

Summary of the survey on AI/DS

The workstream „Artificial Intelligence (AI) and Data Science (DS)“ of the TF Roles of Actuaries is working on drafting a data strategy for the Board of the AAE, and creating a position paper about the consequences of developments in AI and Data Science on the Actuarial profession.

Member Associations were asked to consider a set of questions. We received 16 answers (Belgium, Czech Republic, Croatia, Denmark, Germany, Hungary, Ireland, the Netherlands, Portugal, Romania, Spain, Sweden and Switzerland), where the numbers do not add up without the realisation that there were two answers from Croatia, Denmark and Portugal each.

DEFINITIONS

Artificial Intelligence (AI)

Artificial intelligence refers to the attempt to reproduce human-like decision-making structures by machine (high-tech systems and software that can function increasingly independently of humans and can execute tasks that would require intelligence when carried out by humans). Closely related concepts are:

- **Data Analytics** is the extraction of (new) information from data - often referred to as **data mining** with phases of **data acquisition, data preparation, modelling, data analytics, model validation, evaluation,**
- **Actuarial Data Science** consists of the **collection, recording, processing and evaluation of insurance-specific data** under an actuarial question,
- **Machine Learning** where based on a learning procedure, a model is trained instead using the input data,
- **Statistical Learning** where the focus is on interpretation, while the task in machine learning is prediction.

Data Science (DS)

Data Science means the science that deals with data in general. This includes the entire process of handling data, beginning with the collection and recording of data, the preparation and storage, the processing and evaluation up to data mining. When collecting and processing data, technical questions of data management are just as relevant as the principles of data protection regulations. Data Science combines experience and skills in the programming of software tools, and knowledge of mathematics, statistics, and actuarial science to extract insights from data.

There are commonalities between AI and DS

13 out of 16 respondents see commonalities while 3 respondents think the concepts are totally different.

The development of AI/DS has consequences for the Actuarial Profession on a scale 1 to 10,

The average of the answers was 8,25 (Standard deviation 1,44), with answers between 5 and 10. In the more sceptical end of the spectrum was it was noted that ‘DS/AI will change the way we do the work, and the scope of it, but it will not fundamentally alter the nature of the work (at least not within the next 10 years)’

Positive consequences of AI/DS to the Actuarial Profession

AI/DS brings to actuaries

- better modelling tools and other elements of the actuarial toolkit, with more predictive power and improved statistical performance,
- improved actuarial practice in domains such as pricing, reserving, uncertainty calculation, internal modelling, back-testing, fraud and cyber risk, risk prevention, identification of emerging risks, etc.,
- involvement of the actuary in the development of innovative services,
- new people with new skills to the profession, cross-fertilising actuarial competencies,

In the area of professional opportunities, AI/DS offers

- an opportunity to provide a better service to their industry, employers, customers and society in general (e.g., customization of the insurance and financial offer),
- demand for people with a solid background in mathematics, probability, and programming but requirements also for persons with a view and understanding of risk management and actuarial practice,
- expansion of the scope of work actuaries can do and the opportunity for a closer connect with industries other than financial: medical, engineering, meteorological, etc., placing the profession in a privileged position to lead a disruptive change in society (e.g., insurance as a component of the Internet of Things, IoT).

Negative consequences of AI/DS to the Actuarial Profession

Negative consequences for actuaries

- overreliance on automated systems,
 - o lack of control over the 'black box' models (Danger of statistical bias, unwanted differentiation/discrimination, less expert judgement, overfitting, et.),
 - o lack of control over the data (filtered/manipulated/biased by third parties).
- The excess of personalization of the offer can carry out the demutualization of the risk (balance between equity and risk mutualization).

In the area of professional opportunities, negative consequences are:

- automatization of actuarial work leading to job destruction, danger of actuaries being reduced into programmers of DS/AI algorithms,
- need for continuous learning, danger if actuaries' skills do not match the requirements of novel tools,
- inappropriate competition between actuaries and data scientists in case actuaries cannot constructively embrace data science (or if actuaries are burdened with ill-designed standards etc.)

In what areas of AI/DS should Actuaries be active? Why, or why not?

- Actuaries must be open to new techniques and new technologies in general, and actuaries must be active in all new areas where new insights can be earned in relation to insurance and risk management - Setting boundaries to the scope of actuaries' involvement in DS/AI would limit the potential for actuaries to become recognised experts in the field.
- At the very least actuaries should understand novel models and techniques very well, together with their limitations, say, in independence assumptions, proportional hazards, stationarity of the process.
- Actuaries should considerably extend their role in all the areas of model development: a) Data measurement and gathering b) Data quality c) Data visualization. d) Pre-processing of data. e) Parameter selection f) Training of the model g) Interpretation of model results.

- Actuarial practice should make the best use of AI and DS techniques, especially in their application to personal contracts in the following aspects: pricing, product design, reserves and risk and capital management.
- The actuary must specialize and add value in the connected insurance that is already beginning to settle in branches such as cars, life, health and home insurances - the insurance premium will be calculated in real time, based on the client's decisions and habits.
- Actuaries should aid in transfer from the current concept of an insurance company that reacts to losses, to a new concept where the insurance industry prevents these losses.
- Actuaries should be active for the appropriate and responsible use of machine learning in the insurance industry.

Expectations towards the AAE

- the AAE should ensure that the actuarial profession knows how to adapt to this new reality and that we all understand that it is not a threat but an opportunity for the profession.
- The AAE must take care of all the ethical questions that surround a technological breakthrough as disruptive as this, in such a way that it is the people control the machines and not vice versa.
- Defend the profession:
 - o **Advocate** with all stakeholders why actuaries are well placed/needed to handle data science topics.
 - o **Inform:**
 - Highlight the critical items of interest brought by DS/AI techniques in actuarial duties.
 - Give guidance in terms of the reasonable application of DS/AI models.
 - Create awareness on the adequate governance that should be in place before using AI.
 - Share best practices in applying DS/AI within an insurance context.
 - Define training material, courses, events.
 - Keep actuaries updated in terms of the DS/AI models.
 - o **Lobby:** Active involvement in the regulatory and legal decision process (European and National) around the use of AI in the financial sector.
 - o **Connect:** Strengthen collaboration between member associations: communication hub between the different members.
- The AAE is uniquely placed to coordinate joint efforts to meet previous challenges via CPD, common practicing, ethical and professionalism standards, etc
- Some scepticism also: inclusive but remain focused on the core of the actuarial profession

What kind of an organisational structure does your association have in place to deal with AI/DS?

Many, and especially the larger, associations have a dedicated body within the association to handle AI/DS related issues.

Other suggestions to the future work of the AAE

- Coordination with other industries.
- Organise an event where actuaries involved in DS&AI can meet and exchange.
- Expand the definition/ role of the Actuary.
- Develop a discussion paper that FMAs can review and opine.
- Having a common insurance data science qualification across the EU would be very practical and contribute towards best practice, high standards, etc.

COLLECTION OF RAW DATA TO THE SURVEY

1. Definitions

1.1 Do you have definitions for AI and DS (or other concepts closely related to these) in your association?

1.1.1 AI

- The term artificial intelligence refers to the attempt to reproduce human-like decision-making structures by machine (usually using software). Furthermore, we also defined the following words that are closely related to these: **Data Analytics** is the extraction of (new) information from data under a specific question. This is **often referred to as data mining**. However, by data mining we mean the entire process as defined in the relevant data mining process models. Data mining thus includes in particular the phases: **Data acquisition, data preparation, modelling, data analytics, model validation, evaluation**. Since the specific questions we are confronted with are always of an actuarial nature or more generally concern the principle of insurance, we refer to them as **Actuarial Data Science (ADS)**. By Actuarial Data Science we understand the **collection, recording, processing and evaluation of insurance-specific data** under an actuarial question. **Machine Learning (ML)**: The evaluation or analysis of the data (data analytics) is usually carried out by machine learning methods. ML is in contrast to classical programming, where a (previously known and programmed) algorithm for data input is processed. With ML no algorithm is known in advance (and usually not afterwards). Based on a learning procedure, a model is trained instead using the input data. One also says that the model learns from the data. If the learning process was successful, the trained model can be applied to new data (supervised learning) or the model provides intrinsic patterns in the data and thus new information about the data (unsupervised learning). **Statistical Learning (SL)**: While the central task in monitored machine learning is prediction, the **focus in statistical learning is on interpretation**. Furthermore, the **consideration of random errors and the quantification of uncertainty is a central instrument in statistical learning procedures**. Uncertainty in this context means both model non-uniformity and "simple" random fluctuations. A sharp delineation of areas is not possible because the transition between areas is almost fluid. Therefore, machine learning is often generally referred to as machine learning, even when statistical methods are used. (DE)
- **Artificial Intelligence (AI) is high-tech systems and software that can function increasingly independently of humans and can execute tasks that would require intelligence when carried out by humans**: on insurance sector we can point out the use of algorithms and statistical, mathematical and actuarial models. With these issues, actuaries can perform specific tasks without the need for explicit instructions, since AI is based on patterns and inference. (ES)

1.1.2 DS

- **By data science we mean the science that deals with data in general**. This includes the entire process of handling data, beginning with the collection and recording of data, the preparation and storage, the processing and evaluation up to data mining. When collecting and processing data, technical questions of data management are just as relevant as the principles of data protection regulations. (DE)
- **Data Science (DS) combines experience and skills in the programming of software tools, and knowledge of mathematics, statistics, and actuarial science to extract insights from data**. This information can be translated by actuaries into tangible and measurable value, such as market intelligence, risk assessment and support for management and executive decisions (ES)

- As defined in Wikipedia, **data science "employs techniques and theories drawn from [...] mathematics, statistics [...] and computer science"/information technology, including signal processing, and uses probability modelling, machine learning, statistical learning, computer programming, data technology, pattern recognition, prediction, uncertainty modelling and data warehousing.** (CH)

1.2 Do you think AI and DS are totally different topics or do you see commonalities between them?

- 13 answers seeing commonalities.
- 3 answers seeing them as totally different topics.
- interestingly, both for Croatia and Portugal one answer sees commonalities and the other sees these as totally different topics.

2. Do you think, on a scale 1 to 10, the development of AI/DS has consequences for the Actuarial Profession (with 10 meaning fundamental consequences)?

- 1 answer 5
- 4 answers 7
- 4 answers 8
- 3 answers 9
- 4 answers 10
- Croatia gave 8 and 10, take the average of these, i.e. 9
- Denmark gave 5 and 9, take the average of these, i.e. 7
- Portugal gave 7 and 8, take the average of these, i.e. 7,5
- **the average answer therefore 8,2**
- with the **Danish 5** the motivation: DS/AI introduces new methods which do have consequences for the actuarial profession, just like the introduction of Generalized Linear Models 30 years ago changed the way tariffs were created. **DS/AI will change the way we do the work, and the scope of it, but it will not fundamentally alter the nature of the work (at least not within the next 10 years).** The changes are biggest for Casualty, and smallest for Life.

3. What are the positive and negative consequences of AI/DS to the Actuarial Profession?

3.1 Positive

- **Strengthen the position of the actuary in the company (BE):**
 - o **Actuaries will be equipped with models, which have more predictive power and improved statistical performance.** Together with more data being available in more domains, this will lead to better definition of homogeneous risk groups, better understanding of risks in various domains of the profession, ultimately leading to improved profitability for the employer and strengthening the value of the actuary within the company.
 - o **More data will lead to increasing impact of actuarial practice** in domains such as pricing, reserving, uncertainty calculation, internal modelling, back-testing, fraud and cyber risk, identification of emerging risks, ...
 - o **DS/AI** will demand people with a solid background in mathematics, probability, and programming but **requires also persons with a view and understanding of risk management and actuarial practice** in a business context. The actuary will have to understand and be able to connect both sides.
 - o **Broaden actuarial competences beyond financial problems:** The actuary will have the opportunity to closer connect with industries other than financial: medical, engineering, meteorological, environmentalists...

- Embed actuarial profession in innovation: **Involvement of the actuary in the development of innovative services.**
- Attracts new people to the profession; encourages actuaries to seek new tools and techniques. (CZ)
- more efficient use of large quantity of data/faster analysis of large amounts of data (HR)
- New opportunities to explore and improve on, if actuaries are prepared to embrace new techniques/Better statistical methods, more exciting models, more domains where actuaries can be useful. (DK)
- new tools for actuarial use; higher efficiency in data evaluation, data presentation and data processing; quickly spotting important data developments; Great chance to expand actuarial fields to marketing, underwriting, claims management, ... - all fields where Data Science/ AI is needed (DE)
- Better service to the users of actuarial work. Actuarial work can focus on real added value services including judgments (HU)
- **a) It increases the profession's toolkit to carry out its work. b) It expands the scope of work actuaries can do, making them more relevant outside financial services c) It allows actuaries to provide a better service to their industry, employers, customers and society in general (IE)**
- More data driven decisions, better insights (NL)
- Actuaries will use DS/AI to make faster and more reliable decisions/Actuaries can play an important role in DS and AI (PT)
- More insides on how to assess the risks and help developing new tools (RO)
- **a) The actuarial role, due to its capabilities, uses in many ways the results that DS offers, placing the profession in a privileged position to lead a disruptive change in society. b) Possibility of accompanying the transformation of society through insurance and led by the actuarial profession c) Big Data, DS, and AI algorithms drive underwriting, pricing and management to reach levels of precision that were hard to imagine just a few years ago d) Connected insurances collect data about profile, location, context, behavior and others to virtually build consumer relationships. e) Advance in prediction and prevention in such a way that insurance will become an instrument of risk prevention f) DS and AI will facilitate the customization of the insurance and financial offer g) Customers will be more careful and try to avoid claims instead of asking for reparations h) DS and AI help to capture the immediacy that customers increasingly expect and demand i) So, the use of DS/AI will increase the agility which reduce the time to market for new products/services and redesigned client service. j) Increase the scalability of the companies (ES)**
- Growth of DS/AI means actuaries will be relevant for more fields than insurance, More correct and granular pricing of insurance contracts, More advanced and better methods for modeling risk (SE)
- It gives actuaries additional tools to do their job. It allows actuaries to deal with current challenges in the insurance industry. It allows actuaries to be more efficient and focus on the core rather on side topics. (CH)

3.2 Negative

- a) **Control over the models:** It might get **harder for the actuary to capture insights from a 'black box'**. DS/AI models should not be applied "blindly" to actuarial problems. This could indeed lead to a.o. **Statistical bias; / Unwanted decision criteria (e.g. discriminate on the ground of gender-type for instance); / Less expert judgement (e.g. AI not properly capturing catastrophe risk); / Overfitting; / Inability to interpret and explain the outcome from the models.** The technique (computer science) can evolve faster than its (deep) understanding (statistical soundness). Ultimately, DS&AI might lead to loose model

management with difficult even impossible validation/sign-off of models by the actuary. This does not fit the regulatory landscape of the Insurance sector. b) **Control over the data:** Actuaries might have less control on their data: there is a risk that the data that the **actuary will receive are filtered/manipulated/biased by third parties**. Anti-selection could become a more prominent issue. c) **Job destruction:** Some actuaries fear that companies will need less actuaries for the same job. d) **Continuous learning:** Actuaries have to be up to date with new technologies within the field of DS/AI to stay relevant in the market. (BE)

- Might lead to data scientist to draw incorrect conclusions from data as they not always have such a professionalism as actuaries. (CZ)
- too much reliance on results of automated processes, lack of results plausibility checks/ The DS/AI lacks an essential understanding of the insurance industry and therefore a proper interpretation of the data which could lead to completely wrong direction in risk management overall (HR)
- It is a threat, if actuaries are not able or willing to develop their methodologies/ None really, as long as data ethics and GDPR is observed (DK)
- new credibility studies required; high documentation effort; new approaches require additional research; there might be a **competition between Data Scientists and Actuaries** (DE)
- The actuarial profession may become less relevant to the users of actuarial services if the profession does not make a significant advancement (HU)
- a) Other **DS/AI professionals will compete with actuaries for some jobs and employers will not necessarily value what the profession offers in relation to professionalism, ethics, etc.** There is a risk that employers see actuaries as difficult and expensive. ·b) The risks of using DS/AI are, in many cases, still poorly understood and there is not always best practice available to help actuaries. c) Daniel Shreiber, CEO of Lemonade has said that: “the next insurance leaders will use bots not brokers and AI not actuaries”. The profession could become irrelevant or be relegated to fulfilling regulated jobs if it fails to adapt. (IE)
- More education needed, different skillset (NL)
- Danger that in the future **actuaries are reduced to programmers of DS/AI algorithms./** Some of the actuaries work will be done by computers (PT)
- a) The question of how AI could contribute to actuarial work is a controversial question within the insurance sector. Some have speculated on the ability of AI and Machine Learning to replace traditional actuarial work and could therefore reduce insurers' requirements for actuaries. Others argue that expert DS actuaries could turn machine learning knowledge into a useful asset in our skill offering. b) There is a huge risk of obsolescence in the insurance industry and for actuaries if we are not well prepared for this disruptive transformation. c) **The excess of personalization of the offer can carry out the demutualization of the risk.** d) The traceability of data for underwriting, pricing or risk selection among others, will be a potential problem for avoiding possible situations of inequality and discrimination (conscious or unconscious). e) At industrial level, the use of DS/AI will transformer capex/opex that likely change the level of expertise required (ES)
- Some technical skills of actuaries might become less relevant/outdated/automated (SE)
- That is currently too early to say. And it depends how the actuaries will deal with the topic in the future. (CH)
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- 4. In what areas of AI/DS should Actuaries be active? Why, or why not?
 - Very often, the actuaries have final responsibility for some of the models that use DS&AI. Some examples are pricing and reserving, but also in view of regulatory requirements. Therefore, **at the very least they should understand these models very well.** Actuaries

should be able to understand and appreciate the validity of **model hypotheses with respect to the problem tackled (e.g. independence assumptions, proportional hazards, stationarity of the process)**. Actuaries should considerably extend their role in **all the areas of model development: a) Data measurement and gathering (possibly need to connect to other industries). b) Data quality (a view on cleaning and processing is needed). c) Data visualization. d) Pre-processing of data. e) Parameter selection (automated or actuarial expert judgement, mind discrimination, ethics). f) Training of the model, next to calibration of parameters. g) Continued and increased front-line position in pricing and reserving (e.g. clustering of data). h) Interpretation of model results.** (BE)

- keeping up with DS/AI trends in general. What techniques can be used for traditional actuarial tasks, such as pricing and reserving. Furthermore what are the potential regulatory implications of those - programming tools. Open-source tools in Python and R, seem to be the future of DS. Maybe the same mindset is also useful for actuarial field. (CZ)
- design and review of algorithms, assessment of results DS/AI will affect many aspects of everyday life, changing risks we are exposed to. Hence new products or new approaches to risk assessment and risk mitigation will be needed. And actuaries already have experience with similar tasks/ Actuaries know the risk that is the subject of DS analysis (the industry in which they work and the type of risk for which the analysis is performed), they can correctly interpret the output results of the DS model. DS statistically process the data and do not have the skills to detect model inadequacies since the results ultimately do not know how to interpret. misunderstanding data can be so high that business decisions about risk management can lead to absurdity. (HR)
- **Actuaries must be open to new techniques and new technologies in general, and actuaries must be active in all new areas where new insights can be earned in relation to insurance and risk management/** In the intersection between DS/AI and Pensions and General Insurance. This may be slightly too broad. It should definitely include actuarial modelling, pricing, capital modelling, and reserving. Image and natural language processing should probably be outside the scope (they are too specialized for actuaries to have a chance of becoming serious contenders), but the line will be blurry and hard to make clearly. For example, actuaries may well be attracted to work on models for marketing, claims handling, fraud, etc. and create models that draw on aspects of images and text/speech. (DK)
- Actuaries should be active in the areas of statistics and data evaluation, model credibility as well as data quality. reason: wide experience already exists in actuarial field Maybe we should expand the definition of Actuaries in fields of AI/DS: Hans Bühlmann promoted the Actuary of the 3. Dimension 25 years ago, later came the Actuary in the field of ERM (4. Dimension). Should we now have the Actuary of the 5. Dimension: Actuary in AI/DS? (DE)
- I think actuaries should be active in all areas of DS/AI. **Setting boundaries to the scope of actuaries' involvement in DS/AI would limit the potential for actuaries to become recognised experts in the field.** DS/AI will become a critical function in the future of insurers and actuaries need to be able to extend their knowledge where it is required to keep their relevance and usefulness for employers. In time some actuaries might specialise in specific DS/AI aspects such as model development, model risk management and review, etc, which is how actuaries currently apply their actuarial expertise to pricing, reserving, etc. (IE)
- Healthcare, retail, public sector, finance (NL)
- Improved data. New computation. More developed methods. New opportunities in new areas./ DS: detailed data analysis It's important because we will need to substitute some types of work that will be done by computers. Actuaries are the most qualified professionals to do claim analysis (PT)
- i see no area where actuaries could not be involved (RO)

- a) **Actuarial practice should make the best use of AI and DS techniques, especially in their application to personal contracts in the following aspects: pricing, product design, reserves and risk and capital management.** b) It will also be useful for the actuary in reducing reporting deadlines, improving quality control, monitoring and optimizing balance sheets, and in their commercial applications. c) **The actuary must specialize and add value in the connected insurance that is already beginning to settle in branches such as cars, life, health and home insurances.** d) The risk changes in its origin and in the way it is measured (in real time), so the actuary must be trained for this change, which will allow us to move **from the current concept of an insurance company that reacts to losses, to a new concept where the insurance industry prevents these losses.** This new paradigm will transform the insurance industry, so the actuarial profession must also be adapted to. e) The insurance customer will use their AI assistant to perform some daily tasks, so **the insurance premium will be calculated in real time, based on the client's decisions and habits.** The actuary must be prepared for this new management and pricing way. f) The actuary must combine predictive models to interpret and analyze large amounts of information g) The actuary must preserve that the variables used do not incorporate biases or discriminate in their treatment. g) The actuary must try to ensure **the balance between equity and risk mutualization** h) Insurers and actuaries are at risk of becoming obsolete if they do not join this process of technological transformation. As member of society, we have a great responsibility that the application of the DS/AI does not mean a reduction in the offer and the lack of protection of some people. Technology related with DS & AI will transform risk and insurance. As technology and processes change, the nature of risk is also changing, so the actuary must also adapt his capabilities to this new environment. i) Current actuarial technology and software are not always best suited to meet the growing needs of insurance industry and society. (ES)
 - Given the deep knowledge of insurance actuaries have the focus should be on data analytics, data visualization and business intelligence / strategy (SE)
 - **1) Actuaries should be interested in the topic in general and upskill and learn it. 2) Actuaries should be trained in Machine Learning. 3) Actuaries should be active for the appropriate and responsible use of machine learning in the insurance industry. 4) Actuaries should be active in communication that it is more than just machine learning, i.e. legal, regulatory and professional standards topics.** (CH)
5. What are your expectations towards the AAE on the role of actuaries when it comes to AI/DS?
- a) **Defend the profession: Advocate with all stakeholders why actuaries are well placed/needed to handle data science topics.** b) **Inform:** i) **Highlight the critical items of interest brought by DS/AI techniques in actuarial duties.** ii) **Give guidance in terms of the reasonable application of DS/AI models.** iii) **Create awareness on the adequate governance that should be in place before using AI** iv) **Share best practices in applying DS/AI within an insurance context.** For example, sharing some cases where a new technology was successfully applied/verified/monitored within the insurance industry. v) **Define training material, courses, events** vi) **Keep actuaries updated in terms of the DS/AI models** c) **Lobby: Active involvement in the regulatory and legal decision process (European and National) around the use of AI in the financial sector.** Indeed the future regulations will impact our profession when it comes to properly defining and regulating the duties, rights and protection of the signing-off person in general, the responsible actuary in particular. d) **Connect: Strengthen collaboration between member associations: communication hub between the different members.** (BE)

- Helping to define professionalism for DS/AI when used by actuaries. Training and knowledge exchange. (CZ)
- experience exchange, maybe some guidelines or best practice examples/ emphasize more than ever the importance of understanding and managing risk through strengthening the role of the actuarial function (HR)
- **I am not convinced that it is for the AAE to run this agenda.** DS/AI are global trends/ Computer scientists and engineers have a dominant role in DS/AI. AAE needs to make up its mind on how to define the border between "actuaries" in a broad sense (working within the AAE) and "non-actuaries" (working outside the AAE), and how to deal with the growing intersection between the two fields. My advice is to be **inclusive but remain focused on what is the core of the actuarial profession.** It would be really nice if AAE would arrange **online talks with leading researchers and practitioners in the cross-section between DS/AI and the actuarial profession.** (DK)
- Leading a process within the associations to add AI/DS to the fields of actuaries. (DE)
- A great deal of actuaries (but not necessarily all) should have a good understanding of DS/AI. DS/AI should be part of the education program of new actuaries (HU)
- Most actuarial associations in Europe face similar challenges in relation to DS/AI: training and education, engaging with potential employers, marketing actuaries as experts in data science, etc. **The AAE is uniquely placed to coordinate joint efforts to meet those challenges via CPD, common practicing, ethical and professionalism standards, etc.** There is also an opportunity for **associations to share their experience and lessons learned** in their activities to date in order to promote DS/AI within their membership, marketing actuaries as DS/AI experts, etc. (IE)
- Offering a roadmap on courses including ratings and compulsory courses (NL)
- More research is required. Actuaries must be motivated to enhance their knowledge of DS/AI techniques and to learn how these will help them to better perform their tasks. AAE and the Member Associations can take actions with this purpose in view./ To organize online courses together with member associations, universities and Actuviv (PT)
- First is about **professional ethics; it is highly important that we are aware how the information and developed tools are used** (e.g. to prevent discrimination based on age, gender, etc.) (RO)
- a) **We would like the AAE to ensure that the actuarial profession knows how to adapt to this new reality and that we all understand that it is not a threat but an opportunity for the profession.** We must not only defend what we have and the status quo but move forward as society demands it and lead this change. Citizens increasingly want and expect real-time information and data, and if we don't execute this as an industry and as a profession, we will have missed a significant opportunity b)The AAE must also ensure that **the training gap between the more traditional actuarial profiles and this new professional role is reduced.** c) The AAE must take care of all **the ethical questions that surround a technological breakthrough as disruptive as this, in such a way that it is the people (the actuaries in this case) who must control the machines and not vice versa.** (ES)
- That AAE collaborate closely with the DS/AI field to gain insights and market the actuarial profession, Defines what skillset the future actuary needs in relation to DS/AI, Work closely with authorities on DS/AI related questions for insurance, Take a stance on ethics and data security (SE)
- **The AAE showed in the past that it is not able to really contribute in this area. 1) There were ideas on AAE level to approach the topic, but nothing was achieved in the last three years. 2) The use of AI so prominently shows that the AAE has not yet really understood what it is all about.** (CH)

6. What kind of an organisational structure does your association have in place to deal with AI/DS?
- A dedicated Working Group is established which reports to the management of the association. (BE)
 - A working group discussing the potential implications and usage of DS/AI in actuarial tasks. (CZ)
 - No particular organisational structure. We have talks on AI and machine learning a couple of times per year, by members who work with DS/AI as well as AI researchers from local universities. Talks on AI/DS are particularly frequent in our biannual meetings of our local ASTIN chapter, which are attended by more than 100 members. (DK)
 - Separate actuarial data science expert committee connecting with all other traditional actuarial committee streams; Education of a CADS (Certified Actuarial Data Scientist) (DE)
 - The Society of Actuaries in Ireland (SAI) has a dedicated Data Analytics Committee that works in conjunction with its Wider Fields Committee, which coordinates the actions of committees dedicated to non-traditional actuarial work and ultimately reports to SAI's council. (IE)
 - Data Science Committee (NL)
 - a) The IAE does not have a specific structure on this issue, although it will be one of the basic pillars of its strategy in the upcoming years. b) In terms of education and training, these issues related to DS & AI have been given relevance for some time through CPD specific seminars. c) The IAE also needs a strong leadership at the AAE level on these issues, as it is an area of knowledge to explore, so the alliance of the actuarial profession must be strong at the international level both moral/ethical and technical. (ES)
 - A board member dedicated to the topic and a dedicated working party. The working party supports the association in strengthening the awareness and provides the mathematical foundations for the proper application of machine learning in actuarial applications. (CH)
7. What other suggestions do you have for the future work of the AAE in this area, word is free?
- a) **Coordination with other industries**, not specifically limited to the financial services (e.g. interesting developments in predictive maintenance in heavy factories – which could be interesting for non-life/catastrophe risks). b) **Organize an event where actuaries involved in DS&AI can meet and exchange** (e.g. in the context of a broader congress). (BE)
 - None - as stated above, I am not convinced that it is for the AAE to run this agenda/ Be open and inclusive, invite researchers and practitioners from other fields (including DS/AI) to share their ideas, without losing focus on pensions and insurance. (DK)
 - **Expanding the definition/ role of the Actuary!** (DE)
 - **To develop a discussion paper that FMAs can review and opine** (HU)
 - On the qualification issue, if there is going to be one, it would make a lot of sense if it came from the AAE. I believe the US Society of Actuaries has one such qualification now (available to non-actuaries too) and the IFoA has debated for years the introduction of a data science specialist path in its syllabus. All actuaries will learn the basics and some may want to specialise (I suspect it is already in development). However, Brexit brings the issue of mutual recognition of qualifications across the EU so we need to take the potential usefulness of US or UK qualifications with a pinch of salt. **Having a common data science qualification across the EU would be very practical and contribute towards best practice, high standards, etc. Presently, each national association is doing their best in this regard (the French have a qualification, the Spanish institute has been running good courses but without a formal qualification, I believe DAV might already have an insurance data science programme...) but skills and standards are bound to vary significantly.** A separate point would be whether the market would value such qualification. My personal view is that **a generic qualification would simply join the already crowded market of masters in data analytics, etc but that**

there could be interest for a more focused one such as 'insurance data science' or 'data science for financial services' that combined data science skills with knowledge on how those businesses operate, their environment, etc. The main challenge at the moment is finding individuals with expertise in data science coupled with business knowledge (essentially, the data science equivalent of an actuary) as otherwise the full potential of the professional is not fulfilled until that business knowledge is acquired. This has led to the rise of 'data translators' or 'data strategists' who are people who know enough of the business and data science to be either more effective at their job than a pure data scientist or to guide data science teams on how to best help the business. Given the proliferation of data science courses to meet past demand, the current and most immediate challenge is finding these 'data strategists'. In my experience, most insurance companies struggle to attract and retain data science talent as they cannot compete in CV prestige and financial remuneration with the technology companies. It is also less frustrating for data scientists to work at technology companies as they already have solutions for most of the day-to-day IT challenges of running a data science team and this plays a significant role in job satisfaction and retention. Insurance has a reputation for being boring and most of my data scientist contacts would rather work in the Pharmaceutical industry or digital marketing than go to a bank or an insurance company. Helping channel interested actuaries towards filling that specific niche could prove a relatively easy / quick win. (IE)

- Promote the actuarial professional as more than an insurance/pension mathematician (NL)
- AAE should clearly define how an actuary should behave when addressing DS/AI topics. (RO)
- **a) The AAE should mark the path for the actuary to go from a predictive model scheme to cognitive models b) Review the incidence of DS & AI in all its dimensions: Pricing, underwriting, reinsurance, management, etc. c) A topic to study will be the link between DS & AI and the technology called internet of things (IoT), since the technological developments that are taking place to connect all the systems and to create an interconnected environment will require the development of DS and AI models that allow the offer of insurance products adapted to every citizen. d) Do not lose sight of matters as relevant in the area of DS & AI as equity, justice or privacy of data and calculations e) It would be advisable to work with external groups in which to combine different knowledge through collaborations with universities or with civil society organizations f) Have an extended vision of the ethic impact on Science which could change the Society and the insurance sector.** (ES)
- **First, I do not understand what a "data strategy" should contain and why this is useful. A position paper is not really what should be done. The AAE should have a strategy and an execution plan how to deal with the current developments.** (CH)