

Chapter 479

Assignment

Introduction

The object of the assignment algorithm is to assign n objects (workers, machines, etc.) to the same number of jobs (tasks) in such a way that will minimize the total cost. The problem assumes that only one task is assigned to each object. Although special assignment algorithms exist, NCSS solves the problem using the Mixed Integer Programming algorithm available in the *Extreme Optimization* mathematical subroutine package.

Assignment Model

We will present the assignment model using the following example. Suppose four consultants are available to work on four tasks. Each task is expected to take about one week to complete and all must be completed during this week (no consultant can be assigned two tasks). The consultants have bid on each of the tasks. The following table gives their bids. The challenge is to find solution that will minimize the total cost of performing all four tasks. The solution is shown by the entries that are underlined and bolded.

Consultant Bids

<u>Consultant</u>	<u>Task1</u>	<u>Task2</u>	<u>Task3</u>	<u>Task4</u>
A	1050	1300	<u>1625</u>	900
B	1050	1350	1650	<u>1000</u>
C	<u>1000</u>	1400	1700	950
D	1150	<u>1300</u>	1660	1250

In this example, you might have been able to guess the solution by hand. However, this would become increasingly hard to do as the size of the problem becomes larger. The solution is found using mixed integer programming. You could code this problem to run in that procedure or in the transportation algorithm procedure. This separate, specialized procedure simplifies the input.

Data Structure

This procedure requires a special data format in which the rows represent the objects (workers, machines, etc.) and the columns represent the tasks. The cell entries are the costs for the worker to complete the task. Here is the way the above example would be entered. It is stored in the dataset *Assignment*.

Assignment dataset

Consultant	Task1	Task2	Task3	Task4
A	1050	1300	1625	975
B	1050	1350	1650	1000
C	1000	1400	1700	950
D	1150	1300	1660	1250

Example 1 – Consultant Assignment

This section presents an example of how to run the data presented in the example given above. The data are contained in the *Assignment* database. Here is the data.

Assignment dataset

Consultant	Task1	Task2	Task3	Task4
A	1050	1300	1625	975
B	1050	1350	1650	1000
C	1000	1400	1700	950
D	1150	1300	1660	1250

Setup

To run this example, complete the following steps:

1 Open the Assignment example dataset

- From the File menu of the NCSS Data window, select **Open Example Data**.
- Select **Assignment** and click **OK**.

2 Specify the Assignment procedure options

- Find and open the **Assignment** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 1** settings template. To load this template, click **Open Example Template** in the Help Center or File menu.

Option

Value

Specifications Tab

Type of Optimum **Minimum**
 Job Columns **Job1-Job4**
 Label of Worker Column **Consultant**

3 Run the procedure

- Click the **Run** button to perform the calculations and generate the output.

Costs for Workers Assigned to Jobs

Costs for Workers Assigned to Jobs

Worker	Possible Jobs			
	Job1	Job2	Job3	Job4
A	1050	1300	1625	975
B	1050	1350	1650	1000
C	1000	1400	1700	950
D	1150	1300	1660	1250

This report lists the individual costs that were input.

Assignment

Job Assignment Solution to Minimize Cost**Job Assignment Solution to Minimize Cost**

Worker	Assigned Task	Cost
A	Job3	1625
B	Job4	1000
C	Job1	1000
D	Job2	1300

Minimum Cost 4925

Solution Status: The model is optimal.

This report presents the solution. The report lists each worker with the task they are assigned to and the cost of having them perform that job.

Worker Assignment Solution to Minimize Cost**Worker Assignment Solution to Minimize Cost**

Task	Assigned Worker	Cost
Job1	C	1000
Job2	D	1300
Job3	A	1625
Job4	B	1000

Minimum Cost 4925

Solution Status: The model is optimal.

This report presents the solution. The report lists each worker with the task they are assigned to and the cost of having them perform that job.