SCM 701 -- Case 2 Fabrics and Fall Fashions

From the tenth floor of her office building, Katherine Rally watches the swarms of New Yorkers fight their way through the streets infested with yellow cabs and the sidewalks littered with hot dog stands, On this sweltering July day, she pays particular attention to the fashions worn by the various women and wonders what they will choose to wear in the fall. Her thoughts are not simply random musings; they are critical to her work since she owns and manages TrendLines, an elite women's clothing company.

Today is an especially important day because she must meet with Ted Lawson, the production manager, to decide upon next month's production plan for the fall line. Specifically, she must determine the quantity of each clothing item she should produce given the plant's production capacity, limited resources, and demand forecasts. Accurate planning for next month's production is critical to fall sales since the items produced next month will appear in stores during September, and women generally buy the majority of the fall fashions when they first appear in September.

She turns back to her sprawling glass desk and looks at the numerous papers covering it. Her eyes roam across the clothing patterns designed almost six months ago, the lists of materials requirements for each pattern, and the lists of demand forecasts for each pattern determined by customer surveys at fashion shows. She remembers the hectic and sometimes nightmarish days of designing the fall line months ago and then presenting it at fashion show in New York, Milan, and Paris in the following weeks. That's now all done and paid for and she must decide what's next.

Ultimately, she has already paid her team of six designers a total of $860,000 for their work on her fall line. With the cost of hiring runway models, hair stylists, and makeup artists, sewing and fitting clothes, building the set, choreographing and rehearsing the show, and renting the conference hall, the three fashion shows had also already cost her an additional $2,700,000 in total.

She studies the clothing patterns and material requirements. Her fall line consists of both professional and casual fashions. She determined the prices for each clothing item by taking into account the quality and cost of material, the cost of labor and machining, the demand for the item, and the prestige of the TrendLines brand name.

The fall professional fashions include:

Clothing Item	Materials Requirements	Retail Price	Labor and Machine Cost
Tailored Wool Slacks	3 yards of wool, 2 yards of acetate for lining	$ 300	$ 160
Cashmere Sweater	1.5 yards of cashmere	$ 450	$ 150
Silk Blouse	2 yards of silk	$ 180	$ 100
Silk Camisole	0.5 yard of silk	$ 120	$ 60
Tailored Skirts	2 yards of rayon, 1.5 yards of acetate for lining	$ 270	$ 120
Wool Blazer	2.5 yards of wool, 1.5 yards of acetate for lining	$ 320	$ 140

The fall casual fashions include:

Clothing Item	Materials Requirements	Price	Labor and Machine Cost
Velvet Pants	3 yards of velvet, 2yards of acetate for lining	$ 350	$ 174
Cotton Sweater	2 yards of cotton	$ 130	$ 60
Cotton Miniskirt	0.5 yards of cotton	$ 75	$ 40
Velvet Shirt	1.5 yards of velvet	$ 200	$ 160
Button-Down Blouse	1.5 yards of rayon	$ 120	$ 90

She knows that for the next month, she has already ordered 45,000 yards of wool, 28,000 yards of acetate, 9,000 yards of cashmere, 18,000 yards of silk, 30,000 yards of rayon, 20,000 yards of velvet, and 30,000 yards of cotton for production. The prices of the materials are as follows:

Material	Price per yard	Quantity Ordered (yds)
Wool	$ 9.00	45000
Acetate	$ 1.50	28000
Cashmere	$ 60.00	9000
Silk	$ 13.00	18000
Rayon	$ 2.25	30000
Velvet	$ 12.00	20000
Cotton	$ 2.50	30000

These fabrics come on a giant roll from which amounts can be cut off in any size panel, similar to pulling and cutting tape from a tape dispenser. Under current contracts, any material left on the roll can be sent back to the textile wholesaler for a full refund, although scrap materials left after cutting pattern pieces out of a cut panel cannot be sent back to the wholesaler. Once it's cut from the roll, it's paid for as a panel. For example, a cotton sweater requires cutting off a 2 yards panel from the roll (creating a panel of 54" x however wide the roll is) and charging 2*$2.50 = $5.00 in materials. Pattern pieces for the sweater are then laid out into that panel, cut, and assembled. If there are sections of that panel unused due to the layout of the pieces, they are typically trash/recycled.

However, she knows that the production of both the silk blouse and cotton sweater leaves leftover scraps of material that could fit pattern pieces from other designs if desired. Specifically, for the production of one silk blouse or one cotton sweater, 2 yards of silk and cotton, respectively, are needed. From these 2 yards, 1.5 yards are used for the silk blouse or the cotton sweater and 0.5 yard is left as scrap material. She does not want to waste the material, so she plans to use the rectangular scrap of silk or cotton to produce a silk camisole or cotton miniskirt, respectively, if it is profitable to produce them at all. Therefore, whenever a silk blouse is produced, a silk camisole *could* also produced at essentially zero material cost and only labor and machine cost. Likewise, whenever a cotton sweater is produced, a cotton miniskirt *could* also be produced at essentially zero material cost. (Note that it is possible to produce a silk camisole without producing a silk blouse and a cotton miniskirt without producing a cotton sweater, however, those would have to be charged their material costs in addition to labor and machine cost. Likewise, we do not have to produce these scraps into skirts/camisoles if the labor/machine costs and demand do not justify their production. Thus we should consider "skirts from scratch" and "skirts from scraps" as separate plans; likewise with camisoles.s)

The demand forecasts indicate that some items have limited demand. Specifically, because the velvet pants and velvet shirts are fashion fads, TrendLines has forecasted that it can sell only 5,500 pairs of velvet pants and 6,000 velvet shirts. TrendLines does not want to produce more than the forecasted demand because once the pants and shirts go out of style, the company cannot sell them above cost. TrendLines can produce less than the forecasted demand, however, since the company is not required to meet the demand. The cashmere sweater also has limited demand because it is quite expensive, and TrendLines knows it can sell at most 4,000 cashmere sweaters. The silk blouses and camisoles have limited demand because many women think silk is too hard to care for, and TrendLines projects that it can sell at most 12,000 silk blouses and 15,000 silk camisoles.

The demand forecasts also indicate that the wool slacks, tailored skirts, and wool blazers have a great demand because they are basic items needed in every professional wardrobe. Specifically, the demand for wool slacks is 7,000 pairs of slacks, and the demand for wool blazers is 5,000 blazers. Katherine wants to meet at least 60 percent of the demand for these two items in order to maintain her loyal customer base and not lose business in the future. Although the demand for tailored skirts could not be estimated, Katherine feels she should make at least 2,800 of them.

A. Ted is trying to convince Katherine not to produce any velvet shirts since the demand for this fashion fad is quite low. He argues that this fashion fad alone accounts for $500,000 of the fixed costs of design. The net contribution (price of clothing item - materials cost - labor cost)) from selling the fashion fad should cover these fixed costs. Each velvet shirt generates a net contribution of $22. He argues that given the net contribution, even satisfying the maximum demand will not yield a profit. What do you think of Ted's argument? What does this tell us about the timing of decisions? How might our decisions in this problem be different if we'd evaluated it before the design process?
B. Formulate and solve a linear programming problem to maximize profit given the production, resource, and demand constraints.

Given the results in B, modify for each of the following. Explore the following questions **independently**. I.e. the issue in C does not apply to the issue in E.

C. The textile wholesaler informs Katherine that the velvet cannot be sent back because the demand forecasts show that the demand for velvet will decrease in the future. Katherine can therefore get **no refund for the velvet**. How does this fact change the production plan?
D. What is an intuitive economic explanation for the difference between the solutions found in parts b and c ?
E. The sewing staff encounters difficulties sewing the arms and lining into the wool blazers since the blazer pattern has an awkward shape and the heavy wool material is difficult to cut and sew. The increase labor time to sew a wool blazer increases the labor and machine cost for each blazer by $80. Given this new cost, how many of each clothing item should TrendLines produce to maximize profit?
F. The textile wholesaler informs Katherine that since another textile customer canceled his order, she can obtain an extra 10,000 yards of acetate. How many of each clothing item should TrendLines now produce to maximize profit?
G. TrendLines assumes that it can sell every item that was not sold during September and October in a big sale in November at 60 percent of the original price. Therefore, it can sell all items in unlimited quantity during the November sale. For which products might we consider increasing production?