COSC 480/MATH 482
Assignment #1
Fall 2012
Source: Hillier and Lieberman

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 material 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 and presenting at fashion shows in New York, Milan, and Paris. Ultimately, she paid her team of six designers a total of $860000 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, each of the three fashion shows cost her an additional $2700000.

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	Price	Labor and Machine Cost
Tailored wool slacks	3 yards of wool, 2 yards of acetate	$300	$160
Cashmere sweater	1.5 yards of cashmere	$450	$150
Silk blouse	1.5 yards of silk	$180	$100
Silk camisole	0.5 yard of silk	$120	$60
Tailored skirt	2 yards of rayon, 1.5 yards of acetate	$270	$120
Wool blazer	2.5 yards of wool, 1.5 yards of acetate	$320	$140

The fall casual fashions include:

Clothing Item	Materials Requirements	Price	Labor and Machine Cost
Velvet Pants	3 yards of velvet, 2 yards of acetate	$350	$175
Cotton sweater	1.5 yards of cotton	$130	$60
Cotton miniskirt	0.5 yard of cotton	$75	$40
Velvet shirt	1.5 yards of velvet	$200	$160
Button-down blouse	1.5 yards of rayon	$120	$90
Funny T-Shirt	0.25 yards of cotton	$15	$5

She knows that for the next month, she has ordered 45000 yards of wool, 28000 yards of acetate, 9000 yards of cashmere, 18000 yards of silk, 30000 yards of rayon, 20000 yards of velvet, and 30000 yards of cotton for production. The prices of the materials are as follows:

Material	Price per Yard
Wool	$9.00
Acetate	$1.50
Cashmere	$60.00
Silk	$13.00
Rayon	$2.25
Velvet	$12.00
Cotton	$2.50

Any material that is not used in production can be sent back to the textile wholesaler for a full refund, although any scrap material cannot be sent back to the wholesaler.

She knows that the production of both the silk blouse and cotton sweater leaves leftover scraps of material. 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. Therefore, whenever a silk blouse is produced, a silk camisole is also produced. Likewise, whenever a cotton sweater is produced, a cotton miniskirt is also produced. Note that it is possible to produce a silk camisole without producing a silk blouse and a cotton miniskirt without producing a cotton sweater.

The demand forecasts indicate that some items have limited demand. Specifically, because the velvet shirts are fashion fads, TrendLines has forecasted that it can sell only 5500 pairs of velvet pants and 6000 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. 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 4000 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 12000 silk blouses and 15000 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 7000 pairs of slacks, and the demand for wool blazers is 5000 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 demand for tailored skirts could not be estimated, Katherine feels she should make at least 2800 of them.

Funny t-shirts were a flop in her regular demographic, but she found that younger clientele enjoyed the item and demand is currently set at 2500.

LP portion: Formulate and solve a linear programming problem to maximize profit given the production, resource, and demand constraints.

Programming portion: Create a program to model this linear programming problem that will allow, through a menu driven system, for the user to adjust material cost, available material quantity, price per unit, and manufacturing cost of any and all items and materials.

Using the above, answer the following:

(a) 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 increased labor time to sew a wool blazer increases the labor and machine cost for each blazer by $80. How does this change the optimal solution?

(b) The textile wholesaler informs Katherine that since another textile customer canceled his order, she can obtain an extra 10000 yards of acetate. How does this change the optimal solution?

Team Member Reviews: you are required to send by 5pm 9/25, a numeric grade (out of 100) to me via email. If the grade is < 80, you must provide a reason for the grade in that email.

DUE: All sources and a write up of the solution is due at 11:59pm on 9/24.