

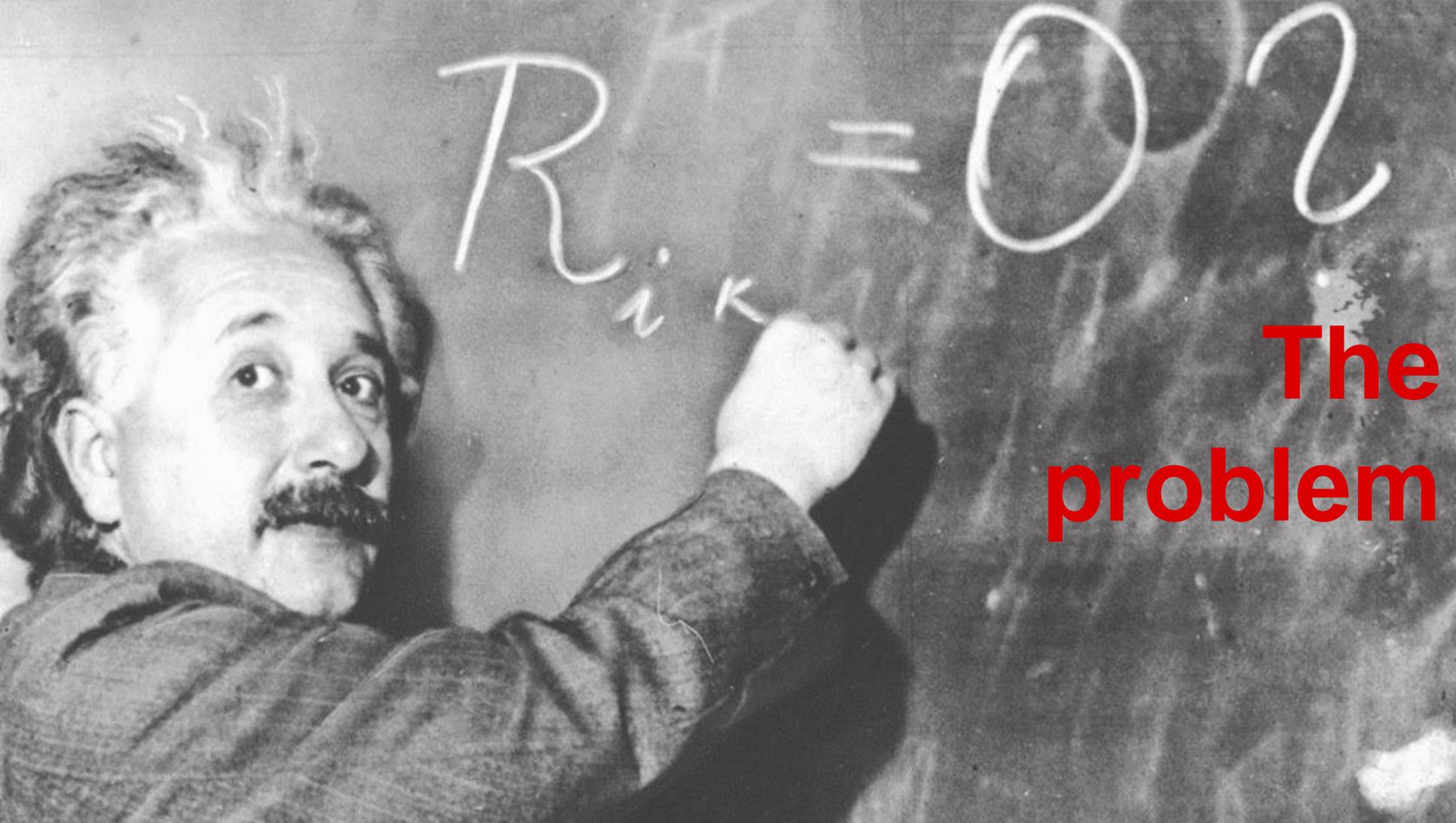
# DEUTSCHES HOLZPROBLEM



# Agenda

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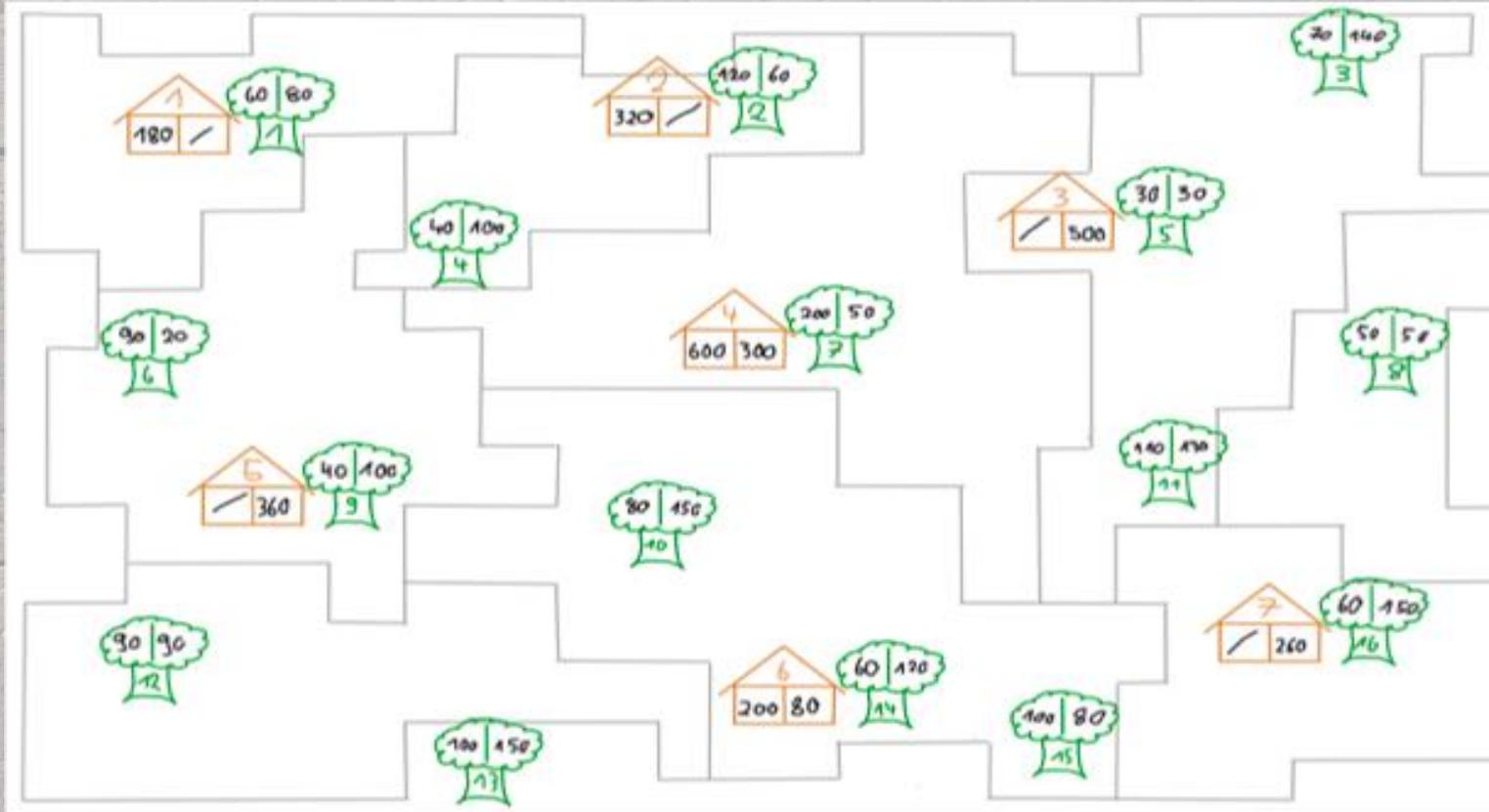
- The problem
- The model
- The results
- The real world application



$$R_{ik} = 0$$

**The  
problem**

# Supply and demand in German logging



**Essentially, a 2-tiered problem**

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**In class terms...**

**beer transportation &  
traveling salesman**

# Step 1. Trees = Beer

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**TYPE 1:**

**High Density**



**TYPE 2:**

**Low Density**



# Sawmills can only process one type

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OR

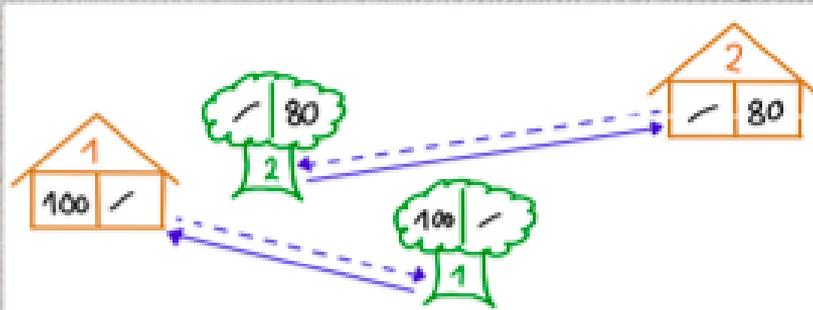


NOT

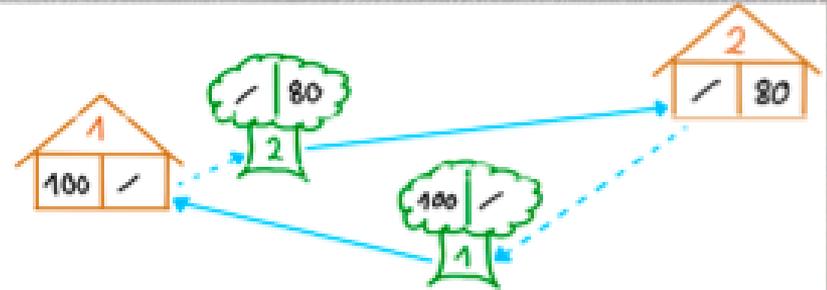


## Step 2. Traveling salesman = German trucker

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**Without**



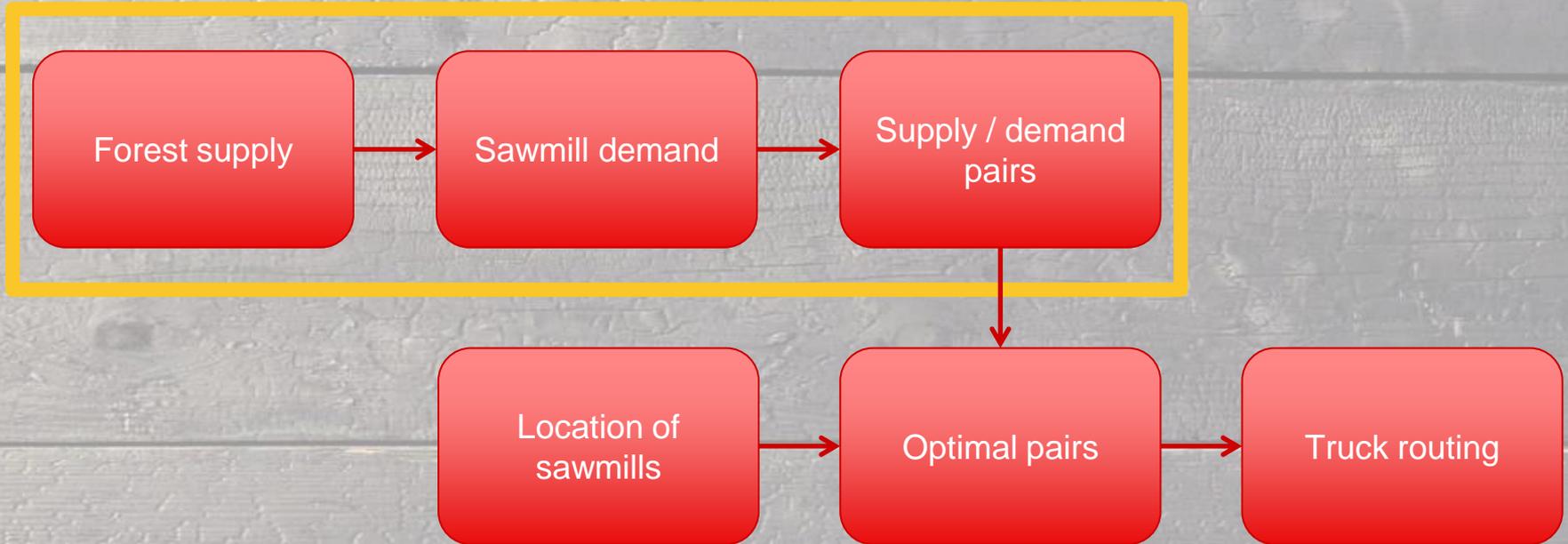
**With**

**The  
model**



# Simultaneous problem solving

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# Initial setup, the six-node map

	1	2	3
1	30 40	30 40	100
2	60	60	60 20

*Legend*

Type 1    Type 2

Supply 1    Supply 2

Demand 1    Demand 2

# Initial setup, the Excel allocation

## Type 1 Timber related

Density

1

### Timber Allocation

		1	1	1	2	2	2	Supply
		1	2	3	1	2	3	
1	1				30	0		30 <= 30
1	2				30	0		30 <= 30
1	3							
2	1							
2	2							
2	3				0	60		60 <= 60
Demand					60	60		>= >=
					60	60		

## Type 2 Timber related

Density

2

		1	1	1	2	2	2	Supply
		1	2	3	1	2	3	
1	1				40			40 <= 40
1	2				40			40 <= 40
1	3							
2	1							
2	2							
2	3				20			20 <= 20
Demand					100			>=
					100			

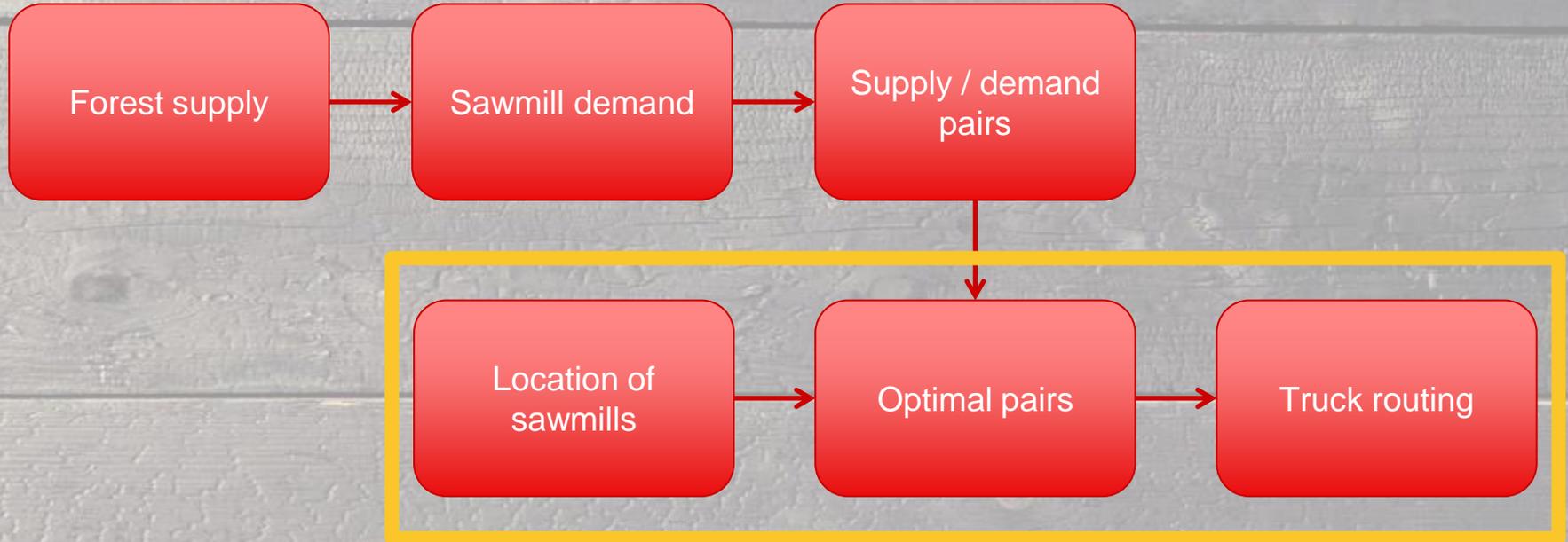
# Constraints for timber allocation

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- **Trees:** Finite supply
- **Mills:** All have minimum demand  $>0$
- **Trucks:** Finite capacity  
Homogeneous  
Limited driving hours

# Simultaneous problem solving

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# Truck routing setup

	1	2	3
1	30 40	30 40	100
2	60	60	20

Diagram illustrating truck routing setup. A 2x3 grid shows quantities at Mill [1,3]. Red arrows indicate flow: 30 units from (1,2) to (1,1), 40 units from (1,2) to (1,3), 60 units from (1,3) to (2,3), and 60 units from (2,3) to (2,2).

## Truck #1 Routing (located at Mill [1,3])

		<i>General Routing</i>								
80.0		1	1	1	2	2	2	1	>=	1
		1	2	3	1	2	3			
1	1			0	0	0		0	=	0
1	2			1	0	0		1	=	1
1	3	0	0				1	1	=	1
2	1	0	0				0	0	=	0
2	2	0	1				0	1	=	1
2	3			0	0	1		1	=	1
		0	1	1	0	1	1			

# Constraints for truck routing

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- **Valid routes:**  
# times arrive = # times leave each mill
- **No subtours**
- **Come home:**  
Trucks must return to home depot<sup>TM</sup>

**The  
results**



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**With cooperation, trucks  
drive 417 miles ... as  
compared to 845 miles if  
they had not cooperated**

A grayscale photograph of a forest with a misty atmosphere. Tall, slender trees line a path that leads into the distance. The ground is covered with grass and low-lying vegetation. The overall mood is serene and slightly mysterious.

**The  
real world application**