國立臺北大學自然資源與環境管理研究所 106學年度第二學期『環境災害與風險管理』

課程講義(09):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
 - □ Acceptable Risk, Probability of Exceedance, and Extremes
 - □ Outlier vs. Extremes; Outlier Test
 - $\Rightarrow \text{ Method based on Inter-Quartile Range: } IQR = Q_3 Q_1; \quad Q_1 1.5IQR \text{]} \quad [Q_3 + 1.5IQR] \text{ https://www.sfu.ca/~jackd/Stat203_2011/Wk02_1_Full.pdf}$
 - ⇒ Grubbs' T Test; Hampel's Test; Dixon's Outlier Test http://www.hsprj.com/health-maintanance/using-outliers-detection-in-policy-analysis-a-pilot-case-study-of-the-detection-and-a nalysis-of-average-healthcare-expense-in-china.pdf
 - Extreme Event Analysis and Extreme Value Theory https://www.actuaries.org.uk/documents/short-introduction-extreme-value-theory-slides

• FUNDAMENTAL STATISTICS RELATED TO RISK

- D Mode, Mean, Median and Range; Higher Order Moments
- □ Outliers vs. Extremes; Risk, Safety and Reliability
- □ 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

STATISTICS OF EXTREMES

□ What are Extreme Value Statistics (<u>http://www.assessment.ucar.edu/toolkit/index.html</u>)

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.

- □ Statistical Distribution
 - ⇒ Gaussian Family: Normal and Log-Normal
 - ⇒ Extreme Type I: Gumbel Distribution
 - ⇒ Extreme Type III: Weibul Distribution
 - \Rightarrow Pearson Type III and Log-Pearson Type III
- □ Some Generic Approaches
 ⇒ Weibul Plotting Position
 - \Rightarrow Q-Q Plot (Normality Test)



- □ Flood and Flooding Routing: Return Period vs. Design Flood
- □ Software Packages: Palisade @Risk, Oracle Crystal Ball
- Homework Assignment #3 (2018/05/08 Due) 請詳閱「<u>綜合治水措施及方案研擬-淡水</u> <u>河流域綜合治水策略之過去與未來</u>」,以整理淡水河流域防洪計畫重點,並繪製淡水 河系主要支流之計畫洪水量(頻率年 200 年)。