

**國立臺北大學自然資源與環境管理研究所**  
**107 學年度第二學期 『環境系統分析專題』**

課程講義(07)：績效評估與資料包絡分析  
 Performance Evaluation and Data Envelopment Analysis

• DATA ENVELOPMENT ANALYSIS

- Performance, Efficiency, and Productivity => Intensity
  - ⇒ CP 值 (Cost-Performance value)、BC Ratio (Benefit/Cost)、資源/能源生產力、Eco-Efficiency
  - ⇒ 效率評估方法：平衡計分卡 (Balance Score Card, BSC)、比例分析法 (Ratio Analysis)、迴歸分析法 (Regression Analysis)、財務比率分析法、多準則評估法、生產力及生產效率分析法、資料包絡分析法 (<http://www.wunan.com.tw/www2/download/preview/1FQF.PDF>)
- Total Factor Productivity (TFP) vs. Production Possibility Set (PPS)
- Key Components of the Data Envelopment Analysis (DEA)
  - ⇒ Decision Making Unit (DMU) => Technical vs. Scale Efficiencies; Reference (Peer) DMU
  - ⇒ Inputs and Outputs => Formulation Orientations => Returns to Scale
- Formulations of the Charnes, Cooper, and Rhodes (CCR) DEA Model

**Table 1.1** CCR DEA model

Input-oriented Envelopment model	Multiplier model
$\min \theta - \varepsilon \left( \sum_{i=1}^m s_i^- + \sum_{r=1}^s s_r^+ \right)$ <p>subject to</p> $\sum_{j=1}^n x_{ij} \lambda_j + s_i^- = \theta x_{io} \quad i = 1, 2, \dots, m;$ $\sum_{j=1}^n y_{rj} \lambda_j - s_r^+ = y_{ro} \quad r = 1, 2, \dots, s;$ $\lambda_j \geq 0 \quad j = 1, 2, \dots, n$	$\max z = \sum_{r=1}^s \mu_r y_{ro}$ <p>subject to</p> $\sum_{r=1}^s \mu_r y_{rj} - \sum_{i=1}^m v_i x_{ij} \leq 0$ $\sum_{i=1}^m v_i x_{io} = 1$ $\mu_r, v_i \geq \varepsilon > 0$

(Cooper et al., 2011, Table 1.1, p.13)

- Variable Return to Scale (VRS) => Banker, Charnes, and Cooper (BBC) Model
  - Malmquist Productivity Indexes and DEA
  - [Ehrlich and Holdren \(1971\)](#) Impact Equation (I=PAT) and Kaya Identity
    - ⇒ Human impact on the environment (I): Population (P), Affluence (A) and Technology (T)
    - ⇒ Affluence (A): Per capita GDP; Technology (T): Emissions/GDP=> intensity
    - ⇒ [Simplified Kaya Identity: CO<sub>2</sub> = GDP×\(Energy/GDP\)×\(CO<sub>2</sub>/Energy\)](#)
- HOMEWORK #3 (2019/04/23 Due) : Solve the second example (7 DMUs with 2 inputs) presented by **Liu** using What'sBest, LINGO, and Open Source DEA. After finding the efficient frontier, please use Microsoft Excel to illustrate the results.