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AI and Machine Learning Usage in Actuarial Science

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Artificial Intelligence and Machine Learning Usage in Actuarial Science

Artificial Intelligence and Machine Learning Usage in Actuarial Science

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Abstract

Some people in the world work hard and do whatever it takes in order to get a job that they love. There are others that don't care about their jobs and solely perform them in order to make money. So, there are individuals or groups that wouldn't care if a machine or computer were to replace them in their job, but others would, understandably, be devastated. The main question for this paper is: Is it possible that actuaries will be completely replaced by computers, or do we need the human mind in order to make proper decisions and judgements?

Key words and phrases: actuarial science, artificial intelligence, machine learning, deep learning, statistics, insurance

I. Introduction

In today's technologically advanced world, there have been many conversations about how machines and computers are going to replace everyone's jobs and that they're going to execute them a lot more effectively than the human alternatives. There are many reasons that companies could look to technology to do certain jobs. It could be to save money, because robots don't have to be paid. It could also be in order for the task to be completed more efficiently, by having less mistakes or being finished quicker. For some jobs out there that may be incredibly monotonous or overly difficult, this technology could make some people happy to be relieved of a certain position, but there's also those who wouldn't want to lose their jobs. The purpose of this paper is to research actuarial science, artificial intelligence and machine learning, and determine whether or not actuaries could become totally obsolete and ultimately be replaced by computers. While it's doubtful that actuaries will be completely wiped out anytime soon, it's a common opinion that artificial intelligence and machine learning are nearly guaranteed to make some drastic changes in the field.

II. What is Actuarial Science?

“Part super-hero. Part fortune-teller. Part trusted advisor.”

-Be an Actuary

An actuary is a person who analyzes statistical data and helps manage risk. They help people and businesses plan for their futures and work to minimize and prevent losses. Actuaries have incredible statistical skills and use them to analyze risks and uncertainty. While actuarial science is considered mostly to be a subset of statistics, an actuary possesses knowledge of many other specialties as well. Actuarial science is a study that combines finance, mathematics, statistics,

and computer science in order to appraise risks and price insurance premiums. Because actuarial science encompasses this complex set of skills, there are a handful of difficult exams that a person has to pass in order to become an actuary. Unlike other areas of study, no one can graduate university and automatically be an actuary. It takes approximately six to ten years in order to be a fully certified actuary. The image below gives a great visual for how actuarial science is a combination of various areas of study.

Fig. 1

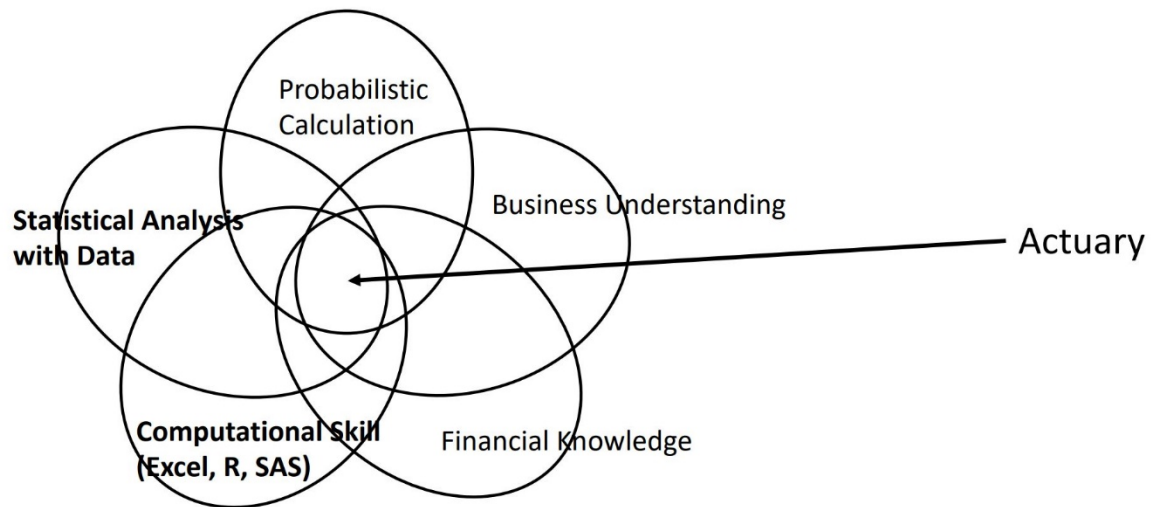


Fig. 1: Image courtesy of Dr. Nao Mimoto, professor at The University of Akron

III. What is Artificial Intelligence?

“Our intelligence is what makes us human, and AI is an extension of that quality.”

-Yann LeCun

John McCarthy, known as “the father of AI,” said that artificial intelligence is “the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not

have to confine itself to methods that are biologically observable” (McCarthy, 2007). Whether you realize it or not, you probably use AI everyday of your life. Whether it’s using Google to search for information, or using iPhone’s Siri or Amazon’s Alexa, artificial intelligence has definitely made its way into most of society’s everyday lives. Artificial intelligence allows computers and machines to mimic human intelligence and perform tasks that would usually require a human brain. Two commonly known examples of this technology are self-driving cars and chess-playing computers. Normally, you would need a human in order to drive a car and to play a game of chess. Artificial intelligence allows for these tasks to be done through a computer, rather than needing a human to make the decisions and carryout the task at hand. This allows for certain jobs that require human intelligence input to be replaced by machines or computers that are programmed with artificial intelligence.

IV. What is Machine Learning?

“A breakthrough in Machine Learning would be worth ten Microsofts.”

-Bill Gates

Machine learning (ML) is considered to be a subset, or branch, of artificial intelligence. Similar to actuarial science, machine learning is also a topic that combines different knowledge bases and morphs into a new one. Machine learning uses algorithms and neural networks to make computers improve themselves over time. An algorithm is a set of rules, or guidelines, that tells the computer how to perform a certain task. A neural network is a set of algorithms that is designed to imitate the human brain. These networks are programmed to recognize patterns and interpret them in order for the computer to make future judgements. The algorithms build models by using a sample set of data that “trains” the computer so that it can learn to make decisions by

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itself without needing human input (Foote, 2019). If you're still unsure of what exactly machine learning is, here are nine examples of applications that involve the use of machine learning: Virtual personal assistants (Siri, Alexa, Google), GPS traffic predictions, video surveillance, social media (people you may know, photo facial recognition), e-mail spam filtering, online customer support, search engine refining, product recommendations, and online fraud detection (Daffodil, 2017). Many of these applications are very familiar to us and some people would probably be lost without them.

Fig. 2



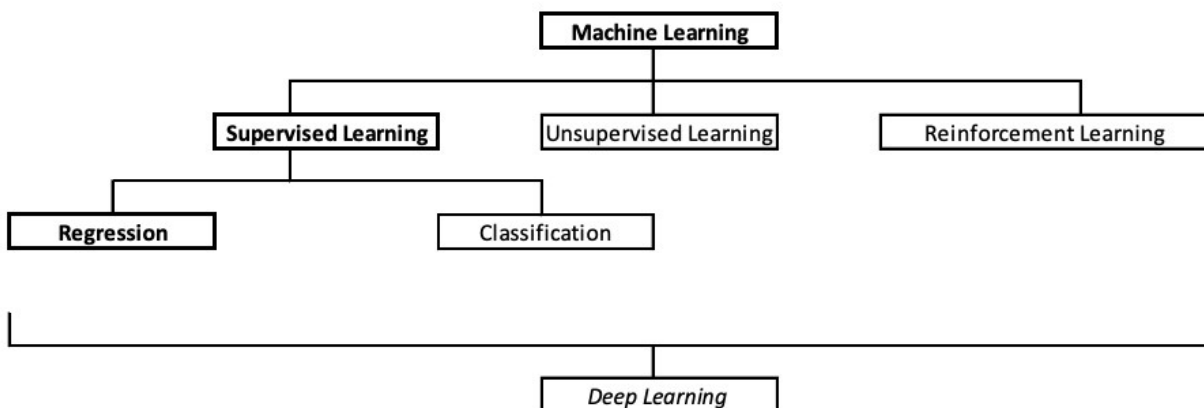
Visual of how various concepts come together to form the subject of machine learning.

Fig. 2: Image from <https://www.dataversity.net/a-brief-history-of-machine-learning/>

V. How Can Artificial Intelligence and Machine Learning Be Used in Actuarial Science?

Machine learning can be explained in further detail by separating it into three broader categories – supervised learning, unsupervised learning and reinforcement learning, with supervised learning being the most familiar to actuaries (Richman, 2018). Some examples of supervised learning that are common in the actuarial field are “the fitting of [generalized linear models] to claims datasets to predict the frequency and severity of claims, or to policyholder datasets to predict lapse rates” (Richman, 2018). Supervised learning models can be either simple linear regression models or more complex models. Unsupervised learning is the portion of machine learning that concerns the recognizing of sequences and patterns. “The task of unsupervised learning is to find meaningful patterns using only X , which can be then used to further understand the data, or, in some cases, model it” (Richman, 2018). Reinforcement learning is a part of machine learning that doesn’t relate to actuarial science at the moment, but it is defined as “learning what to do—how to map situations to actions—so as to maximize a numerical reward signal” (Sutton and Barto, 2018).

Fig. 3



The previous image shows how machine learning can be classified into the three sections mentioned in the preceding paragraph. Regression is a popular modeling method in actuarial science, hence the bold text.

“If an actuarial problem can be expressed as a regression, then machine learning and deep learning techniques can be applied.” says Richman, 2018

Fig. 3: Image from Richman, Ronald, *AI in Actuarial Science* (July 24, 2018)

VI. How Will Artificial Intelligence and Machine Learning Change the Actuarial Industry?

“Do you think the actuarial and insurance industries are immune to this tidal wave? Think again. AI will change the insurance businesses more in the next 10 years than it has changed in the past 200.”

-The Actuary, 2018

At this point in time, it seems that the collective opinion of the community is not that artificial intelligence is going to entirely replace actuaries, but that AI is going to help them flourish instead. Nicholas Yeo, the founder of Nicholas Actuarial Solutions, says that “actuarial work will be completed quickly, efficiently and accurately” and that “actuaries will be freed up from crunching numbers and producing reports, thus freeing up time to focus on high value activities such as insightful recommendations, business development and risk management” (Yeo, 2017). He also mentions that even though automation has decreased modeling runtimes while simultaneously improving the quality, “actuarial judgment is still applied at every step of the process, be it data manipulation, assumption setting or methodology selection” (Yeo, 2017).

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Unlike other processes that can be easily completed with automation, in order for the work of an actuary to be credible, it needs some kind of intelligence input, whether it be human or artificial, to make decisions and judgements. But, with automation and AI combined, the work of an actuary will be revolutionized. Instead of a human actuary going through all of the actuarial processes and using their judgement at each individual step, instead they would only need to review it at the end of the line to make sure that it is valuable. “With process automation and AI, the actuaries’ time would no longer be unnecessarily spent in processing data and crunching numbers. Instead, actuaries could spend more time performing analysis and making recommendations in areas they understand well such as marketing financial products and managing enterprise risk” (Yeo, 2017).

As previously mentioned, a popular implementation for AI is in the game of chess. In 1968, the father of AI, John McCarthy, was actually involved in a bet in which he said computers would be able to beat human chess players within the next ten years. This wager came about after McCarthy lost a game of chess to Scottish chess champion David Levy (Baraniuk, 2015). After decades of battling between human and computer chess champions, a revelation was made. The perfect chess player isn’t a human, and it isn’t a machine, but a combination of the two. In 2005, two amateur chess players, Steven Crampton and Zackary Stephen, won a chess tournament by using a database of chess strategies and multiple computers. Their technology alongside their own chess skills proved to be no match for any opponent, machine or human. “We had really good methodology for when to use the computer and when to use our human judgement, that elevated our advantage,” said Stephen (Baraniuk, 2015). So, maybe Yeo is right. Actuarial science could become easier and more meaningful if actuaries have artificial intelligence technology at their disposal. Maybe instead of trying to create technology that will

replace humans, the focus should be on developing technology that humans can work with in a collaborative manner instead.

The article “Is Machine Learning a Threat to the Actuarial Profession?” gives an insightful rundown of three possibilities for the future of actuarial science in the wake of the “AI Revolution,” as some have called it. The first given possibility is that yes, AI and ML are going to take over in only a matter of time. It explains how the technology can learn and make improvements faster than any human can, and how actuarial prediction methods that are formulated by technology “don’t age or drop in performance over time” (Looft, 2016). Also mentioned is how this may be a popular venture for companies that are looking to reduce costs, which was mentioned earlier in the introduction paragraph. The next option discussed is how AI and ML are merely tools that are going to be used to aid human actuaries in their careers. “As much as machine learning has been successful in taking certain tasks away from the human actuary, the current technological development of machine learning is still at a stage where it requires human governance and intervention,” says Looft. The final path mentioned is that AI and machine learning will elevate actuarial work and “take it to the next level.” This notion that human actuaries will end up working in conjunction with AI and machine learning in order to transform the career seems to be the most popular opinion out there regarding where these technologies will take actuarial science. The article says that the technology will allow for more time for the actuary to focus on the more important aspects of the job, much like Yeo’s opinion that was mentioned prior. This company also conducted a survey that gathered information about how machine learning is being implemented in the field today. The first question of the survey asked respondents if they were using machine learning in their jobs at that moment, to which fifty-four percent of survey-takers answered “yes” and forty-six percent answered “no.” The next

question asked how the individual would describe their organization’s adaptation of machine learning, and only fourteen percent of individuals said that it was a core strategy and that all areas of the company are encouraged to use it. The following figure is a graph depicting the survey responses of the individuals when asked what benefits they experienced with machine learning in their workplace. Over half of the respondents believe ‘greater analytical accuracy’ to be a top benefit, while ten percent of individuals claim that there are no significant benefits as of yet.

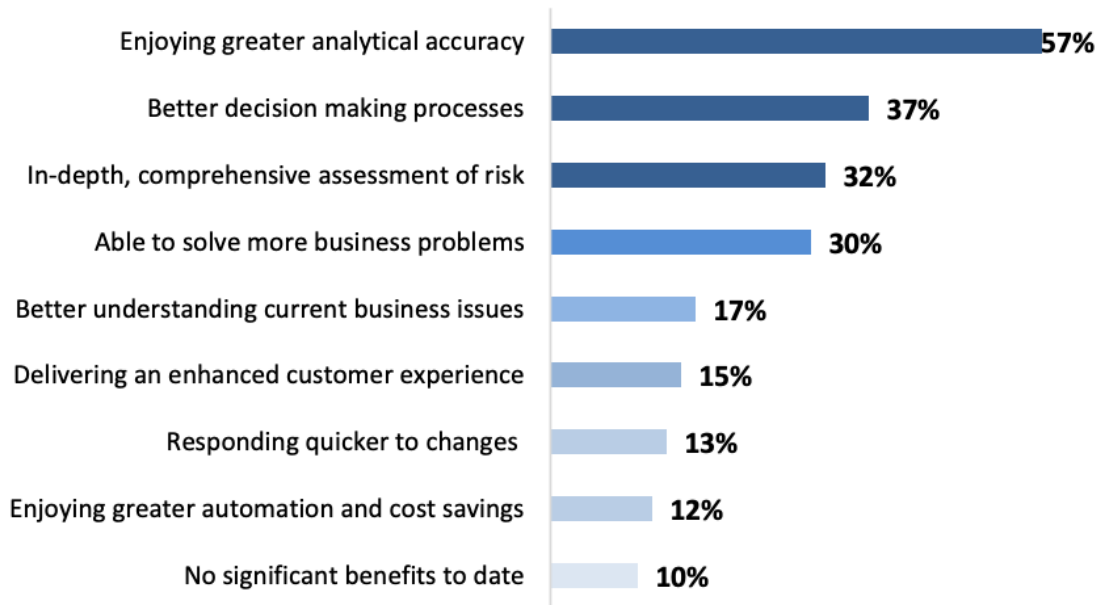


Fig. 4: Image from Earnix.com, *Machine Learning Survey 2017*

Another perspective on artificial intelligence and actuarial science is a different but interesting one, and it comes from the CEO of Lemonade Insurance, Daniel Schreiber. Lemonade Insurance Company is a different type of insurance company. They use artificial intelligence to provide their customers with affordable home insurance rates, and they don’t employ any actual brokers (Dehn, 2020). One source even says that “Lemonade, a relatively new

New York-based insurance provider, has already claimed to have processed the world's first insurance claim exclusively handled by an AI [program]" ("Actuaries"). At the Digital Insurance Agenda in 2017, Schreiber said, "Insurance creates €100B businesses, that live for 200-300 years – But the next insurance leaders will use Bots, not Brokers, and AI, not Actuaries." This outlook is different than the others that have been mentioned. Schreiber actually thinks that AI will usurp the actuary's job instead of facilitating it.

VII. Conclusion

It's no doubt that artificial intelligence and machine learning are going to make some drastic changes in the actuarial world, but just how drastic will these changes really be? It's hard to give a definitive answer as to whether or not the human actuary will die out or vanish in the coming years of undoubtedly many more technological advancements. The purpose of this paper was to answer this question, but it seems that there's no way to tell if humans will be necessary in the field or not, because no one knows exactly what technological advancements are going to occur. Many different people out there have given their opinions on the matter, and many people have said that it's doubtful that humans will become obsolete, but there's no real way to know for sure. It's just not something that can be answered as "yes or no" right now. While it's likely that those invested in the profession or those aspiring actuaries out there would love to have an answer, given that their job is to predict the future in a sense, it seems that it's going to be a situation that will need to be played by ear as time passes.

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