

Welcome to the tenth newsletter for members of the Actuarial Educators Network. These newsletters are intended to provide information that we believe will be of interest to members of the network, and through this improve the quality of actuarial education, and global access to this education. This edition presents articles on Stationary Population Models, a Modelling Tool for actuarial classes and Risk Management. It also provides important updates from the IAA's Mortality working group and Syllabus Review Task Force. The IAA Mortality Working Group welcomes your input and suggestions on their work and information presented on this newsletter. The Syllabus Review Task Force (SRTF) is working towards the goal of producing a draft education syllabus for consideration at a special meeting of the Committee that will take place in Zürich on April 8-9, 2015. The task force looks forward to stimulating debate in Zurich and encourages AEN members to participate.

Syllabus Review Task Force – Article for AEN newsletter

The Syllabus Review Task Force (SRTF) established by the Education Committee at its meeting in London last September has been holding regular conference calls and is making good progress towards its goal of producing a draft syllabus for consideration at a special meeting of the Committee in Zurich during April 2015.

The SRTF aims to develop a revised syllabus that will:

- Recognize the wider set of technical skills actuaries will need for risk management problems in a widening range of contexts. In particular, actuaries will need skills to take advantage of the explosive growth in data availability and processing capability;
- Recognize that business and personal skills like communication and strategic thinking must be recognized in the core educational requirement for an actuary;
- Ensure that there is a strong underpin of professionalism and ethical conduct for the actuary to be effective in society
- Give more guidance to full member associations (and potential full member associations) on the depth of knowledge, understanding and ability to apply the actuarial toolset to realistic problems expected of candidates to demonstrate that they meet the requirements of the syllabus.

In order to achieve all this without materially increasing the time taken to complete the core syllabus the SRTF recognizes that for all actuaries initial qualification is merely one step (albeit a highly significant one) in their career path. The core syllabus will therefore focus as much as possible on fundamental principles and widely applicable techniques to build a solid foundation for those who extend their qualification to become specialist actuaries, as well as those who choose to develop and apply their skills in other ways. A key part of this process has been the development of a competency framework allowing us to answer the question “what can an actuary do?”

Developments like these, of course, require wide consultation and discussion to ensure they meet the needs of actuaries, their clients and employers, around the world. All full member associations are encouraged to send representatives to the Zurich meeting. After Zurich there will be a period of further consultation and refinement with the aim of having a syllabus the IAA Council can adopt in the Spring of 2016. Once the new



syllabus is adopted there will be a period of around two and a half years for full member associations to make changes to bring their education system into line.

An area where many members of the AEN may have a particular interest is the evolution of the statistics part of the syllabus to reflect the developments in data science referred to above. This, of course is a matter for debate well beyond the boundaries of the actuarial profession: for example the American Statistical Association published an interesting report in November 2014 (see link below) much of which could be read as applying directly to the teaching of undergraduate actuarial science.

<http://www.amstat.org/education/curriculumguidelines.cfm>

The SRTF looks forward to stimulating debate in Zurich and hopes that many AEN members will be able to be present.

Task force members:

Chairperson	Andrew Gladwin	Actuarial Society of South Africa
Members	Steve Eadie	Society of Actuaries
	Paul King	Institute and Faculty of Actuaries
	John Shepherd	Actuaries Institute Australia
	Pat Teufel	Casualty Actuarial Society
	Marjon Tjia	Het Koninklijk Actuarieel Genootschap
	Henning Wergen	Deutsche Aktuarvereinigung e. V. (DAV)
Staff Liaison	Karla Zúñiga	IAA Secretariat

Fundamental Theorem in Stationary Population Models

Author: Arni S.R. Srinivasa Rao

Concepts on stationary and stable populations often appear in the actuarial science literature. Arni S.R. Srinivasa Rao, Georgia Regents University, Augusta and James R. Carey, University of California, Davis have come-up with a theorem on Carey's equality, which is a Fundamental Theorem in Stationary Population Models. James R Carey discovered Carey's equality in early 2000s. Among the other places, Rao and Carey's work has featured in science media coverage in the USA, see for example, Eurekalert.org operated by the AAAS (American Association for the Advancement of Science) [1], Math Digest of the AMS (American Mathematical Society) [2]. It was also listed at research highlights of the Mathematical Biosciences Institute, Ohio, USA [3]. The statement of theorem in [4] is provided below and its proof can be found in [4]. A theorem on population stability that was referred in above news reports has appeared in the prestigious publication - Notices of the American Mathematical Society [5].

Rao - Carey's Fundamental Theorem on Carey's Equality (2014): Suppose (X, Y, Z) is a triplet of column vectors, where $X = [x_1, x_2, \dots, x_k]^T$, $Y = [y_1, y_2, \dots, y_k]^T$, $Z = [z_1, z_2, \dots, z_k]^T$ representing capture ages, follow-up durations, and lengths of lives for k -subjects, respectively. Suppose, $F(Z)$, the distribution function of Z is known and follows a stationary population. Let G_1 be the graph connecting the co-ordinates of S_Y , the survival function whose domain is $N(k) = \{1, 2, \dots, k\}$ i.e. the set of first k positive integers and $S_Y(j) = y_j$ for $j = 1, 2, \dots, k$. Let G_2 be the graph connecting the co-ordinates of C_X , the function of capture ages whose domain is $N(k)$ and $C_X(j) = x_j$ for all $j = 1, 2, \dots, k$. Suppose $C_X^*(-j) = x_j$ for all $j = 1, 2, \dots, k$. Let \mathcal{H} be the



family of graphs constructed using the co-ordinates of C_X^* consisting of each of the $k!$ permutation of graphs. Then one of the members of \mathcal{H} (say, H_g) is a vertical mirror image of G_1 .

References:

- [1]. New theorem determines the age distribution of populations from fruit flies to humans, http://www.eurekalert.org/pub_releases/2014-10/mcog-ntd100614.php
- [2]. Math Digest <http://www.ams.org/news/math-in-the-media/mathdigest-index>
- [3]. Mathematical Biosciences Institute <http://mbi.osu.edu/resources/success-stories/>
- [4]. Arni S.R. Srinivasa Rao and James R. Carey. Generalized Carey's Equality and A theorem on Stationary Population Models, *Journal of Mathematical Biology*, DOI: [10.1007/s00285-014-0831-6](https://doi.org/10.1007/s00285-014-0831-6)
- [5]. Arni S.R. Srinivasa Rao (2014). Population Stability and Momentum, *Notices of the American Mathematical Society*, 61, 9: 1062-1165.

Introducing a Free Modeling Tool to your Actuarial Classes

Author: Yvonne Chueh

I had this open-access software project idea for actuaries and students who work with or are learning about stochastic models after acquiring some basic fundamentals of probability theories and applications. In 2005, we launched our free software AMOOF, a plugin MS Excel utility tool that calls for Excel Solver and uses the Excel spreadsheets to show transparent process of fitting data sets to a long list of single and mixed probability density functions using the maximum likelihood estimation and the method of moment methods. The challenging tail measures CTEs (Conditional Tail Expectations) of the data set along with its best fitted model were computed in Excel that added to thousands lines of VBA programming codes. This tool was published on the signature magazine *Contingencies* of the American Academy of Actuaries [Chueh 2005], and then in 2011 (6 years later) it was extensively tested and applied by insurance companies that participated in "Model Efficiency Study", sponsored by *Financial Reporting Section, Product Development Section, Committee on Life Insurance Research, the Society of Actuaries* [2011 Rosser].

Although the VBA codes were modified and updated during the studies to conform to the current features of Excel edition, the tool was prone to more new bugs resulting from the future new release with modified library/function names from Microsoft Excel. Thus, I received a small grant support from the Actuarial Foundation to develop AMOOF 2 with a goal to expand the functionalities not affected by Excel Solver and its library. It was a big task to search for good optimization algorithms/libraries that provide open access to users and remain free of charge. The project team though it would be promising to use Microsoft Solver Foundation as it provides a free solver for professional software developers. This sounded like great news, but after months of research, the Solver Foundation approach failed. The Solver Foundation has difficulty in communicating with open-access libraries as the Solver Foundation was not equipped to program the solver to optimize the likelihood functions made of special math functions such as gamma and beta functions in open-access math libraries. Taking a sharp turn to meet the project deadline, the software team turned to the Excel Solver but built a state-of-art graphical user interface independent of Excel. The ability and flexibility to command Excel Solver and fully control the optimization convergence was so limited that compromised the quality of AMOOF2. Besides, it was not possible or easy to find the most proper initial values of the unknown parameters so that a convergent solution could be reached. Very often, the initial values were too far from the solution (to be found by iterations), thus not only the iterations diverged, but the numerical overflow (given

limited precision supported by the library) errors occurred from time to time and especially more often when the data size is large. It became difficult to identify the problems and issues resulting from the computer precision errors.

The good news I would like to share here is: Thanks to our new master program in Computational Science on campus, with some coordination and joint-advising with Computer Science faculty, AMOOF3 launched an innovative version via a master project. It overcomes numerous challenges and finally presents a high-quality user-interactive software to be used by students, professors, and actuaries. To learn more details about the functionalities of AMOOF3, the first paper will be available on the 2015 ARCH of the SOA, and the second article may appear on the upcoming Contingencies magazine, our next paper will be submitted to Variance of the CAS to hopefully inspire more data analytics and probability model discovery by using this convenient tool to save a great deal of time.

To take the advantage of this free software, visit <https://bitbucket.org/AMOOF3/amoof-3.0/wiki/Home> . The program can be downloaded from the Downloads tab. Quality issues may be submitted under the **Issues** tab for future improvement. In fact, all the actuarial seniors in my loss models class had the opportunity to test and use AMOOF3 and were able to report the best models they found for their real-world data to support their research project goals. If you would like to engage your students in probability or loss models class, this is a great tool for teaching, learning, and research.

Central Washington University, Professor of Actuarial Science, Statistics, and Mathematics. Ph.D., ASA, Email: chueh@cwu.edu

- [1] Chueh, Yvonne C., “Efficient Stochastic Modeling: Scenario Sampling Enhanced by Parametric Model Outcome Fitting”, Contingencies, the major publication of American Academy of Actuaries, 2005.
- [2] Chueh, Yvonne C. and Curtis, Dan, “Optimal PDF (Probability Density Function) Models for Stochastic Model Outcomes: Parametric Model Fitting on Tail Distributions”, 1-17, New Ideas in Symbolic Computation: Proceedings of the 6th International Mathematica Symposium, 2004
- [3] Bruce B. Rosner, FSA, MAAA, Ernst & Young LLP, 2011. “Model Efficiency Study Results”, *Financial Reporting Section, Product Development Section, Committee on Life Insurance Research, the Society of Actuaries.*

WHAT THE STANDARD ISO 31000, RISK MANAGEMENT, COULD HAVE DONE FOR MÉXICO...

Author: Act. María Fernanda Jiménez Méndez.

México’s territory is split by States and Municipalities, one of the larger States is Sonora, a Northern and border State. That’s the place where Cananea Municipality is located: 30° 59’ N latitude and -110° 18’ W longitude.



On 7 August, around 40,000 cubic meters of copper sulfate and heavy metals originated from “Buena Vista” copper mine, a subsidiary of Grupo Mexico located in Cananea, was poured into the rivers Sonora and Bacanuchi. The chemical, which is used to dissolve copper from ore, turned a 60km (40-mile) stretch of the Sonora River orange, causing the authorities to shut down the municipal water supply to 20,000 people in seven towns.

Local officials accused the company of trying to conceal the accident and of lax supervision. On September 22nd, Carlos Arias, director of Sonora's Civil Protection agency issued a new alert of a toxic spill in the Sonora River basin from a copper mine operated by Grupo Mexico.



Grupo Mexico, which has been accused of lying about clean-up and containment measures and of lax supervision at its \$1-billion-a-year Buenavista mine, blamed the new spill on heavy rains caused by Hurricane Odile, 10th to 19th of September. The company, that created a \$147 million fund to help mitigate damages from the previous spill and denied any wrongdoing, was fined \$3 million by the government.

This case can be analyzed reactively from the point of view of International Standard published in 2009 ISO 31000.

First of all I, as a Risk Manager expert, will evaluate the external and internal context of Grupo México. In the external context I will remark political, regulatory, natural environment and international whether national, regional or local context. Also I'll focus on relationships with, and perceptions and values of, external stakeholders.

The broken political regulatory for this event were: Federal Water law and Environmental responsibility; Grupo Mexico was fined with 3 tickets for these cause: \$3,000,000, \$1,500,000 and \$40,000,000 and it wasn't enough for repair the damages.

By August 23, Grupo México (that some years ago absorbed the Southern Peru Copper Corporation) had lost almost two billion dollars of its capitalization in the Mexican stock market. The shares had fallen 7.25% anticipating a fine of 40 million dollars and, more importantly, civil and perhaps also criminal cases launched by federal authorities or by local actors. The main shareholder and CEO of Grupo Mexico is Germán Larrea, a powerful figure in Mexico.



On the other side, my evaluation of the organization internal context as a Risk Manager expert will include governance, roles and accountabilities, policies, decision making processes, models adopted by the organization and contractual relationships.

Grupo Mexico is defending in the Mexican press its dubious reputation, arguing that its operation has been clean, producing almost 200 000 tons of copper per year in Buenavista del Cobre (part of the Cananea complex) and employing 9000 people. They say they are ready to compensate for economic losses from the spill. Also, there is a long and bitter fight in this historical mining area of Mexico between Grupo Mexico and the mining unions. On August 20th, 800 members of section 65 of the National Union of Mining and Metal Workers from Cananea blocked access to the Buenavista del Cobre mine. Tolano Lizárraga, its representative, stated that this last toxic spill made the extent of the company's persistent lies clear (La Jornada, 21 August 2014). Since 2009, the Union had alerted Profepa (the Procuraduría Federal de Protección al Ambiente, the federal agency for the protection of the environment) of the risks and realities of many spills from the company's tailings dams to the river Bacanuchi and then into the river Sonora.

Profepa had by August 21st announced that it would start a criminal case. There is talk in Mexico of "industrial ecocide". There are people already affected by contact with the contaminated river water. Domestic animals (thousands of heads of cattle) have been in contact with the water and many others were moved away. All schools along a stretch of the river of 250 km were closed because of the polluted water.

The political context in Mexico doesn't give much hope regarding the course of a criminal court case launched by Profepa against those responsible in Grupo Mexico for this recent spill. Nevertheless, articles 414 to 420 of the Mexican Criminal Code clearly typify cases such as this large toxic spill as crimes against the environment, with penalties of between one to nine years in prison.

I would like to thank Francisco Rosales Luna, Information Manager of a Mexican media, for providing official information about this case.

Mortality Working Group Update #4 — London, England, 2014

The Mortality Working Group (MWG) meets twice a year as part of a 5 day period of meetings of the IAA committees and working groups. The second meeting of 2014 took place in London, England in September 2014 and this summarizes the discussions.

The MWG exists to study mortality and monitor studies completed by other organizations worldwide, to make this information available to actuaries and others worldwide, and to contribute to and organize other opportunities for communication where appropriate.

A few of the topics in this meeting were:

- Country reports from Japan, Netherlands, UK and USA. These reports summarize recent mortality related activities in the various countries.
 - Japan has adopted a new table, the 2007 Standard Mortality Table.
 - A presentation was provided on the mortality projection method used in the Netherlands. This is an example of what can be done in a country with a relatively small population.



- For the UK, a written report was presented. Topics included: mortality by cause of death, including the prominence of Dementia and Alzheimer's, longevity inequalities by socio-economic status, and different views on longevity improvements. It was noted that the Continuous Mortality Investigation (CMI) released several papers, including updates on Mortality Projections version 1.5, Critical Illness (CI) results based on data from 2007-2010, individual life income protection experience by cause of sickness based on data from 1991-2009 and an experience study of self-administered pension scheme mortality.
- Two new U.S. mortality tables have been released for comment. For the uninsured private retirement market, the RP-2014 Mortality Tables and the accompanying MP-2014 mortality improvement scale. For the individual life market, the 2014 VBT table has been exposed for comment. In addition, an experience study of individual payout annuities was published. The results of a survey providing insights into the nature of underlying select mortality assumptions has been published. Issue 1 of 2014 of the North American Actuarial Journal (published by SOA) provides a number of articles focusing on Longevity Risk and Capital Markets.
- Two presentations were given to the MWG, one on "Projecting Mortality by Cause of Death" by Peter Banthorpe, Chair of the UK Mortality Research Steering Committee. The second was on "Mortality Improvement work by CMI" currently underway by Tim Gordon, chair of CMI. Tim was keen to encourage sharing of knowledge and data internationally, which will enable better projections all round. The MWG agreed to support this, and MWG chair Paul Lewis will put together an issues document.
- A presentation on recent Finnish mortality research
- A study on a comparison of mortality cohorts in a 36 countries
- Al Klein mentioned the Society of Actuaries initiative to create a longevity strategy taskforce. Its goal is to educate actuaries and the public about the implications of longevity. They are also looking for potential partnerships.
- The group discussed how it can develop on its aim to make the Group's **Information Base** (www.actuaries.org/mortalityinfo) more accessible and more useful to actuaries and others interested in mortality and longevity, worldwide. The initiative to circulate the Mortality Update to actuarial associations in five languages had proved successful, and volunteers were forthcoming to increase the number of languages for the London (this) update.
- Dov Raphael gave a presentation on his work on an International comparison of the cohort effect on mortality projections and its parameterization

This is a summary of the MWG's discussions in London. The full minutes, presentations and papers from this meeting (and previous meetings) are available (without the need to register) at: www.actuaries.org/mortalityupdates

While translations are not yet ready, we hope to issue this Update in English, French, German, Italian, Japanese, Mandarin, Portuguese and Spanish.

Your response and suggestions

The IAA Mortality Working Group welcomes your input and suggestions on our work. Please address any comments to the Mortality Working Group at iaamwg@actuaries.org



Actuarial Teachers and Researchers Conference 2014

The UK Actuarial Teachers and Researchers Conference was hosted by the School of Mathematics at the University of Edinburgh in December. The programme, put together by Dr Sotirios Sabanis and Dr David Siska, took as its overarching theme *Bridging the Gap between Academia and Industry* and the organizers should be congratulated for their engineering skills because they constructed a very effective bridge. There was an excellent mix of speakers (see the conference web page for details: <http://www.maths.ed.ac.uk/events/conferences/atrc2014>) and the level of discussion clearly showed the topics presented were of both academic and practical interest.

The emphasis was on risk models and one of the most interesting aspects was the application of mathematical and statistical techniques on an industrial scale. Actuaries need a solid grasp of the basics but they also need to understand the computational techniques needed to deal with large amounts of data and high-dimensional models. And, of course, they need to understand, manage, and communicate the risks of such models. The commercial part of the profession will need to work closely with the academic part to achieve this, not only in developing modelling techniques but also in educating actuaries, pre and post qualification, in the skills required. ATRC 2014 was a valuable step in this process.

Future Meetings of Actuarial Educators

Country	Event	Dates	Host
Canada	Actuarial Research Conference (ARC)	5-8 August, 2015	University of Toronto www.arc2015.utstat.toronto.edu

Recent Publications



Bayesian Simulation for Collective Risk Models in insurance. Application to a Health case

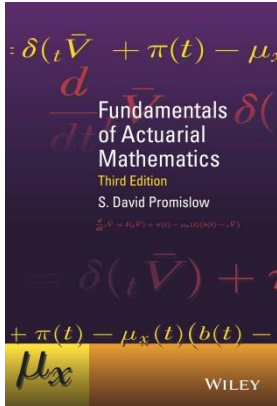
Author: Evaristo Diz

Publisher: Publicia

Date: 2014

Description: This textbook is a very basic introduction to the essentials of Bayesian Simulation Analysis for students with little background in statistics. We analyzed a Health insurance case in Depth using R and Winbugs software. The basic idea is to provide the fundamentals of Bayesian statistics in the insurance field. The approach adopted here is very pragmatic and straight in the solutions to specific problems. It could be used in one semester course in actuarial science or statistics

Available in Spanish only

**Fundamentals of Actuarial Mathematics** Third Edition**Authors:** S. David Promislov**Publisher:** John Wiley & Sons**Date:** 2014**Description:** *Fundamentals of Actuarial Mathematics* provides a comprehensive coverage of both the deterministic and stochastic models of life contingencies, risk theory, credibility theory, multi-state models and an introduction to modern mathematical finance.*Fundamentals of Actuarial Mathematics* is the ideal text for students planning for a professional career as actuaries, providing a solid preparation for the modelling examinations of major actuarial associations. It also serves as a highly suitable reference for those wanting a sound introduction to the subject, and for those working in insurance, annuities and pensions.

Final Comments

Remember that we have now further developed the membership directory to allow search functionality; you can now search for all educators in a particular country, university, teaching area or other specialisation. You can find this at http://www.actuaries.org/AEN/Directory_Login.cfm and access it with the username and password issued in the e-mail accompanying this newsletter.

If you don't see your own name in the directory, this means you haven't entered your details on our website. Please then take the opportunity to enter your details; this can be done at <http://www.actuaries.org/AEN/Membership.cfm>.

If you know of any educators, or people interested in actuarial education, who would be interested in the network, please encourage them to join by filling out this online form (<http://www.actuaries.org/AEN/Membership.cfm>)

Finally, you are receiving this newsletter because you are currently on our e-mail distribution list. We would very much like you to remain part of the network, but if you do want to opt out, or are receiving this e-mail in error, please inform Karla Zúñiga (karla.zuniga@actuaries.org) who will remove you from the distribution list.

Please note that we welcome any education news article, information on future education conferences or publications on actuarial science. Should you have any such information, please do not hesitate to forward it to Karla Zuniga (karla.zuniga@actuaries.org) for consideration on future newsletters. We are looking forward to receiving your material.