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(02)：課程與應用軟體簡介；環境系統、模式與量化指標
Introduction; Software Applications; Environmental Systems, Modeling, and Indicators

- THE COURSE
  - Handout Download: http://web.ntpu.edu.tw/~yml/download/system2019s
    https://www.box.com/ntpu-inrm-prof-lee-classes => system2019s
  - Content ⇒ Systems Analysis Models and Applications Concerning the *Environment*
    - ⇨ Systems vs. Systems Analysis
    - ⇨ Systems Analysis vs. Operations Research (Operational Research)
    - ⇨ Systems Analysis vs. System Simulation
    - ⇨ Systems Thinking and System Dynamics
    - ⇨ Programming vs. Planning => Simulation and Optimization
    - ⇨ Conceptual models => Mathematical models => Simulation/Optimization models
  - Mathematical Models (Quantitative Models)
    - ⇨ Classification: Prescriptive vs. Descriptive; Deterministic vs. Stochastic
    - ⇨ Solution Techniques: Symbolic/Graphical Interpretation; Analytical vs. Numerical
    - ⇨ Algorithms, Numerical Methods => Linearity, Convexity, and Complexity
  - Computer Applications
    - ⇨ Command Line Interface vs. Graphical User Interface (GUI)
    - ⇨ Imperative Programming vs. Object Oriented Programming
    - ⇨ Commercial Packages vs. GNU General Public License; Open Source & Open Data
    - ⇨ Cloud Computation and Cloud Storage

- SOFTWARE TO BE COVERED
  - Microsoft Office Applications: Excel, Visio, and Project
  - LINGO (LINDO System's Product): "LINGO is a comprehensive tool designed to make building and solving linear, nonlinear and integer optimization models faster, easier and more efficient." (v.18.0 64bit 32bit)
  - What'sBest! (LINDO System's Product) is an add-in to Excel that allows you to build large scale optimization models in a free form layout within a spreadsheet. (v.16.0 64bit 32bit)
  - EULER: "EULER is a numerical matrix system. It is not a MatLab clone, but very similar to that."
  - Open Source DEA (OSDEA GUI): A free and open source Data Envelopment Analysis Software.
  - FreeMind /Freeplane: free mind mapping software.
  - Vensim (Vensim from Ventana Systems): "Vensim is used for developing, analyzing, and packaging high quality dynamic feedback models."
  - Stella (isee Systems): "STELLA offers a practical way to dynamically visualize and communicate how complex systems and ideas really work."
  - ExpertChoice: A decision support software using Analytical Hierarchy Process (AHP)
  - Super Decisions: Decision support software that implements the AHP and ANP.

- ENVIRONMENTAL SYSTEMS ANALYSIS: MODELING AND DECISION MAKING
  - Environmental Systems and Environmental Modeling
    - ⇨ A **system** is composed of interrelated components, connected together in order to facilitate information, matter and energy flows.
    - ⇨ **Modeling** can be defined as the process of application of fundamental knowledge or experience to simulate or describe the performance of a real system to achieve certain goals.
    - ⇨ Physical modeling, Empirical modeling, and Mathematical modeling
    - ⇨ **Environmental Systems**: Ecological/Biological, Chemical (Engineering) and Socio-Economical Phenomena/Processes
    - ⇨ **Environmental Modeling** => *e.g.*, Streeter-Phelps Equation of Oxygen Sag Curve
  - Environmental Systems Analysis and Environmental Informatics (Environmatics)
    - ⇨ **Environmental Systems Analysis**: Applications of system approaches to dealing with problems/issues of environmental modeling and decision making
    - ⇨ **Environmental Informatics** is a part of applied Informatics and supports methods and procedures of information technologies that contribute to environmental data analysis and environmental protection.
    - ⇨ **Environmental Data**: Cross section, Time series, Spatial data, Panel data
    - ⇨ Topics of environmental informatics:
      - Data capture and data storage
      - Methods of environmental sampling
      - Environmental data analysis
      - Environmental statistics
      - Environmental time series
      - Environmental simulation models
      - Decision support systems
      - Geographic information system

- INDICATOR, INDEX AND METRIC SYSTEM
  - Metric System: Performance, Benchmarking, Indicator, and Index
    - ⇨ Index, Sub-indices, and Indicators
  - OECD *Handbook on Constructing Composite Indicators: Methodology and User Guide*
    - ⇨ Composite indicators which compare country performance are increasingly recognised as a useful tool in policy analysis and public communication.
    - ⇨ The construction of composite indicators:
      1. Theoretical framework
      2. Data selection
      3. Imputation of missing data
      4. Multivariate analysis
      5. Normalisation
      6. Weighting and aggregation
      7. Robustness and sensitivity
      8. Back to the real data
      9. Links to other variables
      10. Presentation and Visualisation
  - Examples of Index Systems
    - ⇨ Environmental Indices: PSI vs. AQI; RPI vs. WQI => CTSI
    - ⇨ UN Sustainable Development Goals => Goal, Target, Indicator
    - ⇨ Yale University: 2018 Environmental Performance Index
    - ⇨ Germanwatch Climate Change Performance Index 2019
    - ⇨ World Economic Forum (WEF) The Global Risks Report 2019

- Homework Assignment #1 (Reading Assignments)

  請閱讀 OECD (2008) Handbook，並嘗試操作 Normalization and Visualization。