Chapter VII Homework, 2009

1. Charles Chicken manufactures chicken products. He has an integrated operation which raises, processes and packages chicken for distribution. His operation is broken into 3 parts. Under chicken raising he has the following situation:

Inputs per chicken	Intensive	Extensive	Not incubated
Price of young chick	$0.20	$0.20	$0.25
Housing	4 sq. ft.	2 sq. ft.	3 sq. ft.
Feed	4 lbs. @ $0.05/lb.	4.1 lbs. @ $0.05/lb.	4.2 lbs. @ $0.05 lb.
Farm Labor	1/2 hour	1/3 hour	1/4 hour
Cost of misc. services	$0.10	$0.15	$0.17
Incubator space	0.1 sq. ft.	0.1 sq. ft.	0 sq. ft.
% of chickens which die or are unacceptable	10%	13%	15%
Body weight at maturity	3.0 lbs.	2.95 lbs.	3.1 lbs.

Of the limiting resources he has ...

Housing	55,000 sq. ft.
Labor	5,000 hours
Incubator	3,000 sq. ft.

Furthermore, he may buy additional chickens with a body weight of 2.9 lbs. for $0.75 of which 3% are rejected as unacceptable. Suppose you can not buy any more than 1000.

In his cutting operation the following cut outs are true regardless of body weight:

	% of Total Body Weight by Category
Neck	3%
Legs	15%
Thighs	20%
Breast	30%
Back	15%
Giblet	10%
Waste	7%

Cutting a chicken takes 2 minutes labor time. He has 25 men who work 8 hours each. Further, he may hire up to 10 more men for 8 hours/day for $35.00 each or may get his existing people to work overtime at $4.50/hr, up to 300 hours.

In his packaging operation he formulates and sells several products.

Packed Breasts	in 3 lb packages @ $1.00/lb.
Packed Thighs	in 3 lb packages @ $0.95/lb.
Packed Legs	in 3 lb packages @ $0.90/lb.
Whole cut up chickens	in 3 lb in same proportions as chickens are cut up excepting waste @ $0.75/lb.
Chicken salad	3 lb of chicken meat (which comes from the procedure below) which takes 4 minutes of labor per pack (Giblets cannot go in) @ $1.40/lb
Giblets	1 lb packages @ $0.70/lb.
Backs	in 3 lb packages @ $0.20/lb.
Necks	in 3 lb packages @ $0.15/lb.
Boned Chicken Meat	in 3 lb packages @ $1.05/lb.

For chicken salad or boned chicken he bones out chicken meat as follows:

Necks	yield 10% meat
Legs	yield 60% meat
Backs	yield 20% meat
Thighs	yield 70% meat
Breasts	yield 85% meat

Waste must be disposed of @ .01/lb.

a) Formulate a profit maximizing LP

b) Setup and interpret the dual equation for the major different types of variables.

c) Design a set of reports for management. Indicate how you would combine activities into the reports.

d) Draw a flow diagram of the formulation.

2. Suppose you are in charge of the Contgill grain and you have the problem of managing company storage. Further, you know today:

a) Grain can be sold for $2.00/bu. and you think the price will go up by 5¢ per bushel per month the next 8 months, then down by 10¢ for the subsequent four months.

b) It costs you 2¢/month/bu. to keep the grain.

c) Eight months from now your chairman has said 10% of the grain you have on hand must be committed to PL 480, for which you are not reimbursed. You must commit at least 50,000 bushels.

d) You have 10,000,000 bushels of grain on hand.

e) 0.1% of the grain spoils each month.

Set up a profit maximizing LP.

3. 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
Land Plowing			
	Acres/hour	3	2.5
	Labor /hour plowing	1	1
Planting Corn			
	Acres/hour	5	6
	Labor/hr of planting	1	1
Planting Soybeans			
	Acre/hour	6	8

	Labor/hr of planting	1	1
Harvesting Corn			
	Acre/hour	3	3
	Labor/hour	1.5	1.5
Harvesting Soybeans			
	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 with 4 people working. Farm 1 has 300 acres, Farm 2 has 200 acres.

Feed Lot Data	Characteristics of Alternative Feeding Systems per Feeder Animal			
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 feeder animals	$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

Cost of raising corn		$100/acre
soybeans		$ 60/acre
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/cow unit: 5 acres
Number of feed animals raised in year per cow unit: 0.7
Land utilized per feeder raised to sale: 5 acres
Cost/cow unit: $55/year
Cost/feed animal to ship to Illinois: $10/feeder
Weight of feeders raised to mature animals and slaughtered in Montana: 600 lbs.
Cost/feeder raised to maturity in Montana: $50
Annualized Land cost in Montana: $5/acre
Price feeders raised to sale weight in Montana: $.50/lb.
Maximum market potential in Montana: 500 head of feeders raised to maturity

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 chapter (resource allocation, etc.)?

5. Assume you are hired by a meat packing firm which has W warehouses and P plants. Assume each of the plants makes N products by M processes. The plants have R resources. The warehouses each face fixed demand for all goods. Assume the firm has asked you to build a model for them to determine
   (a) Which plants produce which products
   (b) Where goods produced at plants should be shipped.

   Formulate this problem in a general summation notation fashion specifying the data you would need

6. Apply the homogeneity of units test to the improper model in figure 6.5 and discuss any problems you find.