Assignment

1. JoShop wants to assign four different categories of machines to five types of tasks. The numbers of machines available in the four categories are 25, 30, 20, and 30. The numbers of jobs in the five tasks are 30, 10, 20, 25, and 20. Machine category 4 cannot be assigned to task type 4. Table provides the unit cost (in dollars) of assigning a machine category to a task type. The objective of the problem is to determine the optimum number of machines in each category to be assigned to each task type. Solve the problem and interpret the solution.

		Task type				
		1	2	3	4	5
Machine category	1	10	2	3	15	9
	2	5	10	15	2	4
	3	15	5	14	7	15
	4	20	15	13	—	8

2. The demand for a special small engine over the next five quarters is 200, 150, 300, 250, and 400 units, respectively. The manufacturer supplying the engine has different production capacities estimated at 180, 230, 430, 300, and 300 for the five quarters. Back-ordering is not allowed, but the manufacturer may use overtime to fill the immediate demand, if necessary. The overtime capacity for each period is half the regular capacity. The production costs per unit for the five periods are \$100, \$96, \$116, \$102, and \$106, respectively. The overtime production cost per engine is 50% higher than the regular production cost. If an engine is produced now for use in later periods, an additional storage cost of \$4 per engine per period is incurred. Formulate the problem as a transportation model. Determine the optimum number of engines to be produced during regular time and overtime of each period.

3. The National Parks Service is receiving four bids for logging at three pine forests in Arkansas. The three locations include 20,000, 30,000, and 10,000 acres. A single bidder can bid for at most 50% of the total acreage available. The bids per acre at the three locations are given in Table. Bidder 2 does not wish to bid on location 1, and bidder 3 cannot bid on location 2.

(a) In the present situation, we need to *maximize* the total bidding revenue for the Parks Service. Show how the problem can be formulated as a transportation model.

(b) Determine the acreage that should be assigned to each of the four bidders.

		Location		
		1	2	3
Bidder	1	\$520	\$210	\$570
	2	—	\$510	\$495
	3	\$650	—	\$240
	4	\$180	\$430	\$710

4. A business executive must make the four round-trips listed in Table 5.41 between the head office in Dallas and a branch office in Atlanta.
The price of a round-trip ticket from Dallas is $400. A 25% discount is granted if the dates of arrival and departure of a ticket span a weekend (Saturday and Sunday). If the stay in Atlanta lasts more than 21 days, the discount is increased to 30%. A one-way ticket between Dallas and Atlanta (either direction) costs $250. How should the executive purchase the tickets?

Departure date from Dallas	Return date to Dallas
Monday, June 3	Friday, June 7
Monday, June 10	Wednesday, June 12
Monday, June 17	Friday, June 21
Tuesday, June 25	Friday, June 28

5. In the unbalanced transportation problem in Table 5.36, if a unit from a source is not shipped out (to any of the destinations), a storage cost is incurred at the rate of $5, $4, and $3 per unit for sources 1, 2, and 3, respectively. Additionally, all the supply at source 2 must be shipped out completely to make room for a new product. Use Vogel's starting solution, and determine all the iterations leading to the optimum shipping schedule.

$1	$2	$1	**20**
$3	$4	$5	**40**
$2	$3	$3	**30**
30	**20**	**20**	

6. Hank is an intelligent student and usually makes good grades, provided that he can review the course material the night before the test. For tomorrow's test, Hank is faced with a small problem: His fraternity brothers are having an all-night party in which he would like to participate. Hank has three options:

a_1 = Party all night
a_2 = Divide the night equally between studying and partying a_3 = Study all night

Tomorrow's exam can be easy (s_1), moderate (s_2), or tough (s_3), depending on the professor's unpredictable mood. Hank anticipates the following scores:

	s_1	s_2	s_3
a_1	85	60	40
a_2	92	85	81
a_3	100	88	82

Recommend a course of action for Hank.

7. In games (a) and (b) given below, the payoff is for player A. Each game has a pure strategy solution. In each case, determine the strategies that define the saddle point and the value of the game.

(a)

	B_1	B_2	B_3	B_4
A_1	9	6	2	8
A_2	8	9	4	5
A_3	7	5	2	5

(b)

	B_1	B_2	B_3	B_4
A_1	5	−4	−5	6
A_2	−3	−4	−8	−2
A_3	6	8	−8	−9
A_4	7	3	−9	6

8. Two companies promote two competing products. Currently, each product controls 50% of the market. Because of recent improvements in the two products, each company plans to launch an advertising campaign. If neither company advertises, equal market shares will continue. If either company launches a stronger campaign, the other company is certain to lose a proportional percentage of its customers. A survey of the market shows that 50% of potential customers can be reached through television, 30% through newspapers, and 20% through radio.

(a) Formulate the problem as a two-person zero-sum game, and determine the advertising media for each company.

(b) Determine a range for the value of the game. Can each company operate with a single pure strategy?

9. Bayville has built a new elementary school so that the town now has a total of four schools—Addison, Beeks, Canfield, and Daley. Each has a capacity of 400 students. The school wants to assign children to schools so that their travel time by bus is as short as possible. The school has partitioned the town into five districts conforming to population density—north, south, east, west, and central. The average bus travel time from each district to each school is shown as follows:

District	Travel Time (min.)				Student Population
	Addison	*Beeks*	*Canfield*	*Daley*	
North	12	23	35	17	250
South	26	15	21	27	340
East	18	20	22	31	310
West	29	24	35	10	210
Central	15	10	23	16	290

Determine the number of children that should be assigned from each district to each school to minimize total student travel time.

10. The Roadnet Transport Company has expanded its shipping capacity by purchasing 90 trailer trucks from a competitor that went bankrupt. The company subsequently located 30 of the pur- chased trucks at each of its shipping warehouses in Charlotte, Memphis, and Louisville. The com- pany makes shipments from each of these warehouses to terminals in St. Louis, Atlanta, and New York. Each truck is capable of making one shipment per week. The terminal managers have indi- cated their capacity of extra shipments. The manager at St. Louis can accommodate 40 additional trucks per week, the manager at Atlanta can accommodate 60 additional trucks, and the manager at New York can accommodate 50 additional trucks. The company makes the following profit per truckload shipment from each warehouse to each terminal. The profits differ as a result of differ- ences in products shipped, shipping costs, and transport rates:

Warehouse	Terminal		
	St. Louis	*Atlanta*	*New York*
Charlotte	$1,800	$2,100	$1,600
Memphis	1,000	700	900
Louisville	1,400	800	2,200

Determine how many trucks to assign to each route (i.e., warehouse to terminal) in order to maximize profit.

11. Biggio's Department Store has six employees available to assign to four departments in the store— home furnishings, china, appliances, and jewelry. Most of the six employees have worked in each of the four departments on several occasions in the past and have demonstrated that they perform better in some departments than in others. The average daily sales for each of the six employees in each of the four departments is shown in the following table.

	Department Sales ($)			
Employee	*Home Furnishings*	*China*	*Appliances*	*Jewelry*
1	340	160	610	290
2	560	370	520	450
3	270	—	350	420
4	360	220	630	150
5	450	190	570	310
6	280	320	490	360

Employee 3 has not worked in the china department before, so the manager does not want to assign this employee to china.

Determine which employee to assign to each department and indicate the total expected daily sales.

12. Carolina Airlines, a small commuter airline in North Carolina, has six flight attendants whom it wants to assign to six monthly flight schedules in a way that will minimize the number of nights they will be away from their homes. The numbers of nights each attendant must be away from home with each schedule are given in the following table. Identify the optimal assignments that will minimize the total number of nights the attendants will be away from home.

	Schedule					
Attendant	*A*	*B*	*C*	*D*	*E*	*F*
1	7	4	5	10	5	7
2	4	5	4	12	7	5
3	9	9	10	7	10	7
4	11	6	7	5	9	9
5	5	8	5	10	7	5
6	10	12	10	9	9	9