Data Science in the Actuarial Syllabuses

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INTRODUCTION

The actuarial world is changing. This happens with different pace, depending on the region you are looking at. In countries, where actuaries have been traditionally very strong in the area of pensions, you can sense significant shifts. In the UK or the Dutch market for example, actuaries are moving out of the pensions field as there are just less (consulting) jobs for them to acquire. In Germany for example, due to the introduction of Solvency II and its very special insurance market with a lot of small and medium sized independent companies, traditional actuarial roles are still very important and with a high demand from employers.

SENSING FUTURE DEMAND WITH THE RIGHT EDUCATION

Throughout the World and especially in Europe there are many different ways to qualify as an actuary. The international umbrella organizations IAA (International Actuarial Association – worldwide) and AAE (Actuarial Association of Europe – European level) define standards on actuarial education for their members. Especially for Europe – due to the Mutual Recognition Agreement – this has a special importance. Both syllabuses (AEE and IAA) are reviewed and revised on a regular basis. One goal of an actuarial syllabus is to prepare students for the future demand in their knowledge and skills coming from employers, consumers and regulation.

The formal regulations regarding the syllabuses are as follows:

"The Full Member [of the IAA] shall require all of its actuaries who are recognized as having attained fully qualified actuarial status on or after January 1, 2006 to successfully complete an education programme compliant with the Education Guidelines and the Education Syllabus, as adopted by Council from time to time (IAA Internal Regulations, Jan. 2016)."

"Actuarial associations applying for Full membership [in the AAE] must have a Code of Conduct [...], and comply with minimum education standards as set out in the AAE's Core Syllabus for Actuarial Training in Europe of December 1998, as may be amended from time to time (AAE Statutes, Jan. 2014)."

The current discussion on actuarial syllabuses started in the IAA Education Committee. In 2013 the committee agreed to form a task force to look at the core competencies of a future actuary in a changing global environment. The task force came to the conclusion, that while the basic technical toolkit of the actuary is still very useful and forms the core of the profession, this needs to adapt to certain changes such as the "big data revolution". The report "Educating Future Actuaries" was passed by the Education Committee in September 2014 and a new Task Force was set up to formulate a new basic Education Syllabus in the light of the recommendations coming from the report.

After an intensive discussion within the task force and also with representatives from almost all actuarial associations around the world, the new IAA Education Syllabus was passed by the Education Committee in the beginning of 2016.

The syllabus includes the following main topics for actuarial education: Statistics, Economics, Finance, Financial Systems, Assets, Data and Systems, Actuarial Models, Actuarial Risk Management, Personal and Actuarial Professional Practice. Minimum foundamental mathematical knowledge is added to the syllabus in an appendix.

It needs mentioning, that in spring 2017 the governance of this new syllabus is still a matter of discussion.

THE NEW IAA EDUCATION SYLLABUS

The Education Syllabus sets out the minimum requirements for a Fully Qualified Actuary in accordance with the IAA regulations. The intention of the IAA Education Syllabus is to prepare actuaries to operate in a wide variety of professional environments, including insurance companies, health organizations,

pension plans, risk management, government, regulatory regimes and other fields. The syllabus focuses on models and techniques that can be applied across a number of practice areas. It does not include a specialization that might be necessary in certain countries or regions. Especially the Education Syllabus of the AAE includes a specialization to become an actuary in Europe.

The IAA Education Syllabus sets out the depth of knowledge and application required using a model with Learning Objectives (in accordance with the so-called Blooms' Taxonomy).

DATA SCIENCE IN THE NEW IAA EDUCATION SYLLABUS

At least three modules from the new syllabus share a link with the whole area of data science: Statistics, Data and Systems, Actuarial Models. Breadth and depths in these learning fields ranging from A1 (remember facts: Describe common data structures and data storage systems) to C6 (create a process: Create appropriate data visualizations to communicate the key conclusions of an analysis) with regard to their classification according Blooms' Taxonomy.

The module Data and Systems has the following aim: To enable students to apply methods from statistics and computer science to real-world data sets in order to answer business and other questions, in particular with application to questions in long and short term insurance, social security, retirement benefits, healthcare and investment.

To achieve this, the following learning areas are covered:

- ■ Data as a resource for problem solving
  - Aims of a data analysis (descriptive, inferential, predictive)
  - Stages of conducting a data analysis to solve real-world problems
  - Sources of data (including extremely large data sets)
  - Data structures and data storage systems
  - Measures of data quality
  - Tools for cleaning, restructuring and transforming data

- ■ Data analysis
  - Exploratory data analysis; using tools to summarize and visualize
  - Principal Component Analysis
  - Fit a statistical distribution to a data set by using a computer package

At least three modules from the new syllabus share a link with the whole area of data science: Statistics, Data and Systems and Actuarial Models

- Fit a single or multiple linear regression model to a data set and interpret the output by using a computer package
- Fit a survival model to a data set by using a computer package
- Fit a generalized linear model to a data set by using a computer package

- ■ Statistical Learning
  - Statistical Learning and Machine Learning and the difference between supervised learning and unsupervised learning
  - Appropriateness of machine learning (discrete and continuous)
  - Use a computer package to apply neural networks and decision trees techniques in simple examples

- ■ Professional and risk management issues
  - Ethical and regulatory issues involved in working with personal data
  - Risks associated with use of data

- ■ Visualizing data and reporting
  - Appropriate data visualizations to communicate the results
  - Value of reproductive research

Many learning objectives are common practice for actuaries. Some are linked to the Code of Conduct, to a professional behavior of an actuary or to ISAP 1. Other parts – especially Statistical Learning – is new to actuarial syllabuses; but well known and established in mathematical statistics. Completely new is also the need to use computer packages (such as R) as a requirement to fulfill the syllabus.

HOW CAN IT BE PRESENTED? HOW CAN IT BE TESTED? – SHOWN BY THE CASE OF THE GERMAN ASSOCIATION OF ACTUARIES (DAV)

DAV (German Association of Actuaries) is the professional representation of all actuaries in Germany. It was founded in 1993 and has about 5,000 members
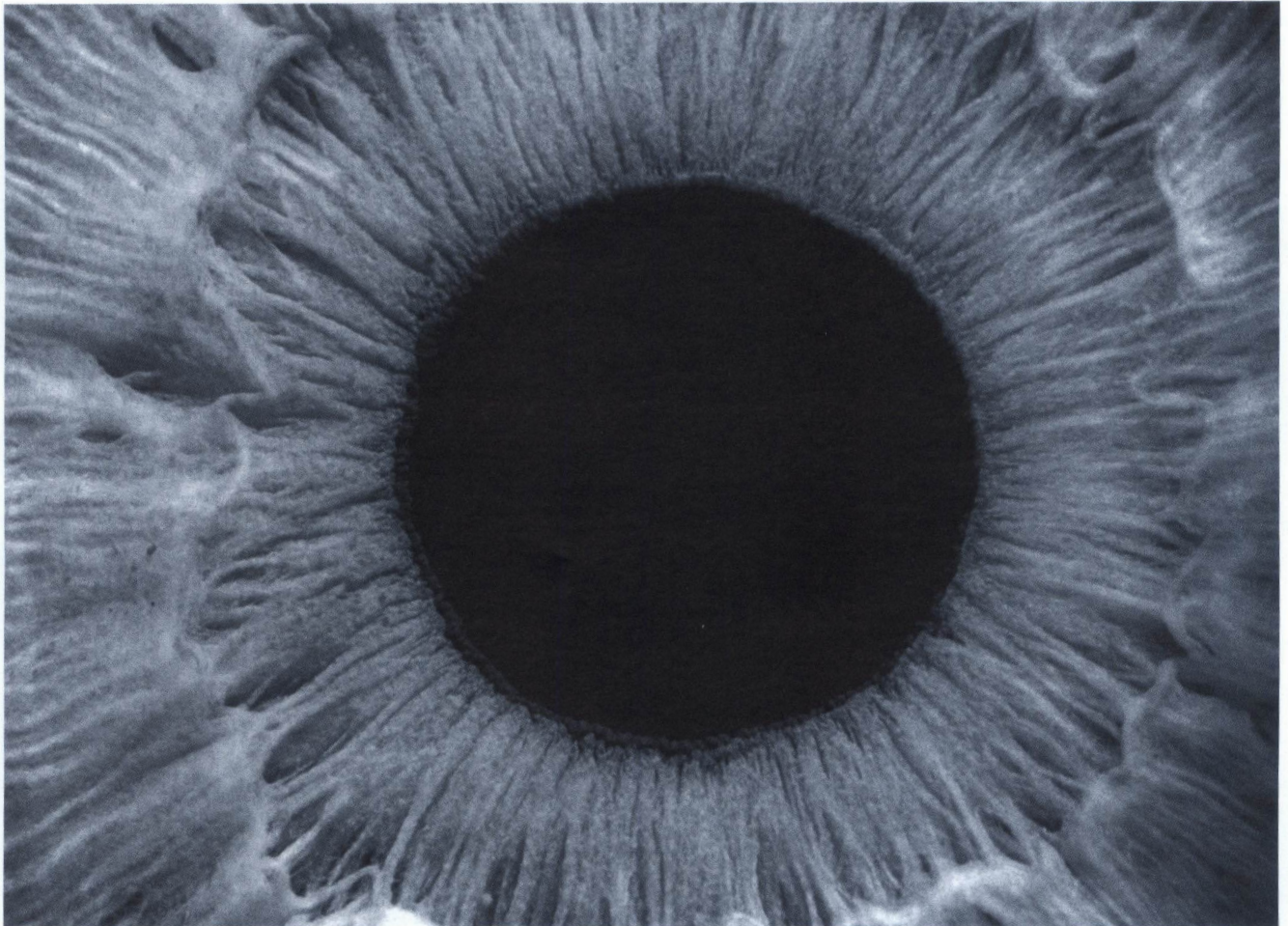
today. Another 1,400 candidates for membership are actively enrolled in the education and examination program. The actuarial qualification in Germany can only be gained through a qualification with the DAV while working full-time after receiving a university degree beforehand.

DAV will introduce a new education and examination system starting 2018. It will include eight modules in the so-called basic knowledge, which will cover the new IAA Education Syllabus, and four further modules in the specialist knowledge.

The course applied stochastics in basic knowledge includes the topics stochastic processes (Markov, Poisson, Brownian motion), descriptive statistics (incl. Machine Learning), inferential statistics, survival models, credibility theory, dependencies and copulas, Time-Series-Analysis and Monte-Carlo-Simulation.

The German Actuarial Academy offers seminars for all necessary courses in basic knowledge and specialist knowledge to prepare candidates for the exams taken by DAV. Applied stochastics will have a three-day seminar. Participants receive detailed material covering all of the content. The seminar will include hands-on (group) exercises for small case-studies / examples (mainly using R) and participants are encouraged to bring their own laptops.

Examination on all courses on the route to become member are taken by DAV in written form with a duration of 180 minutes. Candidates will not use computer packages in the exam, but examination will include source code material with questions on the choice of parameters and their limitations, the output and its interpretation as well as possible mistakes in the source code.

NEW SPECIALIST KNOWLEDGE: ACTUARIAL DATA SCIENCE

With the new education requirements DAV will install a new specialist knowledge ADS. This course will consists of two separate modules (basic and advanced) will four days of training each.

DAV is looking forward to discuss future possibilities to cooperate on an additional credential for actuaries in the field of ADS.