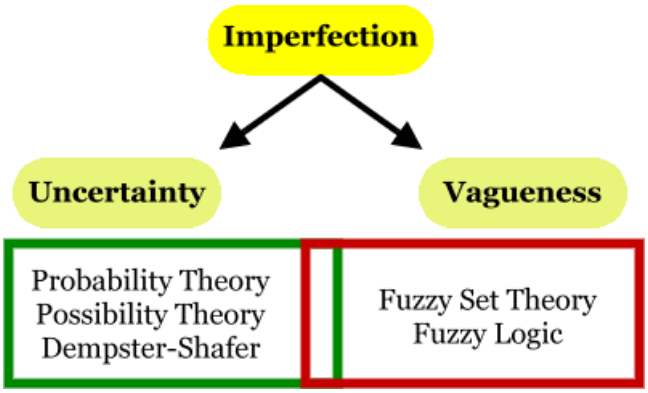
國立臺北大學自然資源與環境管理研究所
九十九學年度第二學期
『環境系統分析』課程講義（八）

進度：模糊理論與灰色系統
Fuzzy Set Theory and Grey System

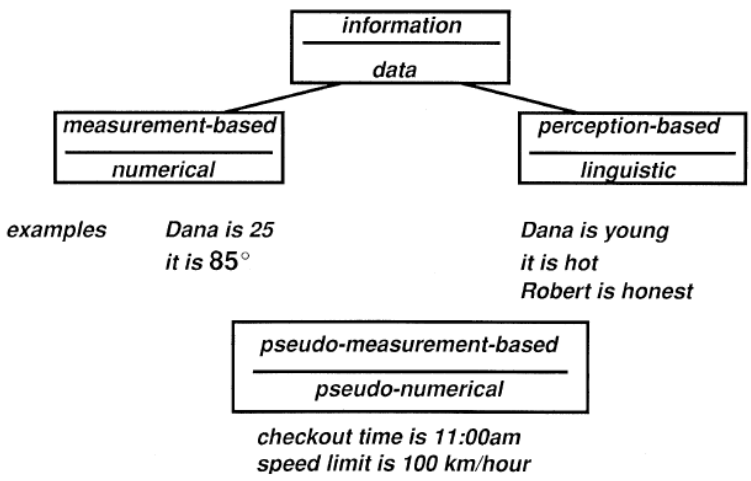
- FUZZY LOGIC AND PROBABILITY THEORY
  - □ Imperfection: Vague (Ill-defined, Fuzzy) Data; Uncertainty (Randomness)
  - □ Fuzzy logic is mainly responsible for representation and processing of vague data.
  - □ Probability theory is mainly responsible for representation and processing of uncertainty.



Imperfection and theories to handle it
(http://pami.uwaterloo.ca/tizhoosh/probability.htm)

Probability Measure	Membership Function
Calculates the probability that an **ill-known variable x** ranging on U hits the **well-known set A**	Calculates the membership of a **well-known variable x** ranging on U hits the **ill-known set A**
Before an event happens	After it happened
Measure Theory	Set Theory
Domain is 2U (Boolean Algebra)	Domain is [0,1]U (Cannot be a Boolean Algebra)

□ Structure of information: measurement-based, perception-based and pseudo-measurement-based information. (Zadeh, 2002)



- FUZZY SETS
  - □ Crisp Sets vs. Fuzzy Sets
  - □ Membership Functions and Properties of Fuzzy Sets
    - ⇨ Membership Functions:

Non-Increasing, Non-Decreasing, Triangular, and Trapezoid
⇨ Properties of Fuzzy Sets?
□ Fuzzy Logics and Fuzzy Control
□ Decision Variables with Vagueness => Fuzzy Programming
□ Fuzzy Granulation => An Emerging Extension

- FUZZY PROGRAMMING
  □ Constraint Fuzziness: Inequities vs. Equations
  □ Fuzziness in Objective Functions: Non-Decreasing and Non-Increasing Functions
  □ Fuzzy Linear Programming
    ⇨ Classification: Symmetric and Non-Symmetric
    ⇨ Assumptions: Linear Membership Functions and Max-Min Operator
    ⇨ Verdegay Approach; Werner Approach; Zimmermann Approach; Chanas Approach

- GREY SYSTEMS
  □ Grey Numbers
    ⇨ Grey Information vs. White Information and Black Information
    ⇨ Intervals => Interval Arithmetic
  □ Grey Systems: Systems with Grey Numbers
  □ Algebra of Grey Numbers and Operators for Grey Numbers
  □ Whitened (Mid-)Value and Grey Width

- GREY LINEAR PROGRAMMING
  □ All of the Decision Variables and Coefficients (Parameters) are Random
  □ Division of the GLP Model
    ⇨ Sign of the Cost Coefficients; Two Sub-Models => Stability

模糊數學（http://www.math.tku.edu.tw/chinese/mathhall/mathinfo/lwymath/chaos.htm）

在人們實際生活中有許多現象本質上就含有某種程度的模糊性，例如考試成績以 60 分為及格，但 59 分與 60 分究竟有多大的差別以致於一分之差就判定 59 分為不及格，如果為了硬要使之精確，未免不符實際，又例如年老高矮大小的概念本身也具有模糊性，你若形容一個 60 歲的人為老人，那 50 歲的人鐵定不是老人，但 59 歲老不老呢？諸如此類的例子實在是不勝枚舉，對於數學而言，人類也逐步意識到傳統數字下的侷限性，如果能把模糊概念的理論應用在數學上，這將使得許多問題的解決獲得突破性的發展，所謂模糊數學就是用數學方法分析與處理模糊性事物的學科。

1965 年美國數學家查統(Zadeh)首先提出模糊集的概念，查氏原來是從事工程控制論的研究，後而轉向研究目標決策的問題，他在長期觀察中感覺到應用傳統數學方法和現代電子計算機在解決決策控制某問題時有其侷限性，如果精確的概念可以用集合來描述，模糊的概念也可以用相對的模糊集合來描述，二十年來的努力這方面的研究已經獲得很好的發展，不但豐富了經典的數學理論，也同時開拓了電子計算機的應用領域，而電子計算機的發展也受到重大的影響，電子計算機對日常的生活的影響自是不可言喻，但即使最先進的計算機也存在一個根本的缺陷，那就是它不具備人腦所特有的模糊推論，模糊決策的能力，不能像人類一樣處理用自然語言表達的知識，不能像人類一樣做近似推論，也不能用自然語言與人對語，如果要求計算機也具備處理模糊信息的能力，將使新的計算機的發展產生推動的作用，新一代的計算機就是智能的計算機。