

Transportation Models

Management 560: Management Science

Tuesday, March 24, 2009

- Learn how to formulate models involving transporting goods from suppliers to destinations.
- Continue to perfect our linear programming skills!

- **Transportation Models:** class of problems involving transporting goods from suppliers to destinations, usually at minimum cost.
- Assumptions:
 - Each source has a fixed supply (not essential).
 - Each destination has a fixed demand (not essential).
- The cost of transporting goods differs between points.
- Meeting demand at each location typically requires supply from multiple sources.

- **Transportation Models:** class of problems involving transporting goods from suppliers to destinations, usually at minimum cost.
- Assumptions:
 - Each source has a fixed supply (not essential).
 - Each destination has a fixed demand (not essential).
- The cost of transporting goods differs between points.
- Meeting demand at each location typically requires supply from multiple sources.

- **Transportation Models:** class of problems involving transporting goods from suppliers to destinations, usually at minimum cost.
- Assumptions:
 - Each source has a fixed supply (not essential).
 - Each destination has a fixed demand (not essential).
- The cost of transporting goods differs between points.
- Meeting demand at each location typically requires supply from multiple sources.

- **Transportation Models:** class of problems involving transporting goods from suppliers to destinations, usually at minimum cost.
- Assumptions:
 - Each source has a fixed supply (not essential).
 - Each destination has a fixed demand (not essential).
- The cost of transporting goods differs between points.
- Meeting demand at each location typically requires supply from multiple sources.

- **Transportation Models:** class of problems involving transporting goods from suppliers to destinations, usually at minimum cost.
- Assumptions:
 - Each source has a fixed supply (not essential).
 - Each destination has a fixed demand (not essential).
- The cost of transporting goods differs between points.
- Meeting demand at each location typically requires supply from multiple sources.

- **Transportation Models:** class of problems involving transporting goods from suppliers to destinations, usually at minimum cost.
- Assumptions:
 - Each source has a fixed supply (not essential).
 - Each destination has a fixed demand (not essential).
- The cost of transporting goods differs between points.
- Meeting demand at each location typically requires supply from multiple sources.

- We have three different grain elevators scattered around the Great Plains that can supply grain:
 - 1 Kansas City supplies 150 tons of grain.
 - 2 Omaha supplies 175 tons of grain.
 - 3 Des Moines supplies 275 tons of grain.
- We have three different grain mills that need grain:
 - 1 Chicago needs 200 tons of grain.
 - 2 St. Louis needs 100 tons of grain.
 - 3 Cincinnati needs 300 tons of grain.

- We have three different grain elevators scattered around the Great Plains that can supply grain:
 - 1 Kansas City supplies 150 tons of grain.
 - 2 Omaha supplies 175 tons of grain.
 - 3 Des Moines supplies 275 tons of grain.
- We have three different grain mills that need grain:
 - 1 Chicago needs 200 tons of grain.
 - 2 St. Louis needs 100 tons of grain.
 - 3 Cincinnati needs 300 tons of grain.

- We have three different grain elevators scattered around the Great Plains that can supply grain:
 - 1 Kansas City supplies 150 tons of grain.
 - 2 Omaha supplies 175 tons of grain.
 - 3 Des Moines supplies 275 tons of grain.
- We have three different grain mills that need grain:
 - 1 Chicago needs 200 tons of grain.
 - 2 St. Louis needs 100 tons of grain.
 - 3 Cincinnati needs 300 tons of grain.

- We have three different grain elevators scattered around the Great Plains that can supply grain:
 - 1 Kansas City supplies 150 tons of grain.
 - 2 Omaha supplies 175 tons of grain.
 - 3 Des Moines supplies 275 tons of grain.
- We have three different grain mills that need grain:
 - 1 Chicago needs 200 tons of grain.
 - 2 St. Louis needs 100 tons of grain.
 - 3 Cincinnati needs 300 tons of grain.

- We have three different grain elevators scattered around the Great Plains that can supply grain:
 - 1 Kansas City supplies 150 tons of grain.
 - 2 Omaha supplies 175 tons of grain.
 - 3 Des Moines supplies 275 tons of grain.
- We have three different grain mills that need grain:
 - 1 Chicago needs 200 tons of grain.
 - 2 St. Louis needs 100 tons of grain.
 - 3 Cincinnati needs 300 tons of grain.

- We have three different grain elevators scattered around the Great Plains that can supply grain:
 - 1 Kansas City supplies 150 tons of grain.
 - 2 Omaha supplies 175 tons of grain.
 - 3 Des Moines supplies 275 tons of grain.
- We have three different grain mills that need grain:
 - 1 Chicago needs 200 tons of grain.
 - 2 St. Louis needs 100 tons of grain.
 - 3 Cincinnati needs 300 tons of grain.

- We have three different grain elevators scattered around the Great Plains that can supply grain:
 - 1 Kansas City supplies 150 tons of grain.
 - 2 Omaha supplies 175 tons of grain.
 - 3 Des Moines supplies 275 tons of grain.
- We have three different grain mills that need grain:
 - 1 Chicago needs 200 tons of grain.
 - 2 St. Louis needs 100 tons of grain.
 - 3 Cincinnati needs 300 tons of grain.

- We have three different grain elevators scattered around the Great Plains that can supply grain:
 - 1 Kansas City supplies 150 tons of grain.
 - 2 Omaha supplies 175 tons of grain.
 - 3 Des Moines supplies 275 tons of grain.
- We have three different grain mills that need grain:
 - 1 Chicago needs 200 tons of grain.
 - 2 St. Louis needs 100 tons of grain.
 - 3 Cincinnati needs 300 tons of grain.

Differing distances between locations, and different gasoline prices along the routes, lead to different costs for transportation.

Source Cities	Destination Cities		
	(A) Chicago	(B) St. Louis	(C) Cincinnati
(1) Kansas City	\$6	\$8	\$10
(2) Omaha	\$7	\$11	\$11
(3) Des Moines	\$4	\$5	\$12

Differing distances between locations, and different gasoline prices along the routes, lead to different costs for transportation.

Source Cities	Destination Cities		
	(A) Chicago	(B) St. Louis	(C) Cincinnati
(1) Kansas City	\$6	\$8	\$10
(2) Omaha	\$7	\$11	\$11
(3) Des Moines	\$4	\$5	\$12

- We want to know how much grain we should send from each grain elevator to each grain mill.
- What is our objective?
- What are our choice variables? How many are there?
- Notation: let x_{1A} denote the amount of grain coming from source 1 (Kansas City) to destination A (Chicago).

- We want to know how much grain we should send from each grain elevator to each grain mill.
- What is our objective?
- What are our choice variables? How many are there?
- Notation: let x_{1A} denote the amount of grain coming from source 1 (Kansas City) to destination A (Chicago).

- We want to know how much grain we should send from each grain elevator to each grain mill.
- What is our objective?
- What are our choice variables? How many are there?
- Notation: let x_{1A} denote the amount of grain coming from source 1 (Kansas City) to destination A (Chicago).

- We want to know how much grain we should send from each grain elevator to each grain mill.
- What is our objective?
- What are our choice variables? How many are there?
- Notation: let x_{1A} denote the amount of grain coming from source 1 (Kansas City) to destination A (Chicago).

- A **balanced transportation model** is one where total demand is equal to total supply.
 - All supplies will be used \rightarrow supply constraints have $=$.
 - All demands are satisfied \rightarrow demand constraints have $=$.
- If demand exceeds supply (**unbalanced transportation model**):
 - All supplies will be used \rightarrow supply constraints have $=$.
 - Not all demands can be satisfied \rightarrow demand constraints have \leq .
- If supply exceeds demand (**unbalanced transportation model**):
 - Not all supplies will be used \rightarrow supply constraints have \leq .
 - All demands can be satisfied \rightarrow demand constraints have $=$.

- A **balanced transportation model** is one where total demand is equal to total supply.
 - All supplies will be used \rightarrow supply constraints have $=$.
 - All demands are satisfied \rightarrow demand constraints have $=$.
- If demand exceeds supply (**unbalanced transportation model**):
 - All supplies will be used \rightarrow supply constraints have $=$.
 - Not all demands can be satisfied \rightarrow demand constraints have \leq .
- If supply exceeds demand (**unbalanced transportation model**):
 - Not all supplies will be used \rightarrow supply constraints have \leq .
 - All demands can be satisfied \rightarrow demand constraints have $=$.

- A **balanced transportation model** is one where total demand is equal to total supply.
 - All supplies will be used \rightarrow supply constraints have $=$.
 - All demands are satisfied \rightarrow demand constraints have $=$.
- If demand exceeds supply (**unbalanced transportation model**):
 - All supplies will be used \rightarrow supply constraints have $=$.
 - Not all demands can be satisfied \rightarrow demand constraints have \leq .
- If supply exceeds demand (**unbalanced transportation model**):
 - Not all supplies will be used \rightarrow supply constraints have \leq .
 - All demands can be satisfied \rightarrow demand constraints have $=$.

- A **balanced transportation model** is one where total demand is equal to total supply.
 - All supplies will be used \rightarrow supply constraints have $=$.
 - All demands are satisfied \rightarrow demand constraints have $=$.
- If demand exceeds supply (**unbalanced transportation model**):
 - All supplies will be used \rightarrow supply constraints have $=$.
 - Not all demands can be satisfied \rightarrow demand constraints have \leq .
- If supply exceeds demand (**unbalanced transportation model**):
 - Not all supplies will be used \rightarrow supply constraints have \leq .
 - All demands can be satisfied \rightarrow demand constraints have $=$.

- A **balanced transportation model** is one where total demand is equal to total supply.
 - All supplies will be used \rightarrow supply constraints have $=$.
 - All demands are satisfied \rightarrow demand constraints have $=$.
- If demand exceeds supply (**unbalanced transportation model**):
 - All supplies will be used \rightarrow supply constraints have $=$.
 - Not all demands can be satisfied \rightarrow demand constraints have \leq .
- If supply exceeds demand (**unbalanced transportation model**):
 - Not all supplies will be used \rightarrow supply constraints have \leq .
 - All demands can be satisfied \rightarrow demand constraints have $=$.

- A **balanced transportation model** is one where total demand is equal to total supply.
 - All supplies will be used \rightarrow supply constraints have $=$.
 - All demands are satisfied \rightarrow demand constraints have $=$.
- If demand exceeds supply (**unbalanced transportation model**):
 - All supplies will be used \rightarrow supply constraints have $=$.
 - Not all demands can be satisfied \rightarrow demand constraints have \leq .
- If supply exceeds demand (**unbalanced transportation model**):
 - Not all supplies will be used \rightarrow supply constraints have \leq .
 - All demands can be satisfied \rightarrow demand constraints have $=$.

- A **balanced transportation model** is one where total demand is equal to total supply.
 - All supplies will be used \rightarrow supply constraints have $=$.
 - All demands are satisfied \rightarrow demand constraints have $=$.
- If demand exceeds supply (**unbalanced transportation model**):
 - All supplies will be used \rightarrow supply constraints have $=$.
 - Not all demands can be satisfied \rightarrow demand constraints have \leq .
- If supply exceeds demand (**unbalanced transportation model**):
 - Not all supplies will be used \rightarrow supply constraints have \leq .
 - All demands can be satisfied \rightarrow demand constraints have $=$.

- A **balanced transportation model** is one where total demand is equal to total supply.
 - All supplies will be used \rightarrow supply constraints have $=$.
 - All demands are satisfied \rightarrow demand constraints have $=$.
- If demand exceeds supply (**unbalanced transportation model**):
 - All supplies will be used \rightarrow supply constraints have $=$.
 - Not all demands can be satisfied \rightarrow demand constraints have \leq .
- If supply exceeds demand (**unbalanced transportation model**):
 - Not all supplies will be used \rightarrow supply constraints have \leq .
 - All demands can be satisfied \rightarrow demand constraints have $=$.

- A **balanced transportation model** is one where total demand is equal to total supply.
 - All supplies will be used \rightarrow supply constraints have $=$.
 - All demands are satisfied \rightarrow demand constraints have $=$.
- If demand exceeds supply (**unbalanced transportation model**):
 - All supplies will be used \rightarrow supply constraints have $=$.
 - Not all demands can be satisfied \rightarrow demand constraints have \leq .
- If supply exceeds demand (**unbalanced transportation model**):
 - Not all supplies will be used \rightarrow supply constraints have \leq .
 - All demands can be satisfied \rightarrow demand constraints have $=$.