國立臺北大學自然資源與環境管理研究所

九十七學年度第二學期

『環境災害與風險管理』課程講義（十一）

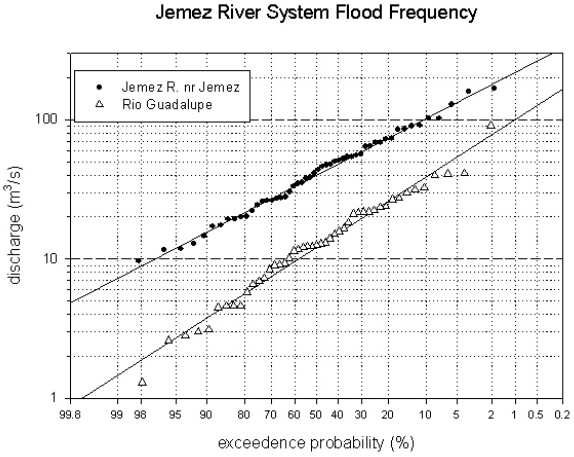
主題：『風險數學』與極值統計

Mathematics of Risk and Statistics of Extremes

- INTRODUCTION
  - Acceptable Risk, Probability of Exceedance, and Extremes
  - Outlier vs. Extremes; Outlier Test (Handout 1; Woodside and Kocurek, 1997)
    - ⇨ Method based on Inter-Quartile Range: $IQR = Q_3 - Q_1$; $Q_1 - 1.5IQR]$ $[Q_3 + 1.5IQR$
    - ⇨ Grubbs' *T* Test; Dixon's Outlier Test
    - ⇨ Youden's Rank Test for Laboratories
  - Extreme Event Analysis and Extreme Value Theory
- FUNDAMENTAL STATISTICS RELATED TO RISK
  - Mode, Mean, Median and Range; Higher Order Moments
  - Outliers vs. Extremes; Risk, Safety and Reliability
  - Normal Distribution and 6-Sigma (Handout 2)
  - Markov Chain and Bayesian Analysis
- STATISTICS OF EXTREMES
  - What are Extreme Value Statistics (http://www.assessment.ucar.edu/toolkit/index.html)

    Extreme value statistics are used primarily to quantify the stochastic behavior of a process at unusually large (or small) values. Particularly, such analyses usually require estimation of the probability of events that are more extreme than any previously observed.

    Many fields have begun to use extreme value theory and some have been using it for a very long time including meteorology, hydrology, finance and ocean wave modeling to name just a few. One example of an application of this theory involves risk assessment for, say, an insurance company. If too many large claims were to occur at the same time, such a company might not have sufficient funds to handle all of them. This could be devastating to the company as well as to the insured whose claims could not be met. Such a scenario is a possible outcome of an extreme event such as a hurricane, earthquake, flood or other large natural disaster. Therefore, it is often of interest to such companies to know the likelihood of such an extreme event occurring within the next 10, 50 or 100 years.
  - A Generic Approach (Handout 3；李光敦)
    - ⇨ Weibul Plotting Position
    - ⇨ Return Period vs. Design Flood
    - ⇨ Two Examples (Bestfit and Sigmaplot)
  - Statistics of extremes in hydrology



- Homework #4 (May 27, 2009 due): 請至 http://water.usgs.gov/nwis/peak 下載美國重要河川之年最大流量（請考量樣本數），並利用點繪法或 Bestfit 分析機率分配模型，以求取 200 年頻率年之最大流量。