

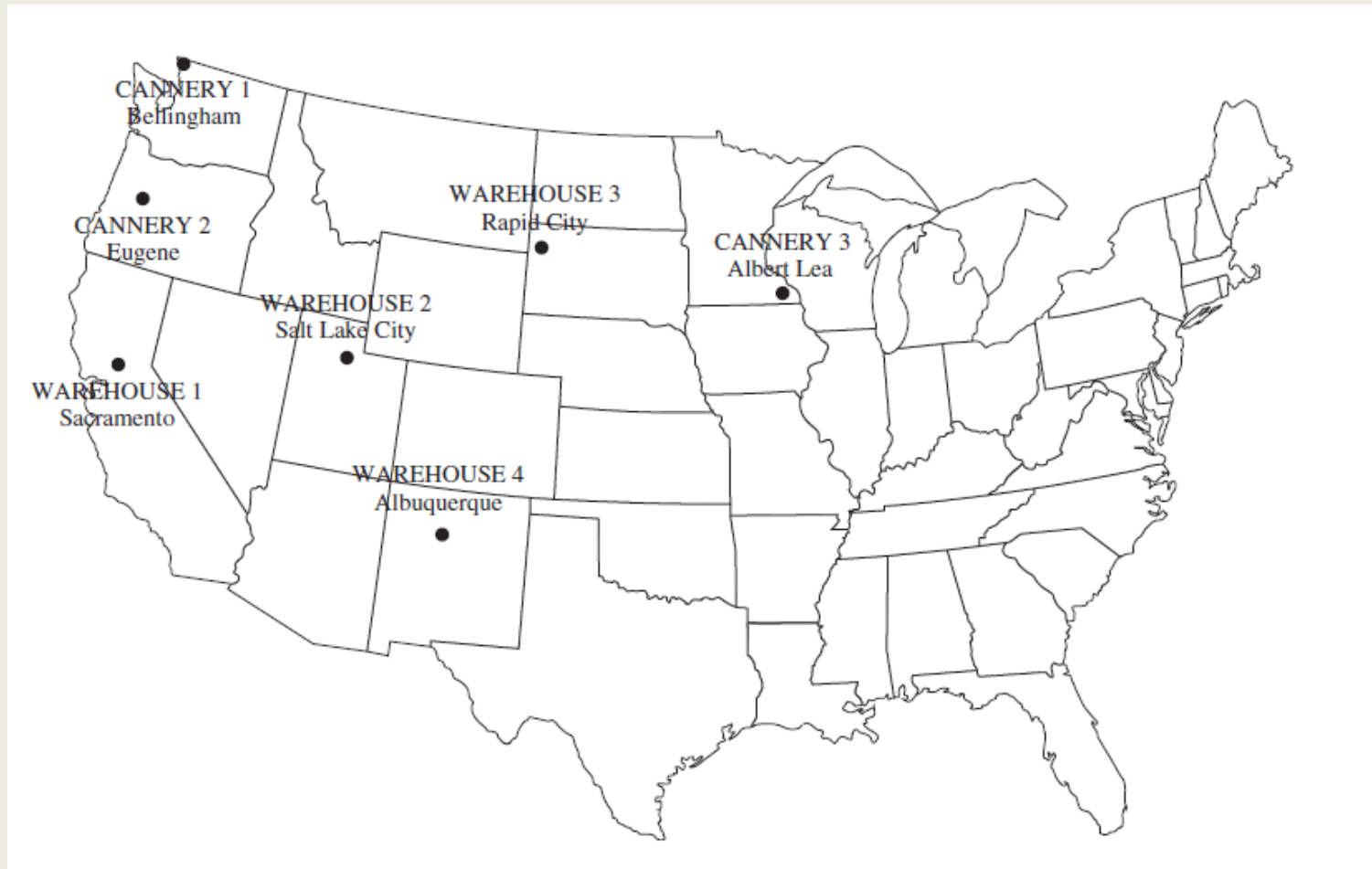
# **Applications of LP (transportation problem)**

Lecture 5

# Introduction

- Involve determining how to optimally transport goods.
- Applications of the transportation tend to require a very large number of constraints and variables, so a straightforward computer application of the simplex method may require an exorbitant computational effort.

# Example



# Shipping data

		Shipping Cost (\$) per Truckload				Output
		Warehouse				
		1	2	3	4	
Cannery	1	464	513	654	867	75
	2	352	416	690	791	125
	3	995	682	388	685	100
Allocation		80	65	70	85	

# Optimization problem

Minimize  $Z = 464x_{11} + 513x_{12} + 654x_{13} + 867x_{14} + 352x_{21} + 416x_{22}$   
 $+ 690x_{23} + 791x_{24} + 995x_{31} + 682x_{32} + 388x_{33} + 685x_{34},$

subject to the constraints

$$\begin{array}{rcccccccc}
 x_{11} + x_{12} + x_{13} + x_{14} & & & & & & & & = & 75 \\
 & & & & x_{21} + x_{22} + x_{23} + x_{24} & & & & = & 125 \\
 & & & & & & & & x_{31} + x_{32} + x_{33} + x_{34} & = & 100 \\
 x_{11} & & & & + x_{21} & & & & + x_{31} & = & 80 \\
 & x_{12} & & & & + x_{22} & & & + x_{32} & = & 65 \\
 & & x_{13} & & & + x_{23} & & & + x_{33} & = & 70 \\
 & & & x_{14} & & + x_{24} & & & + x_{34} & = & 85
 \end{array}$$

and

$$x_{ij} \geq 0 \quad (i = 1, 2, 3; j = 1, 2, 3, 4).$$

# Constraint Coefficients

Coefficient of:

$x_{11}$   $x_{12}$   $x_{13}$   $x_{14}$   $x_{21}$   $x_{22}$   $x_{23}$   $x_{24}$   $x_{31}$   $x_{32}$   $x_{33}$   $x_{34}$

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 & & & & & & & & & \\ & & & & 1 & 1 & 1 & 1 & & & & & \\ & & & & & & & & 1 & 1 & 1 & 1 & \\ 1 & & & & 1 & & & & 1 & & & & \\ & 1 & & & & 1 & & & & 1 & & & \\ & & 1 & & & & 1 & & & & 1 & & \\ & & & 1 & & & & & & & & 1 & \\ & & & & & & & & & & & & 1 \end{bmatrix}$$

Can be categorized into:

- Canney constraints (rows 1, 2, 3)
- Warehouse constraints (rows 4, 5, 6, 7, 8)

# The feasible solutions property

- A transportation problem will have feasible solutions if and only if

$$\sum_{i=1}^m s_i = \sum_{j=1}^m d_j$$

- In some real problems, the supplies actually represent *maximum* amounts (rather than fixed amounts) to be distributed. Similarly, in other cases, the demands represent maximum amounts (rather than fixed amounts) to be received.

# Decisions to be made!

- The number of truckloads of peas to ship from each cannery to each warehouse.
- The total amount shipped from each cannery must equal its output (the supply) and the total amount received at each warehouse must equal its allocation (the demand).
- The overall measure of performance is the total shipping cost, so the objective is to minimize this quantity.



# Results of the QM software

POM-QM for Windows

File Edit View Module Format Tools Window Help

Starting method: Any starting method

Instruction: There are more results available in additional windows. These may be opened by using the WINDOW option in the Main Menu.

Optimal cost = \$152535

Transportation Shipments (untitled) Solution

	Destination 1	Destination 2	Destination 3	Destination 4
Source 1		20		55
Source 2	80	45		
Source 3			70	30

Iterations (untitled) Solution

	Destination 1	Destination 2	Destination 3	Destination 4
Iteration 1				
Source 1	(15)	20	(84)	55
Source 2	80	45	(217)	(21)
Source 3	(728)	(351)	70	30

Marginal Costs (untitled) Solution

	Destination 1	Destination 2	Destination 3	Destination 4
Source 1	15		84	
Source 2			217	21
Source 3	728	351		

Shipments with costs (untitled) Solution

	Destination 1	Destination 2	Destination 3	Destination 4
Source 1		20/\$10260		55/\$47685
Source 2	80/\$28160	45/\$18720		
Source 3			70/\$27160	30/\$20550

Final Solution Table (untitled) Solution

	Destination 1	Destination 2	Destination 3	Destination 4
Source 1	[15]	20	[84]	55
Source 2	80	45	[217]	[21]
Source 3	[728]	[351]	70	30

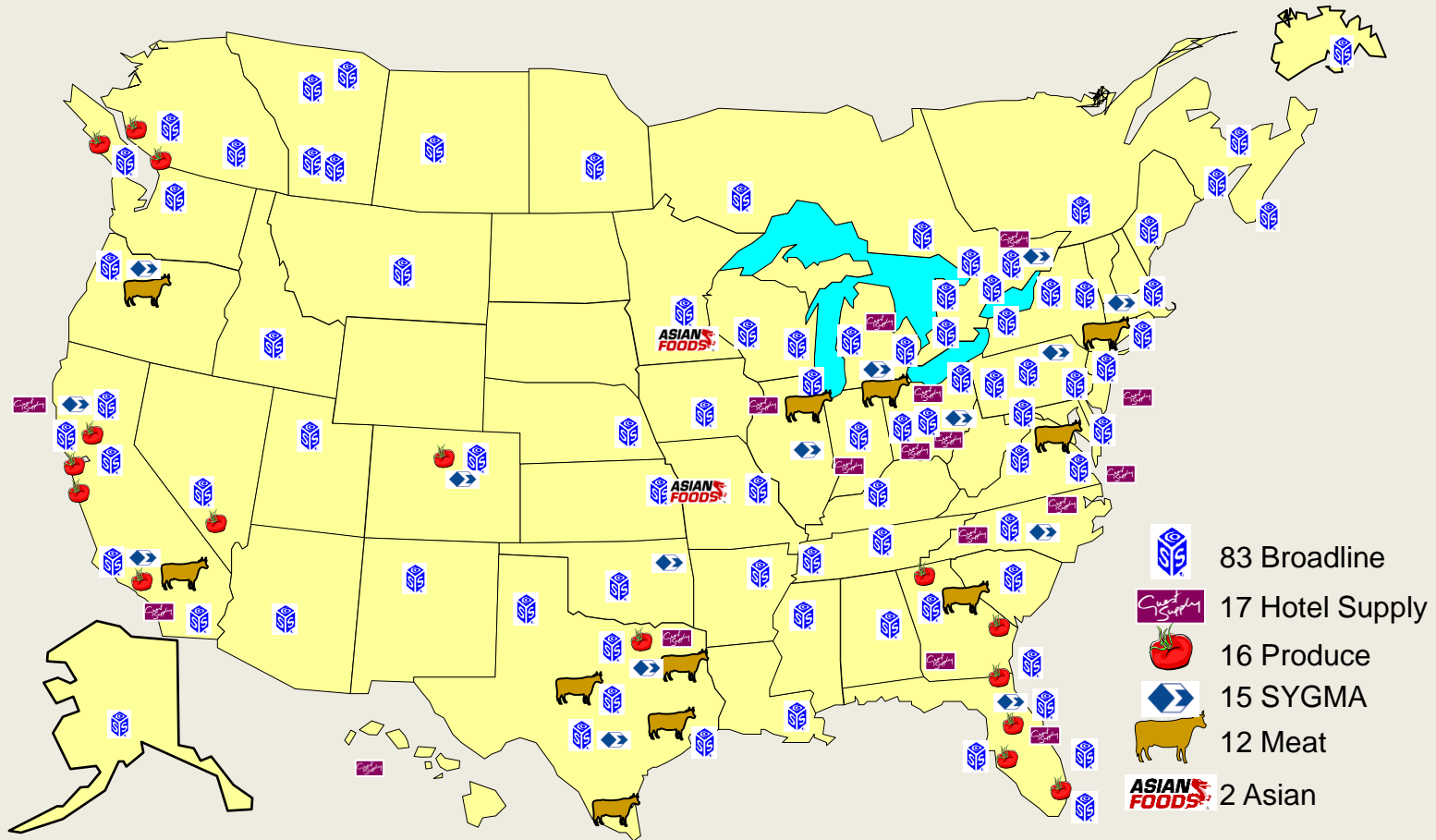
Shipping list (untitled) Solution

From	To	Shipment	Cost per unit	Shipment cost
Source 1	Destination 2	20	513	10260
Source 1	Destination 4	55	867	47685
Source 2	Destination 1	80	352	28160
Source 2	Destination 2	45	416	18720
Source 3	Destination 3	70	388	27160
Source 3	Destination 4	30	685	20550

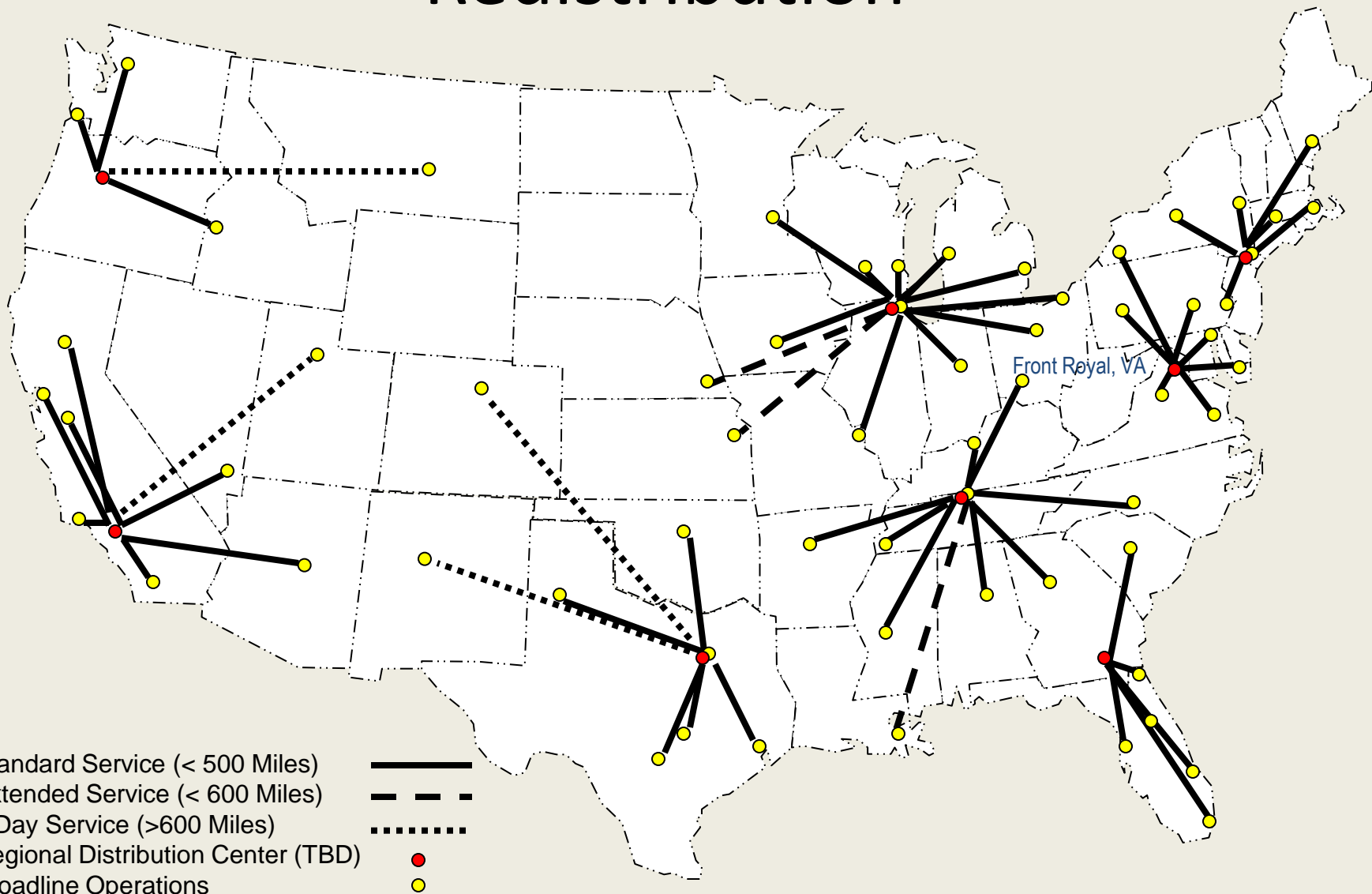
Transportation Solution Screen

Module Print Screen Previous file Next file Save as Excel file Save as HTML

# SYSCO Operates 145 Distribution Locations



# SYSCO's Supply Chain Vision for Redistribution



# Burger King System Restaurants

