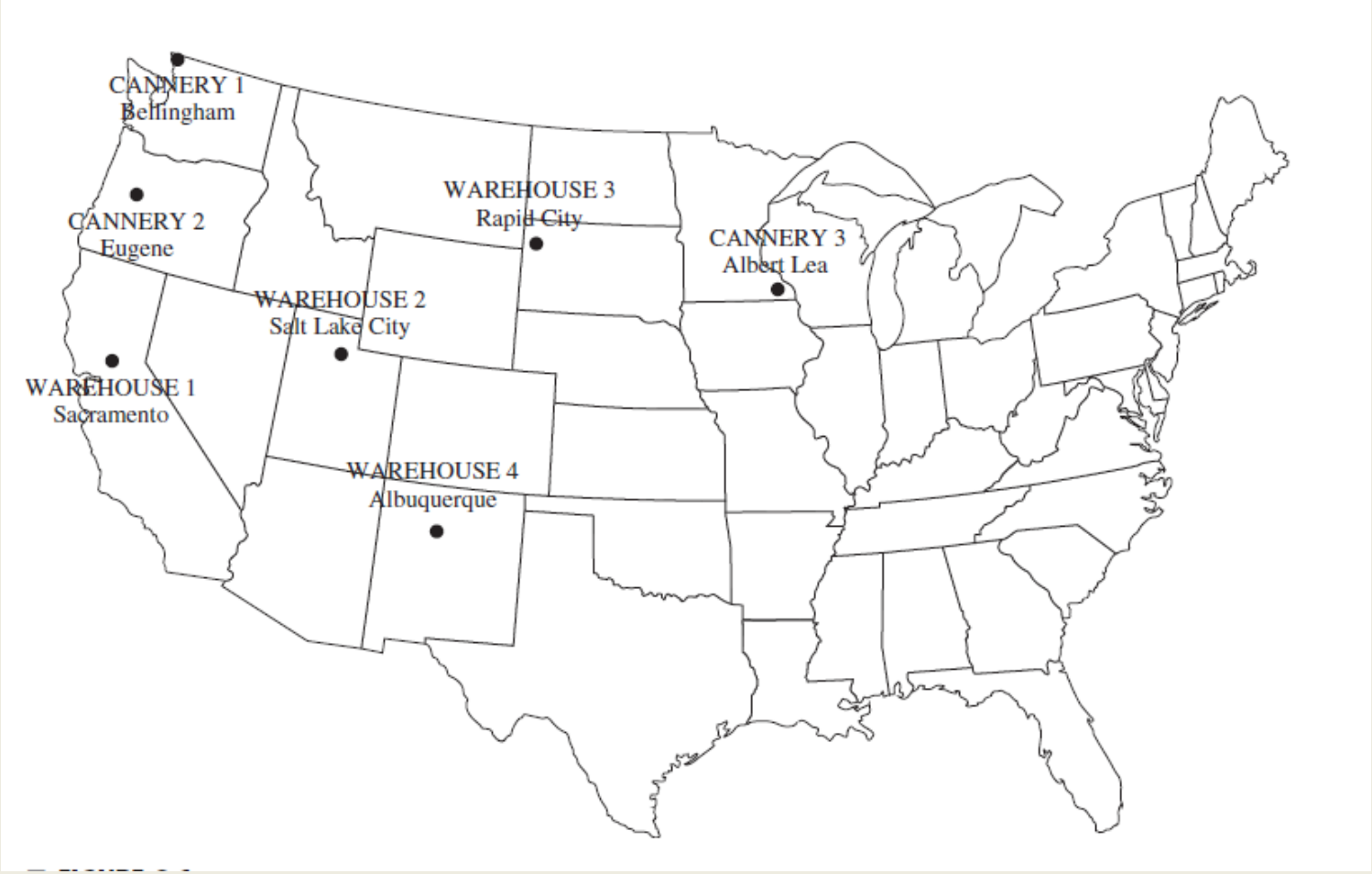
Applications of LP (transportation problem)

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


CANNERY 1
Bellingham
CANNERY 2
Eugene
WAREHOUSE 1
Sacramento
WAREHOUSE 2
Salt Lake City
WAREHOUSE 3
Rapid City
WAREHOUSE 4
Albuquerque
CANNERY 3
Albert Lea

Shipping data

		Shipping Cost ($) per Truckload				
		Warehouse				
		1	2	3	4	Output
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

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

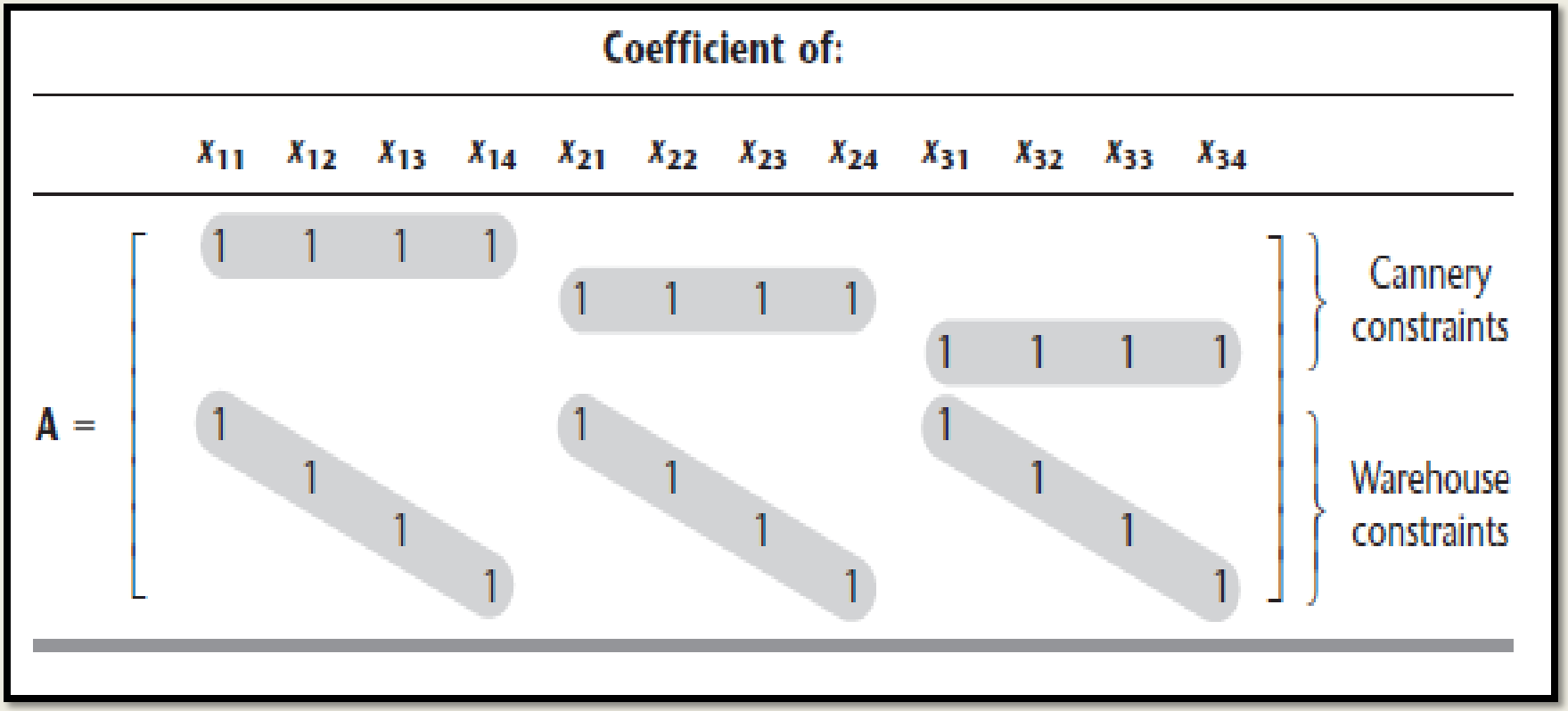
subject to the constraints

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

and

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

Constraint Coefficients



The feasible solutions property

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

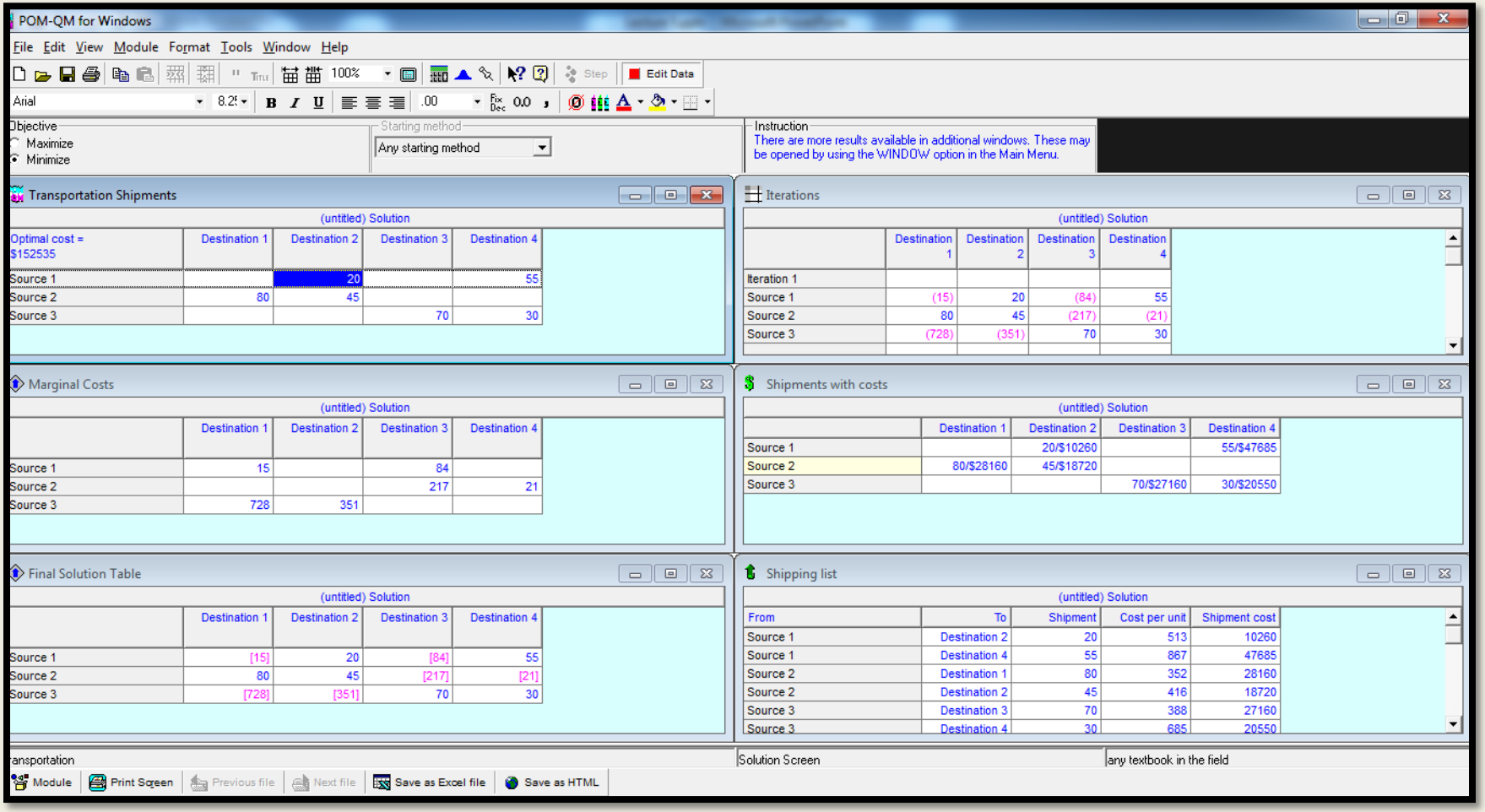
$$\sum_{i=1}^{m} s_i = \sum_{j=i}^{m} d_i$$

- 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.

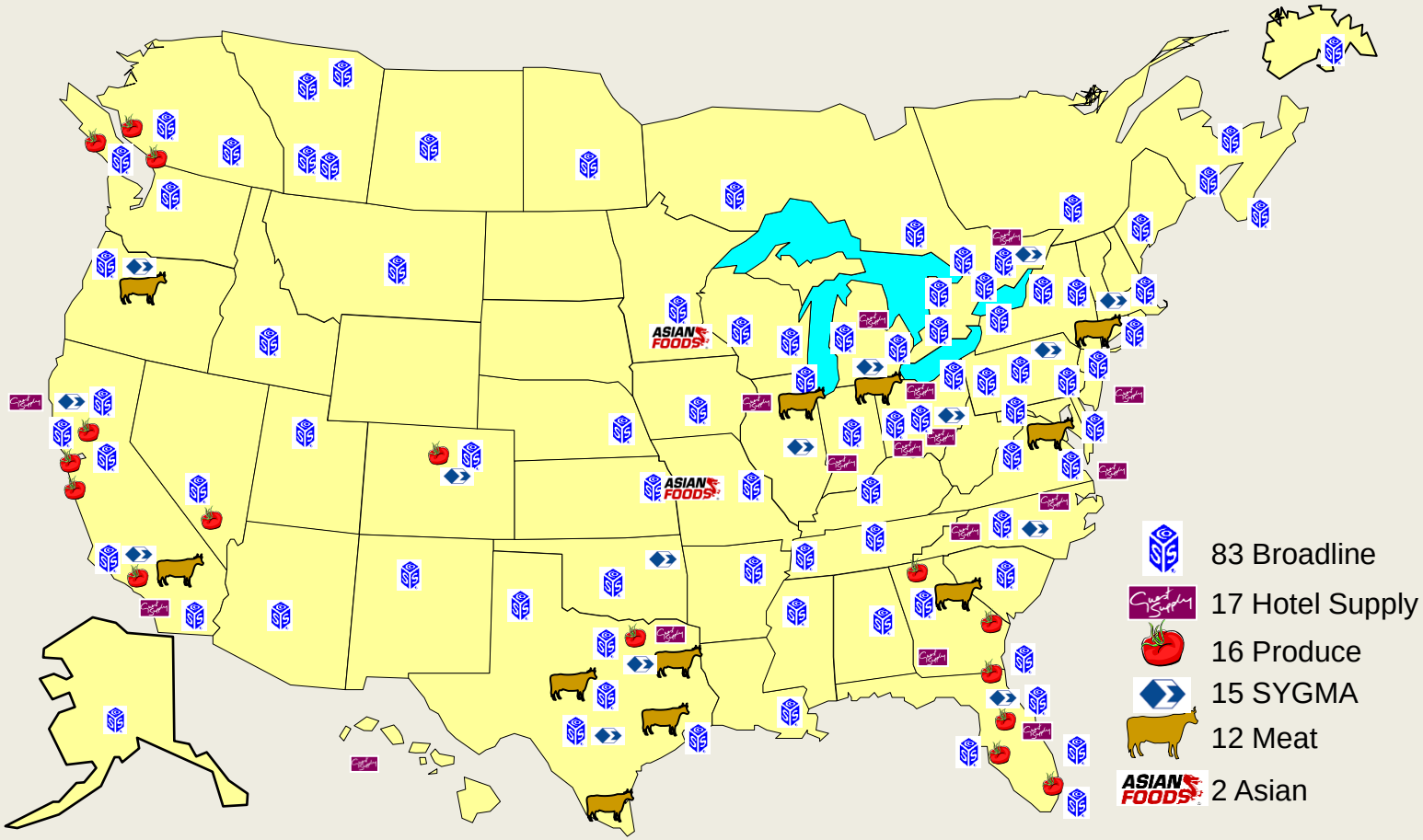
Decisions to be made!

- 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.

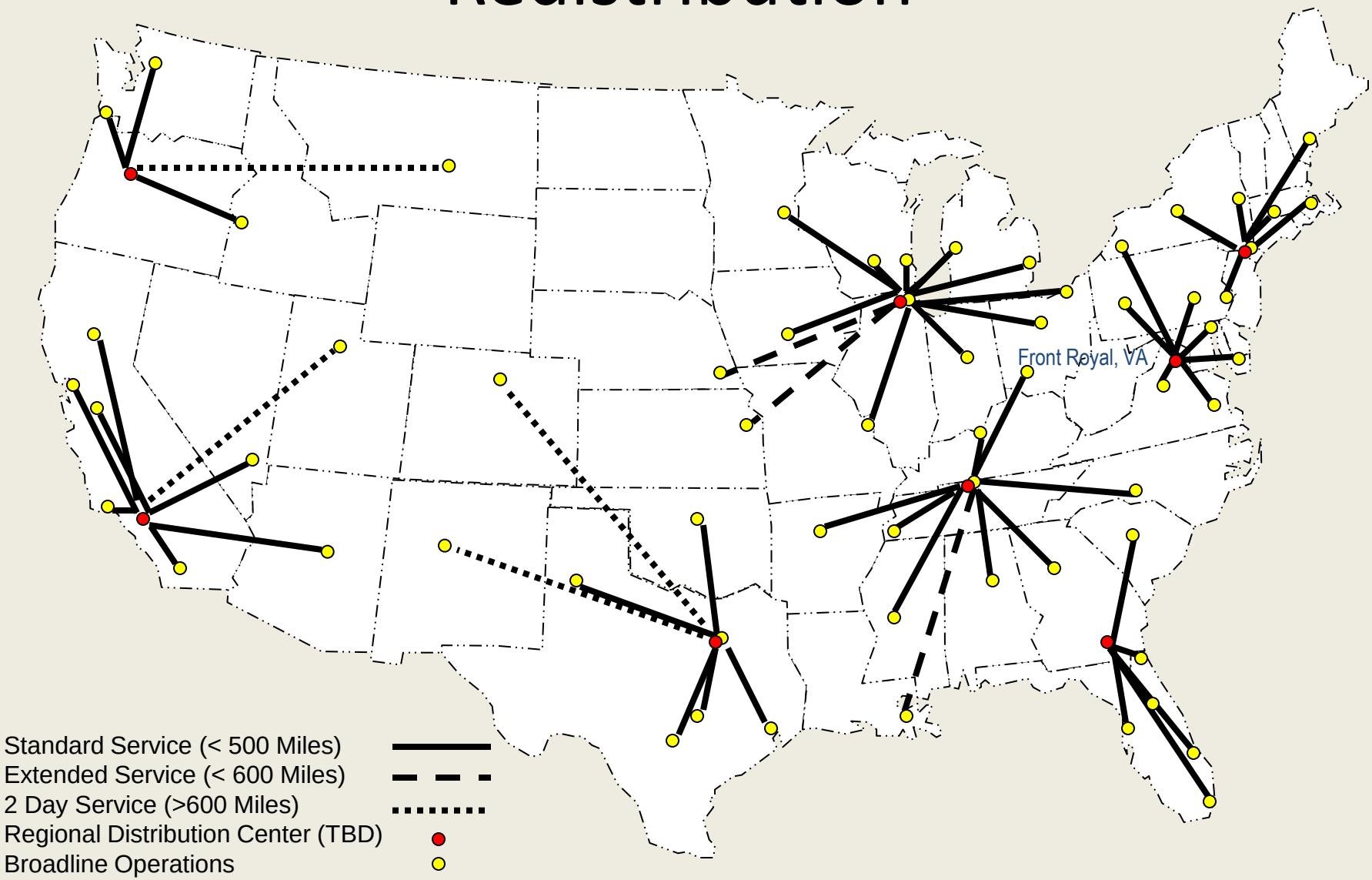
Results of the QM software



SYSCO Operates 145 Distribution Locations



SYSCO's Supply Chain Vision for Redistribution



Burger King System Restaurants