COLUMBIA BUSINESS SCHOOL

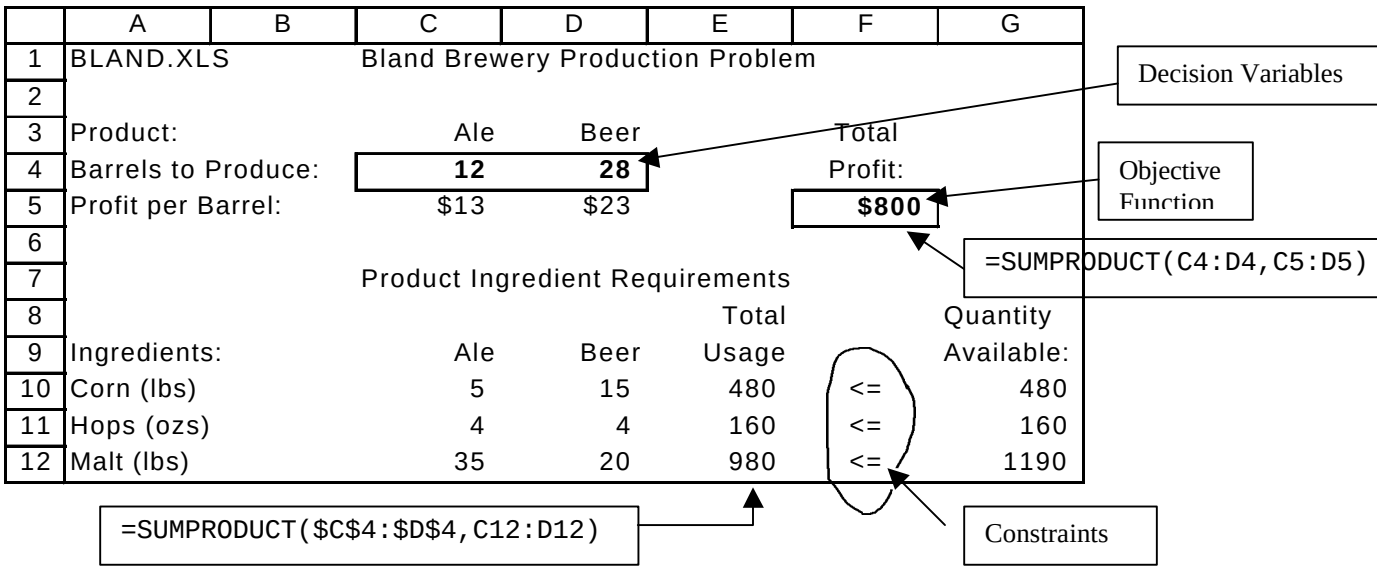
B6015: Decision Models
Summer 2000

Homework Assignment #1

This assignment is an *individual* assignment. Formulate the problems below, and answer the questions.

Instructions on the Write-Up

Try to limit your write-up to at most *six* pages. This includes, for each problem, a printout of your *optimized* spreadsheet (on one page if possible) with formulas. Please follow the style of the sample below: all important formulas are described, constraints are included graphically as "<=" and all important parts of the spreadsheet are labeled. Of course, the labeling can be handwritten:



	A	B	C	D	E	F	G
1	BLAND.XLS		Bland Brewery Production Problem				
2							
3	Product:		Ale	Beer		Total	
4	Barrels to Produce:		**12**	**28**		Profit:	
5	Profit per Barrel:		$13	$23		**$800**	
6							
7			Product Ingredient Requirements				
8					Total		Quantity
9	Ingredients:		Ale	Beer	Usage		Available:
10	Corn (lbs)		5	15	480	<=	480
11	Hops (ozs)		4	4	160	<=	160
12	Malt (lbs)		35	20	980	<=	1190

- To get the file to print with row and column headings, you need to do the following: in Excel go to *File|Print Preview* and then click on *Setup*, pick the *Sheet* tab and check off "row and column headings." Click *OK* and then *Print*.

Assignment

I. Network modeling: Maneuvers in the senate.

Sherill Wiley, the only reporter from Channel 4 News covering United States congressional proceedings knows that the public's perception of partisan politics in the United States Senate is not entirely correct. Although Republicans and Democrats are often at loggerheads over many national issues, members of the two parties frequently vote together on bills that are considered to be beneficial to both. Sherill was surprised at seeing the level of cooperation when passing bills that benefit a certain region.

Richard Kennely, the leading Republican in the Senate and a strong conservative from a Midwestern state, has little or no direct interaction with Robin Doll. Doll, a senator from a New England state, is the Senate's most liberal Democrat. The senators have never served in a committee together or participated in a joint task force. Yet, the two of them rely on each other and their respective parties when voting on many fiscal issues.

Senator Doll recently added an amendment to a finance bill that would provide funding for research on the effects of using a mouse when working on a computer. Several universities from Doll's state submitted grant proposals to do this research, citing the widespread use of the mouse and the growing number of people that complain of arm and wrist fatigue as a result. If the bill and the attached amendments pass, the universities in Doll's state would be the main beneficiaries of the funding. Sherill knows that senator Kennely, who was recently on national television railing against what he referred to as "excessive spending from trivial research," would be the main opponent to the bill. Senator Doll cannot directly influence Senator Kennely's position or vote, but she can contact other senators with whom she has influence, pleading her case, and hoping that they, in turn, will influence others who might eventually influence Senator Kennely to vote in favor of the bill.

After many years in Washington as a reporter, Sherill has developed a sense of the amount of influence that one senator has over another, based on party affiliation, school ties, past favors, mutual interest, and so on. She even developed a numerical scale from 0 to 10 that quantifies the amount of influence that one senator has over another. A 10 means that a particular senator is almost guaranteed to secure the vote of another senator, and a 0 means that there is no interaction at all between the two senators. Sherill created a table that shows the senators' name and the amount of influence each has on the other.

Sherill saw Senators Abbot, Bartle, Crumb, Dodge, and Fernandez leave Senator Doll's office one morning last week. Looking at her influence table, she notes that Doll's influence on Abbot ranks at a 7, on Bartle at a 6, a 9 for Crumb, only a 3 for Dodge, and a 4 for Evans. Later that week, Senator Abbot called in Senators Bartle and Dodge for a strategy meeting. Abbott's influence on Bartle is a 7 and on Dodge is a 5.

Bartle next met with senators Dodge, Evans and Fernandez. Bartle's influence on these senators is 4, 4, and 5, respectively. The senators continued to hold meetings with each other and with senators Gene and Harris.

Sherill summarized the influence rating of all senators in the following table:

Influence Rating

From-To	Abbot	Bartle	Crumb	Dodge	Evans	Fernandez	Gene	Harris	Kennely
Doll	7	6	9	3	4				
Abbot		7		5					
Bartle				4	4	5			
Crumb		5			3				
Dodge					6		5		6
Evans				6		8			7
Fernandez					8			2	5
Gene									8
Harris									2

Sherill believes that if all the senators (other than Doll) bear at least 20 units of influence over Senator Kennely, he would not be able to resist and would have to vote for Senator Doll's proposal. With Kennely's support, the bill would definitely pass because the rest of the senators will follow their leaders.

Considering the amount of networking that takes place between the senators, Sherill thinks that she can build and solve a network model to predict if the bill will pass or not.

(a) Build a decision model to predict if the bill will pass or not.
   i) What are the decision variables
   ii) What is the objective function?
   iii) What are the constraints?

(b) Will the bill pass? Why?

2. Five employees are available to perform four jobs. The time it takes each person to perform each job is given in the table below. (A dash indicates that a person cannot do that particular job.)

Time (hours)

	Job 1	Job 2	Job 3	Job 4
Person 1	22	18	30	18
Person 2	18	--	27	22
Person 3	26	20	28	28
Person 4	16	22	--	14
Person 5	21	--	25	28

Each job must be done by exactly one person (i.e., it cannot be split among more than one person). Also, each person can do at most one job.

(Answer each question independently.)

(a) Determine the assignment of employees to jobs that minimizes the total time required to complete the four jobs. What is the total time required to complete the four jobs? (Note the objective is to minimize the *sum of the times*, not the time of the longest job)

(b) Person #3 has called in sick. How would this affect your (optimal) total time to complete the four jobs?

(c) Person #2 can no longer perform job #1 (but can still do the other jobs as given). How does this affect your (optimal) total time to complete the four jobs and the optimal assignment of persons to jobs?