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Data Envelopment Analysis (DEA)

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Data Envelopment Analysis (DEA)

Our aim in Data envelopment analysis (DEA) is to identify so-called effective decision makig units (DMU's).

Units (alternatives) are suppose to have some know inputs (cost-type criteria in terms of the previous chapter) and outputs (profit-type criteria).

More precisely, Data Envelopment Analysis (DEA) is a technique used to evaluate the technical efficiency of examined units.

Technical efficiency of DMU's

What do we mean by **technical efficiency**?

Vaguely speaking, we search for units which achieve the best outputs at the smallest inputs.

The question is how to measure inputs and outputs in the case when there is more inputs and more outputs.

History of DEA

Data envelopment analysis (DEA) also called frontier analysis, was first put forward by Charnes, Cooper and Rhodes in 1978. Since the technique was first proposed much theoretical and empirical work has been done. Many studies have been published dealing with applying DEA in real-world situations.

What is DEA?

It is a performance measurement technique which can be used for evaluating the relative efficiency of decision-making units (DMU's) in organisations. A DMU is a distinct unit within an organisation that has flexibility with respect to some of the decisions it makes, but not necessarily complete freedom with respect to these decisions.

By this technic, we can typically evaluate activities of bank branches, hospitals, tax offices, departments of some company, schools and university departments, government institutions and so on. To use this technic, we need to have several comparable units evaluated in several inputs (at least in one) and several outputs (at least in one). Then we can run DEA and answer the question, which of the units are effective and what should improve the non-effective ones to become effective.

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Prototype example

The business chain has eight branches. For each branch, we know the number of employees and daily sales (in 10 thousand CzK), see the following table.

Branch	A	B	C	D	E	F	G	H
N. of employees (x)	2	2	3	4	5	5	6	8
Sales (y)	1	4	2	3	4	2	3	5

Which branch is effective and which need some improvements?

Ratios

Rations are commonly used methods, however in 1-1 case it is the easiest to use it. Because there is no doubt how to measure input and how to measure output – since we have only one input and one output, we just compare the ratios of outputs and inputs It is clear that the bigger number means more efficient DMU.
Hence in our example we have:

Branch	A	B	C	D	E	F	G	H
output/input	1/2	2	2/3	3/4	4/5	2/5	1/2	5/8

Relative efficiency with respect to unit B

To compute relative efficiency we divide the ratio for any branch by 2 (the value for the best unit – B) and multiply it by 100 to convert to a percentage.
SO, in our example we get:

Branch	Relative efficiency
A	$100(0.5/2) = 25\%$
B	$100(2/2) = 100\%$
C	$100(0.666/2) = 33.33\%$
D	$100(0.75/2) = 0.475\%$
E	$100(0.8/2) = 40\%$
F	$100(0.4/2) = 20\%$
G	$100(0.5/2) = 25\%$
H	$100(0.625/2) = 31.25\%$

DEA - 1 input - 1 output problem