Metabolic network comparison based on coloured motif occurrences

Sophie S. Schbath

IWAP

2012

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Søren Asmussen, Aarhus University, Recent results on heavy-tailed asymptotics

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Chair: Reuven Rubinstein

I will survey a number of results on heavy-tailed asymptotic obtained within the last year in collaboration with, amongst others, Albrecher, Kortschak and Foss. The issues will be a subset of the following: the tail behavior of the difference X-Y between two possibly dependent sub exponential random variables; finer expansions of the distribution of the ruin time in the classical risk model which was shown by the speaker and Kl"uppelberg (1996) to be either Pareto or exponential; generalizations of the 1996 result to models with dependence; the precise asymptotic of the so-called Asmussen-Kroese (2006) simulation estimator and suggestion of certain improved versions leading to better convergence rates.

Onno Boxma, Department of Mathematics and Computer Science Eindhoven University of Technology, Two-dimensional workload processes and two-dimensional insurance processes

[12 Zion 09:00-09:50]

Chair: Uri Yechiali

In queueing theory, a huge body of literature has been built up for the classical case of a single-server single-queue system. However, one is often faced with a network of interconnected and interacting resources, or with several classes of interacting customers – and thus one needs to study multi-dimensional stochastic processes. These are typically stochastic processes in the positive orthant, with reflection at the boundaries because key performance measures like queue length and workload cannot become negative. In this talk we focus on a few two-dimensional queueing models: (i) the coupled processor model, consisting of two $M/G/1$ queues where the interaction occurs because one server speeds up when the other server becomes idle; (ii) the parallel processor model, consisting of two $M/G/1$ queues where the interaction occurs because jobs (customers) simultaneously arrive at both queues, while their service requirements may be correlated. We discuss methods to analyze such systems, and in particular their interaction. We also relate the second model to an insurance model with reinsurance, in which insurer and reinsurer simultaneously receive claims, with correlated sizes.

Peter Glynn, Stanford University, Small-sample Behavior for Importance Sampling Rare-event Estimators

[11 Zion 17:00-17:50]

Chair: Reuven Rubinstein

Importance sampling (IS) is a widely used technique for computing rare-event probabilities. However, there are many applied settings in which finding a good importance distribution is challenging. In such a context, one might use an importance distribution that is based on one's problem intuition, and that comes without any theoretical guarantees. However, IS can both reduce variance (when the selected importance distribution is good) and increase variance (when the distribution selected is bad). An additional complication is that the standard error diagnostic used in the Monte Carlo setting, the sample variance, tends to be misleading precisely in those problem instances where the importance distribution has been badly selected. In this talk, we will discuss the small-sample behavior of importance estimators when the importance distribution that is used has no provable optimality properties. This analysis provides insight into what one can expect of importance estimators in such settings, how to potentially build error diagnostics for IS, and the role of the variance as a vehicle for theoretical analysis of such algorithms. This talk is based on joint work with Jihye Choi.

Edward H. Kaplan, Yale University, School of Management, Terror Queues

[11 Zion 09:00-09:50]

Chair: Iddo Eliazar

What can queueing theory offer towards understanding and countering terrorism? In terror queue models, newly hatched terror plots correspond to newly arriving customers, the number of ongoing terror plots corresponds to the queue of customers waiting to receive service, undercover agents or informants correspond to service providers, customer service is initiated when a terror plot is detected, and service is completed when the plot is interdicted. Not all plots are interdicted; successful terror attacks correspond to customers who abandon the queue without receiving service. Usually in queueing models, one either has waiting customers or idle servers but not both. Not so with terror queues, where the servers must find the customers. Also, it is usually the case in service systems that customers demand prompt service; with terror queues, the customers prefer not to be served at all. Terror queue servers must also worry about wasting time with "fake customers," that is, allocating undercover effort to shadowing people who ultimately are not involved with terrorism. Finally, terror queues enable simple models for estimating the number of active but as yet undetected terror plots.

Thomas Mikosch, University of Copenhagen, Precise large deviation probabilities for random walks with stationary heavy tailed steps

[13 Zion 17:00-17:50]

Chair: Jureg Huesler

This is joint work with Olivier Wintenberger (Paris Dauphine).We study precise large deviation probabilities in the spirit of A.V. and S.V. Nagaev; see A.V. Nagaev (1969) Theory Probab. Appl., vol. 14, 51--64 and 193--208, and S.V. Nagaev (1979) Ann. Probab., vol. 7, 745--789. They studied random walks of iid steps with a regularly varying right tail and showed that the right tail of the random walk at a given time is equivalent to the tail of the maximum step up to this time. In this talk, analogs are provided for random walks generated from a strictly stationary step sequence. The dependence structure is rather general, but excludes long range dependence. In particular, analogs of Nagaev's theorem can be derived for Markov chains and return models for speculative prices (GARCH, stochastic volatility model).The general framework for these results is regular variation of the finite-dimensional distributions of the step sequence. The proofs use ideas of Adam Jakubowski developed for central limit theory with infinite variance stable limits. Precise large deviations can be used, for example, to derive precise bounds for ruin probabilities for such random walks. For linear regularly varying processes this approach was chosen in T. Mikosch and G. Samorodnitsky (2000) Ann. Appl. Probab., vol. 10, 1025--1064, and for solutions to affine stochastic difference equations in D. Buraczewski, E. Damek, T. Mikosch and J. Zienkiewic (2011). The results of this talk generalize the mentioned papers and also give insight how large deviations occur in a random walk with dependent heavy tail steps.

Pascal Moyal, Université de Technologie, Queues with impatient customers: classical results, advances and perspectives

[12 Zion 17:00-17:50]

Chair: Joseph Glaz

We present an overview on the probabilistic study of queues with impatient customers. In such systems, the customers may leave the system, if not attended before a given deadline. We first present a comprehensive framework in which the stability of the system can be simply addressed in the general case. We then consider a FIFO queue, for which a non-monotonic stochastic recursive representation is proposed, and present an extension technique allowing to solve the stationary problem in several cases. We then address the Earliest Deadline First (EDF) service policy, which has been shown as optimal in several senses. We propose a measure-valued representation, allowing (i) to complete this optimality results and (ii) to derive a fluid limit approximation of the system. We conclude with several open problems.

Adolfo Quiroz, Dpto. de Matemáticas, Universidad de Los Andes, Graph Theoretic Methods in Multivariate Statistics

[13 Zion 09:00-09:50]

Chair: Jureg Huesler

To a multivariate data set, one can associate certain graph theoretic structures, which can be called "proximity graphs", such as the minimum spanning tree, the k-nearest-neighbors graph, the spheres-of-influence graph and others. The study of properties of these graphs offers the statistician a way of adapting to the multivariate context some important statistical procedures, mainly nonparametric, but also some parametric ones. It also opens the door to the invention of new statistical procedures naturally suited to the multivariate context. In this talk, I will present an overview of the use of proximity graphs in multivariate statistics, including applications to the two-sample problem, clustering, outlier identification, dimension identification and local regression. I will briefly describe some of the theoretical developments that support the formalization of the graph theoretic methods and will mention some open problems in the area.

Way Kuo, City University of Hong Kong, Reliability Importance Measures

[14 Zion 17:00-17:50]

Chair: Joseph Glaz

The concept of importance measures in a coherent reliability system was proposed in the 1960s. Given the increasing trend of using complex and complicated systems, it is noticed that optimal design for such systems is nearly impossible without further investigating other types of importance measures. For example, design for safety of Fukushima-Daiichi nuclear power plants affected by the Sendai's earthquakes in Japan has been a typical challenge that we face today. Other applications include the software design and design for nano-systems. This talk is based on the book, published by Wiley in 2012, "Importance Measures in Reliability, Risk, and Optimization: Principles and Applications," 415 pp, by Way Kuo and X. Zhu. This book provides a comprehensive view on modeling the importance measures through which we generalize the problems in reliability and others.

Invited Sessions

Monte Carlo Variance Reduction Methods

[14 Tavor 10:00-11:30]

Chair: Zdravko Botev, The University of New South Wales

1. Zdravko Botev, The University of New South Wales, Splitting for reliability estimation in highly reliable networks with dependent component failures

Static network reliability models typically assume that the failures of its components are independent. This assumption allows for the design of efficient Monte Carlo algorithms that can estimate the network reliability in settings where it is a rare-event probability. Despite this computational benefit, independent component failures is frequently not a realistic modeling assumption for real-life networks. In this paper we show how the splitting methods for rare-event simulation can be used to estimate the reliability of a network model that incorporates realistic dependence among its components via the Marshal-Olkin copula. Authors: Zdravko Botev, P. L'Ecuyer and B. Tuffin.

2. Rolf Waeber, Cornell University, Probabilistic Bisection Search for Stochastic Root-Finding

Stochastic gradient algorithms are popular methods for finding the root of a function that is only observed with noise. Finite time performance and asymptotic performance of these methods heavily depend on a chosen tuning sequence. As an alternative to stochastic gradient algorithms, which are conceptually similar to the Newton-Raphson search algorithm, we investigate a stochastic root-finding algorithm that is motivated by the bisection algorithm. In the one-dimensional case this algorithm uses a sequential test to determine whether the root lies to the left or right of a prescribed point x. This statistical test is correct with probability p(x). A Bayes-motivated algorithm updates after every test a probability density giving, in some sense, one's belief about the location of the root. In contrast with stochastic gradient algorithms, the described algorithm does not require the specification of a tuning sequence --- instead it requires only one input parameter to be specified. We demonstrate how the algorithm works, and provide results that shed light on its performance, both when p(.) is constant and known and when p(.) varies with x and is unknown.

3. Slava Vaisman, Technion, Fast splitting algorithm for networks reliability estimation

We show how the classic splitting method can be efficiently used for estimating static networks reliability. In our method we adopt Elperin, Gerstbakh and Lomonosov approach of replacing the original static model by an auxiliary dynamic one. The simulated sample performance (unreliability) of the auxiliary dynamic networks is obtained using the BFS (breath first search) algorithm. This sample is incorporated into the splitting method, which in turn uses an MCMC (Markov chain Monte Carlo) and in particular the Gibbs sampler. We show numerically that our splitting method is capable to estimate accurately networks reliability with the size of order of tens of thousands of edges and to the best of our knowledge it is the fastest so far method for static networks reliability. This is joint work between Reuven Rubinstein and Radislav Vaisman.

Scan Statistics - Methods and Applications

[13 Gilboa 12:00-13:30]

Chair: Jie Chen, University of Massachusetts Boston, MA, U.S.A.

1. Daniel B. Neil, Carnegie Mellon University, Pittsburgh, PA, U.S.A. Efficient Subset Scanning with Soft Constraints Co-authors: Skyler Speakman, Edward McFowland III, Sriram Somanchi (all co-author affiliations same as presenter)

We present a novel method for incorporating soft constraints (such as spatial compactness and temporal consistency) into the subset scan framework. We demonstrate that many spatial scan statistics can be written as an additive function conditional on the relative risk of the affected subset of locations. This approach allows us to incorporate location-specific bonus or penalty terms, representing the prior log-odds that each location will be affected, while enabling efficient optimization of the penalized log-likelihood ratio statistic over subsets of locations. First, we provide an example in the disease surveillance domain, enforcing soft constraints on spatial compactness [1]. Second, we detect the spread of contaminants in a water distribution system, enforcing connectivity and temporal consistency constraints on the spread of contamination through the network [2]. In each case, incorporation of soft constraints substantially improves detection power and accuracy as compared to existing methods. This work was partially supported by NSF grants IIS-0916345, IIS-0911032, and IIS-0953330.

References: 1. S. Speakman, E. McFowland III, S. Somanchi, and D.B. Neill. Scalable detection of irregular disease clusters using soft compactness constraints. Emerging Health Threats Journal 4: 11121, 2011.

2. S. Speakman. Pattern detection with temporal consistency and connectivity constraints. Technical report, H.J. Heinz III College, Carnegie Mellon University.

2. Joseph Naus, Department of Statistics, Rutgers, The State University of New Jersey, Piscataway, NJ 08854, Simple Window Settings for Multiple Width Scan Statistics

We give approximations to handle multiple window width scan statistics for a variety of temporal and spatial scenarios. Simple rules of thumb together with compact tables allow multiple width window scan testing without calculation for certain useful cases.

3. Wendy Lou, University of Toronto, Toronto, Ontario, Canada, An Application of Scan Statistics to Healthcare Interventions

In the healthcare sector, new strategies for improving health outcomes and quality of care are often implemented within hospital settings such as emergency departments. Methods for evaluating the effectiveness of the interventions are often based on unrealistic assumptions in order to model complex conditions. In this talk, an approach utilizing scan statistics will be presented to allow for systemic assessment of the changes attributed to the interventions, while requiring minimal assumptions. The proposed method will be illustrated through a motivating example from a study involving multiple hospitals of a health system in Ontario, Canada. Some methodological challenges and opportunities will also be discussed.

Recent Work of Professor Uriel G. Rothblum on Markov Decision Processes and Games: a Session to Honor His Memory

[11 Tavor 12:00-13:30]

Chair: Eugene A. Feinberg, Stony Brook University

1. Eugene A. Feinberg, Stony Brook University, Solving Multi-Armed Bandit Problems Using Row Operations

Authors: Eric V. Denardo, Yale University Eugene A. Feinberg, Stony Brook University Uriel G. Rothblum, Technion A novel approach for computing indices of multi-armed bandit problems through the use of elementary row operations is developed. The method will also be used to derive the optimal utility of a priority policy, to prove the optimality of priority policies, to compute optimal priority policies, and to solve constrained problems. The development applies to problems with linear and with exponential utility functions. This abstract was written by Uriel G. Rothblum. This abstract was written by Uriel G. Rothblum.

2. Pelin G. Canbolat, Technion, Stochastic Contests with Exponential Completion Times

Authors: Boaz Golany, Technion Pelin G. Canbolat, Technion Uriel G. Rothblum, Technion This talk focuses on a class of games with several players that compete over the completion of a task. The player that completes the task first earns a reward while the remaining players earn nothing. The players' actions are the amounts of effort that they invest in completing the task. The completion time of the task for a particular player is a random variable having exponential distribution with rate linear in its own action and the completion times of different players are stochastically independent. We refer to these games as "stochastic contests with exponential completion times." We consider three variants of these contests: (i) contests among risk-neutral players whose efforts are subject to only non negativity constraints, (ii) contests among risk-neutral players whose efforts are subject to lower and upper bounds, (iii) contests where players have exponential risk-averse utility functions and the only constraints on their efforts are non negativity constraints. For non degenerate instances of all three variants, we establish the existence of a unique Nash equilibrium by obtaining an explicit representation of the equilibrium solution. We provide efficient computational methods and use the explicit representation in each case to conduct sensitivity analysis with respect to model parameters. Consequently, we derive several insights into how players' attributes such as their bounds and their risk sensitivity affect the Nash equilibrium.

3. Edward H. Kaplan, Yale University, Allocating Resources to Counter Probabilistic and Strategic Risks

Authors: Boaz Golany, Technion Edward H. Kaplan, Yale University Abraham Marmur, Technion Uriel G. Rothblum, Technion Probabilistic uncertainty is caused by "chance" whereas strategic uncertainty is caused by an adverse interested party. Using linear impact functions, the problems of allocating a limited resource to defend sites that face either probabilistic risk or strategic risk are formulated as optimization problems that are solved explicitly. The resulting optimal policies differ -- under probabilistic risk, the optimal policy is to focus the investment of resources to priority sites where they yield the highest impact, while under strategic risk, the best policy is to spread the resources so as to decrease the potential damage level of the most vulnerable site(s). Neither solution coincides with the commonly practiced proportionality allocation scheme.

Risk models

[12 Gilboa 10:00-11:30]

Chair: Esther Frostig, University of Haifa

1. Vladimir Kiashev, City University London, On the joint distribution of the time to ruin, the deficit at ruin and the surplus prior to ruin

Since the seminal paper by Gerber and Shiu (1998), the joint distribution of the time of ruin, the deficit at ruin and the surplus immediately before ruin in the classical compound Poisson risk model has attracted considerable research interest. An explicit expression for the corresponding trivariate joint density and its related (bivariate) marginal densities, in terms of then-fold convolutions, Hn= 1, 2, …Lof the individual claim amount distribution has recently been derived by Landriault and Willmot (2009). In this paper, our aim will be to consider the joint distribution of the time of ruin, the deficit at ruin and the surplus immediately before ruin and its marginals, in a more general, finite-horizon ruin probability model. Under this model, it is assumed that the premium income to the insurance company is represented by any non-decreasing, positive real function, claims arrive according to a Poisson process, claim severities may be dependent with any joint discreteor continuous distribution. An explicit expression in terms of classical Appell polynomials for the joint distribution of the time of ruin, the deficit at ruin and the surplus immediately before ruin is derived, both for the case of continuous and discrete claim amounts. In the latter case this expression is exact. The theoretical and numerical properties of our ruin-probabilistic results are also discussed and explored.

References :1 Gerber, H.U. and Shiu, E.S. (1998).On the Time Value of Ruin. North American ActuarialJournal,2 (1) 48-72.

2: Landriault and Willmot (2009). On the Joint Distribution of the Time to Ruin, the Surplus Prior to Ruin and the Deficit at Euin in the Classical Risk Model. North American Actuarial Journal,13 (2) 252-279.

2. Yonit Barron, University of Haifa, On some recovery policies for MAP risk processes

Under the assumption that the premium income rate is bigger than the claims payment , the surplus process goes to infinity. Therefore, researchers and practitioners have considered policy of dividends payments to the shareholders. Since the ruin probability is very small, and usually the company has internal or external financial funds to support some negative surplus and keep the company alive until recovery. Thus, there is an interest to study risk models where the surplus may go negative. We consider risk models where the premium rate and the claim amount distribution depend on a random environment, which evolves as a continuous time Markov chain. We consider models with and without dividends, where the dividends policy is a barrier strategy, i.e. all the surplus above a given threshold is paid as dividends. We study two models. In the first one the surplus may go negative. For this model we study the Laplace transform of the negative period, the maximum severity of ruin, and the expected discounted dividends. In the second model we assume that whenever ruin occurs, the shareholders pay the deficit. For this model we study the expected discounted deficit payments and the expected discounted dividends. Finally, we obtain the long time average amount of dividends payments and deficit payments per time unit. In this paper we consider Phase Type claim amount. This assumption enables us to apply the fluid flow approach for Markov additive processes without jumps introduced by Ramaswami, 2006 and Ahn and Ramaswami, 2007.

3. Esther frosting, University of Haifa, a Markov additive risk process with a dividend barrier

We study a risk process where all the surplus above b is paid as dividends to the shareholders. The claims arrive according to a Markovian arrival process (MAP) with a Brownian motion component. The premium rate, the claim amount distribution, and the volatility coefficient of the Brownian motion depend on a random environment, that evolves as a continuous time Markov chain. We are interest in the expected discounted dividends, and the expected discounted penalty function. First we study the case where there are positive phase type claims(negative jumps). Then we generalize our results to the more general case with positive and negative phase type claims. In our analysis we apply the semi-regenerative structure of the model, the fluid version of the model, results of first exit for spectrally negative L\'{e}vy process, and change of measure techniques. We obtain linear equations for the quantities of interest.

4. Dimitrina S. Dimitrova, Cass Business School, City University London, UK, On the distribution of the time to ruin in a risk model with dependence

We consider the distribution of the time to ruin in a finite-horizon risk model where claims arrive according to a Poisson process, the claim severities may be dependent with any joint distribution, and the premium income is modeled by any non-decreasing real valued function, allowing discontinuities. We review the finite-time ruin probability formulas obtained by Ignatov and Kaishev (2000, 2004) and Ignatov et al. (2001). As classical Appell polynomials naturally appear in these formulas, we pay a special attention to their properties and efficient numerical evaluation. Explicit formulas for the density of the time to ruin are further derived both for the case of discrete and continuous claim severities. A method for the evaluation of these explicit expressions is developed and illustrated based on examples assuming (in)dependent, discrete and continuous claim amounts. We note that these results cover the special case of the classical ruin model with compound Poisson aggregate claim amount and linear premium income.

References: 1. Ignatov, Z.G. and Kaishev, V.K. (2000). Two-sided Bounds for the Finite-time Probability of Ruin, Scandinavian Actuarial Journal, No. 1., 46-62.

2. Ignatov, Z.G. and Kaishev, V.K. (2004). A Finite-Time Ruin Probability Formula for Continuous Claim Severities.Journal of Applied Probabilityv. 41, 2, 570-578.

3. Ignatov, Z.G., Kaishev, V.K. and Krachunov, R.S. (2001). An Improved Finite-time Ruin Probability Formula and its "Mathematica" Implementation. Insurance: Mathematics and Economics,29, 375-386.

Stein's method in networks, urn models and physics

[13 Tavor 10:00-11:30]

Chair: Larry Goldstein, University of Southern California

1. Gesine Reinert, Oxford University, Stein's Method for the Beta distribution with Applications to the Polya Urn

Stein's method is applied to assess the L^1 distance between a sum of possibly dependent random variables, such as the number of white balls drawn from a Polya urn, and a Beta distribution. As standard coupling techniques do not appear to be successful here we compute the desired bound by making a direct comparison between the characterizing operators of the target and the Beta distribution, the latter derived by extending Stein's density approach to discrete distributions. Joint work with L. Goldstein.

2. Nathan Ross, University of California Berkeley, Vertex degrees in preferential attachment random graphs

Preferential attachment random graphs evolve in time by sequentially adding vertices and edges in a random way so that connections to vertices having high degree are favored. Particular versions of these models were used by Barabasi and Albert in 1999 to explain the so-called power law behavior observed in some real world networks, for example the graph derived from the world wide web by considering web pages as vertices and hyperlinks between them as edges. In this talk we will discuss recent results providing rates of convergence for both the distribution of the degree of a fixed vertex (properly scaled) to its distributional limit and the distribution of the degree of a randomly chosen vertex to an appropriate power law for two basic versions of these models. We obtain these rates through new variations of Stein's method which rely on showing appropriate limiting distributions are the unique fixed points of certain distributional transformations. Joint work with Erol Pekoz and Adrian Roellin.

3. Adrian Roellin, National University of Singapore, Local limit theorems via Landau-Kolmogorov inequalities and smoothing

Local limit theorems (LLT) are among the most refined limit theorems available, and, therefore, typically much harder to obtain than laws of large numbers and central limit theorems. A common strategy to prove an LLT is to prove a CLT and then to identify sums of independent random variables embedded in the problem of interest. This embedded sum will guarantee some smoothness which can be used to obtain an LLT. In this work, we use the so-called Landau-Kolmogorov inequalities from analysis to systematically explore this idea and we provide new techniques to prove smoothness without the embedding of sums of independent random variables. We prove novel LLTs for triangle counts in Erdös-Renyi random graphs and the magnetization in the Curie-Weiss model.

Scan Statistics

[12 Gilboa 12:00-13:30]

Chair: George Haiman, Université de Lille 1, France

1. George Haiman and Cristian Preda, Université de Lille 1, France 1-dimensionnal scan statistics generated by some dependent stationary sequences

A method of approximating the distribution of scan statistics for i.i.d. random variables was presented by the authors in previous papers. The method can be applied to 1-dependent stationary sequences . We apply this method to a parametric model of 1-dependent Bernoulli sequences introduced recently by the first author and to 1-dependent stationary Gaussian sequences. We compare the results with the distributions of scan statistics generated bysequences of corresponding i.i.d. random variables with same marginal distribution and for Markov sequences of Bernoulli random variables.

2. Joseph Glaz , University of Connecticut, Storrs, CT 06269-4120, USA Two Dimensional Variable Window Scan Statistics for Normal Data

In this article we present approximations for the distribution of variable window scan statistics for normal data. Both known and unknown mean and variance case are considered. These approximations are based on the recently developed algorithms for computing high dimensional multivariate normal and t distributions. Numerical results will be presented to evaluate the approximations that have been developed based on these algorithms.

3. Alexandru Amarioarei, Université de Lille 1, France, Approximation for the three dimensional scan statistics distribution

We consider the discrete and continuous three dimensional scan statistics. Viewed as the maximum of an 1-dependent stationary r.v.'s sequence, we provide approximations and error bounds for the probability distribution of the scan statistics. Simulation results and comparisons with other approximations are presented for the binomial and Poisson models.

Stochastic Geometry

[14 Gilboa 10:00-11:30]

Chair: Lothar Heinrich, Augsburg University, Germany

1. Molchanov Ilya, University Bern, Invariance properties of random vectors and stochastic processes based on the zonoid concept

1. With each random vector X it is possible to associate a convex body called the zonoid of X and which is defined as the expectation of the random segment with end-points being the origin and X. It is possible that two different random vectors share the same zonoid, which leads to the idea of zonoid equivalent random vectors. The idea of zonoid equivalence stems also from financial applications, see Molchanov and Schmutz (2011). The talk addresses the properties of zonoid equivalent vectors and also related facts for stochastic processes through their finite-dimensional distributions. In particular, generalizations of the stationarity and exchangeability concepts are explained.

References: 1. Molchanov, I. and Schmutz, M. (2011) Exchangeability-type properties of asset prices. Adv. Appl. Probab., 43, 666-687.

2. Heinrich Lothar, University Augsburg, Asymptotic Normality of the Volume Covered by a Stationary Poisson Cylinder Process

A stationary Poisson cylinder process in the d-dimensional Euclidean space is composed by a stationary Poisson process of k-flats ($0 < k < d$) which are dilated by i.i.d. random compact cylinder bases taken from the corresponding (d-k)-dimensional orthogonal complement. Provided that the second moment of the (d-k)-volume of the typical cylinder base exists, we prove a CLT for the d-volume of the union set of Poisson cylinders that covers an expanding star-shaped set r W as the scaling factor r grows unboundedly, see [2],[3]. Furthermore, sharp bounds of the higher-order cumulants of the d-volume of Poisson cylinders in r W are derived if the (d-k)-volume of the typical cylinder has an exponential moment. Under this condition we can prove an optimal Berry-Esseen bound of the order r^−(d−k)/2and Cramer-type large deviations relations of exact order for the volume distribution, see [2]. The case $k = 0$ corresponds to a stationary Boolean model, see [1].

References: 1. Heinrich, L. (2005) Large deviations for the empirical volume fraction stationary for Poisson grain model, Ann. Appl. Prob. 15 (1A), 392–420.
2. Heinrich, L. and Spiess, M. (2009) Berry-Esseen bounds and Cramer-type large deviations for the volume distribution of Poisson cylinder processes, Lithuanian Math. J. 49 (4), 381–398.
3. Heinrich, L. and Spiess, M. (2012) Central limit theorem for the volume of stationary Poisson cylinder processes in expanding domains, submitted.

3. Spodarev Evgeny, Ulm University, Germany, Estimation of fractal dimension and fractal curvatures from digital images

Most of the known methods for estimating fractal dimensions are based on the evaluation of a single geometric characteristic, usually the volume. We propose a method involving the evaluation of several geometric characteristics, namely all the Minkowski functionals (i.e. volume, surface area, Euler characteristic etc.). Motivated by recent results on the limiting behaviour of Minkowski functionals of the parallel sets of self-similar fractals, we use these functionals to estimate the fractal dimension of sets from digital images by regression and time series methods. Simultaneously, we also obtain estimates of the fractal curvatures of these sets, some fractal counterpart of Minkowski functionals, allowing for a ner classi cation of fractal sets than fractal dimension only.

Lévy processes and applications

[13 Gilboa 10:00-11:30]

Chair: Offer Kella, The Hebrew University of Jerusalem, Israel

1. Zbigniew Palmowski, University of Wraclaw, Poland, Forward-backward extrema of Lévy processes

For a Lévy process X we consider the double future-backward suprema. The analyzed random variables are path-dependent performance measures of fluid queues. They are also risk-performance indicators associated to a financial asset with value-process being an exponential of X. In this case we are interested in the lowest future log-return in the time-window [t,t+S] and in the maximal and minimal such future returns for t ranging over [0,T]. We find the exact asymptotic decays of the tail distributions of above extrema in both the Cramer and heavy-tailed cases. When the jumps of X are of single sign we explicitly identify the one-dimensional distributions in terms of the scale functions. We also analyze some examples. Based on joint work with E. Baurdoux and M. Pistorius.

2. Shelemyahu Zacks, Binghampton University, USA, Distribution of the total time in a mode of an alternating renewal process with applications

We consider alternating renewal processes which change their mode intermittently, like ON and OFF of a system. The distribution of the total ON time for an interval (0,t] is developed explicitly in terms of the distributions F and G of the alternating renewals. This distribution is then applied to determine the distributions of the locations of telegrapher processes and of alternating Brownian motions.

3. Offer Kella, The Hebrew University of Jerusalem, Israel, Useful martingales for stochastic storage processes with Lévy-type input and decomposition results

In this paper we generalize the martingale of Kella and Whitt to the setting of Lévy-type processes and show that under some quite minimal conditions the local martingales are actually L2 martingales which upon dividing by the time index converge to zero a.s. and in L2. We apply these results to generalize known decomposition results for Lévy queues with secondary jump inputs and queues with server vacations or service interruptions. Special cases are polling systems with either compound Poisson or more general Lévy inputs.

Point Processes

[14 Gilboa 12:00-13:30]

Chair: Ilya Molchanov, University of Bern

1. Sergei Zuyev, Chalmers University, Thinning-stable point processes and their inference joint work with Brunella Spinelli

Thinning-stable point processes arise as a limit in superposition-thinning schemes in the case when intensity measures of the summands may assume infinite values. They can be considered a generalization of discrete-stable integer random variables so they are also called discrete alpha-stable point processes, or DaS. By using recent results on the cluster representation of DaS processes we develop statistical tools to estimate their parameters: the exponent alpha, intensity of cluster centres and the spectral measure governing the distribution of the underlying Sibuya point process.

2. Volker Schmidt, Ulm University, Random Geometric Graphs Induced by Stationary Point Processes

For any locally finite set M in the Euclidean space of dimension at least 2, the minimal spanning forest MSF(M) is a generalization of the minimal spanning tree that was introduced originally by Aldous and Steele (1992). They conjectured that MSF(X) is almost surely connected if X is a homogeneous Poisson point process. This conjecture was proven in Alexander (1995) for dimension 2. However, it remains open for higher dimensions (and for non-Poisson point processes X). In the present talk we introduce a family of approximations of the minimal spanning forest, see [1]. Using techniques of Blaszczyszyn and Yogeshwaran (2011) and Daley and Last (2005) we prove the a.s. connectivity of the constructed approximations for all stationary point processes X with finite range of dependence and absolutely continuous second factorial moment measure. We also derive conditions for the a.s. finiteness of cells in the two-dimensional case and discuss some applications to spatial stochastic modeling of telecommunication networks, see [2] and [3]. [1] Hirsch, C., Neuhaeuser, D. and Schmidt, V. (2012) Connectivity of random geometric graphs related to minimal spanning forests. Preprint (submitted). [2] Gloaguen, C., Voss, F. and Schmidt, V. (2011) Parametric distributions of connection lengths for the efficient analysis of fixed access network. Annals of Telecommunications 66, 103-118. [3] Neuhaeuser, D., Hirsch, C., Gloaguen, C. and Schmidt, V. (2012) On the distribution of typical shortest-path lengths in connected random geometric graphs. Queueing Systems (in print).

3. Ilya Molchanov, University of Bern, Stationarity of multivariate particle systems

A Poisson process in the Euclidean space is stationary if its intensity measure is proportional to the Lebesgue measure. More general Poisson processes can be defined on richer spaces, e.g. the space of functions or sets. While in these cases often there is no analogue of the Lebesgue measure, invariance properties of the process can be defined with respect to transformations that account for the internal structure of the relevant phase space. A particle system is a family of i.i.d. stochastic processes with values translated by Poisson points. We obtain conditions that ensure the stationarity in time of the particle system in the Euclidean space and in some cases provide a full characterization of the stationarity property. It is shown how the characterization problem relates to solutions of two-sided convolution equations. The presented results generalise the characterization of univariate Gaussian systems obtained by Kabluchko (2011). Kabluchko, Z. (2010) Stationary systems of Gaussian processes, Ann. Appl. Probab. 20, 2295--2317.

Monte Carlo Methods for Optimization

[11 Gilboa 12:00-13:30]

Chair: Ad Ridder, Vrije Universiteit Amsterdam

1. Qing-Shan Jia, Tsinghua University, Beijing, A Brief Introduction to Ordinal Optimization: Theory and Applications

Simulation-based optimization has provided a general framework for many control, decision-making and optimization problems, in which the performance evaluation is based on simulation. The general difficulties in these problems usually are composed of large and discrete search space, and time-consuming and noisy performance evaluation. In these problems it is difficult if not impossible to find the optimal solution for sure. Ordinal optimization (OO) was first developed by Prof. Yu-Chi Ho to find good enough solutions with high probability. In this talk, we will review the basic ideas of OO,namely ordinal comparison and goal softening; the theoretical foundations, and some applications. The progress in this area in the past 20 years will be reviewed, including extension to multiple objective functions, simulation-based constraints, computing budget allocations, and complexity preferences. The quantifiable global goodness of the solution of OO may bring insights to Monte Carlo methods for optimization. Future research directions will be discussed. This is joint work with Qian-Chuan Zhao.

References: 1. Y.C. Ho, R. Sreenivas, and P. Vakili. Ordinal Optimization of Discrete Event Dynamic Systems, Journal of Discrete Event Dynamic Systems, Vol. 2, No. 2, pp. 61-88, 1992.
2. Y.C. Ho, Q.-C. Zhao, and Q.S. Jia.Ordinal Optimization: Soft Optimization for Hard Problems, New York, NY: Springer, 2007.
3. Z. Shen, Q.C. Zhao, and Q.S. Jia.Quantifying heuristics in the ordinal optimization framework.Discrete Event Dynamic Systems: Theory and Applications, Vol. 20, pp. 441-471, 2010.

2 Bernd Heidergott, Vrije Universiteit Amsterdam, Perturbation Analysis of Inhomogeneous Markov Processes

The assumption of time-homogeneity of Markov processes is often violated in applications. For example, in a call center we are interested in the system behavior over a fixed time period of length T. The arrival rate is typically time dependent. This can be modeled as a inhomogeneous Poisson process, and the resulting Markov process modeling the system process becomes an inhomogeneous Markov process whose generator matrix is time dependent. In this talk we will extend the results on perturbation analysis of homogeneous Markov processes [1] to inhomogeneous Markov processes. Based on a result by Massey and Whitt [3], we provide a representation for the sensitivity of the transition probability over time interval [0 , T]. In addition, show how this formula can be used to derive a simple gradient estimator, where we make use of the fact that the derivative of a generator matrix can be written as re-scaled difference of two Markov transition probability matrices. Provided that the derivative of the generator matrix of the Markov process commutes in a suitable way with transition probability of the Markov process our derivative formulas can be significantly simplified. We will illustrate our approach with models from biology, finance and the call-center model.

References: 1. B. Heidergott, A. Hordijk, N. Leder. Series expansions for continuous-time Markov chains. Operations Research, Vol. 58, pp. 756-767, 2010.
2. W. Massey, W. Whitt.Uniform acceleration expansions for Markov chains with time-varying rates. Journal of Applied Probability, Vol. 8, pp. 1130-1155, 1998.

3. Ad Ridder, Vrije Universiteit Amsterda, Stochastic Enumeration for Combinatorial Optimization Problems

In this paper we consider combinatorial problems in graphs, such as the Hamiltonian cycle problem, the s-t path problem, the perfect matching problem. Associated with optimizing a performance function for these problems, is the problem of counting the number of feasible solutions. The latter issue is our concern. We consider these combinatorial problems on random graphs and we apply the stochastic enumeration method (SE). This method extends the simple one-step-look-ahead approach (OSLA) which generates random points in the state space. Most often the OSLA approach does not lead to feasible solutions. However, the stochastic enumeration method mimicks an oracle who knows after each iteration how to continue for obtaining feasible solution. In our study we are interested in the complexity properties of the OSLA and SE estimators. In fact, we shall show for the Hamiltonian cycle problem on random graphs that these estimators have polynomial complexity for their expectation and are logarithmically efficient. This is joint work with Reuven Rubinstein and Radislav Vaisman.

References: 1. P. Erdos and A. Renyi. On random graphs I. Publications Mathematicae Debrecen, Vol. 6, pp. 290-297, 1959.

2. L.E. Rasmussen. Approximating the permanent: a simple approach. Random Structures and Algorithms, Vol. 5, pp. 349-361, 1994.

3. R.Y. Rubinstein. Stochastic enumeration method for counting NP-hardproblems. To appear in Methodology and Computing in Applied Probability, 2012.

Coupling, Markov Decision Problems, and Techniques for Limits and Concentration

[11 Zion A 15:00-16:30]

Chair: J. Michael Steele, Wharton School, University of Pennsylvania

1. Alessandro Arlotto, Wharton School, University of Pennsylvania, Means, Variances and Limiting Distributions in Finite-Horizon Markov Decision Problems

The literature for Markov Decision Problems is huge, but, despite a shared culture with the rest of applied probability, there are surprisingly few limit theorems for general classes of MDPs. This talk focus on some martingale (and other) methods that are general enough to give us "something" in almost any situation and which in "nice situations" give us a great deal. For clarity and specificity, I focus on examples, but the real intention is to isolate tools that can help take the results of classical MDP analysis toward limit laws for means, variances, and even distributions.

2. Erol A. Peköz, Boston University, Random graphs, urn models, limit distributions and biased couplings

When proving a limit theorem, the usual practice is to start with some prior knowledge of the limit distribution. Here we will discuss a new method for using couplings to help discover limit distributions in some challenging applications, and using these along with Stein's method to prove limit theorems with error bounds. Applications to random graphs, urn models and branching processes will be given. Some additional bonus material and other surprises will be included.

3. J. Michael Steel, Wharton School, University of Pennsylvania, Markov Decision Problems and Concentration Inequalities for the Reward

The typical Markov decision problem posits an objective function, then --- in theory or in practice –-one computes an "optimal" decision policy and perhaps examines its sensitivity to the model assumptions. This often leaves the investigator fatigued, and many interesting questions are left untouched. Central among the commonly untouched problems are the distributional properties of the realized rewards. In this talk, I will illustrate by examples what can be said about some classical MDPs using the more modern tools of concentration theory. In particular, I will cover one widely applicable martingale trick and illustrate a more broadly useful set of ideas from the contemporary theory of sharp thresholds (Russo's formula, Bonami-Beckner, KKL, etc.)

Long-Range Dependence

[12 Zion A 15:00-16:30]

Chair: Murad S. Taqqu , Boston University

1. Vladas Pipiras, University of North Carolina, On distinguishing multiple changes in mean and long-range dependence using local Whittle estimation

It is well known that changes in mean superimposed by short-range dependent series can be confused easily with long-range dependence. I will discuss semi-formal ways to distinguish between the two phenomena. The proposed procedure is based on local Whittle estimation of long-range dependence parameter applied to the series after removing changes in mean. According to the proposed procedure, for example, volatility series in finance seem more consistent with changes in mean models whereas environmental and telecommunication series are more in line with long-range dependence.

2. François Roueff, Telecom Paris Tech CNRS LTCI, Some recent results for non-linear processes with long range dependence

Linear processes with long range dependence are obtained by linear filtering of white noise using a fractional integration operator. Integrated on large scales, such processes can be approximated by a fractional Brownian motion. In the non-linear case, with similar second-order properties, such an approximation no longer holds. We will recall different limit distributions that may appear in the large scale asymptotic, depending on the type of non-linearity. The goal of this talk is to present recent results applying to non-linear long range dependent processes that go beyond the large scale approximation. For instance, we will answer the following question: is the large scale approximation sufficient to determine the asymptotic behavior of estimators of the long memory parameter ?

3. Murad S. Taqqu, Boston University, Properties and numerical evaluation of the Rosenblatt distribution

A finite-variance stationary time displays long-range dependence or long memory if its covariance function decays to zero like a power. The decay should be slow enough so that the sum of the covariances diverges. This happens, for example, if the corresponding spectral density blows up at zero frequency like a power function. These types of time series have been widely studied. Normalized sums of such time series can converge to a Gaussian process, typically fractional Brownian motion, but also to non-Gaussian processes, which can be represented by multiple integrals. But unfortunately, even the marginal distributions of these non-Gaussian processes are not known explicitly. The simplest non-Gaussian member of this family is the Rosenblatt process. It is represented by a double integral. We shall study its marginal distributions and describe a way to obtain them numerically. This is joint work with Mark Veillette.

Statistical Inference of Stochastic Processes

[14 Arbel 10:00-11:30]

Chair: Pavel Chigansky, The Hebrew University

1. Marina Kleptsyna, Universite du Maine, France, Inference in systems with mixed fractional Brownian motion noises

This talk addresses the problem of parameter estimation in linear systems, driven by a sum of the fractional and the standard Brownian noises. The likelihood function in such models can be defined, using the analogs of the usual representation theorems with respect to the semimartingale, which generates the same filtration as the observed process. The consistency and asymptotic normality of the maximum likelihood estimator are established using the properties of the corresponding Wiener-Hopf equation.

2. Mark Podolskij, Heidelberg University, Germany, Limit theorems for high frequency functionals of fractional SDE's with application to statistics

We present some limit theorems for power variations of fractional stochastic differential equations driven by a stationary Gaussian process. In particular, we show the law of large numbers and the associated stable central limit theorem with a mixed normal limit. The probabilistic results are applied to model-free goodness-of-fit tests for the diffusion coefficient.

3. Pavel Chigansky, The Hebrew University, Israel, Estimation in threshold auto regressions driven by colored noise

Large sample statistical analysis of threshold autoregressive (TAR) models is usually based on the assumption that the underlying driving noise is white. In this talk, we shall consider a model, driven by Gaussian colored noise with geometric correlation tail and derive a complete characterization of the asymptotic distribution for the Bayes estimator of the threshold parameter.

Analysis of Extremes

[13 Zion A 12:00-13:30]

Chair: Juerg Huesler, University of Bern

1. Enkelejd Hashorva, University of Lausanne, Finite-time Ruin Probability of "Aggregated" Gaussian Processes With Trend

Let $\{\sum_{i=1}^n \lambda_i X_i(t)-g(t), t\in [0,T]\}$ denote an aggregated Gaussian process with trend $g(\cdot)$.In this talk we shall discuss the exact asymptotic behavior of the finite time ruin probability $$P(\sup_{t\in[0,T]}[\sum_{i=1}^n \lambda_i X_i(t)-g(t)]>u), u\rightarrow\infty,$$under some regularity conditions on the Gaussian processes. Additionally, upper and lower bounds for the ruin probability of interest will be presented, which are of interest for instance in insurance applications related to dividend payments. Furthermore, some novel results for the finite-time ruin probabilities of some general perturbed risk processes will be further discussed. Joint work with Krzysztof Debicki, Lanpeng Ji, Zuoxiang Peng, Zhongquan Tan.

2. Marie Kratz, ESSEC Paris, The tail distributions of functionals of random excursion sets

When a random field $(X_t, \ t\in {\mathbb R}^D)$ is thresholded on a given level γ the excursion set is given by its indicator ${\bf 1}_{(\gamma , \infty)}(X_t)$.The purpose of this work is to study several functionals (as established in Stochastic Geometry) of these random excursion sets, as e.g. the capacity functional, as well as the tails of their distributions. It extends results obtained for the one-dimensional case by M. Kratz and coauthors (Demichel et al. (2011), Estrade et al (2001)) to the multidimensional case, mainly when D=2, with tools borrowed to EVT and to stochastic geometry.Various approaches are considered, among which approaches based on Rice type formulas (e.g. Azais and Wschebor (2009)) or on Morse formulas (Adler and Taylor (2007)).Joint work with Werner Nagel.

References: 1. Azais, J-M. and Wschebor, M. (2009) Level Sets and Extrema of Random Processes and Fields. Wiley.

2. michel, Y., Estrade, A., Kratz, M. and Samorodnitsky, G. (2011) How fast can the chord-length distribution decay? Adv. Appl. Probab. 43, 504-523.

3. Estrade, A., Iribarren, I. and Kratz, M. (2011)Chord-distribution functions and Rice formulae. Application to random media. To be published in Extremes.

3. Michael Falk, University of Wuerzburg, On Max-Domain of Attraction for Stochastic Processes and the Sojourn Time Transformation

We introduce some mathematical framework for extreme value theory in the space of continuous functions on compact intervals. Continuous max-stable processes on [0,1] are characterized by its "distribution function", which can be represented via a normon functional space, called D-norm. This leads to the definition of a functional max-domain of attraction approach for stochastic processes, which is more general than the usual one based on weak convergence. We derive characterizations of this functional max-domain of attraction condition via the corresponding sojourn time transformations. Joint work with Stefan Aulbach, Martin Hofmann.

Statistics of Extremes

[13 Zion A 10:00-11:30]

Chair: Juerg Huesler, University of Bern

1. Armelle Gulliou, University of Strasburg, An entropy based approach to detect changes in climate extremes

The Kullback-Leibler information (Kullback, 1968) is defined as$$I(f;g)=\mathbb E_f\left\{\log\left({f(Z) \over g(Z)}\right)\right\},$$ant it measures the entropy distance between the probability densities f and g for a random variable Z. Kullback (1968) also refers to this quantity as the directed divergence to distinguish it from the divergence given by$$D(f;g)=I(f;g)+I(g;f),\eqno(1)$$which is a symmetrical measure relative to f and g. This notion has been extensively studied in the literature. Here we explore this concept withinthe framework of climatology and Extreme Value Theory. While the divergence (1) is expressed in function of densities, it is more convenient to work with the tail distribution function 1-F when analyzing large excesses. In this talk, we propose an approximation to bypass the need ofcomputing densities. This allows us to derive and study new estimators of the entropy. We applyto the important problem of detecting changes in our warming climate.

References: 1 Kullback, S. (1968). Information Theory and Statistics, 2nd ed., New York: Dover.

2. Pasquale Cirillo, University of Bern, Nonparametric prediction of rare events and catastrophes

We develop a Bayesian nonparametric alarm system to predict rare events and catastrophes, which are generated by spatio-temporal processes. The building blocks of our construction are a particular class of combinatorial stochastic processes. Differently from other approaches in the literature, our model is constantly updated on the basis of the available information, according to the Bayesian paradigm. This guarantees fewer false alarms, increasing the accuracy of the alarm system.The papers includes two exemplifying applications to geological and financial data. Joint work with Juerg Huesler.

3. Juerg Huesler, University of Bern, POT method for interval censored and non-censored data

We will discuss the estimation of the tail of the distribution of random variables where the data come from accurate measurements and from historical observation which are less accurate. The historical data are given as interval censored ones. We investigate too different estimation methods and compare them analytically and by simulations. Finally we discuss a real data example which is the motivation for this paper. Joint paper with Jasmin Wandel.

sequential methods and causality models

[11 Zion A 12:00-13:30]

Chair: Ron Kenett, KPA and UNITO

1. Shelley Zacks, Binghamton U., Bayesian Estimation of the Current Mean of Normal Processes

Chernoff and Zacks (1964) developed a Bayesian tracking method for normal processes which are subjected to random changes in the mean at unknown epochs. We apply the method to sequences that may have several change points, and test its adequacy on different types of sequences. More specifically, we present the theory of the Bayes AMOC estimation, which assumes that there is at most one change-point in the sequence, and apply the Bayesian estimator of the current mean on sequences with multiple change-points via moving windows of small size. We show how close the tracking is and develop also diagnostics on the possible change-points via the location of the maximal posterior probability of the location of the change.

2. Anat Reiner, Haifa U., Scan statistic tail probability computation based on peak length

A scan statistic is used to identify an unusual cluster, or interval, of events within a random process. If an event is defined as an exceptionally high observation, a cluster may be referred to as a "peak". For a given process, the existence of a single peak of a specified length w may be tested if the tail probability of the scan statistic can be evaluated. When a peak is assumed to contain a single observation, such that the scan statistic is merely the maximum over all observations, extreme value theory provides exact formulas for the one-dimensional statistic, and random field theory extends the concept for multiple endpoints. This talk presents formulation that exploits the information provided by the peak length as well as the covariance matrix of the random process, to obtain the scan statistic tail probabilities. Specific results for special covariance structures are given as well. An example from genomics will follow, in which intronic sequences are searched for along the genomic sequence using tiling array data.

3. Ron Kenett, KPA and UNITO, Applications of Bayesian Networks to Small, Mid-size and Massive Data

Modelling cause and effect relationships has been a major challenge for statisticians in a wide range of application areas. Bayesian Networks (BN), Context Statistical Process Control (CSPC),Variable Order Bayesian Networks (VOBN) and Target-Based Bayesian Networks combine graphical analysis with Bayesian analysis to represent causality maps linking measured and target variables (Pearl, 2000, Ben Gal, 2003, 2004, 2007, Kenett, 2007, Cornalba et al, 2007, Gruber and Ben-Gal 2011). Such mapping models can be used for effective process monitoring. The talk will present an introduction to Bayesian Networks and their applications in the context of the amount of data available. We distinguish between small data sets, with multivariate observations over 5-15 time instances, mid-range data sets with data collected over 100-500 time stamps and massive data sets with thousand and even millions data points. The examples we cover include the testing of web services (Bai and Kenett, 2012) and web site usability analysis with massive data sets (Harel et al, Kenett et al, 2009), customer satisfaction surveys (Kenett and Salini, 2011) and operational risks with midrange data sets (Kenett and Raanan, 2010) healthcare systems (Kenett, 2012), and biotechnology with small data sets (Peterson and Kenett, 2011). We will show how to adopt methods to the amount of data and discuss various challenges in dealing with complex data sets. Some directions for future research will be also provided. Details of references will be provided on request.

Applied Statistics Related to Scans, Reliability and Classification

[14 Zion B 12:00-13:30]

Chair: Wendy Lou, University of Toronto

1. Jie Chen, University of Massachusetts Boston, An Application of Variable Window Scan Statistics in Cluster Detection

Scan statistic is defined as the maximum number of events in a certain interval. It has applications in many areas such as cluster detection of unusual evens. When the locations and cluster sizes are both unknown, using fixed length scan statistics may have lower detection power. In this talk, we present testing procedures based on a minimum P-value statistic and an adaptive variable window scan statistic for an example of Knox's (1959) data. Results are compared to generalized maximum likelihood Ratio approach that discussed in Nagarwalla (1996) and multiple window scan statistics discussed in Naus (2004).

References: 1. G. Knox, "Secular pattern of congenital oesophageal atresia," British Journal of Preventive Social Medicine Vol. 13 pp. 222-226, 1959.

2. N. Nagarwalla, "A scan statistic with a variable window," Statistics in Medicine Vol. 15. P845 - 850, 1996.

3. J. Naus, "Multiple window and cluster size scan procedures", Methodology and computing in applied probability, 6, 389 - 400, 2004.

2. Michelle Liou, Academia Sinica, Generalized Intraclass Correlations in Reliable fMRI BOLD Activity During Long-lasting Sensory Stimulation

Recent studies on reliability of blood oxygen level dependent (BOLD) responses have found that cortical activity was intrinsically similar within the same brain region yet heterogeneous among distant regions, when exposing subjects to long-lasting audiovisual movies, narrated stories or music videos. These studies suggested reliability to be a scientific phenomenon beyond the amplitude of brain activity which was indistinguishable among brain regions in experiments involving real-life activities. In this study, we propose using the generalized intra class correlation coefficient (gICC) suitable for characterizing stable BOLD responses in functional magnetic resonance imaging (fMRI) experiments. The gICC includes the regular ICC as a special case. Because the observed gICC values can go beyond the theoretical range between 0 and 1 particularly in neuro imaging applications, we have derived the standard errors and asymptotic distribution for generalized ICCs, which differs from the widely used F-distribution in the literature. For illustration, we have applied the coefficients to estimate reliable BOLD activity during a 12 minutes fMRI experiment involving the eyes-closed and -open paradigm. The gICC coefficients suggest that the thalamus and anterior cingulate have most reliable activity over the entire course of the experiment as compared with other brain regions.

3. Siddik Keskin, Yuzuncu Yil University, Statistical Methods for Fraud Detection in Healthcare Data

In many healthcare systems, fraud is a serious problem that is difficult to detect and that leads to unnecessary costs. In this presentation, some statistical fraud detection methods will be discussed, including ones based on logistic regression, decision trees, neural networks, and peer group analysis. Examples from real applications will be presented. The aim is to provide comparisons and discussions of the performance of these methods, in order to help guide future studies in the field.

Interfacing Applied Probability and Sequential Methodologies-II

[14 Zion A 12:00-13:30]

Chair: Nitis Mukhopadhyay, University of Connecticut, Storrs, USA

1. Kazuyoshi Yata, University of Tsukuba, Tsukuba, Japan, Effective PCA for Large p, Small n Scenario Under Generalized Models

In recent years, substantial work has been done on high-dimensional, low-sample-size (HDLSS) asymptotic theory in which the dimension goes to infinity while the sample size is fixed. Hall et al. (2005,J. Roy. Statist. Soc.) and Jung and Marron (2009,Ann. Statist.) considered the case that the population distribution has normality or a mixing dependency. Yata and Aoshima (2009,Commun. Statist.-Theory Meth.) developed the HDLSS asymptotic theory without assuming either the normality or a mixing dependency under the spiked covariance model introduced by Johnstone (2001,Ann. Statist.). In this talk, we first introduce two effective PCA methodologies, the noise-reduction methodology by Yata and Aoshima (2012,J. Mult. Anal.) and the cross-data-matrix methodology by Yata and Aoshima (2010,J. Mult. Anal.). We show that the two methodologies give consistent estimators of eigenvalues, eigenvectors and PC scores for HDLSS data sets under the spiked covariance model. If the data structure appears Gaussian, we recommend the experimenter to use the noise-reduction methodology. On the other hand, if the data structure appear non-Gaussian, we recommend the cross-data-matrix methodology. Furthermore, we apply the two methods to more generalized models including the spiked covariance model. We also consider the sample size determination for inference on eigenvalues under the generalized models. Finally, we examine how those methods perform in the real data analysis by using a microarray data.

2. Bhargab Chattopadhyay, Department of Statistics, University of Connecticut-Storrs, Connecticut, USA, Percentage Points of Distribution of GMD Based Test Statistics for the Normal Population Mean and Its Applications to Modified Two-Stage Procedure

In many areas including Physics, the number of observations is sometimes quite small, excluding the use of large sample cases. The normal assumption seems generally justified but slight deviations from normality are known to occur, especially in the tails of the distribution. Occasionally a measurement situation is encountered in which a few anomalous observations are suspected for non-statistical reasons from transient systematic errors to misreading of an instrument. A method is desirable which takes all these points into account. Barnett et al. (1967,Biometrika) introduced a test statistic based on Gini's Mean Difference (GMD) for testing the mean parameter of a normal population, analogue to Student's t-distribution but standardized the sample mean with Gini's Mean difference (GMD) rather than a sample standard deviation. In this presentation, a method for computing the percentile points of the distribution of the variable W, will be presented about along with an application, which can be used in constructing confidence intervals/tests for a normal mean parameter. Our approach is versatile enough to be used satisfactorily in finding the percentile points for the distribution of other standardized test statistic of similar nature, not limited by the normality assumption about the population distribution. This is joint work with Prof. Nitis Mukhopadhyay, University of Connecticut-Storrs.

3. Swarnali Banerjee, Department of Statistics, University of Connecticut-Storrs, Connecticut, USA, Sequential Negative Binomial Problems and Statistical Ecology: Selected Review with New Directions

Anscombe (1949,Biometrics) emphasized the role of negative binomial modeling while working with insect counts. Some closely related problems were also introduced by Bliss and Owen (1958,Biometrika). We begin here and first aim to emphasize the interface between sequential methodologies and statistical ecology where a negative binomial distribution has been employed. We quickly realize that the literature is prohibitively large and so we must be selective. In Section 2, we have provided a brief review by covering as many diverse topics as possible within the scope of this paper. However, we hope that one would be able to gather a glimpse of what may be crucial in future advances by approximately connecting some of the dots in the big picture. In Section 3, we provide specifics on certain items selected from Section 2. This part is necessarily technical in nature. We summarize some important theoretical developments and concepts along with precise means of comparisons among competing methodologies. In Section 4, we have formulated and developed some interesting possible directions of future research. Based on our findings, it is safe to say that the interface of sequential methods, negative binomial distributions, and statistical ecology remains very healthy and extremely rich for numerous in-depth explorations in new directions. We have indicated a very small collection of possibilities. Now, imagine the future! This is joint work with Prof. Nitis Mukhopadhyay, University of Connecticut-Storrs.

Abraham Wald Prize in Sequential Analysis Award Ceremony and SQA Editor's Special Invited Paper

[13 Galil 12:00-13:30]

Chair: Nitis Mukhopadhyay, University of Connecticut, Storrs, USA

1. Nitis Mukhopadhyay, Announcement

2. Shelemyahu Zacks, Department of Mathematical Science, Binghamton University, Binghamton, On The Distributions of Stopping Times and Explicit Formulae for Associated Functionals in Two-Stage and Sequential Sampling

The talk will review several cases of two-stage and sequential sampling for fixed-width confidence intervals, or bounded risk estimation. Explicit formulae will be presented for the distributions of the stopping variables, their moments and associated risk functionals.

3. Makoto Aoshima, Discussant

4. Benzion Boukai, Discussant

Interfacing Applied Probability and Sequential Methodologies-I

[14 Zion A 10:00-11:30]

Chair: Nitis Mukhopadhyay, University of Connecticut, Storrs, USA

1. Makoto Aoshima, Institute of Mathematics, University of Tsukuba, Tsukuba, Japan, Misclassification Rate Adjusted Classifier for Multiclass, High-Dimensional Data

We may face data with high dimension but low sample size (HDLSS). We consider multiclass classification for the HDLSS data. We do not assume underlying Gaussian distribution or the equality of covariance matrices among classes. The inverse of the sample covariance matrix does not exist for the HDLSS data. Dudoit et al. (2002,J. Amer. Statist. Assoc.) considered using the inverse matrix defined by only diagonal elements of the sample covariance matrix. Hall et al. (2005,2008,J. Roy. Statist. Soc.) and Chan and Hall (2009,Biometrika) considered distance-based classifiers. There are kernel-based algorithms having sparse solutions such as the support vector machine and the relevance vector machine. However, such methods do not assure pre-specified accuracy and they do not always fully utilize the geometric characteristic of HDLSS data. Aoshima and Yata (2011,Sequential Analysis) proposed a new classification rule utilizing geometric representation of HDLSS data and showed asymptotic normality of the classifier when the dimension goes to infinity. The classifier of Aoshima and Yata (2011,Sequential Analysis) can assure pre-specified accuracy with regard to classification rates by taking samples in two-stages. The above literature mainly dealt with two-class classification. In this talk, we shall develop a classifier in a multiclass scenario. We show the asymptotic normality of the classifier and the sample size determination to assure the pre-specified accuracy. We demonstrate the performance of the classifier by using microarray data.

2. Amitava Mukherjee, Department of Mathematics, IIT Madras, Chennai-600036, India, On a Class of Nonparametric Random Semi-Sequential Tests for Two-Sample Location Problem

In the present paper, we introduce a class of nonparametric two-sample tests based on a new semi-sequential sampling scheme. An existing partially sequential or semi-sequential procedure based on inverse sampling scheme, pioneered by Wolfe (1977,J. Amer. Statist. Assoc.) and Orban and Wolfe (1980,Commun. Statist.-Theory Meth.), is modified in the light of random sequential sampling techniques, proposed by Mukhopadhyay and De-Silva (2008,Statistical Methodology).Our proposed modification is motivated from a practical situation arise in geological field experiment. We discuss in detail the statistical methodologies and some asymptotic results. Numerical results based on Monte-Carlo are provided to justify asymptotic theory. Some power performances against fixed alternative are studied. We also provide an illustrative example with Arsenic contamination data.

3. Debanjan Bhattacharjee, Department of Mathematics, Utah Valley University, Sequential Point Estimation of the Scale in a Uniform Distribution Under Adjusted Non-Sufficient Estimators: A Comparative Study

Ghosh and Mukhopadhyay (1975,Cal.Statist. Assoc. Bul.) introduced a purely sequential minimum risk point estimation procedure for the unknown positive scale parameter in a uniform distribution under squared error loss plus linear cost of sampling. Mukhopadhyay et al. (1983,Sequential Analysis) broadened that methodology. However, the unknown scale parameter was estimated by the randomly stopped largest order statistic (S) in the loss function and stopping rule. Mukhopadhyay (1987,S. Afr. Statist. J.) proposed a different idea. He used the associated randomly stopped versions of SorT(=twice the sample mean) in either the loss function or the stopping rule. Performances of such procedures were compared with those associated with earlier proposed sequential estimators based on S. But, clearly, using a randomly stopped version of T would amount to some loss of information when compared with a corresponding randomly stopped largest order statistic in the loss function and stopping rule. We explore some novel approaches for recovering any such loss of information by fine-tuning the loss function and then properly tailoring the associated sequential methodologies. We will examine how the sequential risks of our newly proposed methodologies would compare with those associated with the existing sequential estimators. We will present small, moderate as well as large sample-size performances of the new randomly stopped versions of T and explore some selected second-order properties.

Spatial and Subset Scanning

[14 Arbel 12:00-13:30]

Chair: Daniel B. Neill, Carnegie Mellon University

1. Luiz H. Duczmal, Universidade Federal de Minas Gerais, Brazil A Constrained Dynamic Programming Approach to Spatial Cluster Detection

A fast algorithm based on constrained dynamic programming is proposed to make detection and inference of arbitrarily shaped connected clusters in aggregated area maps. The Fast Subset Scan [1] finds exactly the optimal cluster; however, the solution may not be connected. A classic knapsack formulation was used, employing bi-objective unconstrained combinatorial optimization [2]. The Geographical Dynamic Scan is proposed to find optimal connected clusters, minimizing a bi-objective vector function $F(z)=(-C(z),N(z))$, where $C(z)$ and $N(z)$ are the number of cases and the population of the candidate cluster z, respectively. The solution which maximizes the spatial scan statistic is included in the set of non-dominated solutions of F. The dynamic programming algorithm is adapted to consider (i) a geographical proximity constraint and (ii) a connectivity constraint, for each region j, searching for only a small number of subsets, which depends almost linearly on the number of neighbors of the region j, on average. Joint work with Gladston J.P. Moreira, Luis Paquete, Ricardo C.H. Takahashi, André L.F. Cançado, and Carlos M. Fonseca. We thank CNPq, Fapemig and Capes.

References: 1. D.B. Neill. Fast subset scan for spatial pattern detection. JRSS-B, 2011, to appear. 2. A.L.F. Cançado. Spatial clusters detection through multi-objective optimization. PhD thesis, UFMG, Brazil, 2009.

2. Guenther Walther, Stanford University, Detection with the Scan and the Average Likelihood Ratio

Scan statistics are the standard tool for a range of detection problems, such as the detection of spatial disease clusters. There have been a number of recent claims in the literature, based on empirical findings, that scan statistics are inferior to an approach that involves the average likelihood ratio. The talk will present the results of an investigation of this issue: The average likelihood ratio attains the detection boundary, i.e. is as powerful as any procedure can possibly be. On the other hand, the scan will typically have inferior power, but optimality can be restored via several simple modifications. I will also explain various connections between statistical optimality and computational efficiency. Joint work with Hock Peng Chan.

3. Daniel B. Neill, Carnegie Mellon University, Fast Generalized Subset Scan for Anomalous Pattern Detection

We present Fast Generalized Subset Scan (FGSS), a new method for detecting anomalous patterns in general categorical datasets. We frame the pattern detection problem as a search over subsets of data records and attributes, maximizing a nonparametric scan statistic over all such subsets. We take advantage of a novel property of nonparametric scan statistics that allows for efficient optimization over the exponentially many subsets of the data without an exhaustive search. We demonstrate that FGSS can successfully detect relevant patterns in various application domains, including customs monitoring, disease surveillance, and network intrusion detection. We compare the performance of FGSS to three other recently proposed detection algorithms: Bayesian Network anomaly detection, Anomaly Pattern Detection and Anomalous Group Detection. FGSS showed substantial decreases in run times and improved detection power for massive multivariate datasets. More details are provided in the full paper [1]. Finally, we discuss recent extensions of FGSS to datasets which contain both real-valued and categorical attributes, and to discovering novel patterns given a set of known and modeled pattern types. This work was partially supported by NSF grants IIS-0916345, IIS-0911032, and IIS-0953330. Joint work with Edward McFowland III and Skyler Speakman.

References: 1. E. McFowland III, S. Speakman, and D.B. Neill. Fast generalized subset scan for anomalous pattern detection. Submitted for publication, 2012.

Biostatistics, design and analysis

[11 Zion A 10:00-11:30]

Chair: Yosef Rinott, The Hebrew University of Jerusalem

1. David Azriel, Technion, Israel, Optimal adaptive designs to maximize power in clinical trials with three treatments.

We consider a clinical trial with three competing treatments and study designs that allocate subjects sequentially in order to maximize the power of both relevant tests. Two different criteria are considered: the first is to find the best treatment and the second is to order all the three. The power converges to 1 in an exponential rate and we find the optimal allocation that maximizes this rate by large deviation theory. For the first criterion the optimal allocation has the plausible property that it assigns a small fraction of subjects to the inferior treatment. The optimal allocation generally depends on the unknown parameters and therefore in order to implement it, a sequential adaptive scheme is considered. At each stage of the trial the parameters are estimated and the next subject is allocated according to the optimal allocation that is based on these estimates. We study the asymptotic properties of this design by large deviations theory and the small sample behavior by simulations.

2. Micha Mandel, The Hebrew University of Jerusalem, Time-to-event analysis using panel data

Consider independent processes on a discrete state-space which are not followed continuously, but are only observed at several time points and their states then are recorded. The aim is to estimate time-to-event probabilities which are defined on the processes' paths. A simple example of such an event is the first visit to a set of states. However, more interesting events are defined by several time points. An example is the first time the process stays in state j at least \Delta time units. Such events are very important in studying diseases such as multiple sclerosis, where the focus is on sustained progression. In this talk, I discuss inference under Markov transition models and under survival analysis models comparing their robustness to model assumptions, their ability to deal with missing data and more.

3. Yosef Rinott, The Hebrew University of Jerusalem, Cross sectional sampling, bias and dependence

We consider a population such as hospital patients, which subjects enter and leave according to certain discrete processes. The population is sampled at a given time (or times), and the sample includes all those that are present at sampling time. This type of sampling results in complicated data: a random sample size, biased observations on the duration of stay (lifetime) in the populations, and dependent observations. The goal is to estimate the distribution of lifetime in the population. We propose various models and methods, parametric and non-parametric, to overcome these complications, and compare them. Joint unfinished work with Micha Mandel.

Applied Stochastic Models

[12 Zion B 12:00-13:30]

Chair: Sheldon Ross, Univ. of Southern California

1. Michael Katehakis, , Rutgers Business School. Newark & New Brunswick NJ USA, On Stopping Criteria for the Quantile Estimation Problem.

In many applications, it is of interest to estimate a value of a control variable that will cause a certain ratio of successes, or failures, in an output variable. Classical methods for this quantile estimation problem are based on up-and-down procedures that generate a Markov chain and the chosen estimate is the mode of its invariant distribution. We present refinements of the Up & Down method for which there is a stopping criterion with a predetermined confidence probability of correct detection. We also discuss worst case performance bounds on the sample size and convergence rates. Further we present applications in inventory control under unknown demand distribution, tailored testing, and drug dosage determination.

2. Rhonda Righter, University of California, Berkeley, The Impact of Customer Flexibility in Service Systems

In many service, production, and traffic systems there are multiple types of customers requiring different types of service. Providing flexible servers that can serve multiple customer types improves performance, but can be very expensive. On the other hand, often some of the customers may be flexible, i.e., they may be willing to change their type in order to achieve faster service, and the infrastructure to take advantage of this customer flexibility is often relatively inexpensive. Our research is in part motivated by a call center which provides service in both English ("Press 1") and Spanish ("Press 2"). Because of the training expense and high turnover of agents, the company policy is to train agents to only handle calls in one language. The company would like to know the benefit of adding a "Press 3" option for bilingual customers, and how this depends on the proportion of customers who are bilingual. We model our system as a set of alternative multi-server queues, and with a mixture of dedicated (to a single queue) and flexible customers, and exponential services. We extend known results showing that JSQ - Join the Shortest Queue - is the optimal policy for flexible customers. This gives us monotonicity: waiting time is decreasing in the proportion of flexible customers, p. We then consider convexity, that the marginal improvement in performance is decreasing as more customers become flexible. We give a model where we can show a strong sample-path version of convexity, but in general, convexity will not hold in this strong sense. We give conditions for weaker notions of convexity to hold. This is joint work with Osman Akgun and Ron Wolff.

3. Flos Spieksma, Leiden University, K-competing queues with impatient customers: optimality of the mu-c rule

A single server has to service K types of customers, each with their own exponential service times distribution and holding cost per unit time. We assume that the customers arrival processes are Poisson. If we order the customers in decreasing order of service rate times holding cost, then it has been long known it is optimal to serve the customer with the smallest index. Value iteration is a typical method to prove this. Event based dynamic programming provides a simple procedure for carrying out the induction step. If, in addition, customers are allowed to renege, uniformising the system is not possible and hence value iteration is not applicable. Truncating the state space destroys the structural properties of the optimal policy. We have developed a truncation procedure, called Smoothed Rate Truncation, that generally preserves structural properties. We will apply this to the K-competing queues model with impatience and derive conditions under which the mu-c rule is still optimal. In passing we will show that SRT seems to behave better than normal truncation even for numerical analysis of uniformisable systems.

Dependence Comparison and stochastic order relations

[12 Zion A 12:00-13:30]

Chair: Moshe Shaked, University of Arizona

1. Franco Pellerey, Politecnico di Torino, Dependence Orders for Vector Functions of Independent Random Variable

The talk is based on joint works with Xiaohu Li (Xiamen University), Moshe Shaked (University of Arizona) and Salimeh Yasaei (Fendowsi University).Dealing with stochastic models for dependent lifetimes or risks, a typical assumption is that the mutual dependence arise from common environmental factors like common shocks or stress. A common way of doing this sort of modeling is to introduce independent random variables and to define the components of random vectors as functions of the independent random variables. Random variables appearing in just one of the expressions defining the components of the vector represent the individuality associated to the corresponding lifetime, while the variables comparing in more than one expression give rise to the mutual partial dependence. Recent results dealing with comparisons of the strength of dependence for some of these models are discussed in the talk. In particular, results for the models corresponding to Generalized Marshall-Olkin distributions and for additive models will be presented along the talk. References- Li, X. and Pellerey, F. (2011). Generalized Marshall-Olkin distributions and related bivariate aging properties. Journal of Multivariate Analysis 102, 1399-1409.- Nelsen, R. B. (1999). An Introduction to Copulas. Springer, New York.- Pellerey, F, Shaked, M and Yasei, S. (2012). Comparisons of Dependence Models. Technical report, Department of Mathematics, University of Arizona.

2. Haijun Li, Washington State University, Dependence Comparison of Multivariate Extremes

A multivariate extreme-value distribution is the limiting distribution of properly normalized component-wise maximums of iid random vectors. All margins of a multivariate extreme-value distribution enjoy parametric features of univariate generalized extreme value distributions, but the dependence structure of the distribution is determined by its spectral measure that is non-parametric. It is well-known that multivariate extreme-value distributions are positively associated. In this talk, we will discuss the dependence comparison of multivariate extreme-value distributions in terms of their spectral measures. Our method is based on a stochastic concentration order of spectral measures on unit sphere, and we will show how such a concentration order leads to the orthant dependence comparison of multivariate extreme-value distributions. Various examples are discussed and the results are applied to comparing dependence among multivariate extremes.

3. Alfred Müller, Universität Siegen, Duality Theory for Stochastic Order Relations

In this talk we will demonstrate how functional analytic results from duality theory can be used in the theory of stochastic order relations. It will be shown how this can be used to give elegant and intuitive proofs of some known results, and how they can be generalized to new results. Special emphasis will be given to the case of characterizing convex ordering of univariate distributions by mean preserving spreads and how these results can be generalized to the multivariate case.

Algebraic and Combinatorial Aspects of System´s Signatures

[14 Tavor 12:00-13:30]

Chair: Fabio L. Spizzichino, Department of Mathematics, University La Sapienza, Rome, Italy

1. Ilya Gertsbakh, Ben Gurion University, Structural Invariants of Monotone Systems and Their Use in Reliability Calculations

We consider monotone binary systems with binary components. Its structural invariant is a multidimensional parameter which depends only on the system structure function. The first invariant is so-called cumulative D-spectrum (signature) which equals the probability that the system is DOWN if it sk randomly chosen components are down. The second invariant is called importance spectrum[F(k;j); j= 1,…,n]where F(k;j)is the probability that the system is DOWN if kof its randomly chosen components are down and component jis present among the k down components. The third invariant is the set S(r) of border states "activated" by component tr. It is (i) a DOWN state; (ii) it has Manhattan distance 1 from system UP state; and (iii) it becomes UP if component tr changes its state from down to up. We show that knowing F(k)allows computing system DOWN probability if it consists of independent components with down probability q. It also allows to find bounds on system DOWN probability if it is known that system components are independent and have failure probability within known bounds . If all components are independent and have equal up probability p, we present a formula to compute the Birnbaum Importance Measure using the second structural invariant. This formula allows obtaining an approximation to system reliability function. It was proved that the partial derivative of system reliability function R(p)can be expressed via the third structural invariant. Reference 1 Ilya Gertsbakh and Yoseph Shpungin. Models of Network Reliability. Analysis Combinatorics and Monte Carlo. CRC Press, December 2009.

2. Tomasz Rychlik, Polish Academy of Sciences/Nikolaus Copernicus

Evaluations of moments of system lifetimes with use of Samaniego signatures

If the system components are exchangeable, the well-known Samaniego formula allows to represent the system lifetime distribution as a convex combination of order statistics distributions with the combination coefficients depending merely on the system structure function. Using the formula, we present sharp upper evaluations of the system lifetime mean and variance. We consider two cases of components with independent identically distributed lifetimes and those with arbitrarily dependent exchangeable lifetimes.

3. Luca De Sanctis, Sapienza Un. of Rome, Characterization and interpretations of signatures by means of simplicial sets"

We give an interpretation of the signature of a coherent system by means of simplicial sets and their combinatorics, and provide an effective characterization of such signatures.

References: 1. J.B. Kruskal, "The number of simplices in a complex", in Mathematical Optimization Techniques, Univ. California Press, Berkeley (1963), 251–278.

Stochastic control

[12 Tavor 10:00-11:30]

Chair: Rami Atar, Technion

1. Anup Biswas, Technion, On risk-sensitive control problems

The theory of risk-sensitive control has received much attention in recent years because of its connection to various fields. In this talk, we would recollect some of the recent developments in risk-sensitive control problems for diffusion processes. We would mainly analyze the Hamilton-Jacobi-Bellman equation, existence of optimal control and other related issues.

2. Adam Shwartz, Technion, Cesaro limits of actions and ergodic control of Markov chains

We consider the ergodic control of discrete time controlled Markov chains with a locally compact state space and a compact action space. The first question we consider is: what characterizes general policies which have the same cost (for a large class of immediate cost functions) as a given stationary Markov policy? A flexible family of controls, called action time sharing (ATS) policies, associated with a given continuous stationary Markov control, is introduced. These policies where first introduced by Altman and Shwartzfor the case of countable state space and discrete control space. It is shown that the long term average cost for such a control policy, for a broad range of one stage cost functions, is the same as that for the associated stationary Markov policy. ATS policies are well suited for a range of estimation, information collection and adaptive control goals. To illustrate the possibilities we present two examples: The first demonstrates a construction of an ATS policy that leads to consistent estimators for unknown model parameters while producing the desired long term average cost value. The second example considers a setting where the target stationary Markov control q is not known but there are sampling schemes available that allow for consistent estimation of q. We construct an ATS policy which uses dynamic estimators for q for control decisions and show that the associated cost coincides with that for the unknown Markov control q.

3. Itai Gurvich, Northwestern University, Excursion-based steady-state Brownian approximations: Universal approximations for the Erlang-A queue

We re-visit the question of many-server approximations for the well-studied Erlang-A queue. This is a queue with a single pool of identical servers and one class of impatient customers. Arrivals follow a Poisson process, service times are exponentially distributed as is the customers' patience. We propose a universal diffusion approximation (rather than limit) that applies simultaneously to all of the existing many-server heavy-traffic regimes: QED, ED, QD and NDS. The approximation yields accurate estimates for a broad family of steady-state metrics. In our analysis, we do not use the steady-state distribution of the Erlang A queue. Rather, we study the excursions of the underlying Birth-and-Death process and relate these to properly defined excursions of the universal diffusion. Regenerative-process and Martingale arguments together with gradients bounds for solutions to certain ODEs allow us to bound the accuracy of the approximation.

Supply and Service Systems

[12 Zion B 10:00-11:30]

Chair: Benjamin Melamed, Rutgers Business School - Newark and New Brunswick

1. Michael Katehakis, Rutgers Business School - Newark and New Brunswick, Rutgers University, Dynamic Pricing and Channel Preference in a Dual Channel Environment

We investigate a retailer of a single product that employs two primary sale channels: (1) a physical channel (the ``store''); and (2) an online one. The retailer has the ability to influence the demand of each channel by using a different product price for each channel. Both channels' demands are satisfied using inventory that is held at the physical channel location. However, there is the following difference in the way demand is serviced. In each period (e.g. one day), the online channel demand is serviced at the end of the period using inventory that remains available after the physical store demand has been serviced during the period. Excess demands are backlogged and are not distinguished. We derive the structure of the retailer's dynamic pricing policy that maximizes the total discounted expected profit over a finite time horizon. Further, it is shown that the one period delivery flexibility of the online channel permits better demand uncertainty management and thus, the retailer may prefer selling through their online channel even if that channel's marginal profit is smaller than the marginal profit of selling through a more traditional channel. * Joint work with Wen Chen, McCombs School of Business, The University of Texas, Austin, TX 78715, and Adam Fleischhacker, Lerner College of Business and Economics, University of Delaware, Newark, DE 19716.

2. Dale Rogers, Rutgers Business School - Newark and New Brunswick, Rutgers Universit, Using Derivatives to Hedge Transportation Risk

Fluctuations in the price of transportation and other logistics services cause logistics' managers serious problems. Volatility in fuel prices observed over the last few years requires new risk management strategies. In the stock market, financial derivatives are used to mitigate risk. Financial options allow buyers the right but not the obligation to purchase a stock at a specified price in the future. An exchange can be developed to enable the trading of formalized options around transportation and logistics services through utilization of an index. This talk proposes a framework for enabling managers to extend the use of derivatives to the future use of logistics and transportation resources.

3. Amir Elalouf, Bar-Ilan University, Fast Algorithms for Routing in Stochastic Networks under Uncertain Traffic Conditions

Joined work with Eugene Levner, Ashkelon Academic College School of Economics We consider routing problems in general stochastic networks where input data (durations of operations, costs, profits, etc.) are random due to fluctuating traffic conditions. Examples that arise in supply and service systems include routing of ambulances, scheduling transportation assets, routing mobile agents, and many others. Finding the optimal (fastest, cheapest, etc.) routes in such networks cannot rely on average data alone; rather, data variability should be taken into account, as well. The routing problems under study are formulated as constrained routing problems on graphs. To each arc we associate a random travel time (cost, profit) with given mean and variance. The problem is to find a path that minimizes the total expected path travel time subject to constraints depending on the variance. Two typical constraints are: (1) the variance of the path travel time does not exceed a prescribed value; and (2) the probability that the path travel time does not exceed a given value is equal to or larger than a prescribed value. We propose exact pseudo-polynomial dynamic programming algorithms and fast ε-approximation algorithms (so-called FPTAS) for these problems, and discuss computational results for several applications in supply and service systems.

Queues and Networks with Losses, Overflows or Blocking

[11 Tavor 10:00-11:30]

Chair: Yoni Nazarathy, The University of Queensland

1. Peter G. Taylor, The University of Melbourne, Blocking Probabilities in Queues with advance reservations

Queues where on "arrival" customers make a reservation for service at some time in the future are endemic in practice and under analyzed in theory. Simulations illustrate some interesting implications of the facility to make such reservations. For example introducing independent and identically distributed reservation periods into an Erlang loss system increases the blocking probability above that given by the Erlang B formula, thus degrading system throughput (despite the fact that the process of 'reserved arrivals' is still Poisson).In this talk I shall discuss some analysis that approximates the blocking probability of a finite system by the probability that there is not enough room to fit a new customer into the "bookings diary" for the infinite server system. Joint work withR.J. Maillardet

2. Ivo Adan, Eindhoven University of Technology, Performance analysis of zone-picking systems

In this talk we consider zone picking systems, where order totes travel between zones and visit only those zones where items need to be collected. However, if an order tote tries to enter a zone and this zone is fully occupied, then the tote is blocked and recirculated in the network, trying to enter in the next cycle. This system is approximated by a closed multi-class queueing network with jump-over blocking, which has a product-form solution. We develop an iterative algorithm based on mean value analysis to evaluate blocking probabilities and performance characteristics such as utilization and throughput.

3. Erjen Lefeber, Eindhoven University of Technology, Finite Buffer Fluid Networks with Overflows

Consider a network where each node has a finite buffer of capacity Ki and a single processor. Material is modeled as a continuous flow and arrives to the nodes exogenously. When material arrives to node i and finds less than Ki in the buffer then it either enters the buffer or is immediately processed if the buffer is empty. Material which is processed at node ican either leave the system or move to other nodes. This follows the proportions pi,j (the proportion of material leaving i which goes to j)with sum j pi,j <= 1; in case the inequality is strict, the remaining material leaves the system. When material arrives to find a full buffer it is diverted (overflows) according to propositions qi,j similarly to the pi,j. The case of random discrete memory less flows and Ki = 8 is the well-known Jackson network and has a product form solution in the stable case. As opposed to that, finite Ki typically implies intractability of the Markov Chain. In this case it is first fruitful to analyze the behavior of the system with deterministic continuous flows. In this respect we formulate traffic equations and show that they can be represented as a linear complementarity problem solved in polynomial time. The solution of the traffic equations is used to approximate the sojourn time distribution of customers through the network which can be represented as a discrete phase-type distribution. Joint work with Stijn Fleuren and Yoni Nazarathy.

Queueing Models in Service Systems

[12 Zion A 10:00-11:30]

Chair: Ohad Perry, Northwestern University

1. Jim Dai, Georgia Tech, Inpatient Flow Management in a Singaporean Hospital

We study patient flow management in an inpatient department of a Singaporean hospital. We focus on understanding the effect of an "early discharge" policy, implemented in late 2009, on ward overflow rate and on fraction of ED patients who have to wait six hours or longer to get a bed. We propose a new stochastic network model whose service times are not independent, identically distributed (iid) and are dictated by a discharge distribution. We discuss a number of other key features that need to be built into the model. We show, via a simulation study, that our model is able to capture the hourly performance of the inpatient operation. The model allows one to evaluate the impact of operational policies such as early discharge and overflow policies. This is joint work with Pengyi Shi (Georgia Tech), Ding Ding (University of International Business & Economics, Beijng), and James Ang and Mabel Chou (NUS).

2. John Hasenbein, University of Texas at Austin, A Two-Stage Call Center Staffing Problem with Bayesian Updating

We consider staffing a pool of agents in which an initial forecast of the call volume is given at the beginning of the day. After an initial observation period, the manager has the ability, for a price, to update the staffing level based on a revised forecast. The manager operates under QoS constraints which can be very general and include utilization, abandonment rate, and proportion of callers queued as special cases. The forecast updating is done in the Bayesian framework with the Gamma distribution used as the (conjugate) prior. The resulting problem can be formulated as a two-stage stochastic program. When utilization is the metric, the resulting solution can be written in a closed form which is analogous to the solution of the classical newsvendor problem.

3. Ohad Perry, Northwestern University, Asymptotic Analysis of Large Service Systems with Blending

We study a large-scale service system, with service blending. For example, a single large service pool in a call center that handles inbound and outbound calls. Specifically, we consider a system with two types of work: The first type arrives as an exogenous stream of customers with impatience (inbound calls), and the other type is modeled as an infinite queue of jobs waiting to be processed (outbound calls).The operational goal is to serve the first type of jobs, minimizing their delay and abandonment, while maximizing the processing rate of the second type. We propose a threshold policy in which agents take second-type jobs whenever the queue of arriving jobs is empty and the number of idle agents is no smaller than some threshold. Analysis of the system requires description of a four-dimensional stochastic process: The queue size of incoming calls, the number of servers working with each type, and the number of idle servers. We conduct heavy-traffic analysis and show, using only tightness of the associated fluid-scaled processes and stability of all fluid limits, that after some short initial time, the four-dimensional stochastic process collapses to a simple one-dimensional process, under any scaling larger than log(n), with the queue and idleness processes being null. Fluid limits are then a solution to a simple ordinary differential equation together with an initial condition, and the diffusion limit is a one-dimensional Ornstein-Uhlenbeck process. Joint work with Guodong Pang.

Inequalities, orderings, and applications to reliability theory

[13 Tavor 12:00-13:30]

Chair: Yosef Rinott, Hebrew University

1. Moshe Shaked, University of Arizona, Global Dependence Stochastic Orders

The research is joint with Miguel A. Sordo and Alfonso Suárez-Llorens of the Universidad de Cádiz. Four basic ideas, that give rise to global dependence stochastic orders, are introduced and studied. The similarities and differences between the resulting global dependence orders, and the known common positive dependence orders, are discussed. Some desirable properties that global dependence orders may be expected to satisfy are listed and checked. Some particular global dependence orders, which come up from the four general ideas, are studied in detail. It is shown, among other things, how these orders can be verified. Some applications in auction theory, in reliability theory, and in economics, are described.
Reference 1 Reference 2 Reference 3

2. Fabio Spizzichino, La Sapienza, Rome, Random-effects maintenance of a system and occurrences of words in sequences of random letters.

Two rather classical areas of applied probability are considered and compared: maintenance of systems and occurrences of words in a sequence of random drawings from an alphabet. Even though the relations among them might appear rather fancy, they both admit a quite natural analysis in terms of finite state-space, irreducible, Markov chains. We concentrate our attention on a parallel system with n components and on a fixed word with n letters. Then we compare two (discrete) waiting times: a) the time to the complete failure of the system and b) time to the first occurrence of the word in the random sequence of letters. Concerning a), we assume that the components are inspected and, when needed, repaired at any unit time; at most one component can fail at a time. But probability for a repair-action being successful is less than 1. One can then have several failed components at any inspection and a new attempt of repair for all of them is made. As to b) we assume that the given word presents some repetition structure (ABRACADABRA is, e.g., a famous example).We analyze conditions which lead to the same structure for the Markov chains associated to the two models and analyze related differences and analogies. This is a joint work with Emilio De Santis.

3. Antonio DI CRESCENZO, University of Slerno, A review of the cumulative entropy

Joint work with Maria Longobardi, The cumulative entropy has been proposed recently as a measure of the uncertainty contained in a random variable. It possesses an interesting role in reliability theory, being suitable to describe the information in problems related to ageing properties based on the past time and on the inactivity time. We provide suitable bounds for such a measure, as well as a description of its dynamic version. The empirical cumulative entropy is also discussed, with reference to its connection with the sample spacings, and to various asymptotic results.

New results in queueing, inventory and applied stochastic processes

[13 Galil 10:00-11:30]

Chair: David Perry, Haifa University

1. Yonit Barron, David Perry, Haifa University, A Make-to-Stock Inventory Model with MAP arrivals and Phase-Type demands

We consider a make-to-stock (MTS) inventory control model with double reflected finite barricades; one positive and one negative, where the inventory rate and the demand amount distribution depend on a random environment. The random environment behaves as a continuous time Markov chain. Accordingly, the production process alternates between two pre-determined production sets of rates, one set with a positive drift and one set with a negative drift. Customers arrive into the model according to a MAP process, and the independent demand amounts have a phase-type distribution. The system is supposed to have a finite storage capacity. If the system is at full capacity, the production is stopped, until a customer arrives. Any demand which cannot be fulfilled immediately is backlogged, provided the total backlog does not exceed a given level; otherwise it is lost. In order to assess the functioning of such an inventory model, four types of costs are essential: the holding cost of the stock, the idle time cost due to the finite storage capacity, the penalty cost of the backlogged demand and the lost sales cost due to unsatisfied demand. By applying the optional sampling theorem to the multi-dimensional martingale of Asmussen & Kella and by using the fluid flow application introduced by Ramaswami we obtain the cost functionals for the discounted and for the long run average cost cases.

2. Iddo Eliazar, Holon Institute of Technology, A macroscopic view of rank distributions

In this talk we establish a “Central Limit Theorem” for rank distributions, which provides a detailed characterization and classification of their universal macroscopic statistics and phase transitions. The limit theorem is based on the statistical notion of Lorenz curves, and is termed the "Lorenzian Limit Law" (LLL.(Applications of the LLL further establish: (i) a statistical explanation for the universal emergence of Pareto's law in the context of rank distributions; (ii) a statistical classification of universal macroscopic network topologies; (iii) a statistical classification of universal macroscopic socioeconomic states; (iv) a statistical classification of Zipf's law, and a characterization of the ” self-organized criticality” it manifests.

References: 1. I. Eliazar and M.H. Cohen, The universal macroscopic statistics and phase transitions of rank distributions, Physica A 390 (2011 4293-4303).

2. I. Eliazar and I.M. Sokolov, Measuring statistical evenness: A panoramic overview, Physica A 391 (2012) 1323-1353.

3. I. Eliazar and J. Klafter, A probabilistic walk up power laws, Physics Reports 511 (2012) 143-175.

3. Gideon Weiss, Haifa University

TBA

Finance and Management

[11 Zion B 12:00-13:30]

Chair: Olympia Hadjiliadis, City University of New York, Brooklyn College and the Graduate Center

1. Sheldon M. Ross, University of Southern California, Systems of dependent components

We consider a multi-component system where the failure of one component increases the instantaneous failure rates of those other components that are still working. We also suppose that there are randomly occurring system shocks that increase the component failure rates. We give conditions under which the component lives are associated as well as presenting efficient ways to simulate and then analyze these lives.

2. H. Dharma Kwon, University of Illinois, Preventing Rare Catastrophic Business Failures with Weak Forewarning Signals.

We consider the problem of a firm facing catastrophic failures with weak forewarning signals. In the model that we study, the failure takes place in two steps: (1) arrival of disruption and (2) the eventual failure. The firm monitors the weak signals that indicate a random arrival of disruption, and it can invest a fixed amount of capital to recover the undisrupted state to prevent the eventual failure, which also arrives at a random time following the disruption. The optimal policy is to recover the undisrupted state when the posterior probability of disruption exceeds a threshold. We investigate the efficacy of the optimal policy when the loss from a failure is large and the arrival of disruption is slow. We find that the efficacy is sensitive to the magnitude of the disruption rate. In particular, the probability of eventual failure is close to one if the disruption rate is extremely small while the probability is close to zero if the disruption rate is moderate. We also extend the model to the problem of recurring disruption; when the disruption rate is moderate, we find qualitatively different results from those of a single-disruption model.

3. Netzahualcóyotl Castañeda-Leyva, Departamento de Economía y Finanzas, Universidad de Guanajuato, México, Optimal investment in discrete time financial markets with bid-ask spreads

A one period financial market model with transactions costs is analyzed. The risky asset price process is redefined conveniently in order to obtain an explicit solution to the utility maximization problem when the risk preferences of the investor are based on the exponential utility function and a liability can be included in her portfolio. For a general liability at this incomplete market, the arbitrage free interval price, as well as its replication price, is characterized via the martingale approach. Finally, we derived the indifference price and its asymptotic limit when the risk aversion is going to infinity.

Finance and Stochastics

[11 Zion B 10:00-11:30]

Chair: Olympia Hadjiliadis, City University of New York, Brooklyn College and the Graduate Center

1. Jan Vecer, Frankfurt School of Finance and Management, Black-Scholes for Asian options

Asian options are securities with a payoff that depends on the average of the underlying stock price over a certain time interval. We identify three natural assets that appear in pricing of the Asian options, namely a stock S, a zero coupon bond BT with maturity T, and an abstract asset A (an "average asset") that pays off a weighted average of the stock price number of units of a dollar at time T. It turns out that each of these assets has its own martingale measure, allowing us to obtain Black-Scholes type formulas for the fixed strike and the floating strike Asian options. The models in dependent formulas are analogous to the Black-Scholes formula for the plain vanilla options; they are expressed in terms of probabilities under the corresponding martingale measures that the Asian option will end up in the money. Computation of these probabilities is relevant for hedging. In contrast to the plain vanilla options, the probabilities for the Asian options do not admit a simple closed form solution. However, we show that it is possible to obtain the numerical values in the geometric Brownian motion model efficiently, either by solving a partial differential equation numerically, or by computing the Laplace transform. Models with stochastic volatility or pure jump models can be also priced within the Black-Scholes framework for the Asian options.

2. Gerardo Hernandez-del-Valle, Columbia University, On the first time that an Ito process hits a barrier

This talk deals with first hitting time densities of Ito processes whose local drift can be modeled in terms of a solution to Burgers' equation. For example: Brownian motion with linear drift, the 3D Bessel process, the 3D Bessel bridge, and the Brownian bridge. In particular, we derive the densities of the first time that these processes reach a moving boundary. We distinguish two cases: (a) the case in which the process has unbounded domain before absorption, and (b) the case in which the process has bounded domain before absorption. The reason as to why this distinction has to be made will be clarified. Furthermore a new classification of processes in terms of linear combinations of solutions to Burgers' equation will be discussed.

3. Olympia Hadjiliadis, City University of New York, Brooklyn College and the Graduate Center, Drawdowns, the speed of market crash, and fair valuation of drawdown insurance

Drawdowns are path-dependent measures of risk and have been used extensively in the description of market crashes. We evaluate the market price of a market crash as measured through drawdowns by considering an investor who wishes to insure herself against the risk of a market crash and does so by purchasing insurance claims against drawdowns. We further examine the fair valuation of drawdown insurance in the possibility of early cancellation and identify optimal cancellation strategies. We proceed to examine further statistics related to the drawdown in order to achieve the characterization of a market crash, namely its speed. By speed we denote the duration of time between the drawdown and the last time at which the maximum was achieved. We derive the joint distribution of drawdown and it speed under general diffusion dynamics. We also examine the sensitivity of the speed of market crash to changes in the drift in the drifted Brownian motion model and discuss potential applications of our work in the online detection of a change in the drift.

Markov and semi-Markov Models

[13 Zion B 12:00-13:30]

Chair: Raimondo Manca, Sapienza University of Rome

1. Vlad Stefan Barbu, Université de Rouen, Reliability estimation of semi-Markov processes

Reliability estimation of semi-Markov processes Vlad Stefan Barbu Université de Rouen, Laboratoire de Mathématiques Raphaël Salem, UMR 6085, Avenue de l'Université, BP.12, F76801 Saint-Étienne-du-Rouvray, France E-mail: barbu@univ-rouen.fr Key words: semi-Markov chains, Markov renewal chains, reliability, statistical estimation. Our talk is concerned with developing some elements of reliability theory for discrete-time semi-Markov processes with countable state space. After a short presentation of infinite matrices and associated operations, we describe the discrete-time semi-Markov setting and we present some elements of Markov renewal theory. These results are applied in order to obtain closed forms for some reliability indicators, like reliability function, availability, mean hitting times, etc. Estimation of these quantities is also addressed. The results presented here are a direct continuation of some results of Barbu and Limnios (2010), and represent a generalization of reliability and estimation results summarized in Barbu and Limnios (2008).

References: 1. V. Barbu, N. Limnios, Some algebraic methods in semi-Markov processes, In Algebraic Methods in Statistics and Probability, volume 2, series Contemporary Mathematics edited by AMS, Urbana, 19-35, 2010.

2. V. Barbu, N. Limnios, Semi-Markov Chains and Hidden Semi-Markov Models toward Applications - Their use in Reliability and DNA Analysis, Lecture Notes in Statistics, vol. 191, Springer, New York, 2008.

2. Giuseppe Di Biase, University of Chieti-Pescara, Fiscal System Effects on Income Inequality: Application to some European Countries

FISCAL SYSTEM Effects on Income Inequality: APPLICATION TO SOME EUROPEAN COUNTRIES G. D'Amicoa, G. Di Biasea and R. Mancab a) Department of Drug Sciences, University "G. D'Annunzio", Chieti, Italy. b) Department of Mathematics for the Economics, Financial and Insurance Decisions, University "La Sapienza", Rome, Italy. In this paper we investigate the impact of the fiscal system on the wealth redistribution in some European countries. We show the methodology of application of the model to data of major European countries. In particular, starting from the net income distributions downloaded from Eurostat website and by using the individual income tax rates, we obtained the gross income distributions. For each country, we evaluated the Dynamic Theil's Entropy that allowed us to recover the total inequality between the net income distribution and the gross income distribution. This comparison allowed us to understand how the fiscal systems affect the wealth distribution. These results can be used for planning welfare policies. Keywords: income distribution, dynamic Theil's entropy, fiscal system, welfare policies JEL classification index: E64, E27.

3. Raimondo Manca, Sapienza University of Rome, Credit Risk Multivariate Evolution in Sectorial Interdependence Models

Credit Risk Multivariate Evolution in Sectorial Interdependence Models Guglielmo D'Amico^, Giuseppe Di Biase^, Raimondo Manca° and Giovanni Salvi° ^Università di Chieti-Pescara G. D'Annunzio Department of Drug Sciences g.damico@unich.it, dibiase@unich.it °Sapienza Università di Roma MEMOTEF raimondo.manca@uniroma1. it The aim of this paper is to investigate how the interdependence among different sectors can influence the rating time evolution. It is easy to think that if two sectors are strictly connected the rating evolution of one sector should influence the rating evolution of the other. We think that this influence is not symmetric in the sense that can happen for example that the default of one sector can give great problems to another sector but that the inverse relation could not have the same strong influence. The study that we propose will consider both the problems of rating evolution and the interdependence among the sectors. To study this phenomenon we will consider a multivariate Markov model that could simultaneously take into account the dynamic evolution of credit risk ratings and the sectorial interdependence Input-Output model both in the open and closed environments. The algebraic properties of the block matrices involved in this model will be also studied.

Stochastic Networks

[13 Zion B 10:00-11:30]

Chair: Amarjit Budhiraja, University of North Carolina

1. Haya Kaspi, Technion, Optimal Control for parallel server model at equilibrium, using measure valued processes

We study the multi-class parallel service model with reneging in the many servers fluid limit. The various classes have independent arrival processes, service times and patience. We assume that the service times and patience of the various classes has densities. Our main tool for the study is the work on fluid limits of the many servers queuing systems using measure valued processes by Kaspi-Ramanan and by Kang-Ramanan. We study a fixed, non preemptive priority assignment and identify the behavior of the queue as the unique solution of the corresponding measure valued fluid equations. We show that in the limit, at equilibrium, the preemptive and the corresponding non preemptive assignments policies give rise to the same solution. When reneging is exponential (with different parameters for different classes of customers) we show that, for a natural cost function, an analogue of the c-mu priority assignment rule is asymptotically optimal at equilibrium. Joint work with Rami Atar and Nahum Shimkin.

2. Chihoon Lee, Colorado State University, Stationarity and control of a stochastic fluid tandem network driven by fractional Brownian motions

A stochastic control model driven by a two-dimensional fractional Brownian motion is considered. This model serves to approximate a controlled tandem network with heavy tailed sources in heavy traffic. We establish the weak convergence results of the state process and construct an explicit stationary state process. Based on suitable coupling arguments, the ergodic cost functional can be represented in terms of the stationary process, which leads to the existence of an optimal control.

3. Mariana Olvera-Craviato, Columbia University, Ranking Algorithms on Directed Network Models

We analyze the typical behavior of linear algorithms on directed graphs, e.g. Google's PageRank algorithm for ranking web-pages in the World Wide Web. Focusing on a special class of random graphs with given degree distributions and local tree-like structure, we show how the analysis of the algorithm naturally leads to a fixed point equation on a weighted branching tree. We then show how the solution to this fixed-point equation can be analyzed under quite general assumptions on the parameters of the algorithm, and how under certain conditions the analysis can be extended beyond linear recursions.

Probabilistic Models in Biology and Genetics

[14 Zion B 10:00-11:30]

Chair: Stéphane Robin, INRA / Agro ParisTech UMR 518, F-75005, Paris

1. Mikael Falconnet, UMR CNRS 8071 / INRA / Univ. Evry, France, Substitution processes with translocation mechanisms

We define Markov processes on the integer lattice as the superimposition of two mechanisms: an evolution of the sites according to a substitution process on a finite alphabet where the rates depend possibly of the neighbors, and translocations with possibly infinite range. We consider several cases and prove in every of them that the process is ergodic.

2. Pierre Pudlo, UMR CNRS 5149 / Univ. Montpellier II, France, Computing Bayesian posterior with empirical likelihood in population genetics

In population genetics, the computation of the likelihood is often a hard problem. Approximate Bayesian computation (ABC) is certainly the most used algorithm to bypass this computation in a Bayesian paradigm (see [1], for a recent survey). But ABC is quite time consuming and needs massive parallelization to be efficient. In this talk we will present a promising alternative using the empirical likelihood [4].That last method profiles the likelihood in a nonparametric way using an estimating equation on the unknown parameters. Our proposal relies on the score functions given by the pair wise composite likelihood [2] which can be explicitly computed in a large variety of evolutionary scenarii when considering microsatellite loci with the stepwise mutation model [3]. Numerical simulations will exhibit that the posterior estimated with our proposal is comparable to the ABCposterior, but that the computation is about thirty times faster.
References: 1. M. Beaumont. Approximate Bayesian computation in evolution and ecology. Annu. Rev. Ecol. Evol. Syst., 41:379--406, 2010.
2. B. G. Lindsay. Composite Likelihood Methods. Contemporary Mathematics, 80:221--239, 1988.
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3. Sophie Schbath, INRA, UR 1077, Mathematique, Informatique et Genome, F78352, Metabolic network comparison based on coloured motif occurrences

Various methods have been recently employed to characterize the structure of biological networks. In particular, the concept of network motif and the related one of coloured motif have proven useful to model the notion of a functional/evolutionary building block. Here we are interested in comparing two metabolic networks, viewed as graphs whose nodes represent reactions and are coloured according to the class of enzymes that catalyze reactions, based on their composition in small coloured motifs. We build an ad-hoc distance between two graphs which takes into account the colour frequency in the graphs and the probabilities of connection. For this, we use the exact expectation and covariance of counts of coloured motifs incoloured Erdos-Renyi random graphs (Schbath et al., 2009). Used iteratively, our method allows providing the most discriminating coloured motifs. (joint work with Stephane Robin and Elie-LaurentBenaroya)Reference 1Schbath, S., Lacroix, V. and Sagot, M.-F. (2009). Assessing the exceptionality of coloured motifs in networks. EURASIP Journal on Bioinformatics and Systems Biology.

Anomalous Diffusion and Anomalous Statistics II

[11 Arbel 12:00-13:30]

Chair: Marcin Magdziarz, Technical University of Wroclaw

1. Igor Sokolov, Humboldt-Universitaet zu Berlin, Harmonic Oscillator (Under Levy Noise) Brings Surprises

A harmonic oscillator under the influence of noise is a basic model of various physical phenomena. We consider a harmonic oscillator with finite friction under the influence of external white Levy noise and show that the model possesses quite unexpected properties in the phase space, which differ crucially from the ones under Gaussian noise. Thus, under Gaussian white noise the position and the velocity of the oscillator are independent random variables which are distributed according to a bivariate Gaussian distribution with elliptic level lines. The distribution of phase is homogeneous. None of these properties hold in the general Levy case. The level lines of the joint probability density are not elliptic. The coordinate and the velocity of the oscillator are strongly dependent, and this dependence is quantified by introducing the corresponding parameter. The distribution of the phase is inhomogeneous and highly nontrivial. The anti-association of velocity and coordinate is so strong that while the marginal probability density of each of them is heavy-tailed, the conditional probability of velocity at given position shows a considerably lighter tail, and always possesses the first moment which leads to the finite level-crossing density and therefore to the finite escape rate if the potential well is of finite depth.

2. Mark Meerschaert, Michigan State University, East Lansing, Stochastic Model For Medical Ultrasound

Sound wave conduction in human tissue exhibits frequency dependent attenuation, typically modeled by a power law with index between one and two. A variety of wave equations use fractional derivatives to model the power law attenuation. The fractional wave equation in Kelly et al, J Acoust Soc Am 124, 2861 (2008), with a delta function forcing term, has an explicit analytical solution in terms of positively skewed stable densities with index between zero and two. That solution is causal only in the case where the stable index is less than one. We present a stochastic model that explains the appearance and meaning of the fractional derivative, based on a continuous time random walk. We then modify the forcing function to get a causal solution for any index between zero and two, and develop the relevant stochastic model, using the inverse of a positively skewed stable process with drift. The resulting model may be useful for image processing in medical ultrasound.

3. Boris Baeumer, University of Otago, Dunedin, New Zealand, Boundary Conditions For Levy Flights on Bounded Domains and their Governing Eqiations

We explore physical boundary conditions for particles undergoing Levy-flights in a bounded domain; i.e. we explore different strategies of what to do if a particle wants to jump across the boundary and identify the corresponding boundary condition in the governing fractional-in-space partial differential equation. We then show well posedness of the Cauchy problem in L_1 and the convergence of the densities of the discrete, volume-averaged Markov processes to the solution of the Cauchy problem.

Anomalous Diffusion and Anomalous Statistics III

[12 Arbel 10:00-11:30]

Chair: Mark Meerschaert, Michigan State University, East Lansing

1. Marcin Magdziarz, Technical University of Wroclaw, Ergodicity and Mixing for Anomalous Diffusion Processes

We study ergodic properties of some classes of anomalous diffusion processes. Using the recently developed measure of dependence called the Correlation Cascade, we derive a generalization of the classical Khinchin theorem. This result allows us to determine ergodic properties of Levy-driven stochastic processes. Moreover, taking advantage of the so-called dynamical functional we show how to verify ergodicity/ergodicity breaking in experimental data. Some examples are presented.

2. Jae-Hyung Jeon, Tampere University of Technology, Finland, Stochastic Modeling On Lateral Diffusion Of Phosphlipid and Cholesterol Molecules in Lipid Bilayers

Amphiphilic phospholipid molecules are building block macromolecules constituting cellular membrane with a variety of proteins. While the lipid molecules are confined in either the upper or lower layer where they belong because of the amphiphilic nature, they are able to have a two-dimensional lateral diffusion in the lipid bilayer due to thermal agitation. The lateral diffusion of a lipid molecule is typically characterized by short-time ballistic, intermediate sub diffusive, and long-time Brownian motions. So far, the lipid diffusion was explained by several theoretical models such as the free volume theory (i.e., rattling-in-the-cage), diffusion in a percolation cluster, generalized Langevin equation, etc. From computer simulation and single-trajectory analysis, here we elucidate stochastic nature of the sub diffusive lipid motion in detail and find the most relevant stochastic model for it. We further investigate how the stochasticity of the lipid motion is changed at different phases of the lipid bilayers and by the presence of cholesterol molecules. To this end, we perform atomistic scale molecular dynamics simulation on lipid bilayer systems, in both gel and fluid phases, composed of single-component lipid molecules with/without cholesterols. From the simulated single trajectories we obtain the time-averaged mean square displacement, its scatter distribution, displacement autocorrelation function, moment ratio of the mean maximal excursion, and the rattling time distribution. The results are then discussed with theoretical expectations derived from the well-established stochastic models such as the continuous time random walk and fractional Brownian-fractional Langevin equation motions.

3. Alexander Weron, Technical University of Wroclaw, Statistical Modelling of Subdiffusive Dynamics in the Cytoplasm of Living Cells: A Farima Approach

Golding and Cox [Phys. Rev. Lett. 96, 098102 (2006)] tracked the motion of individual fluorescently labeled mRNA molecules inside live E. coli cells. They found that in the set of 23 trajectories from 3 different experiments, the automatically recognized motion is sub diffusive and published an intriguing microscopy video. Here, we extract the corresponding time series from this video by image segmentation method and present its detailed statistical analysis. We find that this trajectory was not included in the data set already studied and has different statistical properties. It is best fitted by a fractional autoregressive integrated moving average (FARIMA) process with the normal-inverse Gaussian (NIG) noise and the negative memory. In contrast to earlier studies, this shows that the fractional Brownian motion is not the best model for the dynamics documented in this video.

Anomalous Diffusion and Anomalous Statistics IV

[12 Arbel 12:00-13:30]

Chair: Ralf Metzler, U Potsdam

1. Stas Burov, University of Chicago, Intracellular Transport In Beta Cells

The intracellular transport along micro-tubules is the main focus of this research. We study the transport of insulin granules inside Beta cells. By developing technique for the analysis of single 2D trajectories we observe a transition in the transport behavior from anti-correlated to active as a function of time. We further use the observed effect in order to discriminate between possible scenarios of active transport through disordered media as models of efficient intracellular transport.

2. Tomoshige Miyaguchi, Naruto University of Education, Japan, Ergodic Properties of Random Walks in Random Environment

Fluctuations in the time-averaged mean-square displacement for random walks on hyper-cubic lattices with static disorder are investigated. It is analytically shown that the diffusion coefficient becomes a random variable as a manifestation of weak ergodicity breaking. For two and higher dimensional systems, the distribution function of the diffusion coefficient is found to be the Mittag--Leffler distribution, which is the same as for the continuous time random walks, whereas for one-dimensional systems a different distribution (a modified Mittag--Leffler distribution) arises. I will also present a comparison of these two distributions in terms of an ergodicity breaking parameter and show that the modified Mittag--Leffler distribution has a larger deviation from ergodicity. Some remarks on similarities between these results and observations in biological experiments will be presented. Abstract

3. Christof Kuelske, University Bochum, Metastates in Markov chain driven mean field models

The metastate is a concept in the theory of random Gibbs measures. It is a probability distribution on the Gibbs measures of a disordered system which becomes meaningful when several states are available for the system. We extend the construction of metastates to describe the asymptotic volume dependence of Gibbs measures of disordered finite-state mean-field models to situations where the local disorder terms are a sample of an external ergodic Markov chain in equilibrium. We show that for non-degenerate Markov chains, the structure of the theorems is analogous to the case of i.i.d. variables when the limiting weights in the metastate are expressed with the aid of a CLT for the occupation time measure of the chain. As a new phenomenon we also show in a Potts example that, for a degenerate non-reversible chain this CLT approximation is not enough and the metastate can have less symmetry than the symmetry of the interaction and a Gaussian approximation of disorder fluctuations would suggest. Joint work with M. Formentin and A. Reichenbachs.

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Jobs and Particles: Where Statistical Physics and Queueing Theory Meet - Part I

[13 Arbel 10:00-11:30]

Chair: Shlomi Reuveni, Tel-Aviv University

1. Peter Taylor, University of Melbourne, A Priority Queuing Model and its Relationship to the Totally Asymmetric Exclusion Process (TASEP)

We have recently been looking at queuing models in which customers accumulate priority as a function of the length of time that they have been in the queue: different priority classes at different rates. We are interested in the waiting time distribution of the different priority classes. In trying to derive this, we uncovered an intriguing connection to a model related to the Totally Asymmetric Exclusion Process. In this talk I'll describe this connection along with some of our basic results.

2. Or Cohen, Weizmann Institute of Science, Phase Diagram and Density Large Deviations of a Nonconserving ABC Model

We discuss the effect of particle-nonconserving processes on the steady state of driven diffusive systems by studying a three-species one-dimensional driven model, known as the ABC model. It is shown that in the limit of slow nonconserving dynamics, the large deviation function of the overall particle density can be computed by making use of the steady-state density profile of the conserving dynamics. In this limit one can define a chemical potential and identify first order transitions via Maxwell's construction, similarly to what is done in equilibrium systems. This method may be applied to other driven models subjected to slow nonconserving dynamics.

3. Uri Yechiali, Tel Aviv University, The Asymetric Inclusion Process

We introduce and explore the Asymmetric Inclusion Process (ASIP) -- an exactly solvable, `Bosonic' counterpart of the `Fermionic' Asymmetric Exclusion Process (ASEP). In both processes, random events cause particles to propagate unidirectionally along a one-dimensional lattice of n sites. In the ASEP particles are subject to exclusion interactions, whereas in the ASIP particles are subject to inclusion interactions that coalesce them into inseparable clusters. We note that the ASIP can also be thought of as a system of tandem markovian queues with unlimited batch service. Moreover, we will demonstrate that the ASIP is the natural missing link between the ASEP and the Tandem Jackson Network. We study the dynamics of the ASIP, derive evolution equations for the mean and Probability Generating Function (PGF) of the sites' occupancy-vector, obtain explicit results for the above mean at steady state, and describe an iterative scheme for the computation of the PGF at steady state. We further obtain explicit results for the load distribution in steady-state -- the load being the total number of particles present in all lattice sites. Finally, we address the problem of load-optimization, and solve it under various criteria.

Anomalous Diffusion and Anomalous Statistics I

[11 Arbel 10:00-11:30]

Chair: Alexander Weron, Technical University of Wroclaw

1. Ralf Metzler, University of Potsdam, Germany, and Tampere, Ageing and Erogodicity Breaking In Anomalous Diffusion

In 1905 Einstein formulated the laws of diffusion, and in 1908 Perrin published his Nobel-prize winning studies determining Avogadro's number from diffusion measurements. With similar, more refined techniques the diffusion behavior in complex systems such as the motion of tracer particles in living biological cells or the tracking of animals and humans is nowadays measured with high precision. Often the diffusion turns out to deviate from Einstein's laws. This talk will discuss the basic mechanisms leading to such anomalous diffusion as well as point out its consequences. In particular the unconventional behavior of non-ergodic, ageing systems will be discussed within the framework of continuous time random walks. Indeed, non-ergodic diffusion in the cytoplasm of living cells as well as in membranes has recently been demonstrated experimentally.

2. Iddo Eliazar, Holon Institute for Technology, Holon, Israel, Randomized Central Limit Theorems

The Central Limit Theorems (CLTs) characterize the macroscopic statistical behavior of large ensembles of independent and identically distributed random variables. The CLTs assert that the universal probability laws governing ensembles' aggregate-statistics are either Gaussian or Lévy, and that the universal probability laws governing ensembles' extreme-statistics are either Fréchet, Weibullor Gumbel. The scaling schemes underlying the CLTs are deterministic – scaling all ensemble-components by a common deterministic scale. However, there are "random environment" settings in which the underlying scaling schemes are stochastic -- scaling the ensemble-components by different random scales. Examples of such settings include Holtsmark's law for gravitational fields, and the Stretched Exponential law for relaxation times. In this talk we establish a unified theory of Randomized Central Limit Theorems (RCLTs) – in which the deterministic CLT scaling schemes are replaced by stochastic scaling schemes -- and present "randomized counterparts" to the classic CLTs. The RCLT scaling schemes are shown to be governed by Poisson processes with power-law statistics, and the RCLTs are shown to universally yield the Lévy, Fréchet and Weibull probability laws.

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3. I. Eliazar, J. Klafter, On the generation of log-Lévy distributions and extreme randomness, Journal of Physics A: Mathematical and Theoretical 44 (2011) 415003.

Jobs and Particles: Where Statistical Physics and Queueing Theory Meet - Part II

[13 Arbel 12:00-13:30]

Chair: Uri Yechiali. Tel Aviv University

1. Shlomi Reuveni, Tel Aviv University, The Asymmetric Inclusion Process: Complexity and Limit Laws

The Asymmetric Inclusion Process (ASIP) was recently introduced [1] as a model of queues in tandem with unlimited batch service (see above). In this talk we present the ASIP as a showcase of complexity and discuss several limit laws for this system. In the first part of the talk, we will demonstrate the ASIP's rich statistical complexity which ranges from 'mild' to 'wild' displays of randomness: Gaussian load (total number of particles in the system); Gaussian draining time (elapsed time from an arbitrary moment when the arrival stream stops until the first moment the system becomes empty); Rayleigh outflow with linear aging; Inverse-Gaussian particle coalescence in the circular ASIP (elapsed time from an initial moment in which all sites are occupied to the first moment in which all particles have coalesced to a single site); intrinsic power-law scaling of occupation probabilities and power-law occupancy fluctuations. In the second part of the talk we will take a more rigorous approach towards some of the abovementioned observables and mention others as well. We will be particularly interested in the system's behavior in three different regimes: the heavy traffic limit, the large system limit and balanced system limit.

References: 1. [1] S. Reuveni , I. Eliazar and U. Yechiali, Asymmetric Inclusion Process. Physical Review E 84, 041101 pp. 1-16 (2011).

2. Ori Hirschberg, Weizmann Institute of Science, Static and dynamic condensates in the zero-range process

The formation of traffic jams in transportation systems, the clustering of particles in shaken granular gases, and the emergence of macroscopically-linked hubs in complex networks are all examples of condensation phenomena in which a finite fraction of the “mass” in a macroscopic system is concentrated in a microscopic fraction of its volume. The zero-range process (ZRP) is a paradigmatic model for describing such condensation transitions in out-of-equilibrium systems. In the ZRP, these condensates remain static in the thermodynamic limit. Recently, it was observed that in related models, condensates may move through the system. In this talk, I will review the ZRP and its condensation transition, and present recent work elucidating a generic mechanism which gives rise to condensate motion.

3. Neri Merhav, Technion, Bose–Einstein Condensation in the Large Deviations Regime with Applications to Information System Models

We study the large deviations behavior of systems that admit a certain form of a product distribution, which is frequently encountered both in Physics and in various information system models. First, to fix ideas, we demonstrate a simple calculation of the large deviations rate function for a single constraint (event). Under certain conditions, the behavior of this function is shown to exhibit an analogue of Bose–Einstein condensation (BEC). More interestingly, we also study the large deviations rate function associated with two constraints (and the extension to any number of constraints is conceptually straightforward). The phase diagram of this rate function is shown to exhibit as many as seven phases, and it suggests a two–dimensional generalization of the notion of BEC (or more generally, a multi–dimensional BEC). While the results are illustrated for a simple model, the underlying principles are actually rather general. We also discuss several applications and implications pertaining to information system models, including networks of M/M/1 queues (Jackson networks and others).

Contributed Talks

Louis Chen, National University of Singapore, On the error bound in a combinatorial central limit theorem

[11 Gilboa 15:00-16:30]

Let {X_ij: i, j = 1, …, n} be independent random variables with finite 3rdmoments and let π be a random permutation of (1, …, n) independent of the X_ij.Let U = ∑ X_i π(i) and W = (U – EU)/(Var(U))^ ½. A third-moment error bound is obtained for the central limit theorem for W by using Stein's method of exchangeable pairs and the concentration inequality approach. This proof also provides an explicit constant in the error bound.

Tasos Christofides, University of Cyprus, Conditional demimartingales (joint talk with Milto Hadjikyriakou)

[11 Tavor 15:00-16:30]

Conditionally associated and conditionally negatively associated random variables are objects of current research activity. The partial sum of conditionally mean zero associated random variables and conditionally mean zero negatively associated random variables are special cases of the general class of conditional demimartingales and conditional N-demimartingales respectively. In this talk, we discuss these two classes of random variables with emphasis on probability inequalities and asymptotic results.

Irmina Czarna, University of Wroclaw, Lower barrier for ruin probability with Parisian delay

[11 Gilboa 10:00-11:30]

We analyze lower barrier for Parisian ruin probability. In this case Parisian ruin with lower barrier happens when surplus process first stays below zero longer than fixed amount of time $r>0$ or first goes below the level $-a$. We focus on a general spectrally negative L\'{e}vy insurance risk process. For this class of processes we identify the Laplace transform of ruin probability in terms of q-scale functions. We find its Cram\'{e}r-type and convolution-equivalent asymptotic when reserves tends to infinity. Finally, we analyze few explicit examples. Czarna, I. and Palmowski, Z. (2010) Ruin probability with Parisian delay for a spectrally negative L\'evy risk process. {\it J. Appl. Probab.} {\bf 48(4)} 984--1002.Loeffen, R., Czarna, I. and Palmowski, Z. (2011) Parisian ruin probability for spectrally negative L\'evy processes. To appear in {\it Bernoulli}.

Emilio De Santis, Department of Mathematics, University La Sapienza, Rome, Comparisons between times of occurrences of different words

[11 Tavor 15:00-16:30]

We consider a game in which N players select words of the same length over a given alphabet A and observe a sequence of letters, randomly drawn, from the alphabet A. The winner of the game is the player whose word occurs first. For the N players of this game, public knowledge of the other players' gives an advantage. More precisely a player, who knows the words selected by the other players, can choose a word that gives him a probability of winning larger than 1/N. We show the existence of such a word by an explicit t construction. With respect to the existing literature, the main novelty of our results is in that we deal with an arbitrary finite alphabet and have no limitation on the number of the players. As a correlated problem, we also analyze some sufficient conditions for stochastic orderings between the first-passage times for a pair of Markov chains, belonging to a special class arising from the problem at hand. In particular, we apply our results to the comparison between the waiting times until the occurrence of two different words. This is a joint work with Fabio Spizzichino.

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Krzysztof Debicki, University of Wroclaw, Extremes of locally self-similar Gaussian processes

[11 Gilboa 15:00-16:30]

Let {X(t) tÎ[0,T]} be a centered Gaussian stochastic process with continuous trajectories a.s. Assume that variance function Var(X(t)) attains its maximum at t0Î[0,T] and {(X(t0+t/u)-X(t0))uα} weakly converges to some self-similar centered Gaussian process {Iα(t)}, as u→∞. We give exact asymptotics of P(suptÎ[0,T]X(t)>u), as u→∞. Additionally, we analyze properties of counterparts of Pick ands constants that appear in the obtained asymptotics. The talk is based on a joint work with Kamil Tabiś (University of Wroclaw). Bibliography [1] Dębicki, K., Tabiś, K. (2011) Extremes of the time-average of stationary Gaussian processes. Stochastic Processes and their Applications 121, 2049-2063. [2] Dębicki, K., Tabiś, K. (2012) Extremes of locally self-similar Gaussian processes. In preparation.

Sjoert Fleurke, Radio communications Agency Netherlands, The car density in the multilayer car parking system

[11 Arbel 15:00-16:30]

A multilayer car parking system is a lattice on which “cars” are dropped according to a Poisson process. A new arriving car always tries to park at the first layer but if it overlaps with one or more cars that were already parked earlier it is rejected. Cars that are rejected in a layer will attempt to park in the next layer. This step is repeated until the car finds a layer with enough space to park. During the process the cars pile up and eventually they will fill any layer in the system. Due to the randomness of the arrivals, a layer will not be filled perfectly; small holes between the cars will remain here and there. So, the density of the layers will not reach the maximal possible value. Interestingly, simulations and calculations show that on average the end-densities are not the same on each layer. In some models the cars seem to "organize" themselves in such a way that higher layer stand tor each higher end-densities than low layers while in some other models the opposite is true. In this talk a small multilayer parking system with a width of 3 vertices is treated analytically. It is shown that while this probability reaches 1/3 at the center vertex on the first layer it converges to 1/2 when the layer height grows to infinity.

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Sophie Hautphenne, University of Melbourne, Extinction probability of branching processes with infinitely many types

[12 Tavor 12:00-13:30]

We consider multi-type branching processes with infinitely many types. We emphasize the differences with the finite-type case in the computation of the extinction probability and in the extinction criteria. We propose several convergent sequences to the extinction probability vectors and give them a probabilistic interpretation. This is joint work with Guy Latouche and Giang Nguyen.

Donald Martin, North Carolina State University, Exact distribution of the discrete scan statistic for multi-state higher-order Markovian sequences

[11 Tavor 15:00-16:30]

Scan statistics are used in various areas of applied probability and statistics to study local clumping of patterns. Testing based on a scan statistic requires tail probabilities. Whereas the distribution of various scan statistics has been studied extensively, most of the results are approximations, due to the difficulties associated with the computation. Results have been given to compute exact p-values for the maximum number of successes in sliding windows of length w over a binary sequence that is independent or first-order Markovian. However, in many practical applications, the variables under study take on multiple values, and higher-order dependence supplies a useful model. The present paper fills this gap by obtaining the distribution of the univariate scan statistic for multi-state trials that are Markovian of a general order of dependence. A deterministic finite automaton is developed to index the computation, and matrices corresponding to automaton transitions are used to update probabilities. Numerical examples and an application to charges in a protein sequence are given to illustrate the algorithm.

Yoni Nazarathy, The University of Queensland, Diffusion Parameters of Flows in Stable Queueing Networks

[11 Zion B 15:00-16:30]

We consider open multi-class queueing networks with general arrival processes, i.i.d processing times and bernoulli routing operating under a work-conserving scheduling policy that makes the system stable. A simple diffusion limit for the inter-node flows is presented with an explicit computable expression for the covariance matrix. Under proper technical conditions, the parameters of this covariance matrix dictate the asymptotic variance rate of the inter-node point-processes. We envisage that our formulas may be put to use in improving approximate queueing network decomposition schemes such as the well-known Queueing Network Analyzer (QNA) framework and related methods. This is joint work with Gideon Weiss.

Giang Nguyen, Université libre de Bruxelles, Generalizations of Panjer's algorithm and of Phase-Type distributions

[11 Arbel 15:00-16:30]

Panjer (1981) presents an efficient recursive formula for evaluating compound distributions such as compound Poisson and compound negative binomial, assuming that claim sizes are nonnegative, and identically and independently distributed, and that the claim number follows a distribution that satisfies the Panjer recursive relation. We generalize Panjer's algorithm to two cases: where both the claim number and claim sizes are Phase-Type distributed, and where only the claim number is Phase-Type distributed, and we discuss the associated complexity of these algorithms. Furthermore, extending the Panjer (scalar) recursive relation to a Panjer-like (matrix) recursive relation leads to a new family of distributions that are dense on the real line and exhibit interesting properties. These distributions, tentatively named Panjerized-Phase-Type distributions, provide new modeling tools, the flexibility of which is benchmarked against Phase-Type distributions.

Federico Polito, Università di Torino, The space-fractional Poisson process

[12 Tavor 12:00-13:30]

In this talk we introduce the space-fractional Poisson process. The state probabilities are governed by some difference-differential equations involving a fractional difference operator often found in the study of time series exhibiting long memory. We explicitly obtain the one-dimensional distributions and the probability generating function which is also expressed as the distribution of the minimum of id uniform random variables. Connections with discrete stable distributions are analyzed and discussed, and a useful subordination relation involving the stable subordinator is proved. The comparison with the time-fractional Poisson process is investigated and finally, we arrive at the more general space-time fractional Poisson process of which we give the explicit distribution.

Daniel Quiroz, Universidad Simón Bolívar, Birth-and-death chains on finite trees

[12 Tavor 12:00-13:30]

We prove that every birth and death Markov chain on a finite tree can be represented as a random walk on the underlying tree endowed with appropriate conductances. Then, using the electric network approach, we find the values of the stationary distribution and of the expected hitting times between any two vertices in the tree. We show that our algorithms, unlike the classical ones that involve matrix inversions, are linear in the number of vertices of the tree and do not exhibit ill-posedness.

References: 1. Bertoncini, O. (2011) Cut-off and escape behavior for birth and death chains on trees, Lat. A. J. Probab. Math. Stat. Phys. {\bf 8}, 149-162.

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Laura Sacerdote, Dipartimento di Matematica Università di Torino,
Diffusion processes and their copulas
[11 Gilboa 15:00-16:30]

Classical description of diffusion processes relies with their transition distribution and the related backward and forward Kolmogorov equations. These distributions are known in closed form only in a limited number of instances, including the processes that can be obtained from the Wiener or Feller processes via time space transformations ([1],[2]). To isolate the dependence structure from the marginal behavior of the diffusion process one can use copulas. For a Markov process one introduces the copula, joining the random variables X(s) and X(t), s<t. Here we prove that the derivative of the copula function, with respect to u, of a diffusion process verifies the Kolmogorov equations. Applying different marginal distributions to specific copulas we determine new diffusion processes. Hence we determine the diffusion equations for these new processes. We exemplify the method in the case of Wiener, Ornstein Uhlenbeck Feller processes and we analyze the properties of their copulas. Then we consider the classes of processes that can be transformed into a Wiener or Feller processes via space time transformations, respectively. We show that the copula joining X(s) and X(t), s<t of processes transformable into a Wiener one coincides with the copula of a Wiener copula or with one of its variants obtained through a time transformation. An analogous result if proved for a the class of processes transformable into a Feller one.

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2. Capocelli R. and Ricciardi L.M. (1976) Mathematical Biosciences 29:219-234.

Igal Sason, Technion - Israel Institute Of Technology,
Tightened Exponential Bounds for Discrete Time, Conditionally Symmetric Martingales with Bounded Increments
[11 Arbel 15:00-16:30]

Classes of exponential bounds for discrete-time real-valued martingales were extensively studied in the literature. Our goal in this work is to demonstrate how the assumption of the conditional symmetry improves exponential in equalities for discrete-time real-valued martingales with bounded increments. This work derives some new exponential bounds for discrete time, real valued, conditionally symmetric martingales with bounded jumps. The new bounds are extended to conditionally symmetric sub/ super-martingales, and are compared to some existing bounds. The bounds are finally exemplified in the context of gambling. Earlier results, serving as motivation, appear e.g. in [1, Section 4] and [2, Section 6]. Our first result in this work improves the statement in [3, Theorem 6.1], where the latter does not require the conditional symmetry property. Another result, obtained in this work, improves a classical bound of Freedman (1976) under the assumption of conditional symmetry. The full paper version of this work is available in the ArXiv at the following URL address: http://arxiv.org/abs/1201.0533.

References: 1. I. Grama and E. Haeusler, "Large deviations for martingales via Cramer's method," Stochastic Processes and their Applications, vol. 85, no. 2, pp. 279--293, February 2000.
2. V. H. de la Pena, "A general class of exponential inequalities for martingales and ratios," Annals of Probability, vol. 27, no. 1,pp.~537--564, January 1999.
3. C. McDiarmid, "On the method of bounded differences, "Surveys in Combinatorics, vol. 141, pp. 148--188, Cambridge University Press, Cambridge, 1989.

Igal Sason, Technion - Israel Institute Of Technology, On Stopping Times of Geometric Supermartingales

[14 Zion B 15:00-16:30]

Geometric supermartingales were introduced in a recent work[1]in the context of inverse crosstalk channel estimation using SNR feedback. The expected value of the stopping time of geometric supermartingales is relevant to the analysis of the convergence time of the estimator in [1]. In this talk, we derive upper bounds on the moments of the stopping times for geometric supermartingales, and discuss the tightness of the proposed bounds. We first re-prove the upper bound on the expected value of the stopping time in[1] due to a problematic step in the original proof(this necessitates to derive the bound in a different approach). Along the way, this bound is also improved. The analysis is generalized for the derivation of a closed-form expression for the moments of the stopping times of geometric supermartingales. Finally, some achievability results are used to consider the tightness of the bounds.

References: 1. P.A. Whiting, G. Kramer, C.J. Nuzman, A. Ashikhmin, A.J. van Wijngaarden andM. Zivkovic, ``Analysis of inverse crosstalk channel estimation using SNR feedback, "IEEE Transactions on Signal Processing, vol. 59, no. 3, pp. 1102--1115, March 2011.

2. D. Williams, Probability with Martingales, Cambridge University Press, 1991.

Fabio L, Spizzichino, Dept. of Mathematics,Univ. "La Sapienza", Exchangeable Occupancy Models and Generalized Uniform Order Statistics Property

[11 Tavor 15:00-16:30]

We will start by briefly recalling the most well-know families of occupancy models: Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac (see [1]). We will focus attention on several properties of them such as, in particular, their exchangeability, and their closure with respect to different types of transformations. We then pass to a comprehensive analysis of exchangeable occupancy models in general and show results concerning analogies and differences with the cases of the three classical models M-B., B.-E., and F.-D. After pointing out that the latter models are related with results (given in[2]) about discrete-time processes with the "Uniform Order Statistics Property", we will show how the characterization results in[2] can be unified and generalized in a completely natural way, within the frame of Exchangeable Occupancy Models. Some relations among our results and topics developed in [3] will also be traced. This talk is based on a joint work with F. Collet and F. Leisen, University Carlos III, Madrid, and F. Suter, University of Bucharest.

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2. Shaked M., Spizzichino F., and Suter F.: Uniform order statistics property andl1- spherical densities. Probab. Engrg. Inform. Sci., 18 (3) : 275-297, 2004.

3. Charalambides C. A.: Combinatorial methods in discrete distributions. Wiley Series in Probability and Statistics. Wiley-Interscience, John Wiley & Sons, Hoboken, NJ,2005

Yvik Swan, University of Luxembourg, Stein's method, probability distances and information functionals

[11 Arbel 15:00-16:30]

We generalize the so-called density approach to Stein characterizations of probability distributions. We prove an elementary factorization property of the resulting Stein operator in terms of a generalized (standardized) score functions. We use this result to connect Stein characterizations with information distances such as the generalized standardized Fisher information (for Gaussian approximation) or the scaled Fisher information (for Poisson approximation). We provide a number of old and new approximation results, including a family of variance bounds.

Oren Tapiero, Bar-Ilan University - Graduate School of Business & Administration, The Implied Price of Incomplete State Information

[11 Gilboa 10:00-11:30]

Incomplete markets, which result from incomplete state preferences, implied distributions that are not symmetric or based on unknown probabilities are notoriously challenging. In this paper we provide an approach based on maximum Tsallis (1988) entropy to estimate the option-implied distribution of the underlying asset future price. To do so we elaborate the rationality for the optimization of the Tsallis entropy function and its implication to future state preferences that are not known (and therefore, assume that markets are incomplete). Evidence from option prices on Citigroup and the S&P 500, traded during the period of September to October 2008; confirm the possibility for an incomplete states information risk premium. However the interactions effects between risk-aversion, implied volatility and information incompleteness are yet to be elaborated further. Keywords: Implied distributions, Tsallis entropy, incomplete statistics, information theory.

References: 1. C. Tsallis. Possible generalization of boltzmann-gibbs statistics. Journal of Statistical Physics ,52(1):479– 87, 1988.

Geoffrey Decrouez, The University of Melbourne, The bootstrap and Roth's theorem

[14 Tavor 15:00-16:30]

The bootstrap, at least in its conventional forms, does not perform well when applied to lattice-valued data. The inherent discreteness of lattice distributions confounds standard bootstrap methods for constructing confidence intervals with good coverage accuracy. However, in certain problems involving lattice-valued random variables, where more than one sample is involved, this difficulty can be overcome by ensuring that the ratios of sample sizes are quite irregular. For example, at least one of the ratios of sample sizes should be a reasonably good rational approximation to an irrational number. Results from number theory, in particular Roth's theorem (which applies to irrational numbers that are the roots of polynomials with rational coefficients), can be used to demonstrate theoretically the advantages of this approach. This project is motivated by a problem in risk analysis involving quarantine searches of shipping containers for pests and other environmental hazards.

Alba Maria Franco Pereira, Universidad de Vigo, Estimation of the DPRL aging notion

[14 Arbel 15:00-16:30]

We introduce a new estimator of a percentile residual life function with censored data under a monotonic constraint. Specifically, it is assumed that the percentile residual life is a decreasing function. This assumption is useful when estimating the percentile residual life of units which degenerate with age. We establish a law of the iterated logarithm for the proposed estimator, and its root n equivalence to the unrestricted estimator. The asymptotic normal distribution of the estimator and its strong approximation to a Gaussian process are also established. We investigate the finite sample performance of the monotone estimator in an extensive simulation study. Finally, data from a clinical trial in primary biliary cirrhosis of the liver are analyzed with the proposed methods. One of the conclusions of our work is that the restricted estimator may be much more efficient than the unrestricted one.

Yuri Goegebeur, University of Southern Denmark, Nonparametric analysis of conditional tails with random covariates

[14 Tavor 15:00-16:30]

We present families of nonparametric estimators for the conditional tail index of a Pareto-type distribution in presence of random covariates, which are constructed from locally weighted sums of power transformations of excesses over a high threshold. The asymptotic properties of the proposed estimators are derived under some assumptions on the conditional response distribution, the weight function and the density function of the covariates. We also introduce bias-corrected versions of the estimators for the conditional tail index, and propose in this context a simple consistent estimator for the second order tail parameter. The finite sample performance of some specific examples from our classes of estimators is illustrated with a small simulation experiment. Daouia, A., Gardes, L., Girard, S., Lekina, A., 2011. Kernel estimators of extreme level curves. Test 20, 311--333.Goegebeur, Y., de Wet, T., 2011. Local estimation of the second order parameter in extreme value statistics and local unbiased estimation of the tail index. To appear in Communications in Statistics - Theory and Methods. Wang, H., Tsai, C.L., 2009. Tail index regression. Journal of the American Statistical Association 104, 1233--1240.

Sergey Zeltyn, IBM Haifa Research Lab, Trend Detection, Forecasting and Commitment Management in Software Maintenance

[14 Zion B 15:00-16:30]

Software maintenance constitutes the final stage of software engineering cycle. The maintenance process includes addressing customer problems and bug fixing. Efficient management of this cost-driven process is a necessary prerequisite for overall success of software business enterprise. In its turn, monitoring and prediction of main process metrics is crucial for effective management. This talk is based on the project that has been performed in a large IBM software division. Using large defect repositories (over half million of records), we designed and implemented statistical framework that addresses the above challenges. Handling time of software defects was selected as the key efficiency measure. It turned out that the handling time distribution is heavy-tailed. Therefore, its percentile was monitored and predicted, being more robust to outliers than the mean. Statistically significant period-to-period changes were detected via non-parametric statistical techniques. Then a multi-stage prediction framework was developed. Time series methods were used for the arrival rate, regression for the closure rate and simulation-based forecasting for the percentile metrics. A comprehensive real-data experiment has shown that the prediction goodness-of-fit is significantly better than for alternative forecasting algorithms. Finally, our prediction algorithm is used for computation of probabilities to satisfy performance commitments in future.

References: 1. Bristol D.R. 1990. Distribution-free confidence intervals for difference between quantiles. Statistica Neerlandica, 44 (2).

2. Zeltyn S., Tarr P., Cantor M., Kannegala S., Delmonico R., Keren M., Kumar A.P., and Wasserkrug S. Improving efficiency in software maintenance. In Proceedings of the 8th Working Conference on Mining Software Repositories, Honolulu, USA, May 21-22, 2011.

Gustavo de Souza, Universidade Federal de Ouro Preto and Universidade Federal de Minas Gerais, On incorporating autocorrelation in multivariate capability indices

[14 Gilboa 15:00-16:30]

Joint work of Gustavo de Souza and Fernando L. P. Oliveira The performance of production processes often requires that multiple quality characteristics meet the required specification limits. The monitoring and evaluation of multivariate capability indices is sometimes done assuming independent univariate processes. However, this kind of procedure is not recommended in general, due to possible autocorrelation effects. A correction for those effects, on some multivariate capability indices commonly used for independent processes, was proposed recently employing VARMA(1,1) time series processes [1]. In this work, a closed analytical expression is proposed for incorporating the effect of autocorrelation on some usual multivariate capability indices. Those indices were used before assuming independent processes, but this restriction is dropped in the present work. This correction is shown for VAR(2) time series processes under the multivariate normality assumption. Some multivariate capability indices are extended to the case of multivariate auto correlated processes. Theoretical analyses and numerical simulations are performed to evaluate those indices. Similarly to what is already known for univariate processes, the results show that autocorrelation has a large impact in the multivariate capabilities indices, confirming the importance of the incorporation of autocorrelation effects in practice.

References: 1. [1] Mingoti, S. A. and Oliveira, F. L. P. On Capability Indices for Multivariate Auto correlated Processes. Brazilian Journal of Operations & Production Management. Volume 8, Number 1, 133-152, 2011.

Fernando L. P. Oliveira, Universidade Federal de Ouro Preto and Universidade Federal de Minas Gerais, The Battacharyya Distance Applied to Statistical Process Control of Multivariate Data

[14 Gilboa 15:00-16:30]

Control charts for univariate processes may be regarded as procedures for threshold determination to contain the values of the observed quality characteristic. Multivariate processes frequently make use of the available information from all the observed variables, although the occurrence of elevated correlation may result in unnecessary computational burden. Given a limited monitoring period of m variables, it may be difficult to estimate a large number of probability distribution parameters associated to each one of two classes of interest (in control and out of control). A measure of divergence between classes, based on the probability distributions of two populations was proposed by A. Battacharyya in 1943. Under the multivariate normality assumption, the criterion adopted in the proposed method consists in the Optimization of the Bhattacharyya Distance (OBD) in four particular cases, with the objective to find an-dimensional space (n<m), maximizing the efficiency of classes separation, subject to minimal information loss. A large comparative study is conducted to evaluate the existing procedures to estimate control charts in multivariate processes.

Avi Giloni, Yeshiva University, Assessing the Difference Between Shock Sharing and Demand Sharing in Supply Chains

[12 Tavor 15:00-16:30]

Demand propagation in supply chains under ARMA demand has previously been studied and characterized when it is assumed that all players use a myopic order-up-to policy and either there is no sharing between adjacent supply chain players or there is full information shock sharing between supply chain players (Giloni, Hurvich, Seshadri [2012]). The major contribution of this paper is that we assume that there may be one of three possible sharing arrangements between adjacent players: (i) no information sharing, (ii) demand sharing, or (iii) full information shock sharing. We show that the value provided by a demand sharing arrangement can be (i) equivalent to no sharing, (ii) equivalent to full information sharing, or (iii) intermediate to no sharing and full information shock sharing. We characterize when each of these three cases will occur under demand sharing. We also derive under the possibility of any of the three sharing arrangements (i) a player's full information set, (ii) its full information shocks, (iii) its best linear forecast under demand sharing and (iv) show that the upstream demand propagation model is Quasi-ARMA.

References: 1. Giloni, A., C. Hurvich, and S. Seshadri. "Forecasting and Information Sharing in Supply Chains Under ARMA Demand." Under Review, 2012.

Maria Vlasiou, Eindhoven University of Technology, Separation of timescales in a two-layered network

[11 Zion B 15:00-16:30]

We investigate a network consisting of two layers occurring in, for example, application servers, and model the first layer as a many-server Jackson network. Active servers acts as customers at the second layer, where they are served by a common CPU. This system provides a benchmark example of a layered system. Our main result shows a separation of time scales in heavy traffic: the main source of randomness occurs at the(aggregate) CPU level; the interactions between different types of nodes at the other level is shown to converge to a fixed point at a faster time scale; this also yields a state-space collapse property. Apart from these fundamental insights, we also obtain an explicit approximation for the joint law of the system which is provably accurate for heavily loaded systems, and performs numerically well for moderately loaded systems. The obtained results for the model under consideration can be applied to thread-pool dimensioning in application servers.

Bert Zwart, CWI, Heavy Traffic of the Processor Sharing Queue via Excursion Theory

[11 Zion B 15:00-16:30]

Thanks to a recent result of A. Lambert, it is possible to realize one busy cycle of the queue length of the Processor-Sharing (PS) queue as the image of some functional of a Levy process. The functional involves the local time process and a random time-change. I will show how to exploit this mapping to derive the heavy traffic limit of the PS queue thanks to excursion theory. Joint work with A. Lambert (Paris VI) and F. Simatos (Eindhoven University of Technology).

Yuval Cohen, The Open University of Israel, Record breaking statistics: implications for optimization search-techniques and risk management

[14 Gilboa 15:00-16:30]

Most record breaking research has focused on recorded processes such as weather, sports, and physical measurements [1, 2]. However, very scarce research of record breaking is related to management decision making [3]. This paper starts by showing that record breaking statistics apply to surprisingly different management and planning processes in various fields such as risk management, human resource management and combinatorial optimization. The paper continues, by analyzing the implications and insights contributed by the record breaking statistics to these processes. In particular, the analyzed risk management processes are related to value at risk (VAR) and finding an efficient bound for the damage. The analyzed human resources management process is related to hiring process based on scores, and the optimization is related to search techniques such as genetic algorithms (GA) and simulated annealing (SA). 1. Redner S., and Petersen R. M., (2006). Role of global warming on the statistics of record-breaking temperatures, Physical Review E,Vol. 74, No. 6, paper 061114, pp. 1-14. 2. Krug J., Jain K., (2005). Breaking records in the evolutionary race, Physica A, Vol. 358, No. 1, pp. 1–9.3. BradlowE. T., Park Y. H., (2007).Bayesian Estimation of Bid Sequences in Internet Auctions Using a Generalized Record-Breaking, marketing science, Model, Vol. 26, No. 2, pp. 218–229.3

Bernardo D'Auria, Madrid University Carlos III, Equilibrium strategies for a tandem network under differentinformation levels

[12 Tavor 15:00-16:30]

In this talk we study a 2-queues tandem network from an economical viewpoint and determine what strategies the customers are willing to follow. That is, we assume that customers may decide if to join or bulk the network upon their arrival taking into account the expected waiting time they should bear before receiving their service. We show that the decision taken by the customers will depend on the information they have about the state of the network, and for different levels of information we show how to determine the optimal equilibrium strategy they will follow.

References: 1. B. D'Auria and S. Kanta "Equilibrium strategies in a tandem queue under various levels of information "Working Paper 11-33 (25) at UC3M, Spain, submitted
http://e-archivo.uc3m.es/handle/10016/12262

Sofian De Clercq, Ghent University, Queue content moments of discrete-time queues with zero-regenerative arrivals

[12 Gilboa 15:00-16:30]

Sofian De Clercq, Koen De Turck, Herwig Bruneel, Dieter Fiems. Abstract This paper investigates a single-server discrete-time queueing system with single-slot service times. For a broad class of arrivals processes, closed form expressions for the mean queue content and queue content variance in steady state are obtained. Apart from being stationary ergodic, the arrival process adheres to a regeneration property when there are no arrivals in a slot. Well-studied arrival processes such as autoregressive arrival processes and $M/G/\infty$-input or train arrival processes adhere to this property.

Koen De Turck, Ghent University, Numerical approaches to some large deviations problems with an application to wireless networks

[12 Gilboa 15:00-16:30]

Authors: Koen De Turck, Sabine Wittevrongel, Dieter Fiems Abstract. The theory of large deviation has a long and successful history of applications to telecommunication systems (e.g. [1]) as it enables the study of various rare events which may have an enormous impact on the system performance. A typical large deviation analysis leads to a variational problem, which only in some special cases can be solved completely in closed form. If no such closed solution exists, then one must resort to a numerical solution. Many researchers concentrate on a careful derivation of a suitable large deviation principle, but only relatively few researchers have explored the path of numerical computation. In this contribution, we look at a few possible strategies for efficient computation. Firstly, we consider the discretization to a shortest path problem on a graph, and secondly, we look at the practically important special case of Gaussian inputs, in which case the quadratic form of the (sample-path) rate function provides the necessary structure for an efficient solution. We discuss the application of this work to efficient rare-event simulation of a specific problem in wireless networks.

References: 1. Ayalvadi Ganesh, Neil O'Connell and Damon Wischik. Big Queues. Lecture Notes in Mathematics, volume 1838.

Jan-Pieter Dorsman, Eindhoven University of Technology, Queue length approximations for a layered queueing network with correlated queues

[12 Zion B 15:00-16:30]

In the classical machine-repair (MR) model, a machine subject to breakdown typically faces competition for repair facilities with other machines. This leads to dependencies in their downtimes. What is oftentimes ignored in the MR model is that the machines make products themselves. In this presentation, we explicitly consider the queues of products serviced by the machines. This results in a layered queueing network, where the machines have the dual role of being both customers to the repairman and servers for the products. Due to the interaction between the layers, the queues of products are correlated, making exact analysis generally hard. We present approximations for the distribution of these correlated queues.

Dieter Fiems, Ghent University, Perturbation analysis of paired queuing systems

[14 Tavor 15:00-16:30]

We consider a system of K paired finite-capacity queues. For each of the queues, customers arrive at the queue in accordance with an independent Poisson process, arrival rates in the different queues not necessarily being equal. Departures from the different queues are paired. This means that as long as all queues are non-empty, there are simultaneous departures from all queues with a fixed rate mu. In contrast, if one of the queues is empty, there are no departures. Clearly, even for modest queue sizes and a modest number of queues, the size of the Markov chain that describes the system at hand grows quickly. Numerically solving the chain in a reasonable amount of time is no longer feasible. To cope with this state space explosion problem, we therefore focus on a Maclaurin series expansion in the departure rate mu; note that this is a heavy traffic approximation. In contrast to a direct solution of the Markov chain, the numerical complexity of calculating the terms in the Maclaurin series is linear in the size of the state space. We illustrate our approach by some numerical examples and indicate some multidimensional queuing systems which can be tackled by a similar approach. (Joint work with Eline De Cuypere and Koen De Turck)

Joseph Kreimer, Ben-Gurion University, Real-Time System with Preemptive Priorities

[12 Arbel 15:00-16:30]

We consider a real-time multi-server system with several servers (such as machine controllers, unmanned aerial vehicles, overhearing devices, etc.) which can be maintained/programmed for different kinds of activities (e.g. passive or active). Such a system provides a service for real-time tasks arriving via several channels (such as assembly lines, surveillance regions, communication channels, etc.) and involves maintenance. Servers are subjects to breakdowns, and malfunctioning servers are sent to maintenance. After repair a fixed server can belong to one of several types of quality/activity with given probabilities. These probabilities can be used as control parameters. Only after the repair is completed, the quality control procedure determines the quality type of fixed server. We study these systems working in general regime with preemptive priorities assigned for servers of different activity type. We consider two models (with ample and limited maintenance facilities respectively) with single joint queue (of fixed servers) to all channels. We show how to compute steady state probabilities and various performance measures when both servers operation and maintenance times as well as tasks inter arrival and duration times are exponentially distributed.

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Laszlo Lakatos, Eotvos Lorand University, Cyclic-waiting systems

[12 Arbel 15:00-16:30]

We consider a retrial queueing system with Poisson arrivals where the customers are accepted for service at the moment of arrival (if the server is free) or at moments differing from it by intervals multiple of a given cycle time T (if the server is busy). The service is realized according to the FCFS rule. This model corresponds to the landing of airplanes or can describe the transmission of optical signals at a node. The system is characterized by the number of present customers and the waiting time for them. We find the ergodic distribution for both characteristics and the condition of equilibrium. We investigate some numerical characteristics and their dependence on the length of cycle time. In case of exponential service time, if T tends to zero, one gets the ergodic distribution for the M/M/1 system. The research is supported by the European Union and co-financed by the European Social Fund under grant TAMOP 4.2.1/B-09/1/KMR-2010-0003.

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Hanoch Levy, Tel Aviv University, Fairness in Polling Systems

[12 Arbel 15:00-16:30]

Fairness is a fundamental aspect of polling systems; perhaps it serves as the motivation behind various polling schemes. Despite this fundamental role, fairness in polling systems has not been studied to date. This talk is a first attempt to model fairness in polling systems and study the relative fairness of various polling schemes. We focus, in the context of this work, on counting the number of skips as a measure of fairness. Using this metric we study the cyclic polling system under five different service disciplines: exhaustive, gated, binomial-gated, two stage gated and globally-gated. For these systems we derive their "fairness" level both in a discrete system model and in a continuous model. We use the analysis as well as numerical examples to derive basic fairness properties of polling systems.

Rachel Ravid, ORT Braude College, State Dependent Priorities for Service Systems with Exchangeable Items

[12 Tavor 15:00-16:30]

We consider a repair facility which consists of one server and two arrival streams of failed items, from bases 1 and 2. The arrival processes are independent Poisson processes with different rates. The service times are independent, exponential random variables with equal rates. The items are exchangeable, and a failed item from base 1 could just as well be returned to base 2, and vice versa. The items are admitted to one line but the customers wait and marked according to their sources. We assume that the system is in steady state. A backorder is created for each arrival. At a completion of service the item is delivered to the base which currently has the most backorders. In case of a tie, the item will be delivered to base 1 or base 2 with probability 0.5. Such facilities occurs as part of multi-echelon exchangeable item provisioning systems in which backorders are filled according to needs instead of FIFO or SIRO policies. Many organizations extensively use multi-echelon repairable-item systems to support advanced computer systems and sophisticated medical equipment. Our aim is to compute certain steady state performance measures of the system. Underlying these performance measures is the joint steady state distribution of the backorders Joint work with D. Perry and O.J. Boxma.

Joanna Rodriguez, Universidad Carlos III de Madrid, Identifiability of the two-state Batch Markovian Arrival Processes (BMAP).

[12 Tavor 15:00-16:30]

Since Batch Markovian arrival processes were introduced in the eighties they have received much attention in different contexts where applied probability plays an important role: teletraffic, reliability, queuing or finance. Their capability of modeling dependent and non-exponentially distributed observations as well as correlated batches makes the BMAPs very versatile model in practice. Although many works devoted to the study of properties of the BMAPs can be found in the literature, less studies have considered estimation for such processes. This is mainly due to the typical problems of hidden Markov models such as over-parameterization and lack of identifiably (see Ramírez-Cobo et al. 2010). In this talk, under the assumption that both the inter arrival times and the batches sizes are observed, we show that the two-state BMAP is an identifiable process.

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2. Breuer, L. , Badescu, A., Da Silva Soares, A., Latouche, G., Remiche, M. and Stanford, D. (2005). Risk processes analyzed as fluid queues. Scandinavian Actuarial Journal, 2005:2, 127-141.

3. Ramírez-Cobo, P., Lillo, R.E. and Wiper, M.P. (2010). Non identifiability of the two-state Markovian arrival process. Journal of Applied Probability, 47, 630-649.

Eleni Vatamidou, Technical University of Eindhoven, Error bounds for spectral approximations of the M/G/1 queue

[12 Zion B 15:00-16:30]

Great attention is given in evaluating numerically the waiting time distribution of an M/G/1 or a G/G/1 queue. An important method is by approximating the service times with a phase-type distribution. What is usually not specified though is the number of phases needed in order to achieve a specified accuracy in the approximation of the waiting time distribution. In this presentation, we give the connection between the required number of phases and the specified accuracy we want to achieve for the waiting time distribution. Furthermore, we present an algorithm to approximate the waiting time distribution of an M/G/1 by approximating a completely monotone residual service time distribution with a hyper exponential one. For this approximation, we also provide error bounds. Finally, we compare our approximation with the heavy traffic and heavy tail approximations in the cases where service times follow a Pareto or a Weibull distribution.

Gideon Weiss. The University of Haifa, Skill Based Service Systems

[11 Zion B 15:00-16:30]

We consider systems with several types of customers and several types of servers, where compatibility of servers to customers is given by a bipartite graph. This is motivated by call centers with skill based routing, and by assigning kidney transplants to patients. A common approach is provided by infinite first come first served matching of two infinite multi-type random sequences. We obtain explicit results for this model, and show how to extend them to a host of queueing models, including loss systems, stable queues, overloaded queues, and overloaded queues with abandonments.

Alexander Zadorojniy, IBM HRL, Strong Polynomiality of the Gass-Saaty Pivoting Rule for Controlled Random Walks.

[12 Tavor 12:00-13:30]

We consider the subclass of linear programs that formulate Markov Decision Processes (MDPs). We show that the Simplex algorithm with the Gass-Saaty pivoting rule is strongly polynomial for subclass of MDPs, called controlled random walks (CRWs); the running time is O(|S|3 |U|2), where |S| denotes the number of states and |U| denotes the number of actions per state. This result improves the running time of Zadorojniy et al. [Ref. 1] algorithm by a factor of |S|. In particular, the number of iterations needed by the Simplex algorithm for CRWs is linear in the number of states and does not depend on the discount factor.

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Yan Dolinsky, ETH Zurich, Hedging of Game Options With the Presence of Transaction Costs

[11 Gilboa 10:00-11:30]

In which the discounted stock price process satisfies the conditional full support property. We show that the super--replication price is the cheapest cost of a trivial super--replication strategy. This result is an extension of previous papers which considered only European options. In these papers the authors showed that with the presence of proportional transaction costs the super--replication price of a European option is given in terms of the concave envelope of the payoff function. In the present work we prove that for game options the super--replication price is given by a game variant analog of the standard concave envelope term. The treatment of game options is more complicated and requires additional tools. We combine the theory of consistent price systems together with the theory of extended weak convergence. The second theory is essential in dealing with hedging which involves stopping times, like in the case of game options.

Henry Laniado, Universidad Carlos III de Madrid, Extremality stochastic order and its applications

[14 Zion A 15:00-16:30]

This talk is devoted to the extremality stochastic order that allows comparisons between multivariate distributions in a direction determined by a unit vector. It can be seen as a generalization of the upper orthant order and the lower orthant order. We prove some interesting analytic properties of this new ordering, relations with other multivariate orders previously introduced in the literature and show some applications in portfolio theory.

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Zhengxiao Wu, National University of Singapore, On the Intraday Periodicity Duration Adjustment of High-Frequency Data

[14 Zion A 15:00-16:30]

In the last decade, intensive studies on modeling high frequency financial data at the transaction level have been conducted. In the analysis of high-frequency duration data, it is often the first step to remove the intraday periodicity. Currently the most popular adjustment procedure is the cubic spline procedure proposed by Engle and Russell (1998). In this article, we first carry out a simulation study and show that the performance of the cubic spline procedure is not entirely satisfactory. Then we define periodic point processes rigorously and prove a time change theorem. A new intraday periodic adjustment procedure is then proposed and its effectiveness is demonstrated in the simulation example. The new approach is easy to implement and well supported by the point process theory. It provides an attractive alternative to the cubic spline procedure.

Netzahualcóyotl Castañeda-Leyva, Universidad de Guanajuato, México, Optimal investment in discrete time financial markets with bid-ask spreads

[11 Gilboa 10:00-11:30]

A one period financial market model with transactions costs is analyzed; see [1] [2], and [3]. The risky asset price process is redefined conveniently in order to obtain an explicit solution to the utility maximization problem when the risk preferences of the investor are based on the exponential utility function and a liability can be included in her portfolio. For a general liability at this incomplete market, the arbitrage free interval price, as well as its replication price, is characterized via the martingale approach; see [2] and [3]. Finally, we derived the indifference price and its asymptotic limit when the risk aversion is going to infinity.

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Tzuu Shuh Chiang, Institute of Mathematics, Academia Sinica, Uniform Asymptotic Expansion of European Down and Out option.

[14 Zion A 15:00-16:30]

Under the usual Black-Scholes model with stochastic volatility, we consider the problem of pricing a European down and out option with a smooth pafoff function at maturity T. The stochastic volatility is a mean reverting ergjodic stochastic process may be related to the stock price and converges to its equlibrium with rate 1/e.We show that in order to obtain a uniform second order correction of the price ase®0, a boundary expansion has to be included in its asymptotic expansion. This generalizes the results of [1] and [2] where only European call option and non-uniform expansion were considered.

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2. J.Fouque, G. Papanicolaou and R. Sircar, Derivatives in Financial Markets with Stochastic Volatility, Cambridge University Press, Cambridge, 2000.

Amir Elalouf, Bar Ilan University, Fast Algorithms for Routing in Stochastic Networks under Uncertain Traffic Conditions

[12 Gilboa 15:00-16:30]

We consider general stochastic networks in which input data (operation durations, costs, profits, etc.) are random variables due to varying and uncertain traffic conditions. There are many examples in industry, economics and communications: emergency transport systems, communication traffic, banking networks, stock markets and others. Finding the best (fastest, cheapest, most effective …) routes in such networks cannot rely on "average" data alone. Rather, the data variation should be taken into account, as well. The routing problems can be formulated on a stochastic network with a given source and a given destination. To each arc we associate a random variable with expected time, costs, profits and their variations. The first problem that we consider is to find a path minimizing the total expected time subject to the constraint that the path variance does not exceed a given threshold. Another version of the problem is to minimize the total expected time of traversing a path subject to the constraint that the probability of the path-time not to exceed a given value, is more than a given threshold. We suggest exact pseudo-polynomial dynamic programming algorithms and fast ε-approximation algorithms (so called FPTAS) for these problems. Keywords: Stochastic network, Routing, Fast routing algorithm, FPTAS.

Maria Frolkova, CWI, Fixed-point approximations for bandwidth-sharing networks with rate constraints

[12 Zion B 15:00-16:30]

Bandwidth-sharing networks as considered by Massoulie & Roberts (1998,1999) are important flow level models of communication networks. We focus on the fact that it takes a significant number of users to saturate a link, necessitating the inclusion of individual rate constraints. In particular we extend work of Reed & Zwart (2010) on fluid limits of bandwidth sharing with rate constraints under Markovian assumptions: we consider a bandwidth-sharing network with rate constraints where job sizes and patience times have a general distribution. We obtain a fluid limit in the general case. For monotone networks, we also establish interchange of limits, i.e. convergence of stationary distributions of the pre-limiting networks to the fixed point of the fluid limit.

Ana Gago Benítez, University of Málaga, Log-normal modeling of non-linear sequences of delays with classical change detection methods

[12 Gilboa 15:00-16:30]

Statistical modeling of time series of delays is an important problem in several disciplines, such as distributed control, multimedia or networking. Many of these systems involve a large number of heterogeneous components: the network, operating systems, application software, interfaces, etc., most of them having a stochastic response-time behavior. In spite of that, it is often necessary to maintain these delays below given thresholds to perform control. Therefore we need to predict these delays, which exhibit multiple regimes, bursts and outliers, and thus a good on-line change detection and statistical estimation. This modeling may be done in different ways: state-space methods, hidden markov models, neural networks, etc., often with a high theoretical and computational complexity. In a previous work, we proposed a simpler statistical method based on parametrical distributions and specific change detectors, concluding that log-normal distributions explained well a relevant number of cases as long as abrupt changes were properly detected. In this paper, we build upon our previous results, adapting a CUSUM+RLS change detector to the log-normal in order to propose a more solid and still minimalistic parametrical solution. Experiments carried out using simulated and real data sets coming from networked telerobots confirm that the proposed method is able to provide significantly non-rejected log-normal fittings even in non-stationary and highly variable context.

Mikael Falconnet, Laboratoire Statistique et Genome, Evry, France, Substitution processes with translocation mechanisms

[14 Zion B 15:00-16:30]

We define Markov processes on the integer lattice as the superimposition of two mechanisms: an evolution of the sites according to a substitution process on a finite alphabet where the rates depend possibly of the neighbors, and translocations with possibly infinite range. We consider several cases and prove in every of them that the process is ergodic.

Moler Jose, Public University of Navarra, An adaptive design for clinical trials based on the Klein urn.

[14 Arbel 15:00-16:30]

Response driven adaptive designs have received an increasing interest in the statistical literature due to their applications in industry, economics, medicine, etc. But it is in the framework of clinical trials where they have known their maximum development. In this framework, the responses and allocations of previous patients are used to allocate the next patient to a treatment. The trial can be redirected with ethical goals by skewing the number of allocations to the treatments with better performance. The classical Ehrenfest urn model is applied in Chen (2000) to build an adaptive design. In this paper we study the properties of a response-adaptive design that uses the generalized Ehrenfest model studied in Klein (1957) and it will be called Klein urn design. It incorporates explicitly the responses of the patients to the allocation process. We study the behavior of some stochastic processes associated with the evolution of the urn and a test-statistic to be applied in a random permutation test, as claimed in Rosenberger and Lachin (2002) in the context of clinical trials.

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Marepalli Rao, University of Cincinnati, Hardy-Weinberg Equilibrium for Multi-allelic markers and Gene-Environment interactions via Algebraic Statistics and MCMC

[12 Zion B 15:00-16:30]

Testing Hardy-Weinberg Equilibrium of a marker is a key step before advancing to association between the marker and a phenotype of interest. If the marker is bi-allelic, one could use the traditional chi-squared test if certain conditions are met. If not, one could use an exact test a la Fisher. If the marker is multi-allelic, computational problems pile up uncomfortably. In this presentation, we will show how algebraic statistics, Markov bases, and Monte Carlo Markov Chain help to soothe the computational complexities. The same trio can help to tackle gene-environment interactions.

Serban Badila, Eindhoven Technical University, Defendencis in Risk Models and Their Dual Queueing Models

[14 Zion A 15:00-16:30]

It is known that several problems arising in insurance and risk theory are related to problems queueing theory and performance analysis. More precise for a risk reserve process, we can consider a dual queueing process in which the time ow is reversed and the inter-arrival time of customers and their service times are the inter-claim periods and the claim sizes, respectively, in the risk process. Then quantities of interest, like the probability of ruin or the maximum aggregate loss, are related to performance measures of the queue, like the waiting time distribution W. Under stability conditions, when starting the risk process with initial capital u, the in_nite horizon ruin probability,(u) is equal to the tail P(W > u) of the steady state workload in the dual queue. It is worth mentioning that this duality is a path-wise identity and no independence assumptions are needed. We are particularly interested in models that exhibit some kind of dependence structure. For example the size of the current claim may depend on its inter-arrival time (or dually, the inter-arrival time may depend on the preceding service time in the queueing setting) in such a way that the above performance measures are tractable. The dependence structure to be presented is modeled by a class of bivariate matrix-exponential distributions (Bladt&Nielsen 2010) in which the joint Laplace-Stieltjes transform of the claim size and the inter-claim time is a rational function. This class generalizes some bivariate Gamma models already considered in the literature. We obtain exact results for the ruin probability and for the waiting time distribution in the dual queueing model, by using Laplace transform methods and solving a Wiener-Hopf type boundary-value problem.

Manuel Lladser, University of Colorado, Estimation of dissimilarity in urn models

[14 Arbel 15:00-16:30]

Consider two urns, urn-x and urn-y, each composed by colored balls. We define the (expected) dissimilarity of urn-x relative tok-draws from urn-y as the probability that the color of a random ball from urn-x is not observed in k random draws from urn-y. Using the theory of U-statistics, we can estimate this quantity in the non-parametric case via a uniformly minimum variance unbiased estimator over a range for k determined by the sample size from urn-y. Furthermore, we can provide uniformly consistent estimates of the variance of our estimator via a jackknife approach. Although our estimator of dissimilarity exposes a non-Markovian behavior when applied sequentially over k, in non-pathological configurations, we can show uniform convergence in probability as well as approximately Gaussian marginal distributions when the sample sizes from each urn tend to infinity. Our analysis is motivated by the challenging problem allocating in a somewhat optimal manner samples among an ensemble of various microbial environments (each represented as an urn) so as to better understand what is unique and shared by the environments in the ensemble. Due to the wide generality of our urn model, however, other applications are foreseeable. For instance, each urn could represent a random RNA pool and each colored ball a possible solution to a particular binding site problem over that pool. This research is in collaboration.

Rob Van Der Mei, CWI and VU University, Sojourn-time distributions in polling systems with non-FCFS queuing disciplines

[12 Arbel 15:00-16:30]

Authors: Jan-Pieter Dorsman (CWI), Rob van der Mei (CWI/VU), Petra Vis (CWI) and Erik Winands (UvA) Abstract: Polling systems are multi-queue systems in which a single server visits the queues in some order to provide service to customers waiting at the queues. Polling systems find many applications in areas like telecommunications, production and maintenance. In the vast majority of the research papers on polling systems, the customer at each of the queues are served on a First-Come-First-Served (FCFS) basis. In this study, we look at the impact of different queuing policies (like LCFS, ROS, PS, SJF) on the sojourn-time distributions. In this talk, I will discuss new analytic results for the sojourn-time distributions under a variety of non-FCFS queuing policies.