AGEC 641 Final Exam
Spring 1999

1. (15 points) Model the machinery selection part of the following situation in general:

   A farmer wishes to buy a planter and a harvester. He must buy one of each. The planter comes in either a 4 or 6 or 12 row configuration. The harvester comes in 4, or 6 row configurations. In buying these units he knows that the harvester can be used only with a planter that is an even multiple in terms of rows that the planter is. Thus the 4 row harvester can be used with the 4 or 12 row planter and the 6 row harvester with the 6 or 12 row planter.

2. (20 pts) Given the problem:

$$\begin{aligned} \max \quad & -\sum_j c_j X_j + \sum_k p_k Z_k \\ s.t. \quad & \sum_j y_{kj} X_j + Z_k \leq 0 \quad \text{for all k} \\ & \sum_j a_{ij} X_j \leq b_i \quad \text{for all i} \\ & X_j, \quad Z_k \leq 0 \quad \text{for all j and k} \end{aligned}$$

   a. What is the nature of the demand curve for the items Z_k and the supply curves for b_i
   b. Modify the model so it includes linear downward sloping demand curves for each product k, as well as upward sloping supply curves for inputs i
   c. Tell where in the solution of the model in b one would find prices for the products and inputs

3. (15 pts) Discuss how you would find the marginal change in the objective function for a change in the right-hand side under multiple objective, quadratic and integer programming. Also tell how these differ from the shadow prices you would get from the solver (if they do).

4. (10 pts) Address the truth of the following:
   Linear programs can never represent situations where items are uncertain or a process exhibits non constant returns to scale.

5. (20 pts) Suppose you had the following problem.

$$\begin{array}{lrcrcl} \text{Max} & -3x_1 & + & ax_2 & & \\ & -x_1 & + & x_2 & \leq & 0 \\ & & & bx_2 & \leq & c \\ & x_1 & , & x_2 & \leq & 0 \end{array}$$

Where you are certain of the coefficients of x_1 but do not know a, b, and c with certainty.
Suppose we establish this model under the condition that today we must choose the amount of x_1 to undertake; later we receive information on the parameters of a, b, and c where the following possible outcomes can exist.

Outcome	Probability	a	b	c
1	.25	5	1.0	30
2	.30	2	1.2	35
3	.45	4	1.1	30

and then you can choose the x_2 level.

Formulate this model including risk aversion.

6. (10 pts) Suppose you were working with an individual who stated that they were interested in profits, risk avoidance and guaranteeing they had sufficient food to eat in a setting up farm plan with a programming model. How could you simultaneously incorporate these interests into your model.

7. (10 pts) Given the EV model

$$\begin{array}{lll} \text{Max} & cX - qX'VX & \\ \text{s.t} & AX & \leq b \\ & X & \leq 0 \end{array}$$

Develop the optimality conditions for the model and discuss how altering θ from zero to nonzero value affects the solution conditions.
Tell how you would get a value of θ