ITM 601 – Winter 2012

Assignment 3 (due March 19)

Garage Design Company (GDC) is considering a reorganization of its product line of residential garage doors. This reorganization idea has originated from a customer complaint (mostly from customers shopping online) that there are too many styles and options to select from. The high level of customization offered to customers is usually considered as a critical strategy and GDC had expanded their product line over the years based on this premise. Recently however, a significant proportion of new customers have been suggesting that although they appreciate the ability to customize, they would appreciate an easier decision process even more.

GDC management has decided to take action and test a new strategy. Some of the current production capacity will be allocated to a new line (Easy-Go Family) of garage doors that will make the customers' selection process much easier. This line will consist of five products: Ranch, Old-Country, Classic, Contemporary, and Fusion. These products are not new designs; they simply constitute the core categories from GDC's existing residential garage door designs. Although limited, there will still be options offered for each new product, however with a much more streamlined selection process.

The basic steps of the manufacturing process for all these doors are (1) roll forming and press, (2) cutting and panel formation, (3) insulation, (4) component installation. It has been estimated that the capacity that can be allocated in these four processes are 20%, 25%, 18%, and 30%, respectively. That is, for example, 20% of the total capacity for the roll forming and press process can be allocated for the production of the five new products. The remaining 80% is being used for other products of the company.

The production planning department also came up with the estimates for the usage of assigned capacity. These values are given in the table below. The values show the percentage capacity used for a given process for every 10 units of a product in a month. For example, if GDC produces 10 units of the Classic product in a given month, this would use 1.3% of the allocated capacity of the insulation process (as noted earlier, a total of 18% of overall capacity has been allocated to the insulation process).

Process	**Product**				
	Ranch	*Old-Country*	*Classic*	*Contemporary*	*Fusion*
Roll forming and press	2	1	0.9	1.8	1.5
Cutting and panel formation	1	1	1	1	1
Insulation	1	1.8	1.3	0.7	1.2
Component installation	1.5	1	1	1.8	2

In the initial stages of this new reorganization, GDC management team wants to make sure that a minimum of 10 doors are produced of each product every month. On the other hand, they have limited the total monthly production (of all five products) to a maximum of 200 units.

Based on the marketing department's earlier work during the feasibility analysis, it is believed that the five products can be grouped in a way that allows the opportunity to offer the customer a substitute if the customer's first choice is not available. In this regard, Ranch and Old-Country are thought of as one group. For example, a customer interested in the Ranch line may also be offered the Old-Country product. The Contemporary and Fusion lines are also considered as another group. The Classic line is considered to be an individual line which can be offered to any customer as a second alternative. Based on this grouping idea, it was decided that the total monthly production for Ranch, Old-Country, and Classic should be at least 35 units. On the other hand, the total monthly production for Ranch and Old-Country should not exceed 50 units. Similarly, the total monthly production for Contemporary and Fusion should be between 40 and 50 units.

There will be a few options offered for each new product and the prices (and profits) will vary based on the options selected. The team members from the marketing, accounting and finance departments have come to the conclusion that on the average, the profit per unit for Ranch, Old-Country, Classic, Contemporary and Fusion are $700, $1,000, $800, $1,200, and $1,500, respectively.

a) Construct a linear programming model to determine the monthly product mix for the new products. Clearly state and explain your decision variables. State your objective function and all of the constraints necessary.
b) Use Excel Solver to solve the product-mix model you developed. What is the product mix? What is the monthly profit achieved with this mix? Is all of the allocated capacity in each of the four processes used? Show all results clearly based on the Solver output you provide.

Note: Your hard-copy submission must include (i) the mathematical model (all decision variables ***clearly*** defined, and the proper LP formulation), (ii) Excel Solver output (showing your model and results), (iii) Clear answers to the questions asked in part (b). You must also send me your Excel file through Ryerson e-mail.