CURRICULUM VITAE OF
Serena SPINA

Personal information

Date of birth: 30/11/1987
Place of birth: Aosta (AO)
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Current position

Academic teacher for the courses:

- Course "System reliability and statistical quality control", CFU 6, Class LM40, University of Basilicata;
- Course "Analisi Matematica", CFU 9, Class L31, University of Salerno;

Post-doc experiences

01/10/2015 – 30/09/2016: Research Fellow (Probability and Statistics), Department of Mathematics, University of Salerno.

Academic studies

08/05/2015: PhD in Mathematics, University of Salerno.
Thesis: "Stochastic diffusion processes with jumps for cancer growth and neuronal activity models".
Research Director: Virginia Giorno.
Tutor: Antonio Di Crescenzo.

20/07/2015: TFA (Tirocinio Formativo Attivo) A047 - MATEMATICA.

26/09/2011: 2nd level degree - Master: Mathematics, University of Salerno, final degree mark: 110/110 cum laude.
Dissertation/thesis title: "Gompertz Process: Application to Tumor Growth and Study of the effect of Therapy".
Thesis supervisor: Giorno Virginia. Dissertation/thesis keywords: Gompertz Process, Tumor growth, Therapy, First passage time problem.

Academic teaching experiences

- 2012-2105: Internship during PhD at University of Salerno: Educational support in the courses of Mathematical Analysis, 120 hours;
- 2015: "Help Teaching"at University of Salerno for the course of 'Mathematics and Statistics", 30 hours;
- 2016: Course "Probability and Mathematical Statistics", CFU 6, Class LM40, University of Basilicata;
- 2016: "Help Teaching"at University of Salerno for the course of Mathematics and Statistics, 15 hours;
- 2016: "Help Teaching"at University of Salerno for the course of Analisi Matematica II, 15 hours.

Summer Schools

- 2012: Scuola Matematica Interuniversitaria (SMI)
  Perugia (Italy) | Language: English | Duration: 1 month
  Courses: Stochastic Differential Equation, Statistics

- 2013: Biomat 2013-Mathematics of Planet Earth: Evolution and cooperation in social sciences and biomedicine
  Granada (Spain)| Language: English | Duration: 1 week
  Courses: An introduction to stochastic methods in mathematical biology; Fare evasion and social networks; Mathematical models for social changes and criminology; Mathematical challenges in medicine; On the evolution of cooperation; Cooperation and construction

- 2013: Saint-Flour Probability Summer School
  Saint-Flour (France) | Language: English | Duration: 2 weeks
  Courses: Brownian motion and its applications to mathematical analysis; Statistical Mechanics and algorithms on sparse and random graphs; Aggregation and high-dimensional statistics.
  Contributed talk: A Stochastic Model with Jump for an Intermittent Treatment in Cancer Growth.

Workshops and Conferences

- 20-24/02/2017, EUROCAST2017, Las Palmas de Gran Canaria, Conference on Computer Aided Systems Theory.
  Contributed talk: "note on diffusion processes with jumps and applications"

- 13-16/06/2016, "Simai 2016", Politecnico di Milano, Milano, Italia.
  Contributed talk: "Analysis of a growth model and an analogue stochastic process"

- 8-10/06/2016, "SIS 2016", University of Salerno, Salerno, Italia.
  Poster: "Inference on a non-homogeneous Gompertz process with jumps as model of tumor dynamics"

- 8-12/02/2016, School and workshop "PDEs and applications", University Federico II, Napoli, Italia.

- 21-22/01/2016, International Workshop "Stochastic Models And Related Topics", University of Salerno.
  Poster: "A new model of population growth"

- 8-13/02/2015, EUROCAST2015, Las Palmas de Gran Canaria, Conference on Computer Aided Systems Theory.
  Contributed talk: "A model of tumor dynamics subject to an intermittent treatment involving reduction of tumor size and rise of growth rate"

- 24-26/02/2014, First Salerno-Tbilisi Workshop On Modeling In Mathematics, University of Salerno.
  Contributed talk: "A Gompertz model with jumps for an intermittent treatment in cancer growth"

- 4-6/04/2013, Workshop on Theoretical Approaches and Related Mathematical Methods in Biology, Medicine and Environment, Milano.
  Contributed talk: "A Jump Stochastic Gompertz Model for an Intermittent Treatment in Cancer Growth"

- 10-15/02/2013, EUROCAST2013, Las Palmas de Gran Canaria. Conference on Computer Aided Systems Theory.
  Contributed talk: "A jump stochastic Gompertz model for an intermittent treatment in tumor growth"

- 04-08/06/2012, BIOCOMP2012, Vietri sul Mare, Mathematical Modeling and Computational Topics in Biosciences.
  Poster: "On the return process with refractoriness for non- homogeneous Ornstein-Uhlenbeck neuronal model"

Organizing Committee

21-22/01/2016, International Workshop "Stochastic Models And Related Topics", University of Salerno.

Foreign language skills

Languages skills English:
Overall: Excellent, Speaking: Good, Writing: Excellent
Diplomas and certificates: Trinity Level 7, TOEFL course

Information technology skills

Generic skills Operating systems: Good
Programming languages : Good
Internet skills: Good
Specific skills Programming languages known: Matlab, Mathematica, R
EIPASS (European Computer Passport) certificate

Research Activity

The research activity is concerning the development and analysis of mathematical models based on continuous and discrete stochastic processes finalized to describe the behaviour of certain dynamic systems.
The research themes can be summarized as follows.

- Diffusion processes with jumps:
  In [9] the main properties of these processes are studied; various results of interest in applications have been obtained, with special attention to the probability density functions, the moments and the first passage time.
  In [1], [2], [5] some results on diffusion processes with jumps are applied in the context of cancer growth: in order to analyze the effect of a therapeutic program that provides intermittent suppression of cancer cells, a Gompertz process with jumps is constructed; in this context a jump represents a therapeutic application and it shifts the process to a certain return value which, in general, is assumed random.
  In [1] and [2], a particular model is studied, in which the Gompertz process has the same characteristics between two consecutive jumps, the return points and the inter-jump intervals are random and identically distributed. For this model, the transition pdf, the average state of the system (representing the mean size of the tumor) and the number of therapeutic applications to be carried out in time intervals of fixed amplitude are analysed.
  In [5] a more realistic model is considered. Specifically, it is assumed that the therapeutic program has a deterministic scheduling (so that jumps occur at fixed and properly chosen time instants), the return points are deterministic and when a therapy is applied there is a selection event in which only the most aggressive clones survive (for example this perspective could be applied to targeted drugs leading to a much lower toxicity for the patient).
  Taking into consideration these aspects, the deterministic ([6], [8]) and the stochastic ([5]) processes with jumps are constructed. Since each therapeutic application involves a reduction of the tumor mass, but it also implies an increase of the growth speed, the problem of finding a compromise between these two aspects raises. Two possible schedulings are proposed in order to control the cancer growth.
  In [6] and [8] a constant amplitude between successive jumps is considered and a criterion for an efficient choice of the instants of the therapeutic treatment has been determined.
  In [5], it is suggested to apply the therapy just before the cancer mass reaches a fixed control threshold. To this aim, the FPT problem through a constant boundary is studied and rules on the choice of the application times are provided such that the cancer size remains bounded.
  Another application of diffusion processes with jumps is proposed in [3]. A process with jumps is considered in the neurobiological context: starting from a non-homogeneous Ornstein-Uhlenbeck process, a return process with refractoriness is formulated and studied to describe the neuronal

activity.

- Time non-homogeneous queueing systems with catastrophes:
  In [4] a queueing systems subject to jumps occurring with time varying intensity is considered. The effect of a catastrophe is to make the queue instantly empty. The transition probabilities, the related moments and the first visit time (FVT) density to zero state are analyzed. Particular attention is dedicated to queueing systems in the presence of catastrophes with periodic intensity function. Some interesting properties of the asymptotic distribution and the FVT density have been obtained. Various applications are provided, involving the non-stationary birth-death process with immigration, the $M(t)/M(t)/1$ and $M(t)/M(t)/\infty$ queueing systems.

- Rumor spreading models:
  In [7] a process of news spreading with a time dependent rate is built, generalizing the classical Susceptible-Infected model. The time-dynamics of the sharing and diffusion process of news on the Internet is considered. The study is focused on the counting process describing the number of connections to a given website, characterizing the cumulative density function of its inter-arrival times. Moreover, starting from the general form of the finite dimensional distribution of the process, an expression for the time-variable rate of the connections is determined. Its relationship with the probability density function of the interarrival times is established. The dynamic of the process is studied on the Internet and the proposed model is validated on the Memetracker data set.
  In [9] the effect of a denial in rumor spreading models is introduced and modelled with a deterministic process with jumps. A denial, which is represented by a Poisson event, resets the process to the previous rules. Denials are introduced in the classic Daley-Kendall model and in a suitable generalization; the steady state densities are analysed for these models.

- New model of population growth:
  In [12], a new model of population growth is proposed to describe phenomena exhibiting growth curve having some characteristics of the Gompertz law and the Korf law. The new model has the same carrying capacity of the previous models, but it is able to capture different evolutionary dynamics. The deterministic model, the corresponding non-homogeneous birth-death and simple birth process are considered and analysed in details.

- Random walk on graphene:
  The current research activity ([13]) is focused on modeling a random walk on graphene. The hexagonal structure of graphene is represented on a system of axes and its vertexes are subdivided into two classes. The transition probabilities and the probability generating functions are defined for each classes. The probability generating function for the random walk is obtained, from which the means, the variances and the covariances of the variables of the random walk are computed. The asymptotic analysis of the random walk under the influences of large and moderate deviations is also performed.

List of Publications

1. V. Giorno, S. Spina (2013) *A jump stochastic Gompertz model for an intermittent treatment in tumor growth.* In Computer Aided Systems Theory - Extended Abstracts - EUROCAST 2013 (Alexis Quesada-Arencibia, Jose Carlos Rodriguez, Roberto Moreno-Diaz jr., Roberto Moreno Diaz.), pp. 16-17, IUCTC Universitad de Las Palmas de Gran Canaria, ISBN: 978-84-695-6971-9

2. V. Giorno, S. Spina (2013) *A jump stochastic Gompertz model for an intermittent treatment in tumor growth.* Lecture Notes in Computer Science, Volume 8111, Part I, pp. 61-68

3. V. Giorno, S. Spina (2014) *On the return process with refractoriness for a non-homogeneous Ornstein-Uhlenbeck neuronal model.* Mathematical Biosciences and Engineering, Volume 11, Number 2, pp. 285-302

4. V. Giorno, A. G. Nobile, S. Spina (2014) *A note on time non-homogeneous adaptive queue with catastrophes.* Applied Mathematics and Computation 245, pp. 220-234

5. S. Spina, V. Giorno, P. Roman-Roman, F. Torres-Ruiz (2014) *A Stochastic Model of Cancer Growth Subject to an Intermittent Treatment with Combined Effects: Reduction of Tumor Size and Rise of Growth Rate.* Bulletin of Mathematical Biology 76, pp. 2711-2736, DOI: 10.1007/s11538-014-0026-8

6. V. Giorno, S. Spina (2015) *A Model of tumor dynamics subject to an intermittent treatment involving reduction of tumor size and rise of growth rate.* In Computer Aided Systems Theory - Extended Abstracts - EUROCAST 2015 (Alexis Quesada-Arencibia, Jose Carlos Rodriguez, Roberto Moreno-Diaz jr., Roberto Moreno Diaz.), pp. 55-56, IUCTC Universitad de Las Palmas de Gran Canaria

7. G. De Martino, S. Spina (2015) *Exploiting the time-dynamics of news diffusion on the Internet through a generalized Susceptible-Infected model.* Physica A: Statistical Mechanics and its Applications 438, pp. 634-644, DOI: 10.1016/j.physa.2015.07.022

8. V. Giorno, S. Spina (2015) *A Cancer Dynamics Model for an Intermittent Treatment Involving Reduction of Tumor Size and Rise of Growth Rate.* Springer International Publishing Switzerland 2015, R. Moreno-Diaz et al. (Eds.): EUROCAST 2015, LNCS 9520, pp. 174-182, 2015, DOI: 10.1007/978-3-319-27340-2 23

9. V. Giorno, S. Spina (2015) *Some remarks on stochastic diffusion processes with jumps.* Lecture Notes of "Seminario Interdisciplinare di Matematica", Vol. 12, pp. 161-178

10. V. Giorno, S. Spina (2015) *Rumor spreading models with random denials.* Physica A, 461: 569-576, doi:10.1016/j.physa.2016.06.070

11. B. Paolillo, S. Spina (2016) Applicazione dell'algoritmo della divisione euclidea alle derivate di polinomi. Periodico di matematiche 1/2016

12. S. Spina, V. Giorno, P. Roman-Roman, F. Torres-Ruiz (2016) *Estimating a non-homogeneous Gompertz process with jumps as model of tumor dynamics.* Computational Statistics and Data Analysis (to appear) DOI: 10.1016/j.csda.2016.10.005

13. A. Di Crescenzo, S. Spina (2016) *Analysis of a growth model inspired by Gompertz and Korf laws, and an analogous birth-death process.* Mathematical Biosciences (to appear) DOI: 10.1016/j.mbs.2016.10.005

14. A. Di Crescenzo, C. Macci, B. Martinucci, S. Spina (2016) *Random walks on graphene: generating functions, state probabilities and asymptotic behavior.* Submitted