The team of ANR project LoLitA (Longevity with Lifestyle Adjustments) and the Research Lab SAF (Actuarial Science and Finance) of ISFA, University of Lyon, invite applications for a

2-year Post-doctoral position on Longevity risk and/or Long-term care insurance

Overview

The LoLitA research project, funded by the *Agence Nationale pour la Recherche*, invites applications for a 2-year post-doctoral position on the theme of LoLitA: Longevity with Lifestyle Adjustments. The successful candidate will carry out his/her research in the Research Laboratory of Actuarial Science of Finance (*Laboratoire des Sciences Actuarielle et Financière - LSAF*) associated to the Institute of Financial Science and Insurance (*Institut de Science Financière et d'Assurances - ISFA*) and will be based in Lyon, France. He/She will also work regularly with members of the other main research laboratory involved in LoLitA project, the Laboratory of Probability and Stochastic Models (*Laboratoire de Probabilités et de Modèles Aléatoires - LPMA*) in Paris, and will also benefit from interactions with the 30 researchers who take part in the LoLitA project. This project aims at taking into account individual characteristics of individuals at the micro level to understand the macro level evolution of a population and at studying different aspects of human longevity and long-term care. The context and the brief description of the research project are given at the end of this document.

This research project takes part to the development of the "management longevity and long-term care risks" axis and its links with sustainable and responsible development which LSAF and ISFA are currently undergoing.

Description of the position

The successful candidate will be expected to participate to all the activities of the LoLitA project: he/she will scientifically contribute to the project by international publications of articles on the themes of the project, work

jointly with the researchers belonging to the project and to LSAF and LPMA teams. The successful candidate will also be expected to work with potential additional partners who may provide us with some longevity and health datasets. He/she will also be expected to help with the scientific management of the research project. Moreover, the successful candidate will be faced with statistical as well as probabilistic problems but he/she also will collaborate with professionals from insurance, actuaries, as well as scientists from other fields, including economics, medical science and sociology.

Qualification Applicants must hold a Ph.D. in Probability, Statistics, Actuarial Science or a closely related discipline; ideal candidates may possess a professional experience in one or more of the above fields.

Selection criteria

- Previous research experience on longevity and long-term care, although not required, will be given strong consideration.
- Preference will be given to applicants with good knowledge in actuarial science and/or population dynamics and/or rare event simulations.
- Enjoy working in a team.
- Good spoken and written English.
- Be able to communicate in French is a plus but is not at all required and is only a secondary criterion: this is a pure research position.

Treatment conditions: salary is market-competitive and commensurate with qualifications and scientific experience, according to the current collective agreement for academic positions.

Position duration: 2 years maximum.

Job starting date: Between March 2015 and September 2015, ideally before May 2015.

Application procedure: Applicants should send a motivation letter, a curriculum vitae along with a statement of research interests and experience,

and give names and addresses of two persons who will accept to provide a letter of reference. All documents must be sent to

postdoc-lolita@isfa.fr

by December 18, 2014.

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Context

Most developed countries are currently experiencing unprecedented improvements in longevity. These developments raise a number of problems to which historical experience offers no answers. Improved longevity puts pressure on

existing insurance systems such as health insurance and pensions, on public health services, and on social security. For instance, occupational pension schemes need to find adequate funding with fewer workers and more retirees in the future, and financing of state pensions and benefits must be adapted to the ageing of the population and the ensuing transform of needs. Ageing may also modify individual behavior, for example concerning risk aversion, investment, and savings. Certain intergenerational issues also arise from fluctuations in the age composition of memberships in pension schemes and in national populations, key words being solidarity, social cohesion, and - of course - economic sustainability. This way, a number of developed countries are poised to increase the retirement age by 2 to 5 years in order to account for the aging of the population in the funding of state pensions. Also insurance companies and pension funds systems are also facing a number of challenges related to longevity risk, notably of significant longevity improvements in the future. More capital has to be raised to offset long-term risk, a case in point being new European regulation of banks and insurance companies in the wake of the financial crisis. The ongoing move from defined benefits to defined contributions in occupational pension schemes means that longevity risk, formerly carried by the sponsors, is increasingly passed on to the policyholders. In addition, insurance companies and pension funds are facing the heterogeneous evolution of policyholders mortality. There is a bias, known as basis risk, between the mortality in an individual portfolio and that of the national population – a result of selection effects. Prospective life tables containing longevity trend projections are frequently used, but are no longer sufficiently accurate to measure the the longevity risk of individual insurance companies or pension funds. Among the many standard stochastic models for mortality, some have been inspired by the credit risk and interest rate literature, and as such produce a limited definition of aggregate mortality by age and time. Moreover, because of the long-term nature of longevity risk, accurate mortality projections are delicate.

A real need for new points of view on mortality modeling emerges from this context. The necessity to define and test political reforms has to be helped with new theoretical and numerical tools, which can contribute to offer guidance for governmental strategies at social and political levels (e.g. immigration and retirement age policy). At the same time, it is necessary to identify and measure the risk exposure of specific insurance companies and institutions. New methods, studied in an interdisciplinary research group,

could provide useful benefits for longevity risk analysis and constitute a real basis for a unified regulatory system.

Increasing longevity is shifting the age distribution of populations toward older age groups. One question, that has been raised for several years and is still raised, is whether people will be live in wellness during the gained years of life expectancy or whether they will require all along external assistance to manage their daily life. It seems realistic to assume that the reality will be somewhere in between, but everybody is convinced that the increasing life expectancy will cause an increase in the demand for long term care in the coming decades and that long term care expenditures will represent a significant financial risk for the elderly. European countries offer various examples of organization, financing, and delivery of long term care. The mix of public and private funding, i.e. the balance between public financing that spreads risk broadly across the entire population and private responsibility through individual cost-sharing and family care-giving support, differs greatly among these countries. Since 2002 France has experimented a universal program which covers people age 60 and older but vary benefits according to income. For those who do not qualify for sufficient public benefits private insurance offers an interesting opportunity. The French long term care insurance market is one of the two first leading markets with the American market that can claim over 25 years of experience. However, they differ in terms of proposed solutions to the issues of long term care products.

The long term care risk is today very complex in terms of assessment and evaluation. There is a great deal of uncertainty about the extent to which the loss of autonomy has changed over time and could change for future generations. Moreover the cost factor – the rate of inflation in care services – represents an intertemporal risk that affects everybody in a pool. The interdependence between risks makes diversification harder whilst the sequential correlation of costs may make diversification across cohorts impossible. Therefore it is not clear whether the long-term care aggregate risk can be reasonably predicted.

The European insurance industry will soon be expected to comply to the new Solvency II Directive. The regulatory standards of the directive place emphasis on the manner in which insurance company endorsed risk should be handled so that it can withstand adverse economic and demographic situations. The regulation is scheduled to come into effect by 2015, and will certainly enhance the development of risk transfer solutions for insurance-

risk generally, as well as for longevity and long term care risks in particular. It also increases the need for advanced and reliable simulation methods for longevity, mortality, long term care and savings insurance portfolios.

The LoLitA project

The LoLitA project has been selected by the *Agence Nationale pour la Recherche* in 2013. It is a 4-year project that started in December 2013. The project aims to develop models for the uncertain long term development of human longevity and methods for managing longevity-related risk in pensions and long term health care. From a mathematical point of view, this requires advances in stochastic models for population dynamics and in certain classes of semi-Markov models, development of advanced numerical methods for such models, and development of new statistical methods (online change-point detection, calibration issues in longevity and long term care models,...). The project is composed of six interconnected tasks, concerning respectively population dynamics modeling, long term care contracts, advanced simulation methods, multi-year solvency issues and joint stress tests, statistical aspects of longevity risk, and finally management of longevity risk in pensions.

The first task is devoted to stochastic models for population dynamics, which go beyond the deterministic models used in demography. Inspired by recent advances in the field of ecology, especially Individual-Based Models, we are interested in constructing and studying particle systems including specific individual characteristics, suited to the analysis of short and long-term longevity risk.

In the second task, we introduce multi-state processes with path-dependent intensities (semi-Markov and beyond) for actuarial analysis of various forms of long term care insurance. Stochastic models for longevity and long-term care are computationally demanding.

The third task is devoted to advanced simulation methods for population dynamics models of high complexity. These models are applied to actuarial products (life insurance, variable annuities, etc) with excessively long maturities, hence also simulation time. We will devise, adapt or transfer advanced sophisticated techniques (extrapolation, variance reduction, semi-closed forms, quasi-Monte Carlo) to provide a flexible and powerful simula-

tion toolbox (fast computation, rare events, local refinements, etc...).

In the fourth task, we consider average and long-term solvency issues, and develop extreme scenario generators and joint stress tests for longevity and long term care. We also study aspects of behavioral risk associated with pension and long term care insurance.

In the fifth task, we address various statistical issues that arise in the context of longevity. Our goal is to introduce new statistical procedures for various types of models for mortality, longevity, and population dynamics. These methods will partly rely on extreme value theory, change point detection techniques, estimation procedures for stochastic differential equations, and bootstrap methods.

In the last task, we revisit the traditional paradigm of life insurance, whereby non-diversifiable economic and demographic risk was shared by the insured. A solution with index-linked payments is proposed. A unified approach is taken to the with-profit scheme, encompassing all forms of bonuses, and pursuing ideas of experience-based first-order technical basis and optimal bonus schemes. An extension to inter-generational risk sharing is proposed and examined.

To sum up, we consider **in some integrated way** important sources of longevity and long-term care risks, their representation with innovative models, their estimation, the way they can be analyzed by new mathematical techniques and computed through advanced simulations and other numerical methods. The mathematical models are aimed at generality and unification, and their applications are aimed to be timely, addressing current risk management issues in longevity, long-term care, and pensions.