AGEC 641 Midterm

Answer 4 of the first 5 questions take number 6 home and 1 of the other 5 of your choice.

1. Given that you know a Basis for the primal

$$\begin{aligned} \text{MAX} \quad & cX + 0S \\ \text{s.t.} \quad & AX + IS = b \\ & X, S, \geq 0 \end{aligned}$$

   a) Derive the criteria you would use to determine if it would be attractive to bring in any of the non basic variables into the solution
   b) Derive an expression that tells how the objective function will change with a small change in the right hand side

2. If you wish to restrict the sum of two shadow prices, say $u_1 + u_2$, to be no more than \$10 and no less than \$5 what types of variables would you add to the primal?

3. Explain the following briefly:

   a) the relation between primal degeneracy and dual variables

   b) the way one could develop product supply curves from an LP and why one might do that as opposed to generating an econometrically based curve

   c) the homogeneity of units criterion one uses to assure rows and columns are properly modeled

   d) why one would develop a model in summation notation rather than only in a numerically specific tableau

   e) the difference in assumptions underlying equilibrium, and disequilibrium dynamic models

4) Set up an LP of the following

$$\begin{aligned} \text{Max} \quad & 4X^{1/2} - (3 + 2Y)Y \\ \text{s.t.} \quad & 0.3X - 10Y \leq 0 \\ & X + Y \leq 30 \\ & X, \quad Y \geq 0 \end{aligned}$$

and tell whether this model relaxes any of the LP assumptions

5. Suppose you have a problem where you

   a) Can buy a single homogeneous good at any of N supply locations during any of M time periods during a year

   b) Must have a given quantity of goods available at each of D demand locations during each time period T

   c) Face a maximum supply at a prenegotiated price at each supply location but can obtain an unlimited amount at twice that price

   d) Have limited storage facilities at each demand point to carry over goods from month to month at a price with a spoilage rate

   Now

   a) Set up a small tableau for a case with 2 supply points, 3 time periods during a typical year and 2 demand points

   b) Tell how you are handling between year linkages

   c) Set up a general summation notation model

   e) Interpret the dual implications of the storage possibilities

6. The Peck family is studying whether to make an offer on some property. Currently, the Peck's own two farms and a feedlot in Illinois. The option they are considering is the purchase of some land in Montana. The land in Montana would be used to raise cattle which would be in part fed to slaughter age in Montana and in part shipped to Illinois for feeding. Technical data follows:

Farm Data		Farm 1	Farm 2
Plowing	Cost/hour	15	12
	Acres/hour	3	2.5
	Labor /hour plowing	1	1
Planting Corn	Cost/hour	13	12
	Acres/hour	5	6
	Labor/hr of planting	1	1
Planting Soybeans	Cost/hour	15	12
	Acre/hour	6	8
	Labor/hr of planting	1	1

Harvesting Corn			
	Cost/hour	45	45
	Acre/hour	3	3
	Labor/hour	1.5	1.5
Harvesting Soybeans	Cost/hour	45	45
	Acres/hour	5	5.5
	Labor/hour	1.5	1.5

Corn yields in bushels on Farm 1 are:

		Planting Date	
		May	June
Harvest Date	October	120	110
	November	140	130

Corn yields on Farm 2 are 90% of those on Farm 1.

Soybean yields in bushels (bu) on Farm 1 are:

		Planting Date	
		May	June
Harvest Date	September	40	38
	October	45	42

Soybean yields on Farm 2 are 110% of those on Farm 1. Plowing is done in December, March, April or May. Farm labor is shared between the farms and there are 60 hours in each month. Farm 1 has 300 acres, Farm 2 has 200 acres.

Feed Lot Data	Characteristics of Alternative Feeding Systems per Calf Fed			
Method Number	1	2	3	4
Final Animal Weight/lbs.	900	870	900	920
Bushels of Corn	40	45	30	42
Bushels of Soybeans	10	5	20	6
Other Costs	20	25	15	30

Market Data:

Purchase cost of calves	$125/head
Market price of corn (same to both farms)	$3.00/bu
Market price of soybeans (same to both farms)	$6.75/bu
Cost of purchasing feed	120% of market price
Price of fed beef applicable to final animal weight	$50/100 lbs

Transport Costs:

Farm 1 to Feedlot	
Corn	$0.05/bu
Soybeans	$0.12/bu
Farm 2 to Feedlot	
Corn	$0.10/bu
Soybeans	$0.05/bu

Assume purchased feed and crops sold to market have a zero transport cost.

Montana Proposal

Land required/cow unit(cow and calf)	5 acres
Number of calves raised in year per cow unit	0.7 calves/cow
Amortized Cost to buy and maintain a cow unit	$55/year
Land utilized per calf raised to sale	5 acres
Cost/calf to ship to Illinois	$10/calf
Weight of calves if raised to slaughter in Montana	800 lbs.
Cost/calf raised to maturity in Montana	$250
Annual cost of acquiring land in Montana	$5/acre
Sale price of calves raised to slaughter in Montana	$.50/lb.
Maximum slaughter market potential in Montana	500 head calves

a. Formulate a model for optimum firm size including both farms, the feedlot, and the Montana option.
b. Discuss how you would use this model to determine whether to invest in Montana land.
c. What types of formulations are implicit in this solution relative to those in the chapters we studied (resource allocation, etc.)?