1. OilCo is building a refinery to produce four products: diesel, gasoline, lubricants, and jet fuel. The minimum demand (in bbl/day) for each of these products is 14,000, 30,000, 10,000, and 8000, respectively. Iraq and Dubai are under contract to ship crude to OilCo. Because of the production quotas specified by OPEC (Organization of Petroleum Exporting Countries), the new refinery can receive at least 40% of its crude from Iraq and the remaining amount from Dubai. OilCo predicts that the demand and crude oil quotas will remain steady over the next 10 years.

The specifications of the two crude oils lead to different product mixes. One barrel of Iraq crude yields 0.2 bbl of diesel, 0.25 bbl of gasoline, 0.1 bbl of lubricant, and 0.15 bbl of jet fuel. The corresponding yields from Dubai crude are 0.1, 0.6, 0.15, and 0.1, respectively. OilCo needs to determine the minimum capacity of the refinery (in bbl/day).

2. Investor Doe has $10,000 to invest in four projects. The following table gives the cash flow for the four investments.

project	Cash flow ($1000) at the start of				
	Year 1	Year 2	Year 3	Year 4	Year 5
1	-1.00	0.5	0.3	1.8	1.2
2	-1.00	0.6	0.2	1.5	1.3
3	0	-1.00	0.8	1.9	0.8
4	-1.00	0.4	0.6	1.8	0.95

The information in the table can be interpreted as follows: For project 1, $1.00 invested at the start of year 1 will yield $.50 at the start of year 2, $.30 at the start of year 3, $1.80 at the start of year 4, and $1.20 at the start of year 5. The remaining entries can be interpreted similarly. The entry 0.00 indicates that no transaction is taking place. Doe has the additional option of investing in a bank account that earns 6.5% annually. All funds accumulated at the end of 1 year can be reinvested in the following year. Formulate the problem as a linear program to determine the optimal allocation of funds to investment opportunities.

3. Professor Yataha needs to schedule eight roundtrips between Boston and Washington, D.C. The route is served by three airlines, Eastern, US Air, and Continental, and there is no penalty for the purchase of one-way tickets. Each airline offers bonus miles for frequent fliers. Eastern gives 1500 miles per (one-way) ticket plus 5000 extra miles if the number of tickets in a month reaches 3 and another 5000 miles if the number exceeds 5. US Air gives 1800 miles per ticket plus 12,000 extra for each 6 tickets. Continental gives 2000 miles per ticket plus 7500 extra for each 5 tickets. Professor Yataha wishes to allocate the 16 one-way tickets among the three airlines to maximize the total number of bonus miles earned.

4. ABC is an LTL trucking company that delivers loads on a daily basis to five customers. The following list provides the customers associated with each route:

Route	Customers served on the route
1	3,2
2	5,3,4
3	2,5,1,3
4	2,3,5
5	1,4,2
6	1,3,5

The segments of each route are dictated by the capacity of the truck delivering the loads. For example, on route 1, the capacity of the truck is sufficient to deliver the loads to customers 3 and 2 only. The following table lists distances (in miles) among the truck terminal (ABC) and the customers.

Miles from i to j						
i/j	**ABC**	**1**	**2**	**3**	**4**	**5**
ABC	0	10	12	16	9	8
1	10	0	32	8	17	10
2	12	32	0	14	21	20
3	16	8	14	0	15	18
4	9	17	21	15	0	11
5	8	10	20	18	11	0

The objective is to determine the least distance needed to make the daily deliveries to all five customers. Though the solution may result in a customer being served by more than one route, an approximation in the implementation phase assumes that only one such route is used. Formulate the problem as an ILP.

5. An assembly line consisting of three consecutive stations produces two radio models: HiFi-1 and HiFi-2. The following table provides the assembly times for the three workstations.

Workstation	Minutes per unit	
	HiFi-1	HiFi-2
1	6	4
2	5	5
3	4	6

The daily maintenance for stations 1, 2, and 3 consumes 10%, 14%, and 12%, respectively, of the maximum 480 minutes available for each station each day. Determine the optimal product mix that will minimize the idle (or unused) times in the three workstations.