RAPPORT D'ACTIVITÉ SCIENTIFIQUE

FLORIN AVRAM, DANIEL MATEI

Titre du projet: *Methodes algébriques en probabilités et statistique.*

Participants: Florin Avram (Université de Pau et des Pays de l'Adour) et Daniel Matei (Institut de Mathématiques "Simion Stoilow" Bucarest).

Rapport 2010: One year ago, inspired by the "algebrization of analysis" as embodied in the development of computer software like "Ore modules", and by theoretical work of Sturmfels, we have dreamt jointly about working towards furthering the "algebrization of probability and statistics". We can see now clearly the immensity of the task, as compared to our limited resources. The project has lead for now to two papers, and to new directions of investigation:

(1) The first, *A Lie systems approach for the first passage-time of piecewise deterministic processes*, by F. Avram, J.F. Carinena, and J. de Lucas, is a modest first step in the first direction mentioned in our proposal. It was presented and published in the conference proceedings "Modern Trends in Controlled Stochastic Processes", edited by Alexey B. Piunovskiy (see http://arxiv.org/abs/1008.2625). The funding LEA Math-Mode (acknowledged) and the conversations with Daniel Matei were indispensable for achieving the results of the paper.

(2) The second is an ongoing rather technical paper by F. Avram, that we attach, concerning an important queueing model with an integer parameter s (number of servers) which has been only solved for $s \leq 2$, by using Gauss hypergeometric functions. For $s \geq 3$, nonclassic Okubo-type hypergeometric functions appear, for which not much information is known. We hope to make progress here by studying these functions, using the symbolic package "Holonomic Functions" of C. Koutschan, and ideas from the theory of hyperplane arrangements.

(3) Another goal of our project was the application of hyperplane arrangements theory to two areas of statistics and probability. The first is the asymptotics of multivariate generating functions as described for example in the recent survey *Analytic combinatorics in d variables: An overview*, by R. Pemantle, in "Algorithmic Probability and Combinatorics", A.M.S. Contemporary Mathematics, vol. 520 (2010). The second is the maximum likelihood estimation, related to the recent work B. Sturmfels and his collaborators from the paper *The maximum likelihood degree*, Amer. J. Math., vol. 128 (2006). The joint work on these problems is still in preliminary form. We hope to further pursue them during Matei's planned visit to Pau, in May 2011.

Activités du projet 2010:

F. Avram a visité IMAR, Bucarest en 2010 (entre 9-20 août), ou il a donné une série de conférences sur *Algebraic methods in mathematical finance and probability.*

Activités et visites envisagées pour 2011:

D. Matei va visiter UPPA, Pau pour 2 semaines en mai 2011, ou il va donner une série de conférences sur *Algebraic statistics.*

Financement demandé au L.E.A. pour 2011:

Frais de logement (330 euro, résidence universitaire) et perdiem (30 euro par jour, total 420 euro) pour 2 semaines de séjour en France (Pau), pour un total de 750 euro. Les frais de voyage de D. Matei seront supportées par IMAR sur un contrat de recherche.