Math 484 2020-2021 Fa Byrne Exam 2

Turn In Mathematica Notebook Named Like This: FamilyName GivenName.nb

A company manufactures two products, A and B. The company forecasts demand to avoid producing more than they can sell. The manufacture of each product requires raw material and machining. The table summarizes the per unit consumption of the raw material and machining for each product, along with the profit and weekly demand. Assume no negative production and profit includes all costs except any extra raw material and/or machining time purchased.

Product	Machining (hr)	Raw Material (lbs)	Profit ($)	Weekly Demand (units)
A	1	5	60	900
B	2	4	90	700
Available per week without extra purchase	1000	3200		

1. Write an LP to determine how many of each product the company should make to maximize profit. Use Mathematica comments to document your LP near the top of your file (your pivot function should be at the top.)
2. Using Mathematica, graph the feasible set. Use Mathematica's drawing tools to add any constraint that cannot be plotted as a function. Mark the feasible set in your graph using drawing tools.
3. Solve your (primal) LP from (1) by pivoting in Mathematica according to the simplex algorithm using Bland's Rule with the "natural ordering" (i.e. control variables 1,…,n then slack variables 1,…,k) … Mark the argmax in your plot and document the optimal production plan and corresponding profit in a text box in the plot or in a Mathematica comment below the plot.
4. If no more machining time is available, but more raw materials can be bought at $4/lb., should the company buy more? If so, how much more? Make a new plot to show the new feasible set and new optimum. Make a new tableau, using the new value of b2, and including the price of any resources bought or sold as a constant in the objective. Pivot to the new solution by the simplex algorithm, and document the solution as in (3).
5. Copy your plot from (4) and paste 8 copies (each in its own cell or 2 side by side per cell) so you have working copies to explore 8 changes to constraints. Use these plots and your optimal tableaux from (4) to answer the questions that follow, and document your answers in a Mathematica comment below each plot or pair of plots. Starting at the solution to (4), ignoring the price of resources, what is the change of z*
   i. per unit increase in machining? (holding all other variables constant)
   ii. per unit decrease in machining? (holding all other variables constant)
   iii. per unit increase in raw materials? (holding all other variables constant)
   iv. per unit decrease in raw materials? (holding all other variables constant)
   v. per unit increase in demand for product A? (holding all other variables constant)
   vi. per unit decrease in demand for product A? (holding all other variables constant)
   vii. per unit increase in demand for product B? (holding all other variables constant)
   viii. per unit decrease in demand for product B? (holding all other variables constant)
6. Starting at the solution to (4), if more machining time can be purchased for $28/hr and more raw material can be purchased for $4/lb., should either or both be purchased and, if so, how much of each should be purchased if the company has $34,800/week to invest (on top of any resource purchase or sale made in (4)? Formulate and solve a new LP in Mathematica with additional variables for resources purchased, and document the full solution of the new LP, including any resource purchases, production plans and max net profit in a new plot and mark the argmax graphically (Plot is still in x1-x2 space; resource purchases x3*, x4* corresponding to optimal production (x1*,x2*) documented in text but not "plotted" because our plot is still 2-dimensional. This is what we have been doing in class and HW.
7. EX CR: If extra funds were available for weekly investment in machine time and material, assuming demand is fixed, would it be worth paying 10% total interest and if so how much should you borrow maximize profit?