The comparative analysis of Hungarian assessment, matrix ones assignment and alternate mansi method in solving assignment problem

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Abstract. This paper discusses about the comparison of the three methods in the assignment that is the Hungarian Method, Matrix Ones Assignment, and Alternate Mansi Method. The Hungarian methods determine penalties in every row and column by decrease the smallest or largest point in row and column. The Matrix Ones Assignment determine penalties, divide minimum or maximum point in every row and column. The Alternate Mansi Method find the minimum or maximum value in each row that has unique value relate with the column. The concept of this problem is applied to car manufacturing company, with balanced data. While University Port Harcourt Project, using unbalanced data. Thus, it can be concluded that the Hungarian method is the most optimal.

1. Introduction

Today the company is required to be able to maximize profits by considering the constraints of the resources it has. One way is to assign employees or machines according to their competencies so that they can produce optimum results for the company [1]. Assignments can be applied in daily life not only limited to the assignment of work with workers or machines but more broadly. Assignment is one special case of transportation problems. So far, the assignment problems can be solved by four methods, namely the simplex method, enumeration methods, transportation methods and Hungarian methods. Among all methods, the Hungarian method is the most optimal method [2]. Assignment problems have several methods including the Hungarian method [3], the Matrix Ones Assignment [3], and the Alternate Mansi Method [4].

The Hungarian method and the Matrix One Assignment in the S.Singh et al journal entitled "A Comparative Analysis of Assignment Problem" [3], is an assignment method in which to obtain the optimal solution by finding the optimum value for each row or column calculated by add up the results by subtracting the minimum value in each row and column. While the Matrix Ones Assignment is by dividing the value minimum in each row or column. In another journal, namely the journal Akpan N.P and Abraham U.P entitled "A Critique of the Hungarian Method for Solving Assignment Problem to the Alternate of Assignment Problem by Mansi [4], is a method in which there is an Alternate Mansi method, which is a new method of assignment problems. The method use in this research is Alternate Mansi method. The result of this research is comparison of the three methods to obtain the optimal solution, which the Hungarian method is the best one.
2. Methodology
The method used in this study is the Alternate Mansi method. The stages are as follows:

1. Change the data into the assignment matrix with the order size that matches the data size. Consider lines as resources and columns as activity.
2. Form a terminal column activity, where the terminal column activities consist of the first column for resources and the second column for activity.
3. Find the minimum unit cost for each row, where the minimum value that is already available must be related to the column, select and write in the terminal column activities. Continue this process for all rows and write in the form I, II, ... in the terminal activity.
4. For each resource if there is a unique activity (or one or not the same as another column) then the existing activity is set for the appropriate resource, then we get a temporary optimal solution.
5. If there is no unique activity for the appropriate resource, then the activity can be created using the following steps:
   a. Search the one of the resources that has a unique activity and then sets the activity for the appropriate resource. Next delete the appropriate rows and columns for the specified resource.
   b. Find the remaining minimum unit costs. Check if stage 1 is fulfilled then do it. If not, check which lines have only the same activity.
   c. If two lines of resource are found to have a minimum value in the same activity column, then find the maximum difference cost by find the difference between the two smallest numbers of each row, taking the one with the greater difference value to set. Delete rows and columns as specified.
   d. But if the maximum difference cost does not have a difference in difference, then take the smallest value in the same column for each row, specifying that activity.
6. Repeat stages c and d until the assigned resource is unique with the appropriate activity.
7. After all the assigned work is completed, then calculate the total cost [5].

In the case of maximization, in stage c and revision in stages 2 and 4 that is choosing the largest value for each row.

3. Results and discussion

3.1. Case studies

3.1.1. Case study balance assignment. The assignment table shows in Table 1 [6].

|   | I  | II | III | IV | V  | VI | VII | VIII | IX  | X  |
|---|----|----|-----|----|----|----|-----|-------|-----|----|
| A | 14 | 13 | 16  | 26 | 12 | 27 | 13  | 24    | 16  | 18 |
| B | 12 | 11 | 20  | 25 | 22 | 27 | 16  | 29    | 30  | 11 |
| C | 31 | 29 | 5   | 16 | 19 | 12 | 14  | 8     | 7   | 17 |
| D | 16 | 14 | 5   | 28 | 14 | 25 | 19  | 7     | 24  | 5  |
| E | 3  | 24 | 9   | 17 | 17 | 8  | 27  | 22    | 11  | 3  |
| F | 2  | 8  | 8   | 23 | 29 | 31 | 18  | 18    | 13  | 6  |
| G | 2  | 29 | 27  | 20 | 26 | 16 | 2   | 18    | 22  | 28 |
| H | 26 | 28 | 15  | 3  | 10 | 24 | 21  | 14    | 27  | 3  |
| I | 12 | 6  | 22  | 17 | 28 | 15 | 30  | 19    | 24  | 25 |
| J | 5  | 11 | 4   | 15 | 29 | 21 | 4   | 2     | 14  | 19 |
3.1.2. Case study unbalanced assignment. The assignment table shows in Table 1 [4].

Table 2. Initial data of port Harcourt university project (in dollar).

|      | ED | EN | PH | MA | CE | HS |
|------|----|----|----|----|----|----|
| SA   | 126| 207| 254| 245| 214| 243|
| JA   | 229| 238| 242| 228| 213| 285|
| ME   | 118| 253| 306| 218| 245| 216|
| VL   | 172| 247| 218| 248| 217| 243|
| HG   | 309| 207| 105| 136| 194| 139|
| KA   | 99 | 168| 220| 140| 215| 116|
| FJ   | 95 | 174| 168| 145| 249| 98 |

3.2. Data analysis

By using Hungarian Method, Matrix One Assignment Method, and Alternate Mansi Method, the authors obtain the optimal solution. The result research is represented in Table 3.

Table 3. The comparison results of 3 method.

|                     | Hungarian | Matrix Ones Assignment | Alternate Mansi |
|---------------------|-----------|------------------------|-----------------|
| **Minimization**    | Balanced  | $58                    | $58             |
|                     | Unbalanced| $881                   | $931            | $1001         |
| **Maximization**    | Balanced  | $280                   | $280            | $271          |
|                     | Unbalanced| $1641                  | $1641           | $1604         |

Based on the Table 3, the solution to the assignment problem is obtained in 4 cases using the Hungarian Method, Matrix Ones Assignment and Alternate Mansi Method, the most optimal solution is produced, as follows:

- In case I Minimized - Balanced, even though the same cost was obtained but the Alternate Mansi Method that was suitable was used. Because the method is the easiest to understand and simple.
- In Case II Maximization - Balanced, the Hungarian Method and the Matrix Ones Assignment have the same profit of $ 280. Then the suitable method for Case II is the Hungarian Method, because in the Hungarian Method use the results of subtracting columns and rows so that the results will remain counts, in contrast to the Matrix Ones Assignment which uses division in each row and column so that the results are integers.
- In Case III Minimization-Unbalanced. The Hungarian method is suitable for use in this case, because it has the smallest optimal cost of the three methods.
- In the Maximum-Unbalanced Case IV, the Hungarian Method and the Matrix Ones Assignment have the same profit of $ 1641. Then the method which is suitable for Case IV is the Hungarian Method, because in the Hungarian Method uses the results of subtracting columns and rows so...
that the results will remain counts, in contrast to the Matrix Ones Assignment which uses division in each row and column so that the results are integers.

In this research, the Hungarian method uses the results of column and row subtraction so that the results will remain counts, the Matrix Ones Assignment that uses division in each row and column so that the results are integers, while the Alternate Mansi Method is the easiest method because it only uses column terminals and searches minimum or maximum value that has a single value. Although the Alternate Mansi Method is the easiest method, it is not suitable for use in the 4 cases. Can be seen in the Table 3 when in the case of minimization, the biggest cost is obtained and in the maximization case the lowest profit is obtained compared to the two methods. So, it can be concluded that the Hungarian Method is the easiest and most appropriate to get the optimal solution to the assignment problem.

4. Conclusion
The Hungarian method is still the easiest method and it is best to get the optimal solution to the assignment problem. This can be seen from the optimal solution generated in the case study in this study. For further research the authors suggest doing a comparison with other methods such as the Ones Assignment which has been modified by the Genetic Algorithm Method. It is suggested to other authors to research with larger data size.

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