Let's see how this constraint works

$s_{A,V} + s_{A,W} + s_{A,X} + s_{A,Y} + s_{A,Z} \leq 4{,}000\ y_A$

If $y_A = 1$, the constraint becomes $s_{A,V} + s_{A,W} + s_{A,X} + s_{A,Y} + s_{A,Z} \leq 4{,}000$

↓

Total shipments from Amadora cannot exceed capacity

If $y_A = 0$, the constraint becomes $s_{A,V} + s_{A,W} + s_{A,X} + s_{A,Y} + s_{A,Z} \leq 0$

↓

$s_{A,V} = 0,\ s_{A,W} = 0,\ s_{A,X} = 0,\ s_{A,Y} = 0,\ s_{A,Z} = 0$

↓

No shipments from Amadora

Proposal 1 Spreadsheet Model*

PARAMETERS

Supplier	Cost of supplying 1 ton to Facility					Supplier capacity
	Valencia	**Wiesbaden**	**Xanten**	**York**	**Zaragoza**	
Amadora	1.78	2.26	2.22	2.30	1.45	4,000
Bergamo	1.64	2.70	2.00	2.44	2.30	2,000
Casablanca	1.70	2.15	2.58	1.28	1.95	1,000
Quantity required	1,000	500	1,500	1,500	500	

DECISIONS VARIABLES

From Supplier	To Facility					Quantity supplied	Select supplier?	Effective capacity
	Valencia	**Wiesbaden**	**Xanten**	**York**	**Zaragoza**			
Amadora	**1,000**	**500**	**1,500**	**500**	**500**	4,000	**1**	4000
Bergamo	**0**	**0**	**0**	**0**	**0**	0	**0**	0
Casablanca	**0**	**0**	**0**	**1,000**	**0**	1,000	**1**	1000
Quantity received	1,000	500	1,500	1,500	500		2	

OBJECTIVE

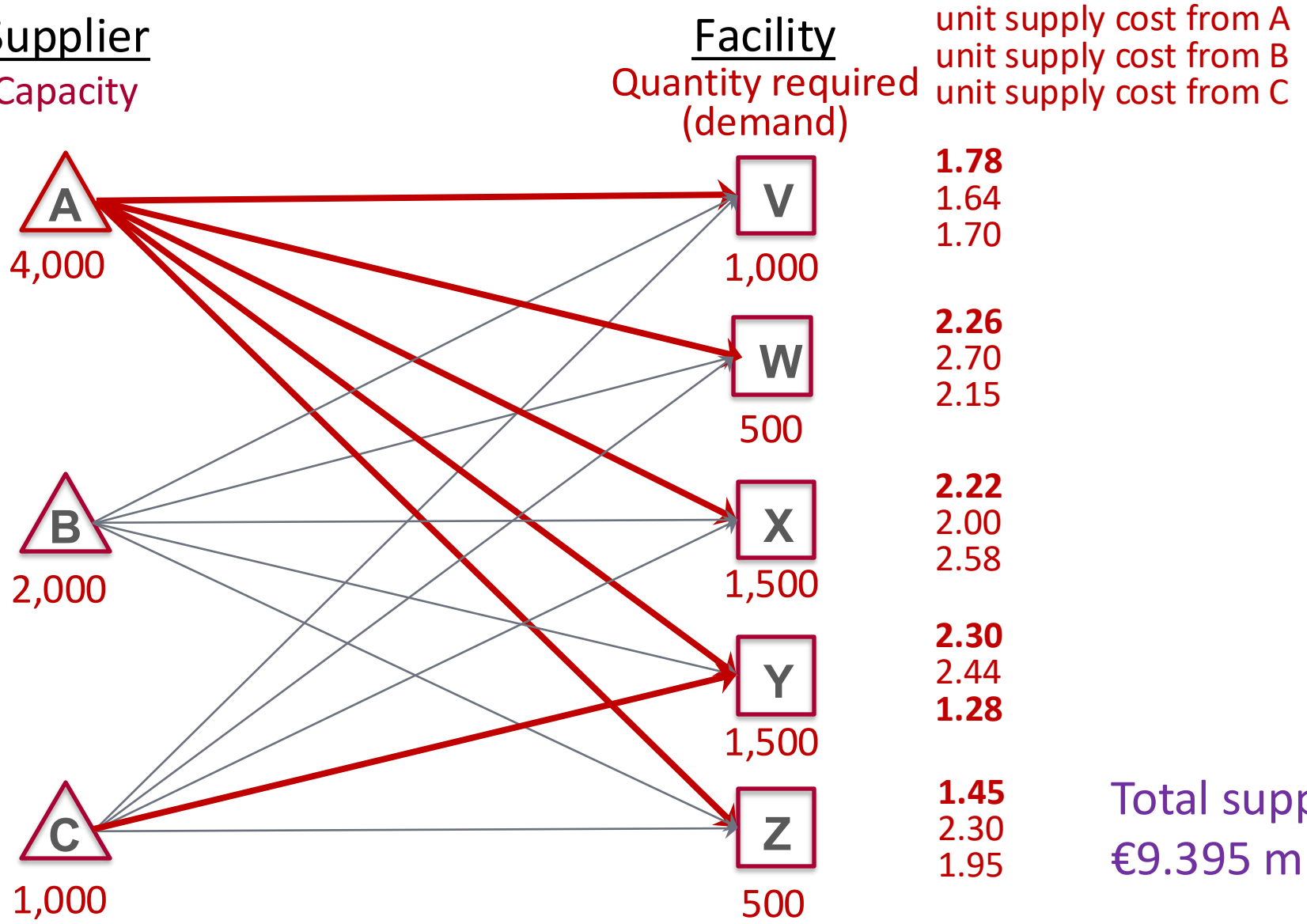
Total Cost	**9,395**	*minimize*

CONSTRAINTS

Supply does not exceed effective capacity
Quantity delivered equals quantity required
Select two suppliers
Nonegativity + binary selection variables

*will be uploaded after class

Proposal 1 Supply Plan



Total supply cost =
€9.395 million

Proposal 2 Formulation – *Will this work?*

minimize

(total supply cost) $1.78\, s_{A,V} + 2.26\, s_{A,W} + \ldots + 1.95\, s_{C,Z}$

subject to

(capacity at A) $s_{A,V} + s_{A,W} + s_{A,X} + s_{A,Y} + s_{A,Z} \le 4{,}000$

(capacity at B) $s_{B,V} + s_{B,W} + s_{B,X} + s_{B,Y} + s_{B,Z} \le 2{,}000$

(capacity at C) $s_{C,V} + s_{C,W} + s_{C,X} + s_{C,Y} + s_{C,Z} \le 1{,}000$

(single sourcing for V) $y_{A,V} + y_{B,V} + y_{C,V} = 1$

(linking constraint for A) $s_{A,V} \le 4{,}000$

(linking constraint for B) $s_{B,V} \le 2{,}000$

(linking constraint for C) $s_{C,V} \le 1{,}000$

(demand at V) $s_{A,V} + s_{B,V} + s_{C,V} \ge 1{,}000$

(demand at W) $s_{A,W} + s_{B,W} + s_{C,W} \ge 500$

(demand at X) $s_{A,X} + s_{B,X} + s_{C,X} \ge 1{,}500$

(demand at Y) $s_{A,Y} + s_{B,Y} + s_{C,Y} \ge 1{,}500$

(demand at Z) $s_{A,Z} + s_{B,Z} + s_{C,Z} \ge 500$

(nonnegativity / binary) $s_{A,V}, s_{A,W}, \ldots, s_{C,Z} \ge 0$; $y_{A,V}, y_{B,V}, y_{C,V}$ are binary

Idea:

$y_{i,V} = 1$ if we use Supplier i to serve Valencia, and 0 if we don't...

Proposal 2 Formulation (Answer)

minimize

(total supply cost) $1.78\, s_{A,V} + 2.26\, s_{A,W} + \ldots + 1.95\, s_{C,Z}$

subject to

(capacity at A) $s_{A,V} + s_{A,W} + s_{A,X} + s_{A,Y} + s_{A,Z} \le 4{,}000$

(capacity at B) $s_{B,V} + s_{B,W} + s_{B,X} + s_{B,Y} + s_{B,Z} \le 2{,}000$

(capacity at C) $s_{C,V} + s_{C,W} + s_{C,X} + s_{C,Y} + s_{C,Z} \le 1{,}000$

(single sourcing for V) $y_{A,V} + y_{B,V} + y_{C,V} = 1$

(linking constraint for A) $s_{A,V} \le 4{,}000\, y_{A,V}$

(linking constraint for B) $s_{B,V} \le 2{,}000\, y_{B,V}$

(linking constraint for C) $s_{C,V} \le 1{,}000\, y_{C,V}$

(demand at V) $s_{A,V} + s_{B,V} + s_{C,V} \ge 1{,}000$

(demand at W) $s_{A,W} + s_{B,W} + s_{C,W} \ge 500$

(demand at X) $s_{A,X} + s_{B,X} + s_{C,X} \ge 1{,}500$

(demand at Y) $s_{A,Y} + s_{B,Y} + s_{C,Y} \ge 1{,}500$

(demand at Z) $s_{A,Z} + s_{B,Z} + s_{C,Z} \ge 500$

(nonnegativity / binary) $s_{A,V}, s_{A,W}, \ldots, s_{C,Z} \ge 0$; $y_{A,V}, y_{B,V}, y_{C,V}$ are binary

Idea:

$y_{i,V} = 1$ if we use Supplier i to serve Valencia, and 0 if we don't...

Proposal 2 Spreadsheet Model*

PARAMETERS

Supplier	Cost of supplying 1 ton to Facility					Supplier capacity
	Valencia	**Wiesbaden**	**Xanten**	**York**	**Zaragoza**	
Amadora	1.78	2.26	2.22	2.30	1.45	4,000
Bergamo	1.64	2.70	2.00	2.44	2.30	2,000
Casablanca	1.70	2.15	2.58	1.28	1.95	1,000
Quantity required	1,000	500	1,500	1,500	500	

DECISIONS VARIABLES

From Supplier	To Facility					Quantity supplied	Used to source Valencia?	Valencia demand * binary
	Valencia	**Wiesbaden**	**Xanten**	**York**	**Zaragoza**			
Amadora	**0**	**500**	**500**	**500**	**500**	2,000	**0**	0
Bergamo	**1,000**	**0**	**1,000**	**0**	**0**	2,000	**1**	1000
Casablanca	**0**	**0**	**0**	**1,000**	**0**	1,000	**0**	0
Quantity received	1,000	500	1,500	1,500	500		1	

OBJECTIVE

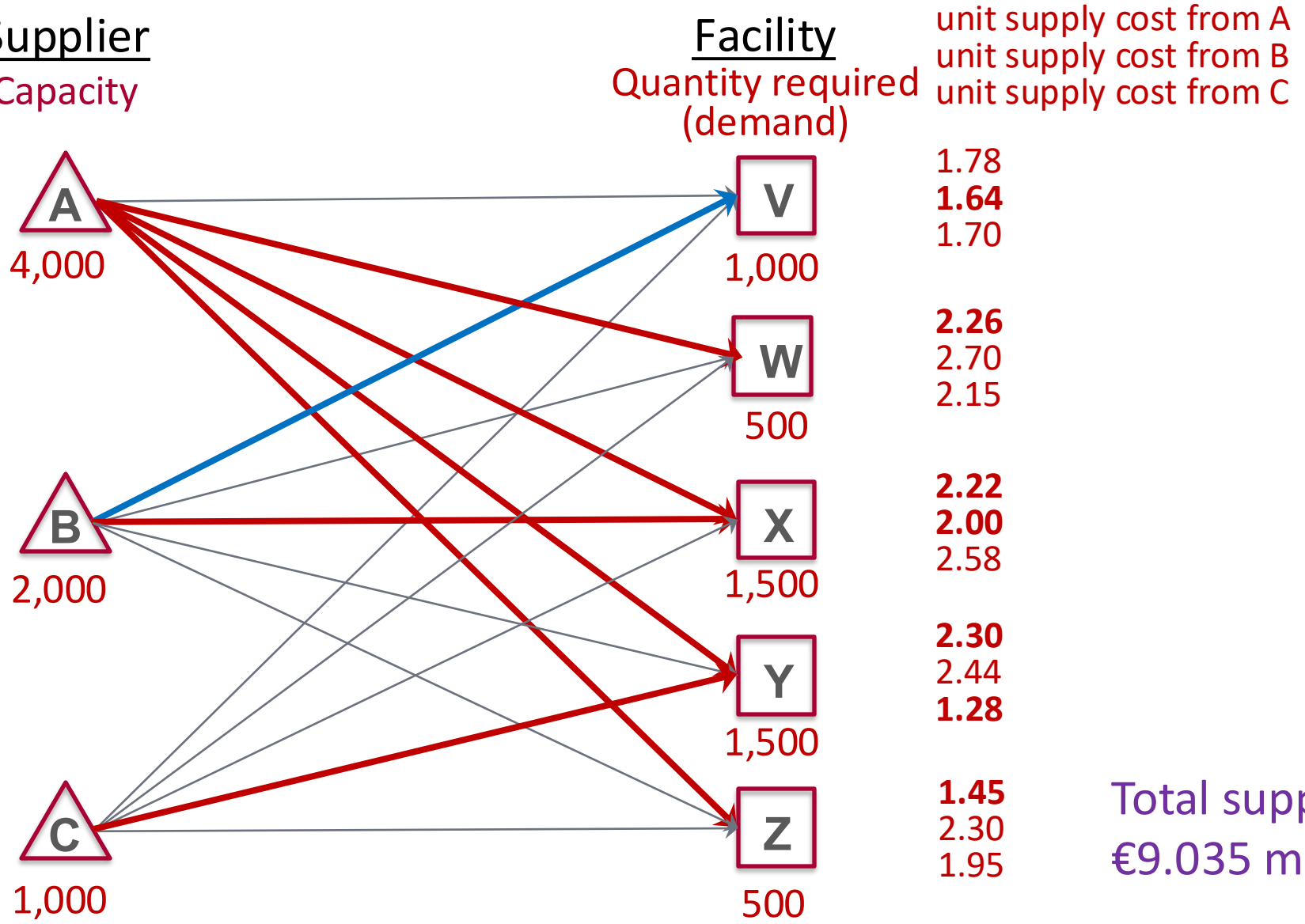
Total Cost	**9,035**	*minimize*

CONSTRAINTS

Supply does not exceed capacity
Quantity delivered equals quantity required
Sum of binaries equals 1 (select only one supplier for location 1)
Cells C12:14 cannot exceed Cells J12:J14
Nonegativity
Binary

*will be uploaded after class

Proposal 2 Supply Plan



Total supply cost =
€9.035 million

Operational Proposals: Cost Implications Summary

	Without supplier consolidation		With supplier consolidation
Without single sourcing	€8.995 million	*+4.44%* →	€9.395 million
	↓ *+0.44%*		
With single sourcing	€9.035 million		(optional)

Class Exercise 2

Assessing Impact of New Supply Conditions

- Bergamo's Condition: The supplier at **B**ergamo has indicated that a renewal of their supply contract would require a **fixed cost** of €1 million for ordering any amount from the supplier. This is on top of the variable cost.

- Amadora's Condition: The supplier at **A**madora has indicated that a renewal of their supply contract would require a **minimum order quantity** of 3,000 tons.

The retailer's senior management wants to understand the cost implications of each of these two new contract conditions (separate and jointly) in order to inform its contract negotiations