. produces three types of high-end organic, bio-diverse, fair-trade, non-harmful-to-animals household cleaners: standard, pine, and lemon. Each gallon of raw soap produces a_s gallons of standard, a_p gallons of pine, and a_ℓ gallons of lemon. Each gallon of standard can be converted directly into b_{sp} gallons of pine at a cost of c_{sp} per gallon. Separately, each gallon of standard can also be converted into $b_{s\ell}$ gallons of lemon at a cost of $c_{s\ell}$ per gallon. Raw soap costs c_r per gallon. Standard, pine, and lemon sell for p_s, p_p, and p_ℓ per gallon, respectively. Suppose that Yobro wants to satisfy a demand for d_s gallons of standard, d_p of pine, and d_ℓ gallons of lemon.

a. Write a linear program that determines the number of gallons of each type of cleaner Yobro should make in order to maximize profit. Make sure to
   - define the input parameters,
   - define the decision variables, and
   - briefly explain the objective function and constraints that you write.

b. YoBro just tweeted that they have created a new process to convert standard to pine and lemon simultaneously. With this process, each gallon of standard converts to f_{sp} gallons of pine and $f_{s\ell}$ gallons of lemon at a cost of $c_{sp\ell}$ per gallon. How do you append the linear program you just wrote to also account for this new process?