Lecture 8

Transportation Problem (TP) and Transshipment Problem

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Unbalanced Problems

- If **(Total Supply) > (Total Demand)**,

- then for Excess supply is assumed to go to the inventory and costs nothing for shipping.
- Dummy destination column is added, **whose demand equals the difference between the total supply and total demand** and zero transportation cost

- If **(Total Supply) < (Total Demand)**,

- **a *dummy source* is created, whose supply equals the difference.**
- **All unit shipping costs into a dummy destination or out of a dummy source are 0.**

Example 1: Balanced Problem

		DESTINATIONS				Supply
		D_1	D_2	D_3	D_4	
Sources	S_1	50	75	30	45	12
	S_2	65	80	40	60	17
	S_3	40	70	50	55	11
Demand		10	10	10	10	

Example 2: Unbalanced Problem

	Destination				Supply
	D1	**D2**	**D3**	**D4**	
S1	50	75	35	75	12
S2	65	80	60	65	17
S3	40	70	45	55	11
(Dummy)	**?**	**?**	**?**	**?**	**??**
Min Demand	0	0	0	0	
Max Demand	15	10	15	10	

	Destination				Supply
	D1	**D2**	**D3**	**D4**	
S1	50	75	35	75	12
S2	65	80	60	65	17
S3	40	70	45	55	11
(Dummy)	**0**	**0**	**0**	**0**	**10**
Min Demand	0	0	0	0	
Max Demand	15	10	15	10	

Total Supply = 40
Total Max Demand = 50
Add Dummy Source with costs =0 to all real Destination and Supply =50-40=10

	Destination					Supply
	D1	**D2**	**D3**	**D4**	Dummy	
S1	50	75	35	75	?	12
S2	65	80	60	65	?	17
S3	40	70	45	55	?	11
Min Demand	0	0	0	0		
Max Demand	7	13	5	10	?	

Total Supply = 40
Total Max Demand = 35

	Destination					Supply
	D1	**D2**	**D3**	**D4**	Dummy	
S1	50	75	35	75	**0**	12
S2	65	80	60	65	**0**	17
S3	40	70	45	55	**0**	11
Min Demand	0	0	0	0		
Max Demand	7	13	5	10	**5**	

Total Supply = 40
Total Max Demand = 35
Add Dummy Destination with costs =0 from all real SOurces and Demand =40-35=5

Example 2: Unbalanced Problem

	Destination				Supply
	D1	**D2**	**D3**	**D4**	
S1	50	75	35	75	12
S2	65	--	60	65	17
S3	40	70	45	55	11
(Dummy)	**??**	**??**	**??**	**??**	**??**
Min Demand	15	5	0	10	
Max Demand	15	13	10	∞	

Example 2: Unbalanced Problem

	Destination				Supply
	D1	**D2**	**D3**	**D4**	
S1	50	75	35	75	12
S2	65	M	60	65	17
S3	40	70	45	55	11
(Dummy)	??	??	??	??	??
Min Demand	15	5	0	10	
Max Demand	15	13	10	∞ $= 20$	

= total supply – total min demand for all other Destinations =40-20

Example 2: Unbalanced Problem

	Destination						Supply
	D1	**D21**	**D22**	**D3**	**D41**	**D42**	
S1	50	75	75	35	20	20	12
S2	65	**M**	M	60	50	50	17
S3	40	70	70	45	40	40	11
(Dummy)	**M**	**M**	**0**	**0**	**M**	**0**	**18**
Min Demand	15	5	0	0	10	0	
Max Demand	15	5	8	10	10	10	

Transshipment Problem

special case of Integer Linear Programming

Transshipment Problems

- ✓ **A transportation** problem allows only shipments that go directly from supply points to demand points.

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

- ✓ Fortunately, the optimal solution to a transshipment problem can be found by converting it to transportation problems and solved by transportation Algorithm.

The following steps describe how the optimal solution to a transshipment problem can be found by solving a transportation problem.

Let $s = \ total\ Number\ of\ units\ in\ the\ system = \max(Total\ Supply, Total\ Dem)$

Step1. If necessary, add a dummy destination or dummy source to balance the problem.

Step2. construct a transportation tableau as follows:

- ✓ A row in the tableau will be needed for each source and junction point.
- ✓ A column will be needed for each destination and junction point
- ✓ Each supply point will have a supply equal to its original supply, and each demand point will have a demand equals to its original demand.
- ✓ each Junction point will have

  supply = its original supply + S, and

  demand = its original demand + S

Each location in the Figure will be classified as one of the following cases

$$Let\ s = \ total\ available\ units\ in\ the\ system \ = \max(Total\ Supply\ , Total\ Demand)$$

1. **Pure source:** is a point that can send goods to another point but can not receive goods from any other point

from the figure: it is a source has supply and all arrows out from it, or there are arrows in and out, but it is the only source in the system. →→ its supply equals to its original supply

2. **Pure Destination**: is a point that can receive goods from other points but cannot send goods to any other point.

from the figure it is Destination has Demand and all arrows in, or there are arrows in and out but it is the only Destination in the system. →→ Its demand equals to its original demand

3- Pure Junction (transshipment point): is a point that can both receive goods from other points and send goods to other points

From the figure: it is neither source nor Destination and it has arrows in and out so units can pass through it.

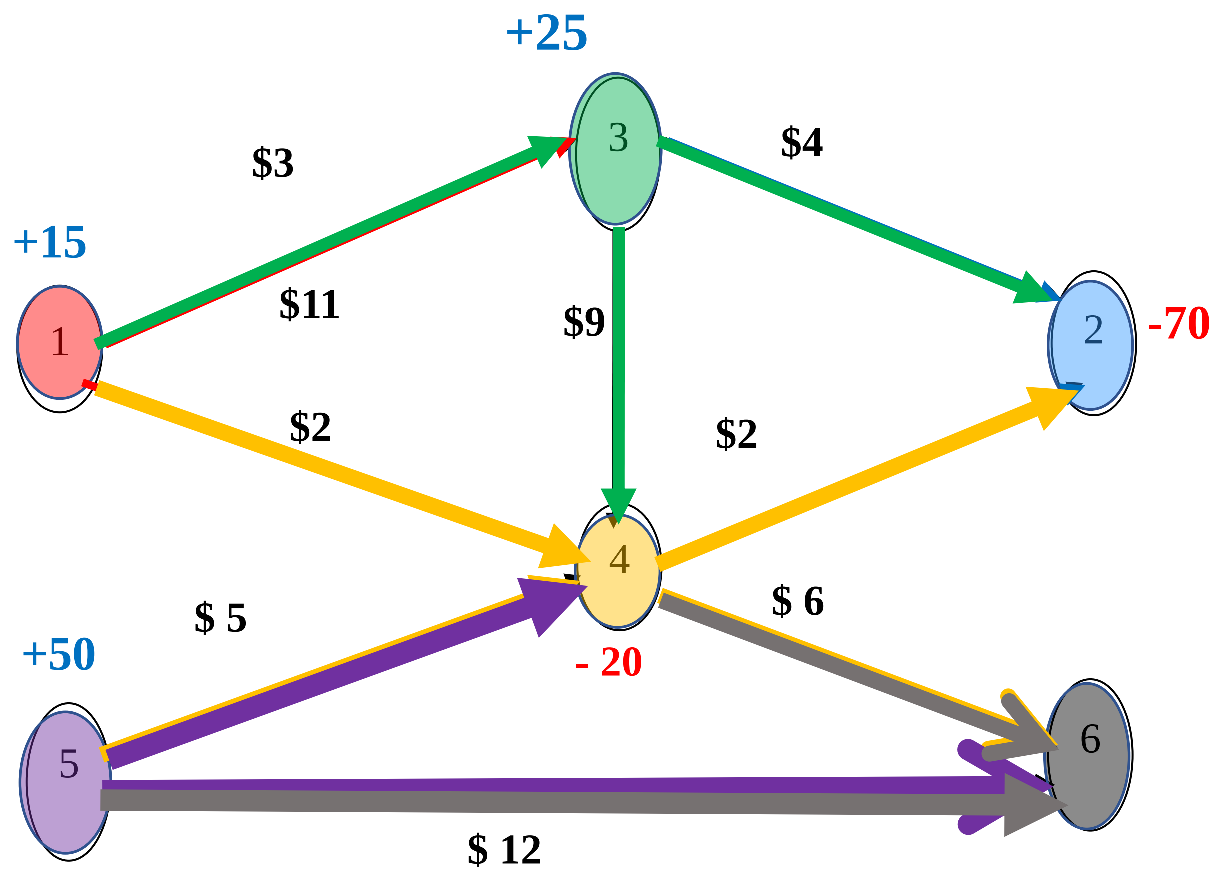
Each Junction point will be considered as source have a supply equals to s and a destination wants demand equals to s.

4- Combined source and junction: if it is a source and it has arrows in and out

it will be modelled as a Source with supply = it's original supply + s and a destination with demand = s

5- Combined destination and junction: if it is a destination and it has arrows in and out

it will be modelled as a source with supply = s and destination with demand = its original demand +S



Total Supply = **25 + 15 + 50 = 90**

Total Demand = **70 + 20 = 90**

→ ***Balanced* Problem**

Total Units in the System = ***S*** = **90**

Location 1: Pure source with supply=15

Location 2: Pure Dest with Demand =70

Location 3: source + junction { Source Supply =S; Dest Demand=S }

with $Supply = 90 + 25 = 115\,, Dem = 90$

Location 4: Dest + junction { Source Supply =90; Dest Demand=90 }

with $Supply = 90, Dem = 90 + 20 = 110$

Location 5: pure source supply =50

	Dest 2	Dest3	Dest4	Supply
Source1	M	3	2	15
Source3	4	0	9	115
Source4	2	M	0	90
Source5	M	M	5	50
Demand	70	90	110	

Location 1: Pure source with supply=15

Location 2: Pure Dest with Demand =70

Location 3: source + junction

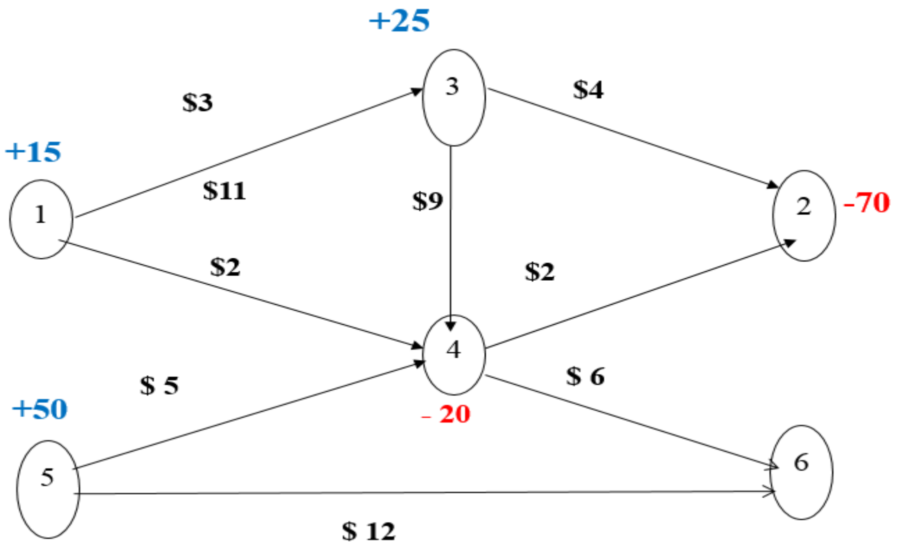
with $Supply = 90 + 25 = 115, Dem = 90$

Location 4: Dest + junction

with $Supply = 90, Dem = 90 + 20 = 110$

Location 5: pure source with supply =50

Location 6: Nothing

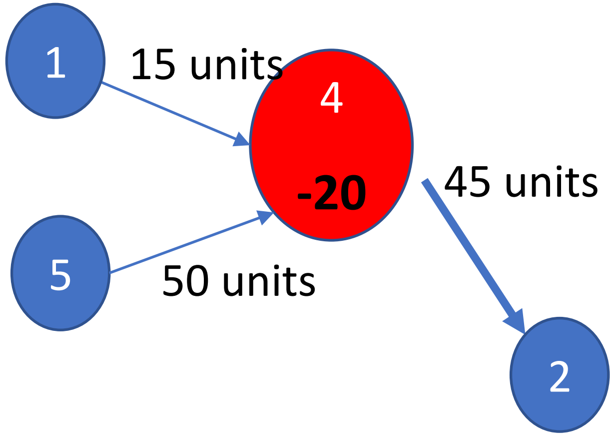


Shipments from a point to itself will cost zero.

	Dest 2	Dest3	Dest4	Supply	u_i
Source1	11 (+)	3 (+)	2 **15**	15	2
Source3	4 **25**	0 **90**	9 (+)	115	2
Source4	2 **45**	M (+)	0 **45**	90	0
Source5	11 (+)	M (+)	5 **50**	50	5
Demand	70	90	110		
V_j	2	-2	0		

Location 3 to itself = 90 unit this mean that 90 units didn't use Location 3 as a junction → so 0 units use it as a junction.

Location 4 to itself = 45 This mean that 45 units didn't use Location 4 as a junction → so only 90-45 use it as a junction.



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