

國立臺北大學自然資源與環境管理研究所

110 學年度第二學期『環境災害與風險管理』

課程講義 (06)：風險評估數學概要與極值統計學

Introduction to Mathematics for Risk Analysis and Statistics of Extremes

● INTRODUCTION

- Observed Values of Concern: Near-normal vs. Extreme Conditions
- Acceptable Risk, Probability of Exceedance, and Extremes
- Fundamental Statistics related to Risk
 - ⇒ Mode, Mean, Median and Range; Higher Order Moments
 - ⇒ Normal Distribution and 6-Sigma => Standard Deviation, Normality => Log-Normal
 - ⇒ Value at Risk (VaR): Originally VaR was intended to measure the risks in derivatives markets. Currently VaR is widely applied in financial institutions to measure all kinds of financial risks
- Outlier vs. Extremes; Outlier Test
 - ⇒ [Method based on Inter-Quartile Range](#): $IQR = Q_3 - Q_1$; $Q_1 - 1.5IQR$ [$Q_3 + 1.5IQR$]
 - ⇒ Box plot / Boxplot / Box-and-whisker plot / Box-and-whisker diagram 盒鬚圖 / 箱型圖
 - ⇒ [Grubbs' T Test](#); [Hampel's Test](#); [Dixon's Outlier Test](#)

● STATISTICS OF EXTREMES / EXTREME VALUE THEORY

□ [What is Extreme Value Theory \(EVT\)](#)

Statistical Theory concerning extreme values- values occurring at the tails of a probability distribution. Society, ecosystems, etc. tend to adapt to routine, near-normal conditions: these conditions tend to produce fairly minimal impacts. In contrast, unusual and extreme conditions tend to have much more substantial net impacts despite, by definition, occurring a much smaller proportion of the time.

□ [An Introduction to Extreme Value Theory](#)

- ⇒ Finance; Hydrology; Meteorology
- ⇒ Central Limit Theorem vs. Fisher-Tippett theorem

□ Statistical Distribution

- ⇒ Gaussian Family: Normal and Log-Normal
- ⇒ Extreme Type I: Gumbel Distribution
- ⇒ Extreme Type III: Weibull Distribution
- ⇒ Pearson Type III and Log-Pearson Type III
- ⇒ Logistic Distribution

□ Some Generic Approaches

- ⇒ Weibull Plotting Position
- ⇒ Q-Q Plot (Normality Test)

□ Plotting Position and Probability Distribution Fitting

- ⇒ Data Source: [USGS Surface Water for USA: Peak Streamflow](#)
- ⇒ R Packages: "fitdistrplus"- fitdist, "nsRFA"- distplots

□ Flood and Flooding Routing: Return Period vs. Design Flood

- ⇒ [降雨量重現期推估](#)：《水利會訊》第十三期 (2010)
- ⇒ [水文系統與頻率分析](#)：《水利會訊》第九期 (2006)
- ⇒ [莫拉克颱風暴雨量及洪流量分析](#)：經濟部水利署 (2009)
- ⇒ [108 臺北地區\(社子島地區及五股地區\)防洪計畫修正報告](#)

□ Software Packages: R packages; [Palisade @Risk](#), [Oracle Crystal Ball](#)

