

ASSIGNMENT PROBLEM

1. An Automobiles dealer wishes to put five repairmen to five different jobs. The repairmen have somewhat different kinds of skills and they exhibit different levels of efficiency from one job to another. The dealer has estimated the number of man-hours that would be required for each job-man combination. This is given in the matrix form as follows:

| MAN | JOB | | | | |
|-----|-----|----|----|----|----|
| | A | B | C | D | E |
| 1 | 11 | 17 | 8 | 16 | 20 |
| 2 | 9 | 7 | 12 | 6 | 15 |
| 3 | 13 | 16 | 15 | 12 | 16 |
| 4 | 21 | 24 | 17 | 28 | 26 |
| 5 | 14 | 10 | 12 | 11 | 15 |

Find the optimum assignment that will result in minimum man-hours needed.

2. A company is producing a single product and is selling it through five agencies situated in different cities. All of a sudden there is a demand for the product in another five cities not having any agency of the company. The company is faced with the problem of deciding on how to assign the existing agencies to dispatch the product to needy cities in such a way that the travelling distance is minimized. The distance (in kms) between the surplus and deficit cities is given in the following distance matrix.

| Surplus Cities | Deficit Cities | | | | |
|----------------|----------------|-----|-----|-----|-----|
| | I | II | III | IV | V |
| A | 160 | 130 | 175 | 190 | 200 |
| B | 135 | 120 | 130 | 160 | 175 |
| C | 140 | 110 | 155 | 170 | 185 |
| D | 50 | 50 | 80 | 80 | 110 |
| E | 55 | 35 | 80 | 80 | 105 |

Determine the optimal assignment schedule.

3. BMC have decided to carry out repairs of five main roads in the city before the onset of the monsoon. Five contractors have submitted quotations as under. It is the policy of BMC to award not more than one contract to a contractor. If the objective of the BMC is to minimize the cost, how should they award the contracts? How much expenditure should be budgeted?

| Contracts | Roadways | | | | |
|-----------|----------|----|----|----|----|
| | R1 | R2 | R3 | R4 | R5 |
| C1 | 18 | 19 | 14 | 25 | NB |
| C2 | 17 | 18 | 13 | 22 | 24 |
| C3 | 19 | 21 | 18 | 20 | 26 |
| C4 | 17 | 22 | 15 | 24 | 27 |
| C5 | 14 | 21 | 10 | NB | 25 |

(NB – No Bid Submitted)

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4. In a Plant, 4 employees are to be assigned 4 jobs on one-to-one basis. The cost in Rs. Thousands for each employee to do each job is given. Find the Optimal combination of employees and jobs to minimize total cost. (Rs. '000)

| Employee/Job | P | Q | R | S |
|--------------|----|----|----|----|
| A | 60 | 50 | 40 | 45 |
| B | 40 | 45 | 55 | 30 |
| C | 55 | 70 | 60 | 50 |
| D | 45 | 45 | 40 | 45 |

5. In a factory 4 workers are there and 4 jobs are to be done. Time required for each worker and job is given in minutes. Find optimal Assignment of workers and Jobs and optimal total time. Is this a case of Alternate Optimal solution? If yes, show Alternate optimal solution.

| Worker/Job | J1 | J2 | J3 | J4 |
|------------|-----|-----|-----|-----|
| W1 | 120 | 100 | 80 | 90 |
| W2 | 80 | 90 | 110 | 70 |
| W3 | 110 | 140 | 120 | 100 |
| W4 | 90 | 90 | 80 | 90 |

6. A Company has 4 machines to do 3 jobs. Each can be assigned to only one machine. The cost of each job-machine combination is given in the table below in Rupees.

| Job/Machine | I | II | III | IV |
|-------------|---|----|-----|----|
| A | 9 | 12 | 14 | 18 |
| B | 4 | 6 | 8 | 9 |
| C | 5 | 7 | 9 | 11 |

Find the optimal assignment which will minimize the cost. Answer the following questions with justification:

- (i) Is there any Alternate Optimal Assignment?
 - (ii) Is it possible to maintain the same minimum cost as per optimal solution if Job B is assigned to either machine II or Machine III?
 - (iii) Does any Machine remain idle as per optimal assignment?
7. In the modification of a plant layout of a factory BMS auto parts, four new machines M1, M2, M3 and M4 are to be installed in a machine shop. There are five vacant places A,B,C,D and E which are suitable for installation. Because of Extra large size, M2 cannot be placed at C and M3 cannot be places at A. The cost of installing machines location wise in hundred rupees is as follows:

| | A | B | C | D | E |
|----|----|----|----|----|----|
| M1 | 9 | 11 | 15 | 10 | 11 |
| M2 | 12 | 9 | X | 10 | 9 |
| M3 | X | 11 | 14 | 11 | 7 |
| M4 | 14 | 8 | 12 | 7 | 8 |

Find the optimal assignment.

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8. A company has 4 machines to do jobs. Each job can be assigned to only one machine. The cost of each job-machine combination is given in the table below in Rupees.

| JOBS | MACHINES | | | |
|------|----------|----|-----|----|
| | I | II | III | IV |
| A | 51 | 77 | 49 | 55 |
| B | 32 | 34 | 59 | 68 |
| C | 37 | 44 | 70 | 54 |
| D | 55 | 55 | 58 | 55 |

- a) Find an optimal assignment which will minimize the cost, using Hungarian Method.
- b) What would be the effect of prohibition of assignment B to IV on the optimal solution.

9. PQR Ltd. Produces 4 different products viz. pen, ink, pencil and rubber using 4 workers viz. Alok, Satish, Vaze and Rathod who are capable of producing any of the four products and they work effectively for 7 hours a day. The time (in minutes) required for producing each product are given in the following matrix along with the profit.

| Workers/Products | Pen | Ink | Pencil | Rubber |
|------------------|-----|-----|--------|--------|
| Alok | 6 | 10 | 14 | 12 |
| Satish | 7 | 5 | 3 | 4 |
| Vaze | 6 | 7 | 10 | 10 |
| Rathod | 20 | 10 | 15 | 15 |
| Profit/unit | 3 | 2 | 4 | 1 |

Find out the assignment of workers to product which will maximize the profit.

10. A Five Star Hotel, which has four banquet halls used for function. The hall are of same size but with varying facilities. Four parties approached to reserve a hall for a function on the same day. These parties were told that the first choice among these 4 halls would cost Rs. 10,000/- for the day. They were told to indicate the 2nd, 3rd and 4th preferences and the price they would be willing to pay – Two parties A and D told that they were not interested in halls 3 and 4.

The following table shows the preference wise income details. What would be the optimal assignment to maximize the total revenue? ('000)

| Parties/Hall | 1 | 2 | 3 | 4 |
|--------------|----|----|---|---|
| A | 10 | 9 | - | - |
| B | 8 | 10 | 8 | 5 |
| C | 7 | 10 | 6 | 8 |
| D | 10 | 8 | - | - |

11. A college head of department has to provide teachers to all courses offered by his department for imparting highest possible quality of education. He has got three professors and one teaching assistant (TA). Four courses must be offered. After detailed analysis and evaluation, the head of the department has arrived at the following relative ratings (100 = best rating) regarding the ability of each instructor to teach each of the four courses respectively.

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| | COURSE I | COURSE II | COURSE III | COURSE IV |
|--------------------|-----------------|------------------|-------------------|------------------|
| Professor 1 | 60 | 40 | 60 | 70 |
| Professor 2 | 20 | 50 | 60 | 70 |
| Professor 3 | 20 | 30 | 40 | 60 |
| TA | 30 | 10 | 30 | 40 |

How should the head of department assign his staff to the courses to optimize educational quality in his department?

12) A Company has four machines and 3 jobs. Each job can be assigned to one and only one machine. The cost of each job on each machine is given in the following table:-

| JOB/Machine | A | B | C | D |
|--------------------|----------|----------|----------|----------|
| I | 18 | 24 | 28 | 32 |
| II | 8 | 13 | 17 | 19 |
| III | 10 | 15 | 19 | 22 |

Determine the optimal assignment so as to minimize the cost using Hungarian Method. Is there any alternate solution? If yes, find same.

13) A Company has four territories open, and four salesmen available for an assignment. Territories are not equally rich in their sales potential. It is estimated that a typical salesman operating each territory would bring in the following annual sales:-

| Territory | I | II | III | IV |
|---------------------------|----------|-----------|------------|-----------|
| Annual Sales (Rs.) | 1,26,000 | 1,05,000 | 84,000 | 63,000 |

The four salesmen also differ in their ability. It is estimated that, working under the same conditions, their yearly sales would be proportionately as follows.

| Salesman | A | B | C | D |
|-------------------|----------|----------|----------|----------|
| Proportion | 7 | 5 | 5 | 4 |

If the criterion is to maximize expected total sales, then the intuitive answer is to assign the best salesmen to the richest territory, the next best salesman to the second richest, and so on. Verify this answer by the assignment techniques.

14) WELLDONE Company has taken the third floor of a multi-storied building for rent with a view to locate one of their Zonal Offices. There are five main rooms on this floor to be assigned to five managers. Each room has its own advantage and disadvantages. Some have windows, some are closer to the washroom or to the canteen or to the secretarial pool. The rooms are of different sizes and shapes. Each of the five managers were asked to rank their preferences amongst the rooms 301, 302, 303, 304 & 305. Their preferences were recorded in a table as indicated below:

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| ROOMS | MANAGER | | | | |
|-------|---------|-----|-----|-----|-----|
| | M1 | M2 | M3 | M4 | M5 |
| | 302 | 302 | 303 | 302 | 301 |
| | 303 | 304 | 301 | 305 | 302 |
| | 304 | 305 | 304 | 304 | 304 |
| | - | 301 | 305 | 303 | - |
| - | - | 302 | - | - | |

Most of the managers did not list all the five room since they were not satisfied with some of these rooms and they have left off these from the list. Assuming that their preference can be quantified by numbers, find out as to which manager should be assigned to which room, so that their total preference ranking a minimum.

15) An Engineering company has branches in Mumbai, Calcutta, Delhi and Nagpur. A Branch Manager is to be appointed one at each city, out of the four candidates A,B,C & D. Depending on the branch manager and the city, the monthly business in the city varies in Lakhs of rupees as per the details below:

| Branch Manager | City | | | |
|----------------|--------|----------|-------|--------|
| | MUMBAI | CALCUTTA | DELHI | NAGPUR |
| A | 2 | 3 | 1 | 1 |
| B | 5 | 8 | 3 | 3 |
| C | 4 | 9 | 5 | 1 |
| D | 8 | 7 | 8 | 4 |

Suggest which manager should be assigned to which city so as to get maximum total monthly business.

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