Chapter 484

Transportation

Introduction

The object of the transportation algorithm is to find the amounts shipped from *m* sources to *n* destinations that will minimize the total cost of distribution while meeting the demands at each destination and staying within the amount that can be supplied from each source. The problem assumes that only whole units can be shipped. Although special transportation algorithms exist, **NCSS** solves the problem using the Mixed Integer Programming algorithm available in the *Extreme Optimization* mathematical subroutine package.

Transportation Model

Suppose a company assembles televisions at three locations: Oakland, Chicago, and Pittsburgh. Further suppose that this company has two distribution warehouses: Denver and Atlanta. The following table gives the unit transportation costs, the amounts produced at each assembly location (supply), and the amounts needed at each warehouse (demand). The challenge is to find solution that will minimize the total transportation costs.

Sample Transportation Problem

Source	Denver	Atlanta	Supply
Oakland	$30	$56	1500
Chicago	$36	$28	1800
Pittsburgh	$66	$29	1900
Demand	2200	3000	

The solution will be given as Example 1 below.

Balancing the Transportation Model

A *balanced* transportation model is one in which the total supply equals the total demand. In the example above, the total supply and the total demand are both 5200 units. If the model is unbalanced, a dummy source or a dummy destination is added to take up the slack.

For example, suppose the capacity of the Chicago assembly facility is actually 1950 units. A dummy destination with a demand of 150 units is added with zero costs.

Sample Transportation Problem

Source	Denver	Atlanta	Dummy	Supply
Oakland	$30	$56	$0	1500
Chicago	$36	$28	$0	1950
Pittsburgh	$66	$29	$0	1900
Demand	2200	3000	150	

Data Structure

This technique requires a special data format which will be discussed under the *Specifications* tab. Here is the way the above example would be entered. It is stored in the dataset *Transport*.

Transport Dataset

Label	Type	Supply	Denver	Atlanta
	D		2200	3000
Oakland	S	1500	30	56
Chicago	S	1800	36	28
Pittsburgh	S	1900	66	29

Example 1 – Transportation Model

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

Transport Dataset

Label	Type	Supply	Denver	Atlanta
	D		2200	3000
Oakland	S	1500	30	56
Chicago	S	1800	36	28
Pittsburgh	S	1900	66	29

Setup

To run this example, complete the following steps:

1   Open the Transport example dataset

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

2   Specify the Transportation procedure options

- Find and open the **Transportation** procedure using the menus or the Procedure Navigator.
- The settings for this example are listed below and are stored in the **Example 1** settings file. To load these settings to the procedure window, click **Open Example Settings File** in the Help Center or File menu.

Specifications Tab

Type of Optimum ....**Minimum**
Row Type Column ....**Type**
Destination Columns......................................**Denver-Atlanta**
Supply Column ....**Supply**
Label of Source Column ....**Label**

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3   Run the procedure

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

Costs from Source to Destination

Costs from Source to Destination

| | Destination | |
| | Denver | Atlanta |
Source		
Oakland	30	56
Chicago	36	28
Pittsburgh	66	29

This report lists costs per unit.

Solution

Solution (Amount Transported)

| | Destination | | |
| | Denver | Atlanta | Total |
Source			
Oakland	1500	0	1500
Chicago	700	1100	1800
Pittsburgh	0	1900	1900
Total	2200	3000	5200

Cost

Total Cost = 156100

Solution Status: The model is optimal.

This report presents the solution. The entries are the number of units to be shipped from each source to each destination. The Total Cost is the minimum cost that is achieved by this allocation method.