



 Innovation and Technology

Top Actuarial Technologies of 2019





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Top Actuarial Technologies of 2019

It is important for actuaries to have the appropriate skills, including technological skills, to do their work. It is equally important for the Society of Actuaries to offer education programs for new and existing actuaries to help ensure members of the profession have the knowledge and skills to remain relevant, especially with the emergence of new technologies and analytical fields, such as data science. This research study aims to understand the current and planned use of various technology types and tools and to highlight those technologies that are anticipated to grow the fastest among actuaries in 2019. It also explores the growing set of emerging technologies and discusses perspectives on the abilities of actuaries to adopt them.

Key Findings

- The types of technology that actuaries expect to increase the most in usage in the coming year include data visualization, predictive modeling, cloud computing and storage, and collaborative tools.
- Data visualization is not only the fastest growing technology among actuaries, it is also used by more actuaries than other technologies in the survey.
- The predictive modeling tools R and Python are currently used by more actuaries than any other tools in our survey. They are also among the fastest growing in their use among actuaries.
- Across the top technologies, more of the anticipated increase in use is expected to come from actuaries currently using these tools than from those who plan to start using them.
- While there are many factors driving the increased use of these technologies, a common theme is how they can bring efficiencies to actuarial work.
- There are also many emerging technologies that actuaries expect to leverage in their work beyond 2019. Some that hold promise include robotic process automation, serverless architecture, and expanded open-source applications and libraries.
- Experts interviewed as part of this project exhibited confidence that actuaries are capable of learning and implementing new technologies if they are given appropriate priority.

Methodology

In order to gather information and insight regarding technologies – those currently used, as well as those anticipated to be used in actuarial practice – the study consisted of both qualitative interviews and a quantitative survey.

Researchers conducted 30-minute interviews with 17 individuals selected based on their level of knowledge about current technologies and their use among actuaries. Following the interviews, a short survey was developed based on the interview responses. The survey was sent to all actuaries who are members of at least one of six SOA professional sections¹ to better understand their current and planned usage of specific tools in various technology areas. The survey was completed by 140 actuaries. All data collection occurred in February and March of 2019.

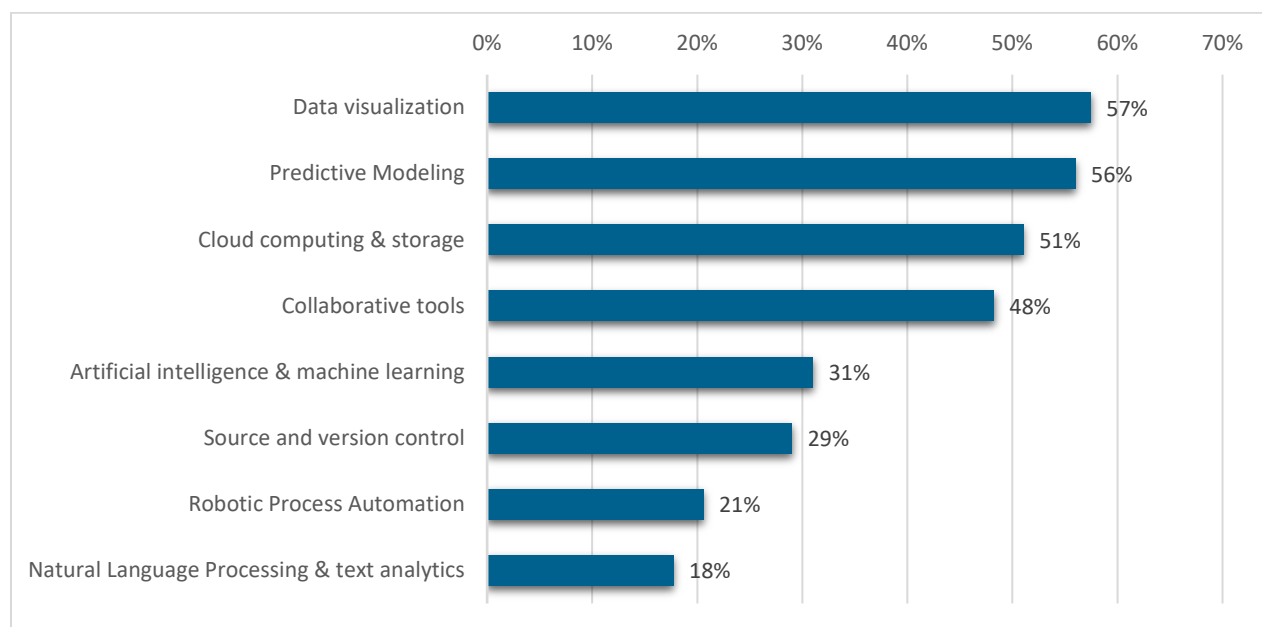
¹Members of the following sections received the survey: Actuary of the Future, Entrepreneurial and Innovation, Marketing and Distribution, Modeling, Predictive Analytics and Futurism, and Technology.

Section 1: Top Actuarial Technologies

For the purposes of this research, the *top technologies* – both in terms of technology areas and the specific tools being applied – are defined as those expected to grow the most in terms of usage among actuaries over the next 12 months. This definition includes technologies that are currently being used, but that actuaries plan to use more than they are being used today. It also includes technologies that actuaries are not using today, but plan to begin using in the coming year. This definition, therefore, does not include tools, such as Microsoft Excel, that are generally recognized as being used universally among actuaries today.

According to the survey definition, four technology areas rise to the top as fastest growing: data visualization, predictive modeling, cloud storage and computing, and collaborative tools (see Figure 1). Across the top technologies, more of the anticipated increase in use is expected to come from actuaries who are already using these tools, but plan to increase their use, than from those who are not currently using them, but plan to start.

Figure 1
Technology Areas Expected to Grow Fastest in Use in 2019*

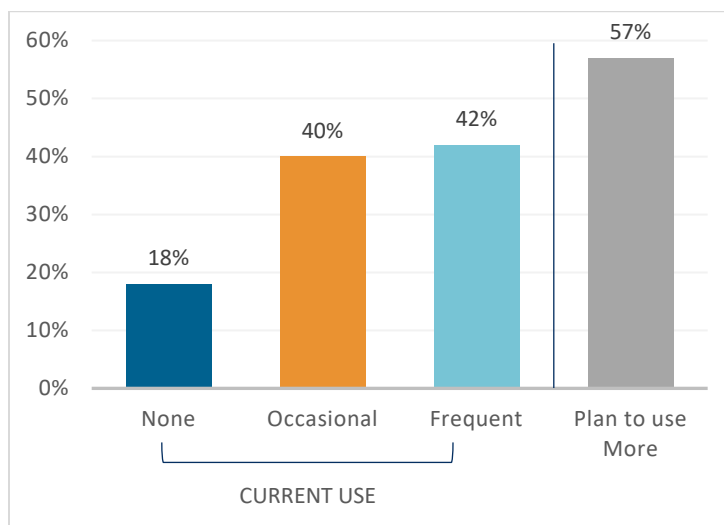


*Percentages represent the percent of actuaries surveyed who believe their usage will increase between March 2019 and March 2020.

1.1 Data Visualization

Among the categories of technology included in the survey, data visualization is not only the fastest growing in use among actuaries, it is also currently used more than any of the other technologies. Two-thirds of current users plan to increase their use and one in eight non-users anticipate using data visualization in the next year. There are many data visualization tools available today. Based on actuaries surveyed, one-third or more are currently using Tableau or Power BI and a quarter to one-third plan to increase their use of these tools.

Figure 2
Use of Data Visualization Among Actuaries



Actuaries are finding many uses for data visualization, chief among them is communication, especially when communicating complex analyses to non-technical audiences. Some see data visualization as helping to augment actuaries’ communication skills.

Other reasons actuaries expect to use data visualization more include management preference and process efficiency. One company created consistent dashboards for use across the organization for various analyses that actuaries were doing in Excel. This allowed for consistency and efficiency in reporting and interpreting results.

“Human beings have evolved to see and evaluate visual patterns. Data visualization is a superior way to convey certain types of information.”
--- Survey respondent

Another company asked actuaries to work in a cloud environment over a period of time so that work could be tracked in order to better understand what was being run, when, and at what cost. The data was then presented in a dashboard for management review and feedback regarding efficiency of actuarial resource use, as well as run time and cost.

Another popular use of data visualization is to aid in the search for insights in increasing volumes of data. As an analytical tool, actuaries are incorporating data visualization across a broad range

of applications, from ratemaking, to understanding inforce block performance, to improving risk management. Several companies have begun looking at automating experience studies and other types of business benchmarking and providing access to a larger internal audience via standardized and regularly updated data visualization tools.

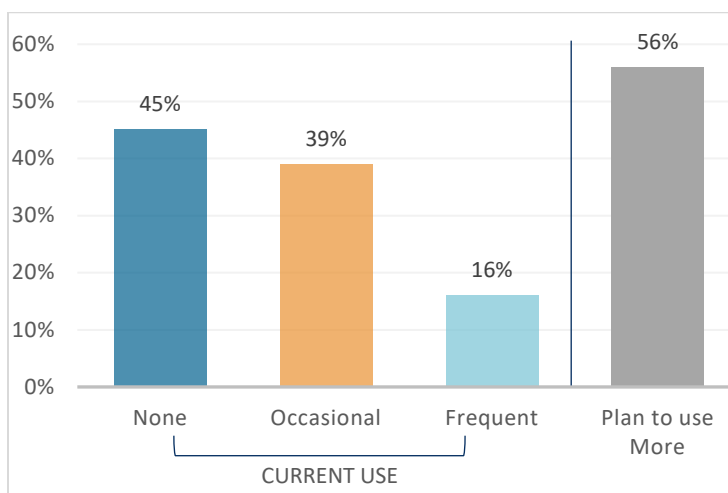
1.2 Predictive Modeling

Use of predictive modeling techniques, and research around those techniques, are expanding within the actuarial community. Property and casualty actuaries have been applying these techniques for many years, and the rest of the profession is increasingly finding new applications.

A smaller percentage of actuaries surveyed for this report indicated they currently use predictive modeling tools (55%) compared with data visualization tools (82%). However, almost the same percentage (56% vs 57%) plan to use them more in the coming year. Like data visualization, existing users of predictive modeling tools are driving anticipated growth in usage; seven in 10 of them plan to use them more in the next 12 months than they currently do. Just under two in five non-users are planning to begin using predictive modeling over the coming year.

While 45% of those surveyed indicated they do not currently use predictive modeling, this statistic varied materially by actuarial function. For example, nearly two-thirds of respondents whose primary responsibility is analytics or modeling indicated they do use predictive modeling, while nearly two-thirds of those whose primary responsibility is risk management indicated they do not use predictive modeling.

Figure 3
Use of Predictive Analytics Among Actuaries



Of the specific technology tools included in the survey questions, R and Python seem to be the most popular in current use, with around 50% of actuaries surveyed indicating they use one or the other (or both). R and Python are also among the fastest growing tools in expected future use, with approximately one-third of those surveyed planning to increase their use in the next year.

Actuaries intending to increase their current use or start using predictive modeling technologies over the next 12 months point to a wide range of applications. The most mentioned applications include enhancing experience studies and related analysis, assumption setting, pricing, reserving, and streamlining underwriting processes.

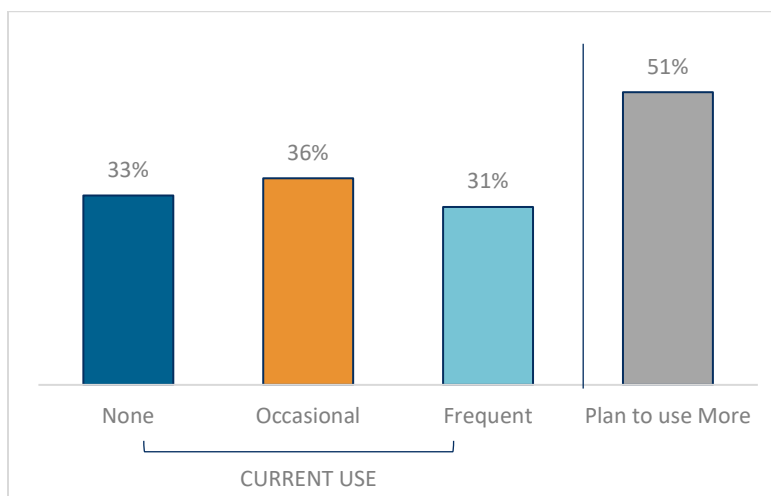
Research articles such as “Predictive Modeling in Long-Term Care Insurance” (Nathan R. Lally & Brian M. Hartman (2016), North American Actuarial Journal, 20:2, pp. 160-183) provide solid foundational support for practical applications of predictive modeling.

Examples of direct application of predictive analytics include a study discussing the development of a lapse model for term life insurance policies that are past their level-term period (<https://www.soa.org/experience-studies/2014/research-2014-post-level-shock/>) and the use of a predictive model to develop risk assessment models for life insurance underwriting (Boodhun, N. & Jayabalan, M. Complex Intell. Syst. (2018) 4:145. <https://doi.org/10.1007/s40747-018-0072-1>).

1.3 Cloud Computing and Storage

About two thirds of actuaries are already using the cloud for computing and/or storage. The most common cloud providers in current use are Microsoft Azure and Amazon Web Services, which are each reported by three in 10 actuaries. However, fewer than one in five actuaries indicate they expect to use either of these specific platforms more in the coming year. This suggests that many actuaries may not yet know which specific tool or provider their organization will use (or use more of) going forward.

Figure 4
Use of Cloud Computing and Storage Among Actuaries



Increased use of cloud computing is driven by several factors. Primary among them are potential efficiency gains in terms of improved access, cheaper storage, or more computing power than on-site servers. Examples of current and potential applications of cloud technology include:

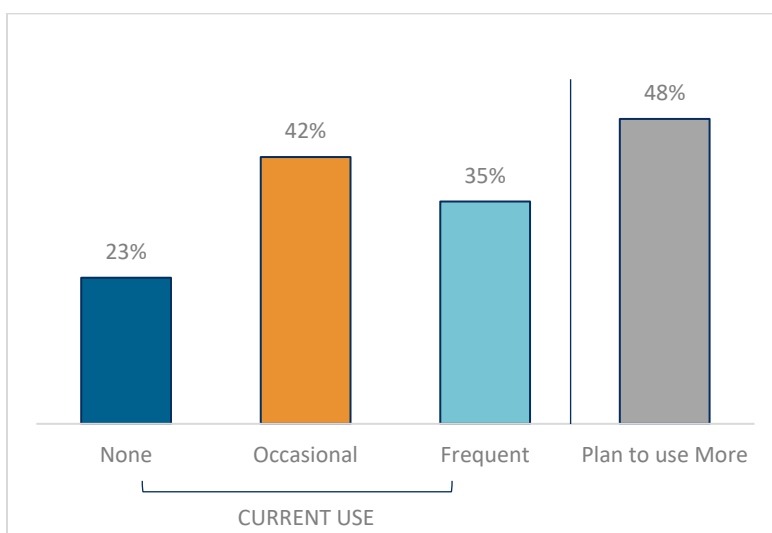
- *Implementation of end-to-end actuarial modernization.* Companies can migrate individual users to the cloud in order to leverage computing power. With cloud-based tools, actuaries can submit model runs on demand by accessing virtual machines in cost-efficient ways. One company was able to implement a process that reduced quarter-end close processing from 5-7 days to less than 1 day.
- *Combination of cloud computing and APIs.* This combination makes it much easier to set up data on demand rather than going through a lot of ETL (extract, transform, load) work.
- *Combination of cloud computing and machine learning applications.* Cloud services can facilitate the application of machine-learning techniques to leverage internal data warehouses. Companies are currently investing time, money, and resources in creating data warehouses and making varying levels of progress. Once that data is easy to access by larger groups within the companies, actuaries expect to see the development of machine-learning applications that leverage that data extensively.
- *Financial modeling.* Cloud computing enables the implementation of more detailed and data intensive modeling methods.

1.4 Collaborative Tools

The fourth leading actuarial technology area is collaborative tools, a category perhaps less clearly defined than others and which may mean different things to different people. While three in four actuaries are already using these tools, nearly half plan to increase their usage going forward.

The main driver of using this technology is efficiency gains, whether in saving time, providing a better platform for communications, or in sharing notes, ideas, and information within and across teams.

Figure 5
Use of Collaborative Tools Among Actuaries



Another example of where collaborative tools are being used is to support work across teams, including internal teams, geographically-dispersed teams (or remote workers), and between organizations. Actuaries are using collaborative tools and program libraries to share modeling approaches across the organization, including re-usable standardized code. Companies are also applying collaborative technologies to improve version control for documents, code, or other work products that will be developed by multiple members of a work team.

Section 2: Emerging Technologies

With the current pace of technological advancements, it is certain that every year will bring new tools for actuaries to assess, with the goal of adopting those that provide the most benefit in improving both efficiency and quality of work processes.

Experts interviewed for this study identified a number of technologies that are not currently in widespread use, but are expected to grow in use among actuaries over the next 3 to 5 years. Comments can be summarized into the following three categories:

1. *Actuarial functions* that are likely to benefit most from emerging technologies;
2. *Methodologies* that can now be applied in an actuarial context as a result of the advancement of technical tools; and
3. *Specific technology/tools* that will allow the implementation of new methods and approaches.

2.1 Actuarial Functions

Actuarial functions that experts predict will see the most benefit from the current pace of technology advancement include assumption setting, experience analysis, financial modeling, underwriting, and financial reporting (real-time). As actuaries apply their skills and knowledge to work on advances in underwriting, they are becoming more involved in the entire new business process. This may lead to actuaries contributing to other parts of the value chain where they traditionally have not been directly involved.

2.2 New Methodologies

New technologies will facilitate increased exploration and use of new methodologies for analyzing data. New tools are already contributing to the expansion of predictive modeling and statistical analysis, including applications of machine learning, neural nets, etc. Interviewees also expect this to lead to the introduction of complexity-science and chaos-theory techniques to better study the impacts of change in complex systems. These applications will increasingly rely on larger and more diverse data sources, which will require new tools and methodologies for preparing data for analysis.

With the advent of open source and collaboration tools, we will see a greater use of program libraries to enable actuaries to share their work with colleagues and, perhaps, the broader profession.

2.3 Tools and Applications

Modernization of the data collection process will be driven both by new sources of data and new tools for accessing that data. New data sources include internal data, such as structured and unstructured customer service and call center data, but will also include new and emerging external data sources such as electronic health records, wearables, drone technology, telematics, and self-driving vehicles.

At the same time, tools such as natural language processing will allow us to mine data from telephone call recordings. Optical character recognition (OCR) will allow collection of data from paper and otherwise non-electronic sources. More tools and methods will emerge to enable conversion of unstructured data into a usable form.

Expansion of predictive modeling and statistical analysis is already being driven by the availability of open source tools, such as R, Python, and STAN, that allow for customized internal model building and the exploration of potentially valuable concepts such as complexity and chaos theory.

Collaboration tools are also expected to drive improvements in actuarial process efficiency and quality. GitHub and emerging GitHub competitors will provide platforms for team development efforts. Serverless architecture will provide the opportunity for experimenting with potential new analysis and modeling approaches before committing to resource intensive IT infrastructure projects. Program libraries, such as those available with current open source applications, are expected to replace the use of Excel and VBA and will allow for greater consistency in program logic and calculations for similar tasks across different functions, such as pricing, financial projections, and valuation.

Experts believe the pace of development and introduction of new technologies will continue for the foreseeable future and this means that actuaries need to be prepared to identify, evaluate, and adopt new applications in an efficient manner in order to remain relevant as an industry and as a profession.

Section 3: Actuarial Capabilities

Experts interviewed as part of this project exhibited confidence that actuaries are capable of learning new technologies if they are made a priority and if actuaries are given the proper training. Interviewees believe the profession is full of very bright people and that actuaries, by training, are self-learners and will take up this challenge. One expert said that solving hard problems requires 1) domain expertise, 2) statistical background and the ability to understand the math, and 3) intellectual curiosity; actuaries have the potential to have all three.

On the other hand, some believe that, in order to move forward, actuaries will have to leave old tools behind. One example is Excel. Interviewees feel that many models built in Excel could be better deployed using open-source tools, such as R and Python. They also think actuaries should be using tools that offer source and version control, something Excel does not. In holding on to past tools, some of the actuaries interviewed think that the profession has lost ground to data scientists. Others suggested that actuaries might build the “garage models” and then turn them over to data scientists to create production-quality versions.

There was also an acknowledgement that these new tools will not be embraced by all actuarial practitioners, which may lead to specialization. One survey respondent summed this sentiment up as follows: *“[This] will also create more niche roles within the profession, blending technology, programming, and actuarial skills. [There is an] opportunity to help establish technology-driven roles and help non-IT savvy actuaries craft roles that leverage more traditional actuarial and management skills.”*

Section 4: The Path Forward

The last question in the survey allowed actuaries to add any additional comments they had regarding top actuarial technologies. Some mentioned that more training is needed, especially for those working at companies that leave the choice of technology (and related support) to the individual; they see the SOA playing a role here.

Others expressed concern that data scientists and other similar practitioners are ahead in adopting new technology and that the actuarial profession needs to become more aggressive in assessing, adopting, and training for these new methods and applications.

Most indicated enthusiasm for the adoption of new technologies and the benefits they can bring in helping actuaries to meet the challenge of new regulatory and market demands.

The SOA plans to conduct regular updates of this report in order to keep actuaries informed about applications of new technology and the impacts they are having on the future direction of the industry and the profession.

The SOA would like to thank the project oversight group for this report for their input and guidance regarding survey design, data collection, and analysis. POG members included:

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Sheamus Kee Parkes, FSA, MAAA

Gene Paul Del Castillo San Valentin, FSA, CERA, MAAA

We would also like to thank the interviewees who volunteered their time and expertise regarding current and future technologies and their relationship to the actuarial function. Finally, we would like to thank the actuaries who provided their responses to the electronic survey.

About The Society of Actuaries

The Society of Actuaries (SOA), formed in 1949, is one of the largest actuarial professional organizations in the world dedicated to serving more than 30,000 actuarial members and the public in the United States, Canada and worldwide. In line with the SOA Vision Statement, actuaries act as business leaders who develop and use mathematical models to measure and manage risk in support of financial security for individuals, organizations and the public.

The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

Objectivity: The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

Quality: The SOA aspires to the highest ethical and quality standards in all of its research and analysis. Our research process is overseen by experienced actuaries and nonactuaries from a range of industry sectors and organizations. A rigorous peer-review process ensures the quality and integrity of our work.

Relevance: The SOA provides timely research on public policy issues. Our research advances actuarial knowledge while providing critical insights on key policy issues, and thereby provides value to stakeholders and decision makers.

Quantification: The SOA leverages the diverse skill sets of actuaries to provide research and findings that are driven by the best available data and methods. Actuaries use detailed modeling to analyze financial risk and provide distinct insight and quantification. Further, actuarial standards require transparency and the disclosure of the assumptions and analytic approach underlying the work.

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