

# HUMAN MORTALITY DATABASE USERS CONFERENCE #2

Paris, 8<sup>th</sup> March 2019



HOUSE OF  
FINANCE DAYS  
2019

*LA FINANCE AUTREMENT*

Du 28 février au 21 mars 2019



## Welcome to the 2<sup>nd</sup> HMD Users conference

We are delighted to welcome you to the second edition of **Human Mortality Database Users Conference**, at Université Paris-Dauphine. This workshop belongs to a series of conferences and workshops during the Dauphine House of Finance Days 2019, please visit <https://housefinance.dauphine.fr/>.

The Human Mortality Database (HMD) is now the standard reference provider of mortality tables for numerous countries and regions worldwide, which serve as a basis for mortality and longevity risk assessment in most major insurance companies and pension institutions. The aim of this workshop is to gather academics and actuaries in the private sector who are using the HMD data for their research and professional needs all over the world as well as to present the HMD new developments and potential uses to a larger audience with interest into mortality and longevity risks. This workshop will include: presentation of the HMD status and future developments, case studies presentation of the use of the HMD for mortality/longevity analysis and roundtable of experts.

We hope that you will find the workshop enjoyable and stimulating.

The organizing committee

Magali Barbieri  
Christophe Dutang  
Marc Hoffmann

Alexandre Boumezoued  
Marine Habart  
Daria Ossipova-Kachakhidze

## Thanks

An event like this would not have been possible without the help of many. Our special thanks go to:

- The scientific committee: Magali Barbieri (HMD), Alexandre Boumezoued (Milliman), Christophe Dutang (CEREMADE, Dauphine), Marine Habart (AXA), Marc Hoffmann (CEREMADE, Dauphine), Stéphane Loisel (ISFA, Univ. Lyon 1), Daria Ossipova-Kachakhidze (SCOR), Razvan Ionescu (SCOR);
- The research initiative Actuariat Durable (Sustainable Actuarial) financed by Milliman under a convention with Institut Louis Bachelier, Paris and the Laboratory SAF at ISFA, Lyon;
- the team of the MIDO department of Paris-Dauphine for its administrative support.
- the team of the House of Finance of Paris-Dauphine for its administrative support and for hosting the event.

We are grateful to our sponsors: Milliman; Actuariat Durable (scientific chair); Université Paris-Dauphine.

### Sponsor & Scientific chair



### Institutional sponsors



## Abstracts

### Session 1: Human Mortality Database status (09:30 - 10:30)

#### HMD status and recent on-going developments

**Magali Barbieri** (Associate Director of HMD, Berkeley and Directrice de Recherche, INED, Paris)  
and **Dmitri Jdanov** (Head of the Laboratory for Demographic Data, Max Planck Institute for Demographic Research, Rostock)

The presentation will describe the current status and on-going developments of the Human Mortality Database (HMD) project. First published in 2002, the HMD is an open-access database with uniformly constructed series of mortality rates, period and cohort life tables, death counts, and population exposures for 40 countries and 49 populations, with data classified by age (up to age 110+) and sex. Due to transparent implementation, extensive data quality checks, uniform methods, and high quality and comparability of the data, the HMD has become a common reference for mortality research; as of December 2018, more than 50,000 users have registered to the database and over 3,500 scientific peer-reviewed articles cited the HMD as one of their main sources of information.

The HMD has also become a main resource for actuaries and about one quarter of all HMD users work for the insurance or re-insurance industry. Actuaries have used HMD data to develop relational models linking mortality in pools of clients to national-level patterns, to evaluate risk fluctuations and variations in human populations, and to develop mortality improvement models. A general presentation of the database current status will be followed by a discussion of three specific new projects, which are the addition of cause-of-death information to the HMD website, the construction of sub-national databases, and investigations into the expansion of the HMD approach to new regions of the world.

### Session 2: HMD case studies (11:00 - 12:00)

#### Using the HMD to assess longevity risk

**Andres Barajas Paz** (Actuarial Research Centre of Institute and Faculty of Actuaries (IFoA) and Department of Actuarial Mathematics & Statistics Heriot-Watt University)

Estimating the true force of mortality, is key in actuarial work. This presentation will address an overview on risk assessment. On the one hand, underestimating mortality would imply that life insurance companies have to pay the benefits sooner than expected. On the other hand, a major risk in pension plans is longevity risk, which would imply paying the benefits longer than expected. We highlight that HMD data quality is the key to giving us confidence in the risk assessment.

Mortality analyses and projections have commonly focused on countries represented in the Human Mortality Database that have good quality mortality data. This presentation will also address the challenge that in many other countries population and deaths data can be somewhat unreliable. In many countries, for example, there is significant misreporting of age in both census and deaths data: referred to as ‘age heaping’. The purpose of our research, is to develop mortality models for countries where their population data is affected by age heaping. In order to design our model for the two dimensional data, we first take into account both population and deaths by age and across calendar years. We design a log-likelihood method for the two dimensional data, based on a parametric model with smooth period effects. We use *Bayesian* Inference framework to obtain values for all of the parameters involved. Hence, we are interested in maximising the log-likelihood function and estimating the posterior of each parameter. We test the sensitivity of choosing different priors for the parameters, and we show empirical results for Mexican mortality to illustrate our approach. We obtain improved exposures and death rates by reducing age heaping across all calendar years, we also highlight that the population data with age heaping is outside the credible intervals.

Finally, we will collaborate with HMD to see how their approach can be adapted to Mexican data for producing complete life table series, which is also relevant to international reinsurance.

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#### Research and regulation: how academic work solves business problems with longevity risk

**Stephen Richards** (Managing director of Longevitas)

Modern insurance regulations, such as Solvency II and the Swiss Solvency Test, require that risks be viewed as potential catastrophes over a one-year time horizon. But how can this be done for slow-burning risks like longevity that unfold over decades? In this talk we look at some of the solutions provided by peer-reviewed academic research. We find that model risk is critical, and that there are some counter-intuitive consequences of viewing a long-term risk over a short-term horizon. We present results showing that different national datasets from the HMD produce different capital requirements for annuity liabilities.

## Roundtable: Is data the new black gold for insurers? (14:00 - 15:30)

Is data the new black gold for insurers?

Speakers:

**Marine Habart** (Group Life, Savings & Health Chief Risk Officer, AXA, Paris)

**Razvan Ionescu** (Head of Longevity R&D Centre, SCOR, Paris)

**Alexandre Boumezoued** (Head of R&D Centre, Milliman, Paris)

Chairman:

**Stéphane Loisel** (Professor, ISFA, Université Lyon 1)

The roundtable will focus on the key datasets for life insurers. Currently, national lifetables provided national statistical institute or by HMD are base recipes for life insurers to price, to underwrite and to manage their risk. Life insurers face many open questions: how far their insured population is different from the corresponding national population? which country experiences the most quick change in longevity both in Europe or worldwide? Is it valuable and relevant to use mortality tables by cause of death?

In the future, insurers may use and accumulate new type of data based on connected objects, social network, etc. . . New challenging questions will emerge in the next decade: how to measure the effect of connected objects on individuals deaths? what type, how the insurance industry can collect data to better manage risk?

## Session 3: some recent advances in mortality models (16:00 - 17:30)

Numerical aspects and challenges of mortality models: the case study of R

**Christophe Dutang** (Assistant professor, CEREMADE & Université Paris-Dauphine)

In this talk, we study fitting parametric models on lifetime data in the R statistical software. For that purpose, two packages have been tested **survival** by T. Therneau and **fitdistrplus** by M.L Delignette-Muller et al. In particular, we investigate the effect of censorship levels when computing maximum likelihood estimators for usual survival distributions such as Weibull and for more advanced distributions such as Chen. A panel of tools and graphics are proposed to assess the quality of the fit, via goodness of fits statistics, statistical distance criteria and distribution function graphics based on the Turnbull algorithm. Then we derive usual survival probabilities using **lifecontingencies** by G. Spedicato et al. as well as annuities and capitals. Thanks to the lifetable class provided by that package, we are able to build tables and graphics. Finally, a special look is given to the computation time between the two last versions of **lifecontingencies** where vectorization has been intensively used.

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Quickest change detection problem and longevity applications

**Stéphane Loisel** (Professor, ISFA, Université Lyon 1)

In this talk, we present quickest change detection problem: how to detect as quickly as possible that actuarial assumptions are not satisfied anymore due to a structural change in the mortality patterns, or due to the materialization of level risk or basis risk? We show that the so-called cusum strategy is optimal in a generalized Lorden sense, and present implementation challenges for longevity and mortality monitoring applications. This talk is based on a joint work with Nicole El Karoui and Yahia Salhi.

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A Class of Random Field Memory Models for Mortality Forecasting

**Yahia Salhi** (Assistant professor, ISFA, Université Lyon 1)

This article proposes a parsimonious alternative approach for modeling the stochastic dynamics of mortality rates. Instead of the commonly used factor-based decomposition framework, we consider modeling mortality improvements using a random field specification with a given causal structure. Such a class of models introduces dependencies among adjacent cohorts aiming at capturing, among others, the cohort effects and cross generations correlations. It also describes the conditional heteroskedasticity of mortality. The proposed model is a generalization of the now widely used AR-ARCH models for random processes. For such a class of models, we propose an estimation procedure for the parameters. Formally, we use the quasi-maximum likelihood estimator (QMLE) and show its statistical consistency and the asymptotic normality of the estimated parameters. The framework being general, we investigate and illustrate a simple variant, called the three-level memory model, in order to fully understand and assess the effectiveness of the approach for modeling mortality dynamics.

## Program

- 8:45 - 9:15** Welcome coffee
- 9:15 - 9:30** [Opening speech](#) (Christophe Dutang)
- 9:30 - 10:30** [Session 1: Human Mortality Database status](#)  
HMD status and recent on-going developments  
(Magali Barbieri, *HMD & INED*)  
(Dmitri Jdanov, *Max Planck Institute for Demographic Research*)
- 10:30 - 11:00** Coffee break
- 11:00 - 12:00** [Session 2: HMD case studies](#)
- Using the HMD to assess longevity risk  
(Andr s Barajas Paz, *IFoA and Heriot-Watt University*)
  - Research & regulation: how academic work solves business problems with longevity risk  
(Stephen Richards, *Longevitas*)
- 12:00 - 14:00** Lunch
- 14:00 - 15:30** [Roundtable: Is data the new black gold for insurers?](#)
- Marine Habart (AXA)
  - Razvan Ionescu (SCOR)
  - Alexandre Boumezoued (Milliman)
- chairman: St phane Loisel (ISFA)
- 15:30 - 16:00** Coffee break
- 16:00 - 17:30** [Session 3: some recent advances in mortality models](#)
- Numerical aspects and challenges of mortality models: the case study of R  
(Christophe Dutang, *CEREMADE*)
  - Quickest change detection problem and longevity applications  
(St phane Loisel, *ISFA*)
  - A Class of Random Field Memory Models for Mortality Forecasting  
(Yahia Salhi, *ISFA*)
- 17:30 - 17:45** [Closing speech](#) (St phane Loisel)