

Programme Doctoral en Recherche Opérationnelle

Zinal Summer Seminar 2016, June 26-30

	Sunday 26	Monday 27	Tuesday 28	Wednesday 29	Thursday 30
07:30 - 8:30		Breakfast	Breakfast	Breakfast	Breakfast
9:00		Cable Car	Cable Car	Cable Car	
9:15 - 10:45		Cirillo	L'Ecuyer	Cirillo	L'Ecuyer 8:30 - 10:00
10:45 - 11:15		Coffee	Coffee	Coffee	Coffee
11:15 - 12:45		L'Ecuyer	Cirillo	L'Ecuyer	Cirillo 10:30 - 12:00
12:45 - 14:00		Lunch	Lunch	Lunch	
14:00 - 16:00		Paper Presentation Workshop	Paper Presentation Workshop	Paper Presentation Workshop	
16:00		Cable Car	Cable Car	Apéro	
17:00		Sport and discussions	Sport and discussions	Cable Car	
18:00 - 19:00	Welcome cocktail	Sport and discussions	Sport and discussions	Sport and discussions	
19:30	Dinner	Dinner	Dinner	Dinner	

Venue:

Hotel Europe
3961 Zinal
Tel.: 027 475 44 04

Public transport:

Station *Zinal Poste*

Sports options

- Minigolf in Zinal. Equipment can be borrowed for free at the Tourist Office.
<http://www.valdanniviers.ch/tourism/minigolf-zinal.html>
- There are a lot of hiking possibilities, depending on the snow remaining.
For the hiking map click here: http://www.valdanniviers.ch/data/montagne/documents/Anniviers/Plans_Rando/Plan_rando_t_SITE.pdf

Keynote presentations

Cinzia Cirillo (University of Maryland)

Lecture 1: **Revenue Management I - basic concepts and methods**

The lecture will provide an outline of the revenue management problem and will discuss its complexities. Research progress will be reported on the following four areas: forecasting, overbooking, seat inventory control, and pricing. The talk will also illustrate methodologies that incorporate customers' behavior, individual preferences and product choice into the revenue management problem.

Lecture 2: **Revenue Management II - choice based methods**

Most case studies in revenue management are in the airline sector, because airlines have the longest history of development in revenue management. This lecture will illustrate the difficulties encountered when transferring methods developed for airlines to other sectors (in particular railways). Methods to account for heterogeneity in individuals' preferences and for dynamic in customers' choices will be also discussed.

Lecture 3: **Optimization methods for econometrics models**

In this lecture we discuss the leading classes of optimization methods that are of particular importance in modern econometrics. In particular, methods for choice analysis have progressed enormously in latest decades in order to overcome limitations of early applications. More complex model specifications require simulation, the maximization of ill-behaved functions, and are computationally intensive. Optimization based on Monte Carlo and quasi Monte-Carlo simulations, adaptive Trust Region methods and on the Genz algorithm will be illustrated and results obtained for specific choice models will be discussed.

Lecture 4: **A multi-disciplinary approach to Big data analytics**

Modern societies continuously produce data. This data revolution is providing researchers with an increasing amount of information from relatively low-cost sources and requires new methods for analysis and research collaboration among scientists from different disciplines. Recent work on travel time estimation from Vehicle Probe Project data will be presented. Two techniques for travel time prediction in real-time will be illustrated. The first identifies a relatively small number of hidden variables using methods from statistical machine learning and stream computing. The second develop Bayesian and approximate Bayesian methods, borrowing ideas from the existing literature on the rapidly growing interdisciplinary field of small area estimation, in order to produce instantaneous prediction of travel time.

References

Lecture 1: **Revenue Management I - basic concepts and methods**

McGill, van Ryzen, "Revenue Management: Research Overview and Prospects", *Transportation Science*, 1999, 33(2), pp. 233–256.

Lecture 2: **Revenue Management II - choice based methods**

Pratt Hetrakul, Cinzia Cirillo, "A latent class choice based model system for railway optimal pricing and seat allocation", *Transportation Research Part E*, 2014, 61(1), pp. 68-83.

Lecture 3: **Optimization methods for econometrics models**

Cinzia Cirillo, Renting Xu, Fabian Bastin, "A dynamic formulation for car ownership modeling", *Transportation Science*, 2016, 50(1), pp. 322–335.

Cinzia Cirillo, Yangwen Liu, Jean-Michel Tremblay, "Simulation, numerical approximation and closed forms for joint discrete continuous models with an application to household vehicle ownership and use" (in print, can be found in the rubric "download material")

Fabian Bastin, Cinzia Cirillo, Philippe L. Toint, "Application of an adaptive Monte-Carlo algorithm for mixed logit estimation", *Transportation Research Part B*, 2006, 40(7), pp. 577-593.

Pierre L'Ecuyer (University of Montreal): **Stochastic Simulation**

We examine some key ideas and methods to simulate stochastic systems efficiently by computer and to estimate some of their distributional properties. Principles, techniques, and theory will be reviewed and illustrated by examples from various areas. We will review Monte Carlo methods for estimating an integral (an expectation), a quantile, an entire distributions (densities), an optimum, etc. We will discuss uniform and non-uniform random number generators with multiple streams and substreams. We will examine various techniques to reduce the variance and more generally improve the efficiency of Monte Carlo simulations. We will see that rare event simulation has many more applications than one might think at first sight.

Lecture 1: Introduction to Monte Carlo Simulation

Stochastic models and simulation, Monte Carlo to estimate an integral, a function of several integrals, a quantile, a distribution, a density, and a conditional density. Confidence intervals. Multiple streams of random numbers. Comparing systems with common random numbers. Discrete-event simulation.

Lecture 2: Random Number Generation

Uniform random number generators, multiple streams and substreams, theoretical analysis of uniformity vs empirical testing, main classes of recommendable generators, combined generators, nonlinear generators, generators for parallel computers. Nonuniform generators, inversion, rejection method, using changes of variables.

Lecture 3: Variance Reduction Methods and Efficiency Improvement

Measures of efficiency, variance versus computing time, variance reduction, common random numbers, antithetic variates, quasi-Monte Carlo methods, stratification, conditional Monte Carlo, multilevel Monte Carlo, variance reduction for estimating a derivative.

Lecture 4: Variance Reduction in Rare Event Contexts

Rare event simulation, change of probability measure, importance sampling, splitting, robustness to rare events. Applications of rare event simulation.

General class notes + Java simulation library

P. L'Ecuyer, Stochastic Discrete-Event Simulation, class notes (draft in progress).
<http://www.iro.umontreal.ca/~lecuyer/ift6561/>

P. L'Ecuyer, SSJ: A Java Library for Stochastic Simulation, DIRO, Universite de Montreal. <http://www.iro.umontreal.ca/~simul/>

Some related articles

Z. I. Botev, P. L'Ecuyer, R. Simard, and B. Tuffin, "Static Network Reliability Estimation under the Marshall-Olkin Copula," *ACM Transactions on Modeling and Computer Simulation*, 26, 2 (2016), Article 14.

P. L'Ecuyer, J. Blanchet, B. Tuffin, and P. W. Glynn, "Asymptotic Robustness of Estimators in Rare-Event Simulation", *ACM Transactions on Modeling and Computer Simulation*, 20, 1 (2010), Article 6, 41 pages.

P. L'Ecuyer, C. Lecot, and B. Tuffin, "A Randomized Quasi-Monte Carlo Simulation Method for Markov Chains", *Operations Research*, 56, 4 (2008), 958-975.

T. Cezik and P. L'Ecuyer, "Staffing Multiskill Call Centers via Linear Programming and Simulation", *Management Science*, 54, 2 (2008), 310-323.

A. N. Avramidis and P. L'Ecuyer, "Efficient Monte Carlo and Quasi-Monte Carlo Option Pricing Under the Variance-Gamma Model", *Management Science*, 52, 12 (2006), 1930-1944.

P. L'Ecuyer and R. Simard, "TestU01: A C Library for Empirical Testing of Random Number Generators", *ACM Transactions on Mathematical Software*, 33, 4 (2007), Article 22, 40 pages.

P. L'Ecuyer and E. Buist, "On the Interaction Between Stratification and Control Variates, with Illustrations in a Call Center Simulation", *Journal of Simulation*, 2008, 2, 29-40.

P. L'Ecuyer and G. Perron, "On the Convergence Rates of IPA and FDC Derivative Estimators for Finite-Horizon Stochastic Simulations", *Operations Research*, 42, 4 (1994), 643-656.

T. Cezik and P. L'Ecuyer, "Staffing Multiskill Call Centers via Linear Programming and Simulation", first draft in 2004, *Management Science*, 54, 2 (2008), 310-323.

A. N. Avramidis, W. Chan, M. Gendreau, P. L'Ecuyer, and O. Pisacane, "Optimizing Daily Agent Scheduling in a Multiskill Call Center", Earlier version in CIRRELT Report 2007-44. *European Journal of Operations Research*, 200, 3 (2010), 822-832.

Paper Presentation Workshop

1. **Cezik, T., and L'Ecuyer, P.: Staffing Multiskill Call Centers via Linear Programming and Simulation, *Management Science*, 54, 2 (2008), 310–323.**

Binder Stefan (EPFL), Forrer Salome (UNIBE), Pacheco Paneque Meritxell (EPFL)

2. **Avramidis, A. N., Chan, W., Gendreau, M., L'Ecuyer, P., and Pisacane, O.: Optimizing Daily Agent Scheduling in a Multiskill Call Center. *European Journal of Operations Research*, 200, 3 (2010), 822–832.**

Scarinci Riccardo (EPFL), Galby Esther (UNIFR), Gnägi Mario (UNIBE), Strub Oliver (UNIBE)

3. **Hetrakul, P., and Cirillo, C.: A latent class choice based model system for railway optimal pricing and seat allocation, *Transportation Research Part E*, 61, 1 (2014), 68–83.**

Sharif Azadeh Shadi (EPFL), Daudet Laurent (EPFL), Fernandez Antolin Anna (EPFL), Rihm Tom (UNIBE)

4. **Cirillo, C., Xu, R., and Bastin, F.: A dynamic formulation for car ownership modeling, *Transportation Science*, 50, 1 (2016), 322–335.**

Maknoon Yousef (EPFL), Kocyigit Cagil (EPFL), Nikolic Marija (EPFL), Zimmermann Adrian (UNIBE)

Organization of the workshop:

- Objective: provide an overview of the paper and present some parts of the paper in detail (e.g., by presenting an illustrative example)
- Presentation should take approximately 20 minutes per group
- Active participation in preparation and in presentation: 1 ECTS per seminar (can be accumulated)
- First group meeting on Monday after lectures
- Pierre L'Ecuyer and Cinzia Cirillo will be present on Monday and on Tuesday 2-4pm for discussing questions of the students
- Presentations: Wednesday 2-4pm