

The Institute of Statistical Mathematics
Cooperative Research Symposium 2012

Extreme Value Theory and Applications

Abstracts

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The Institute of Statistical Mathematics,
Seminar room 5 (3F)

ISM Cooperative Research Program 2012-ISM · CRP-5009

Cosponsor : Ministry of Education, Culture, Sports, Science and Technology
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Organizes: Rinya Takahashi (Kobe University)
Takaaki Shimura (ISM)

July 26th Thursday

Introduction to extreme value theory

Laurens de Haan

Erasmus University and ISM

The extreme value condition is introduced. The shape of the limit distributions is derived. Various equivalent conditions for the extreme value condition are given. Domains of attraction are identified. A preview of application is given.

Maxima: theory, algorithms and applications

Hsien-Kuei Hwang

Institute of Statistical Science Academia Sinica and ISM

Maxima, as a natural extension of the records in one-dimensional random sequences, are useful in many scientific disciplines and appeared under many different names. We survey the recent developments of maxima, aiming at the three most interesting aspects: probabilistic theory, maxima-finding algorithms and real applications, as well as the interplay between them.

A discussion of the limit of human longevity based on data

Nobutane Hanayama

Shobi-gakuen University

In this study we discuss how the limit of human longevity has been changed on a long term basis. By fitting the generalized Pareto distribution to the data on oldest-old survivors in Japan the upper limit of human longevity is estimated between 114 and 145 for male or between 118 and 135 for female. In addition it is estimated that the limit has been increasing for male while it has been decreasing for female though corresponding p -values are not sufficiently small.

Water-related mega disasters in Japan and climate change impacts

Shigenobu Tanaka

International Centre for Water Hazard and Risk Management

Japan has suffered from many water-related disasters such as tsunamis, storm surges and river floods. The Great East Japan Earthquake Tsunami(GEJET) on March 11 in 2011 is one of the huge water-related disasters in Japan. The tsunami heights of GEJET were far beyond of the design tsunami heights and overwhelmed most of the countermeasures. In September 2011, torrential rain lasted several days in the Kii peninsular region and caused severe damages. The total rainfall of several rainfall stations in the area exceeded twice of their past records. Further, several examinations are carried out on the past precipitation record in Japan in order to find climate change impacts.

July 27th Friday

Analysis of tsunami magnitude data

Masaaki Sibuya
Keio University

Rinya Takahashi
Kobe University

We consider the tsunami magnitude catalog by Abe (2006). By fitting the generalized Pareto distribution to the tsunami magnitude data, the tsunami risk is evaluated. We discuss the result.

Two types of extrapolations for examining sea extremes

Toshikazu Kitano

Nagoya Institute of Technology

Extrapolation plays an essential role for evaluating sea extremes frequencies, which is why the concept of return period has been introduced. But we use the extrapolation without being aware of the hidden double meanings. Speaking shortly, the return period employed in handling the past record is substituted for the period of the coming successive event in the future. We can obtain the design force (the return level) by extrapolation of the observed data in the past years, while we should apply it for the future by the extension, which is another extrapolation. In this research, we propose the degree of experience and the durability, which is an enhanced degree of experience with the diffractive effect by the passage of time. An important example applied for the Hook of Holland sea level data, which is consist of the record by the modern instruments and the historic ones with the descriptive uncertainty, will be demonstrated.

Natural disasters

Laurens de Haan

Erasmus University and ISM

This is about application of the extreme value theory to environmental problems. The ideas and methods are explained using two specific applications: The problem of the height of sea walls in the Netherlands (one-dimensional extremes) and the same problem now taking into account not only still water level but also waves (two-dimensional extremes).

Multidimensional EVT and max-stable processes

Laurens de Haan

Erasmus University and ISM

An introduction will be given to the origin and structure of max-stable processes starting from multidimensional EVT. Two applications will be briefly discussed: extreme rainfall in same area and the “lifting” of windstorms.

Tail probability of linear combinations of chi-square variables and its application to influence analysis in QTL detection

Satoshi Kuriki

Xiaoling Dou

ISM

We derive the tail probability formula for linear combinations of chi-square variables when the coefficients are not necessarily positive. We also propose a corresponding QQ plot chart for the tail probability. We demonstrate that this QQ plot chart is useful in detecting individuals that have much influence in the shape of the LOD score curve in QTL detection.

Law of large random numbers

Takaaki Shimura

ISM

A numerical characteristic of large random numbers is studied. Let X be a positive random variable with infinite upper bound. Consider the transformation from a decimal number $d_1d_2d_3\dots d_n.d_{n+1}\dots$ in $(0, \infty)$ to $0.d_2d_3\dots$ in $[0, 1)$. If $X = d_1d_2d_3\dots d_n.d_{n+1}\dots$, then $Y = 0.d_2d_3\dots d_nd_{n+1}\dots$ is a random variable on $[0, 1)$. We are interested in the distribution of Y for large X , which implies the behavior of the large random number except the first figure. The distribution of Y converges as X becomes large for most distributions and the limit distribution is determined by the tail behavior of distribution of X .

Max semiselfdecomposable distributions and their properties

Tatsuhiko Saigo

University of Yamanashi

For the sums of independent and identically distributed (i.i.d.) random variables, there is the Central Limit Theorem (CLT) of normal distributions. Classical CLT was extended to the limit theorems of stable, selfdecomposable, semistable, semiselfdecomposable or some other classes. Similarly in the extreme value theory, for the maximum of i.i.d. random variables, there are limit theorems of corresponding distributions. They are called max stable, max selfdecomposable and so on. Originally it is considered in the case of max stable. In 1977 Balkema and Resnick defined max infinitely divisible and in 1990's some researchers considered further. We deal with the max semi-selfdecomposable distributions.

Preparedness for extremely rare hazard events

Jun Kanda

Nihon University

The East Japan Earthquake Disaster reminded us that the preparedness for rare hazard events was not sufficient. Tsunami occurs relatively frequently in the north part of Sanriku coast, but rarely in the south part of Sanriku coast and even in Fukushima. The load intensity in terms of the annual maximum has been discussed for building structures in Architectural Institute of Japan. The relationship between the load intensity and the return period, i.e. inverse of annual exceedance probability, is described in simple forms for different natural events. Probabilistic hazard assessment for Tsunami has not been commonly conducted, but the variability as a rare hazard event for tsunami is similar to that of the ground motion intensity according to a recent investigation of a committee work of Japan Society of Civil Engineers. People should pay more attention to the expected failure cost including consequences of the failure for very rare probability events.

July 28th Saturday

Another interpretation of bathtub curve, quantitative and qualitative aspects of risk factors

Hiroe Tsubaki

ISM

Many survival analyses have verified the bathtub curves are typical failure rates in different application fields and finite mixture of models as Weibull mixtures, which can represent increasing, constant and decreasing hazard rates simultaneously, are commonly considered essential features of applied statistics. This basic principle should be adopted more general regression analyses, data or residuals of which show heavy tailed empirical distribution. Instead to use formal mixture modeling proposed is a practical approach of combining the results from different data analyses based on some parametric model, semi-parametric proportional hazard model and reverse proportional hazard model. Through the inclusion of the latter two models with appropriate censoring, which are equivalent to the rank logit model, the proposed approach can analyze potential causes of variation of extreme values effectively and these causes are possibly different from those affected to the normal parametric population. An illustrative example will be shown to clarify the idea.

Extreme value analysis of auction data of used apartments

Hiroaki Komatsu

Naoki Makimoto

Japan Real Estate Institute

University of Tsukuba

In a first price auction, the contract price is the highest bid price and thus is expected to follow an extreme value distribution under suitable conditions. In this study, we apply the extreme value analysis to the auction data of used apartments in Tokyo district. Because bid prices of an apartment strongly depend on its characteristics such as location and area, we fit the extreme value distribution to the ratio of the contract price divided by the standard price evaluated by the appraiser. The in-sample tests show that the ratio well fitted to the extreme value distribution while the estimated parameters vary every year. We also explore which characteristics of an apartment have explanatory power for the parameters of extreme value distributions.

Finance

Laurens de Haan

Erasmus University and ISM

Two application of EVT in finance will be discussed: a fragility index of the banking system and the estimation of what is called marginal expected shortfall.