Ranking of Belarusian Universities: Application of Data Envelopment Analysis

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Structure

Academic rankings: trends

- Individual researchers[1]
- Departments[2]
- Universities[3]

[1] Coupé (2003), Cribari-Neto et al. (1999), Combes and Linnemer (2003)
[2] Coupé (2003), Dusansky and Vernon (1998), Lubrano et al. (2003)
[3] Turner (2008), Rodgers and Valadkhani (2006)

Academic rankings: methodology

The main approach in applied studies is **weighted convolution** of criteria

Major shortcomings:

- Mixture of inputs and outputs[4]
- Unclear or arguable weighting scheme[5]
- Unaccounted scale effects[4]
- Absence or facilitation of classification procedure

[4] Academic Ranking of World Universities — `http://www.arwu.org`

[5] US News & World Report — `http://www.usnews.com/sections/rankings/`

Rankings and Productivity Analysis[8]

$$\text{Inputs} \longrightarrow \text{DMU} \longrightarrow \text{Outputs}$$

Approaches:

- Data Envelopment Analysis[6] (DEA)
- Stochastic Frontier Analysis[7] (SFA)

[6] Charnes et al. (1978), Banker et al. (1984)
[7] Aigner and Lovell (1977)
[8] Koopmans (1951), Farrell (1957)

Data Envelopment Analysis

Advantages:

- Multiply inputs — multiply outputs specification
- No assumption on functional form of production function
- Easy to interpret scores
- Weighted convolution is a special case of DEA
- Classification tools[9]

Shortcomings:

- Lack of statistical tools
- Sensitivity to outliers

[9] Bougnol and Dulá (2006)

The objectives of the reseach

1. Evaluation of pure technical efficiency of Belarusian universities
2. Construction of the ranking
3. Comparing the results to existing literature[10]

[10] Abbott and Doucouliagos (2003), Johnes (2006)

Structure

DEA: Technical efficiency

$$\text{Efficiency} = \theta = \frac{v_1 \text{Output}_1 + \ldots + v_m \text{Output}_m}{u_1 \text{Input}_1 + \ldots + u_s \text{Input}_s}$$

DEA: Technical efficiency

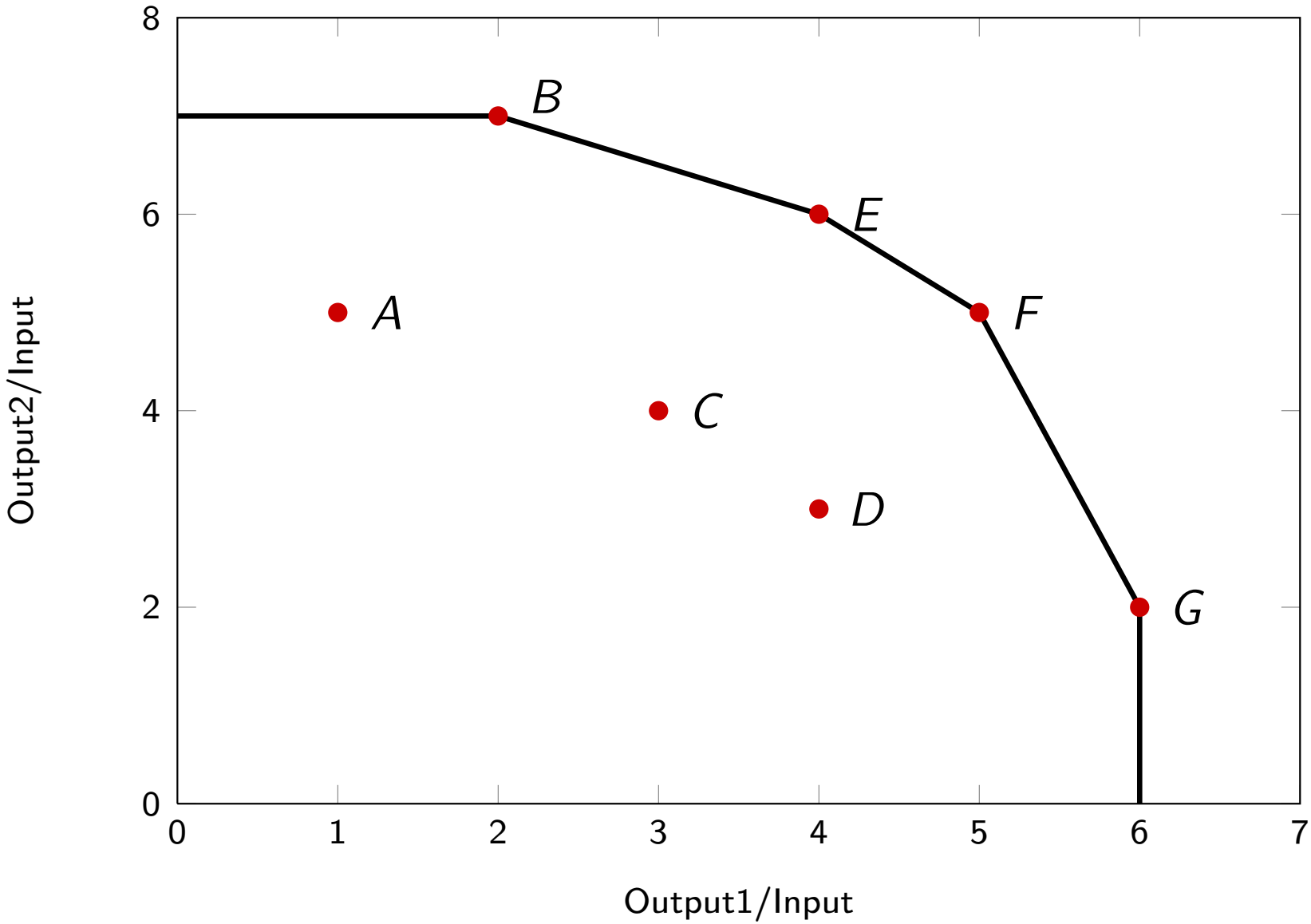
$$\theta \underset{\theta,\lambda}{\longrightarrow} \min$$

subject to

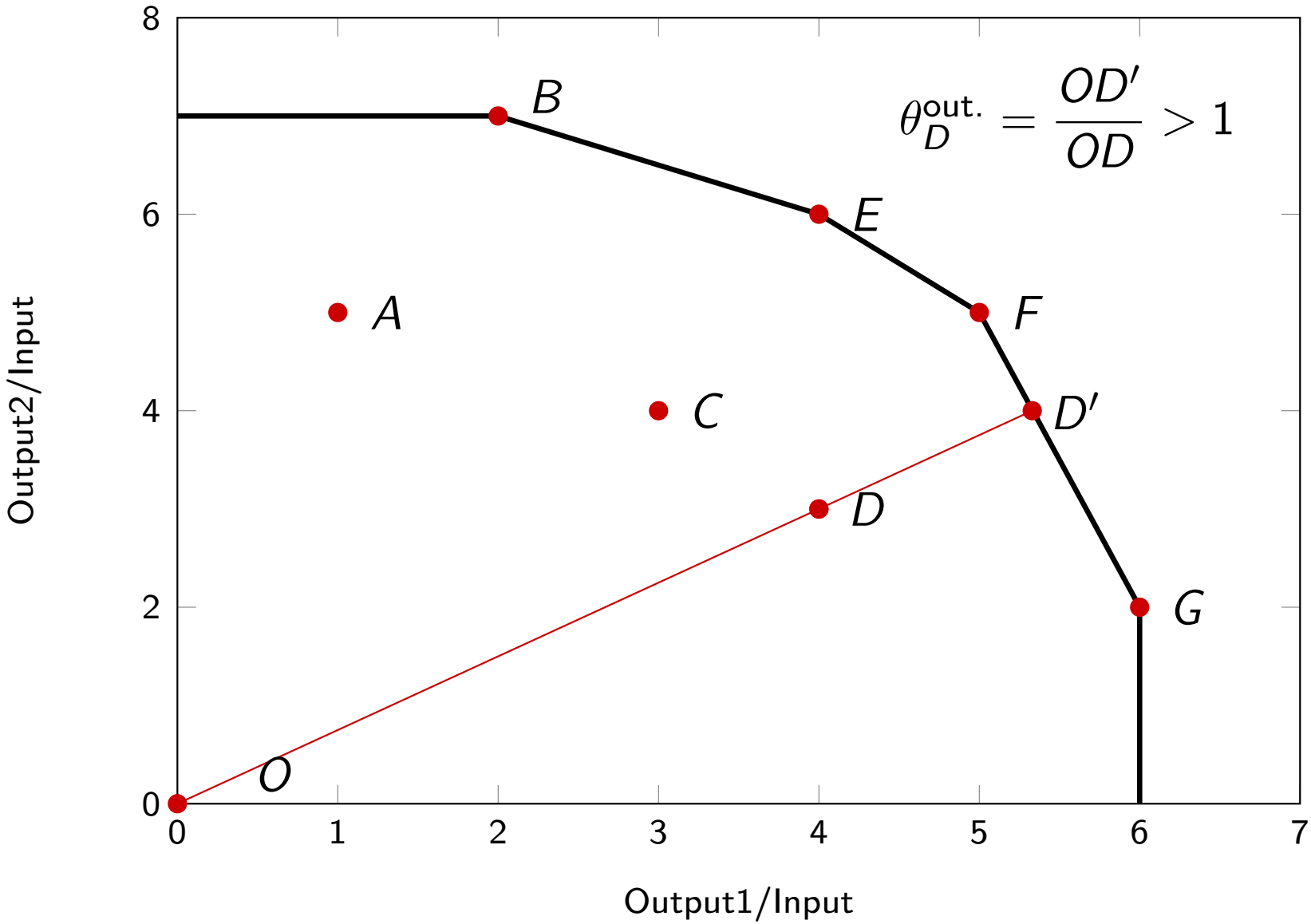
$$\begin{aligned} \theta x_0 - X\lambda &\geq 0 \\ Y\lambda &\geq y_0 \\ e\lambda &= 1 \\ \lambda &\geq 0 \end{aligned}$$

θ — efficiency; λ — optimal weights; X — inputs; Y — outputs; (x_0, y_0) — data of DMU; e — unity vector.

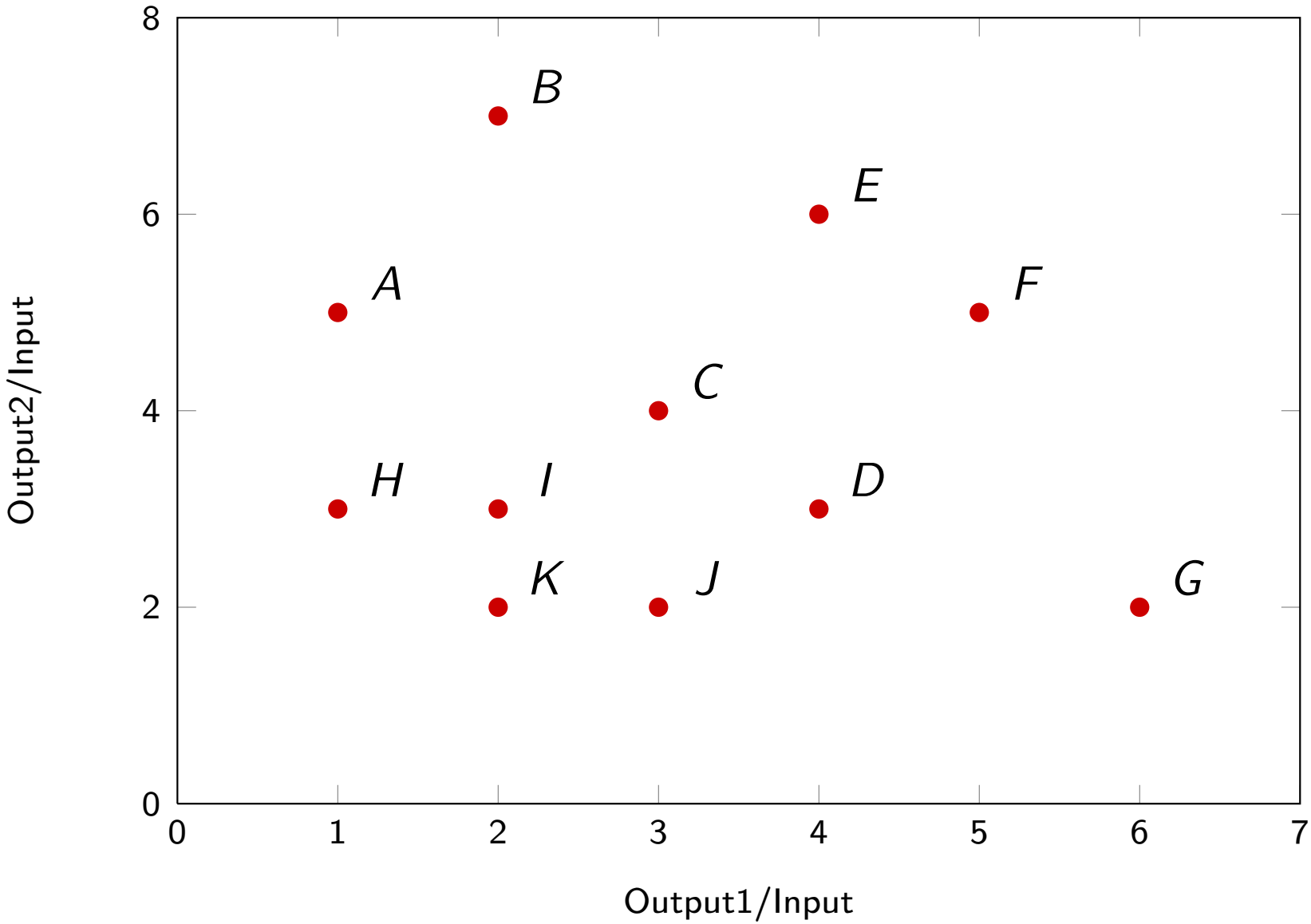
DEA: Technical efficiency



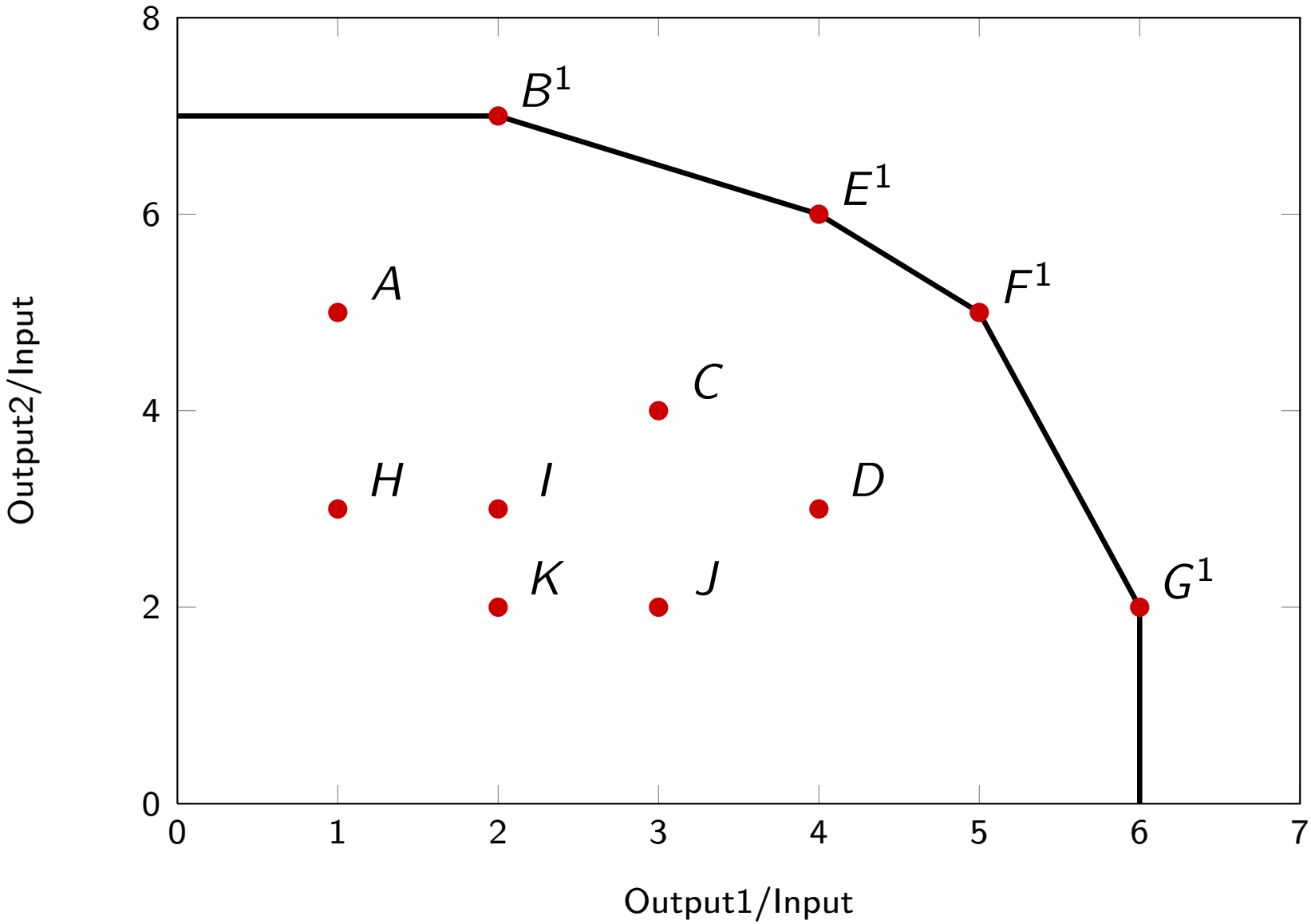
DEA: Technical efficiency



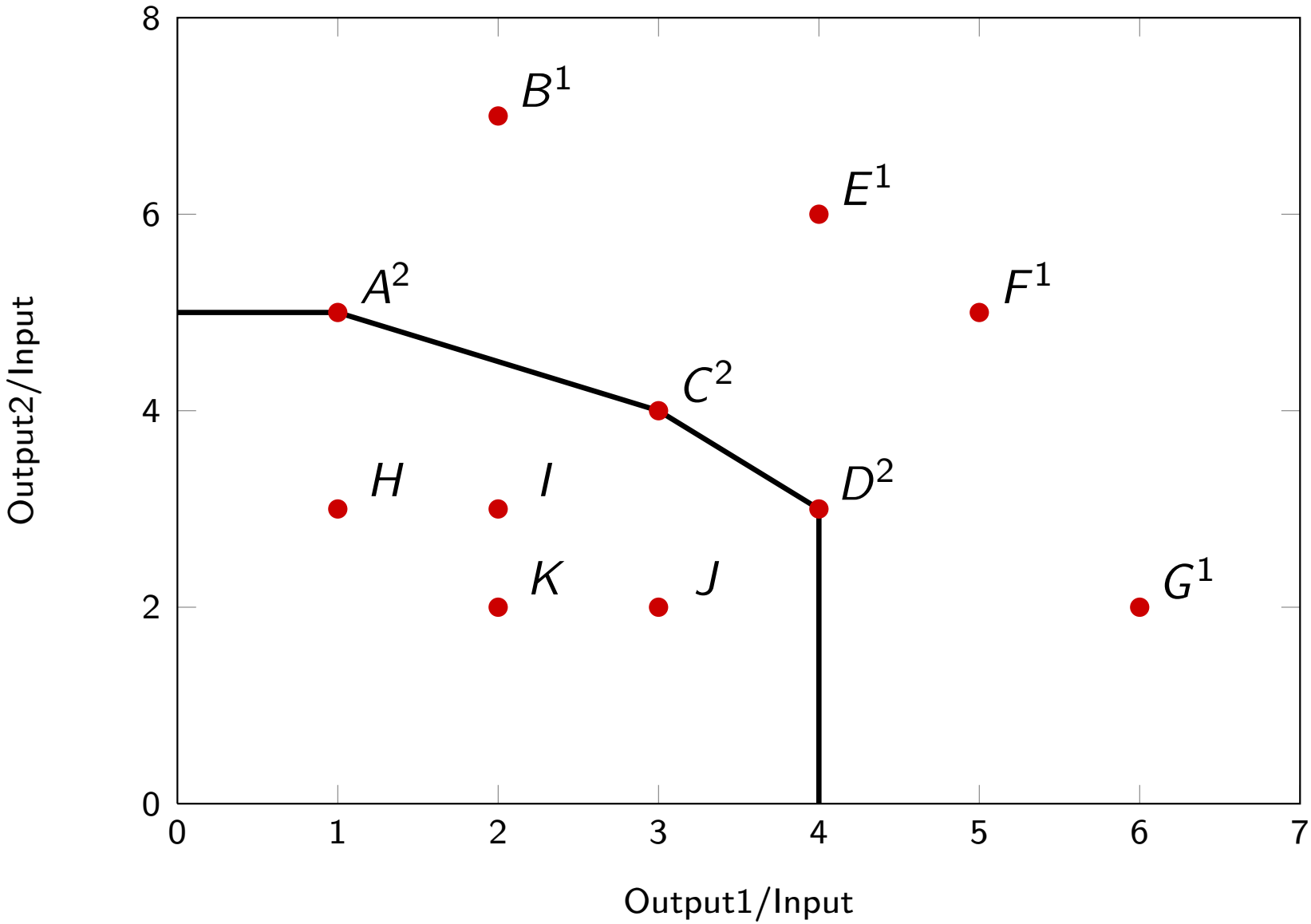
DEA: Stratification



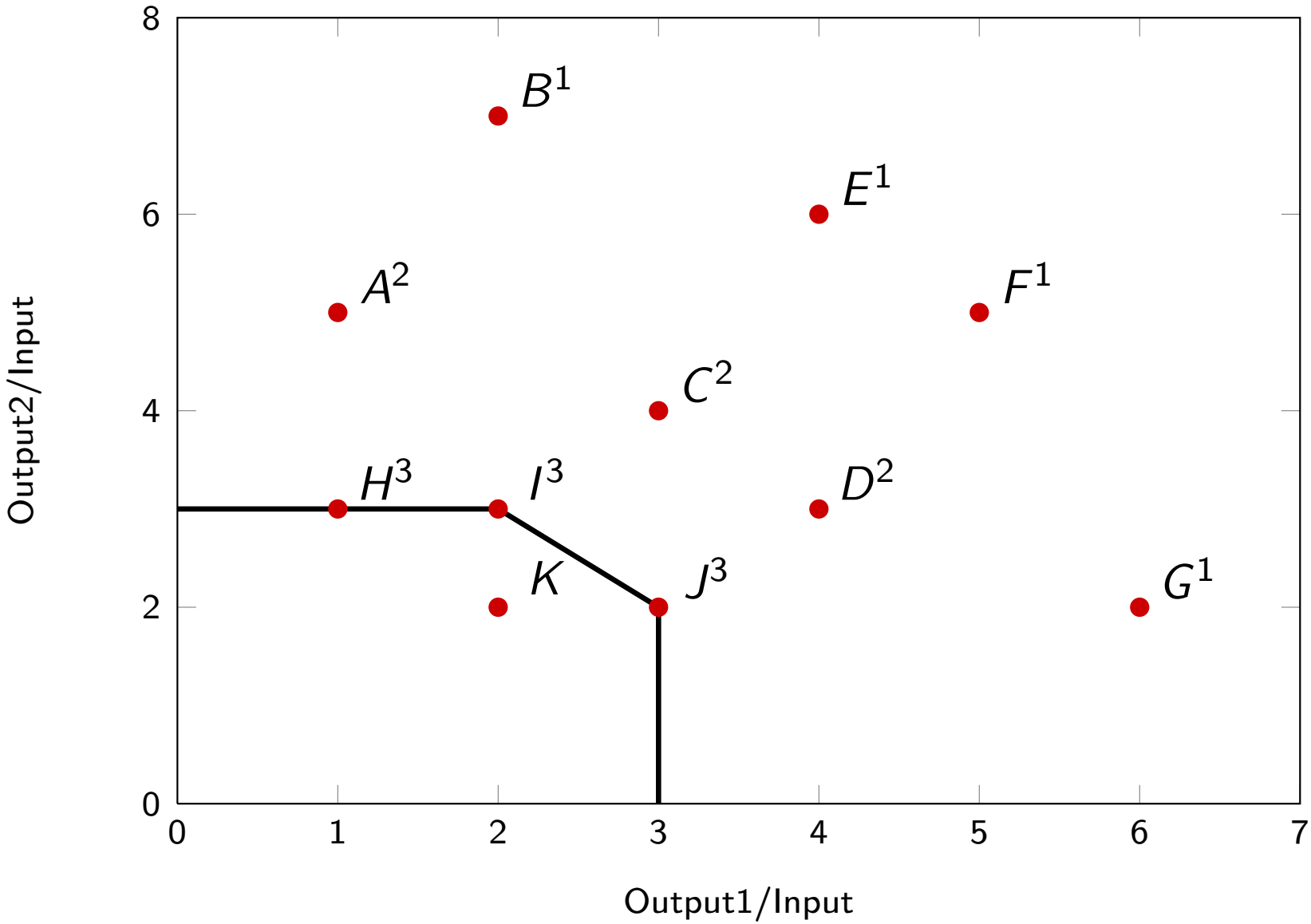
DEA: Stratification



DEA: Stratification



DEA: Stratification



Structure

Data description[11]

Variable	Mean	Median	Max	Min	St.dev.
Inputs (m=4)					
TEACHERS	413	318	1 826	35	358
STUDENTS	4 686	3 608	20 955	284	4 200
SPACE	18 733	13 196	84 347	2 075	17 971
EXPENDITURES	3 380	1 897	29 659	174	5 670
Outputs (s=2)					
GRADUATES	925	778	4 182	58	894
PUBLICATIONS	372	150	4 197	3	665

[11] Ministry of Education Statistical Yearbook(2003)

Structure

Major results

Efficiency	Number of universities
0.8-1	12
0.6-0.8	15
0.4-0.6	25

Major results

Strata	University
1	БГПУ, БГТУ, БГУ, МГЭУ, БГЭУ, БрГУ, БТЭУПК, КИИМЧС, МГВАК, МИУ
2	АМВДРБ, БГМУ, БГУИР, БГУК, БИП, ВГВАМ, ВГКС, ВГТУ, ВГУ, ГрГУ, ИСЗ, МГПУ, МГЭИ, ПГУ, ЧИУП
3	АУПРБ, БарГУ, БГАФК, БНТУ, БРУ, ВАРБ, ВГМУ, ГГТУ, ГГУ, ИПД, МИТСО
4	БГАТУ, БГВРК, БГУТ, БрГТУ, ГрГАУ, ГрГМУ, МГУ, МГУП
5	БГАИ, БГАМ, БГСА, ГГМУ, ИПП, Энвила

Thank you for your attention!

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