Transshipment

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Transportation

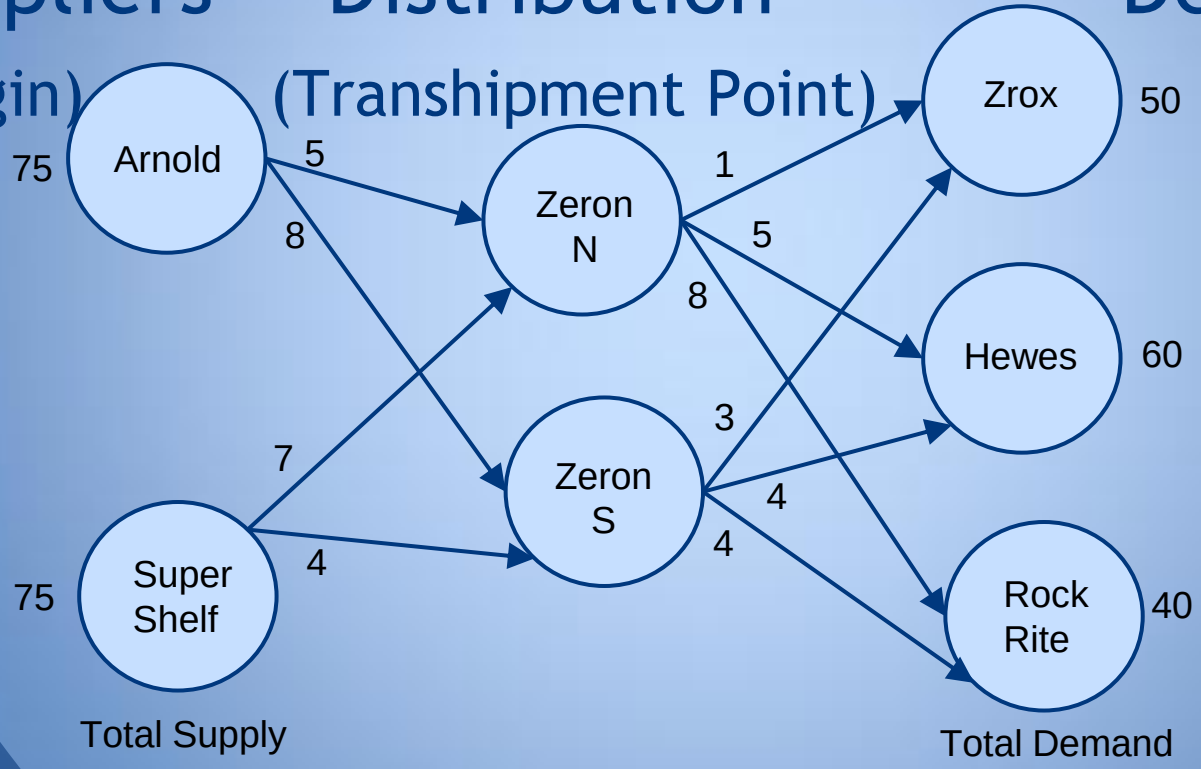
Transshipment problems are transportation problems in which a shipment may move through intermediate nodes (transshipment nodes)before reaching a particular destination node.

Transshipment problems can be converted to larger transportation problems and solved by a special transportation program.

Transshipment problems can also be solved by general purpose linear programming codes.

The network representation for a transshipment problem with two sources, three intermediate nodes, and two destinations is shown on the next slide.

Network Representation Model



Transhipment Example Chapter 6

The Northside and Southside facilities of Zeron Industries supply three firms (Zrox, Hewes, Rockrite) with customized shelving for its offices. They both order shelving from the same two manufacturers, Arnold Manufacturers and Supershelf, Inc.

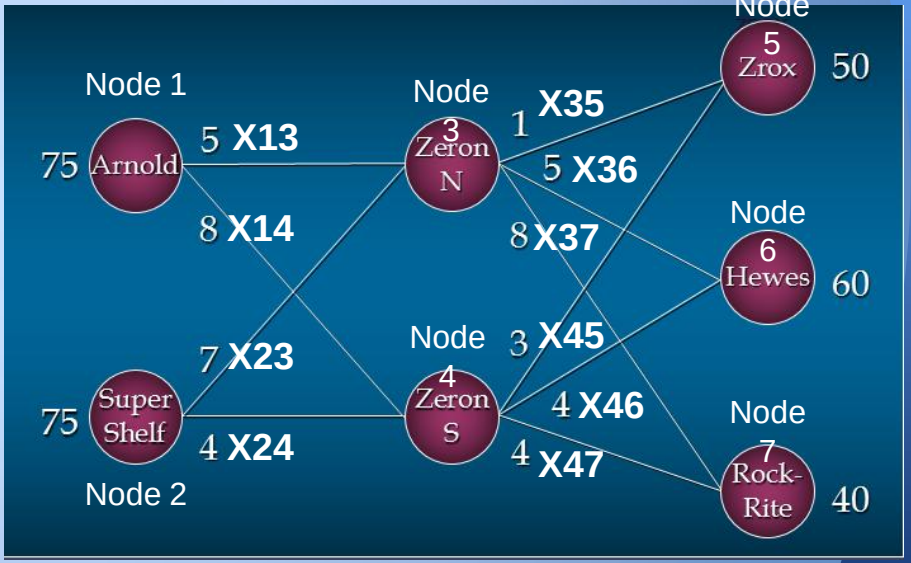
Currently weekly **demands by the users are 50 for Zrox, 60 for Hewes, and 40 for Rockrite**. **Both Arnold and Supershelf can supply at most 75 units to its customers**.

Because of long standing contracts based on past orders, **unit costs from the manufacturers to the suppliers are**:

	Zeron N	Zeron S
Arnold	**5**	**8**
Supershelf	**7**	**4**

The costs to install the shelving at the various locations are:

	Zrox	Hewes	Rockrite
Zeron N	**1**	**5**	**8**
Zeron S	**3**	**4**	**4**



Transshipment Example Chapter 6

Objective Defined:
This is a minimization problem therefore the objective is to reduce shipment costs incurred from supplier to distribution point to destination.

$$\text{Min}=5x_{13} + 8x_{14} + 7x_{23} + 4x_{24} + 1x_{35} + 5x_{36} + 8x_{37} + 3x_{45} + 4x_{46} + 4x_{47}$$

Transhipment Example Chapter 6

Constraints Defined:

Amount Out of Arnold: $x_{13} + x_{14} \leq 75$

Amount Out of Supershelf: $x_{23} + x_{24} \leq 75$

Amount Through Zeron N: $x_{13} + x_{23} - x_{35} - x_{36} - x_{37} = 0$

Amount Through Zeron S: $x_{14} + x_{24} - x_{45} - x_{46} - x_{47} = 0$

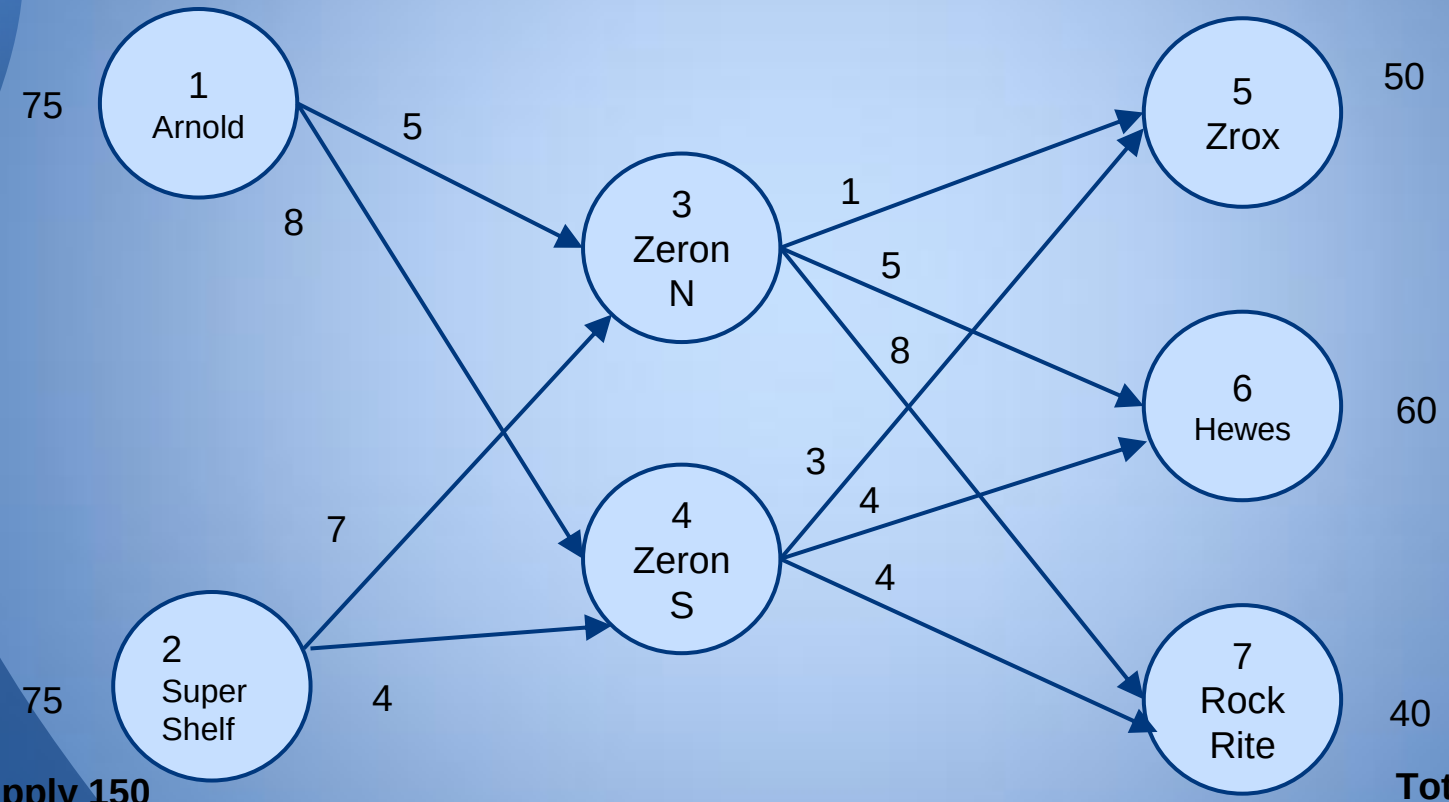
Amount Into Zrox: $x_{35} + x_{45} = 50$

Amount Into Hewes: $x_{36} + x_{46} = 60$

Amount Into Rockrite: $x_{37} + x_{47} = 40$

Non-negativity of Variables: $x_{ij} \geq 0$, for all i and j.

Transhipment Example Chapter 6



Lingo Model:

```
Min=5*x13+8*x14+7*x23+4*x24+1*x35+5*x36+8*x37+3*x45+4*x46+
4*x47;
!subject to;
x13+x14<=75;
x23+x24<=75;
x13+x23-x35-x36-x37=0;
x14+x24-x45-x46-x47=0;
x35+x45=50;
x36+x46=60;
x37+x47=40;
End
```

Lingo Results

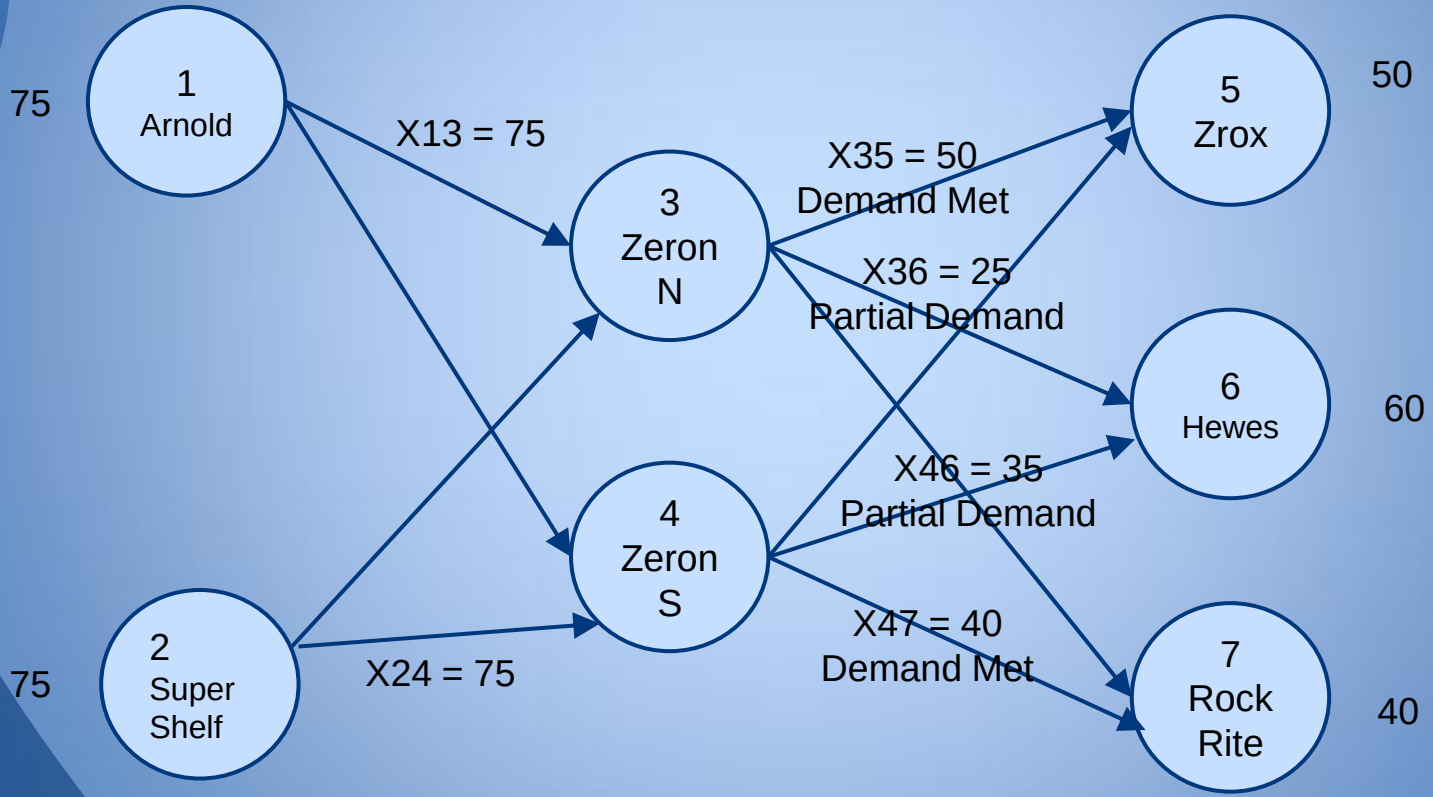
Global optimal solution found.

Objective value:		1150.000
Infeasibilities:		0.000000
Total solver iterations:		3
Model Class:		LP
Total variables:	10	
Nonlinear variables:	0	
Integer variables:	0	
Total constraints:	8	
Nonlinear constraints:	0	
Total nonzeros:	30	
Nonlinear nonzeros:	0	

Variable	Value	Reduced Cost
X13	75.00000	0.000000
X14	0.000000	2.000000
X23	0.000000	4.000000
X24	75.00000	0.000000
X35	50.00000	0.000000
X36	25.00000	0.000000
X37	0.000000	3.000000
X45	0.000000	3.000000
X46	35. 00000	0.000000
X47	40.00000	0.000000

Row	Slack or Surplus	Dual Price
1	1150.000	-1.000000
2	0.000000	0.000000
3	0.000000	2.000000
4	0.000000	-5.000000
5	0.000000	-6.000000
6	0.000000	-6.000000
7	0.000000	-10.00000
8	0.000000	-10.00000

Final Results Illustrated



References

Textbook: Anderson, Sweeney, and Williams. *An Introduction to Management Science - Quantitative Approaches to Decision Making*, West Publishing Company, 12th Edition (2005). ISBN: 0-324-64971-1

Powerpoint: Anderson, Sweeney, and Williams. (2001). *An Introduction to Management Science - Quantitative Approaches to Decision Making [PowerPoint slides].*
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