



Input-Output analysis and modelling with MARIO

Hands-on 3 – Foundations of Input-Output Analysis

Please, be aware that all the supporting materials required for this hands-on session is available on Zenodo at the following link: <https://doi.org/10.5281/zenodo.8308515>



Learning outcomes

By the end of this exercise, you will learn how to:

- 1) Familiarize with fundamental notation.
- 2) Consolidating the basics of Excel's linear algebra functions.
- 3) Understanding the basics of the Input-Output framework.

Important requirement

Please make sure you have Microsoft Excel (or an equivalent alternative) installed on your PC. Use the support Excel file to learn how to use linear algebra in Excel.

Can our industries sustain a conflict?

Knowing that 0.15 kton of steel and 1 M€ of goods and services are needed to produce 1 tank, how much is needed from the whole economy to produce 100 of them?

- Consider an economy with 2 sectors:
- steel sector (producing output measured in kton of steel)
- goods and services sector (producing output measured in M€)

Fill the input-output table knowing the following pieces of information:

To produce 1 kton of steel 0.07 kton of steel and 1 M€ of goods and services are needed plus the work of 10 employees.

To produce 1 M€ of goods and service 0.05 kton of steel and 0.2 M€ of goods and services are needed plus the work of 100 employees.

- 1) Be sure you understand the meaning of every cell of the input-output system.
- 2) Can you demonstrate empirically the following?

$$\mathbf{w} = \mathbf{I} + \mathbf{z} + \mathbf{z}\mathbf{z} + \mathbf{z}\mathbf{z}\mathbf{z} + \dots = \sum_{t=0}^{+\infty} \mathbf{z}^t = (\mathbf{I} - \mathbf{z})^{-1}$$

- 3) Compute the total production from each sector of the economy.
- 4) Can you demonstrate empirically the following?

SOLUTION

1) Be sure you understand the meaning of every cell of the input-output system

First of all, the system must be represented in an input-output fashion.

Sectors	Unit of measure	code	S	G&S	Final demand
			kton steel	M€ goods	
Steel	kton of steel/...	S	0.07	0.05	15.0
Goods and Services	M€ of goods/...	G&S	1.00	0.20	100
Satellite account	Unit of measure	code			
Workers	# of workers/...	L	10.0	18	

Get familiar with how to read an input-output system.

	Sector A	Sector B	Sector C	Final Demand
Sector A	Where is this sector's output flowing?			
Sector B				
Sector C				

- Column sum: reading by row tells us **where the output is flowing**

	Sector A	Sector B	Sector C	Final Demand
Sector A		What does this sector need for producing its output?		What do final consumers need?
Sector B				
Sector C				

- Row sum: reading by column tells us **what is needed by the intermediate or final consumers**

2) Compute the total production from each sector of the economy.

The series can be computed to a sufficiently high order.

Demonstrating		IY	zY	zzY	zzzY	zzzzY	zzzzzY	Column sum
$w = I + z + zz + zzz + \dots = \sum_{t=0}^{+\infty} z^t = (I - z)^{-1}$	S	15.0	6.05	2.17	0.80	0.30	0.11	24.4
	G&S	100	35.0	13.1	4.78	1.76	0.65	155.2

This empirical approximated result can be compared with the analytical representation of the Leontief matrix.

3) Compute the total production from each sector of the economy.

Production

$$\begin{matrix} 24.5 \\ 155.6 \end{matrix} X = (I - z)^{-1} Y$$

4) Compute the total the total sectoral demand of workers and the total embodiment of workers in the final demand.

2.				$R = r\hat{X}$	
Workers - PBA	# of workers	PBA L	245	2'801	3'046
	kton of steel/...	S	1.15	0.07	$w = (I - z)^{-1}$
	M€ of goods/...	G&S	1.44	1.34	
		r_e	$r_e = rw$		$R = rX$
Workers - CBA	# of workers	CBA L	562	2'484	3'046
			$R_e = r_e \hat{Y} = (rw) \hat{Y}$		