



SOCIETY OF
ACTUARIES®

2019 **ANNUAL
MEETING**
& EXHIBIT

October 27-30
Toronto, Canada

Session 051: Actuarial Innovation and Technology

[SOA Antitrust Compliance Guidelines](#)

[SOA Presentation Disclaimer](#)

Actuarial Innovation and Technology

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Session 051

October 2019



SOCIETY OF ACTUARIES

Antitrust Compliance Guidelines

Active participation in the Society of Actuaries is an important aspect of membership. While the positive contributions of professional societies and associations are well-recognized and encouraged, association activities are vulnerable to close antitrust scrutiny. By their very nature, associations bring together industry competitors and other market participants.

The United States antitrust laws aim to protect consumers by preserving the free economy and prohibiting anti-competitive business practices; they promote competition. There are both state and federal antitrust laws, although state antitrust laws closely follow federal law. The Sherman Act, is the primary U.S. antitrust law pertaining to association activities. The Sherman Act prohibits every contract, combination or conspiracy that places an unreasonable restraint on trade. There are, however, some activities that are illegal under all circumstances, such as price fixing, market allocation and collusive bidding.

There is no safe harbor under the antitrust law for professional association activities. Therefore, association meeting participants should refrain from discussing any activity that could potentially be construed as having an anti-competitive effect. Discussions relating to product or service pricing, market allocations, membership restrictions, product standardization or other conditions on trade could arguably be perceived as a restraint on trade and may expose the SOA and its members to antitrust enforcement procedures.

While participating in all SOA in person meetings, webinars, teleconferences or side discussions, you should avoid discussing competitively sensitive information with competitors and follow these guidelines:

- **Do not** discuss prices for services or products or anything else that might affect prices
- **Do not** discuss what you or other entities plan to do in a particular geographic or product markets or with particular customers.
- **Do not** speak on behalf of the SOA or any of its committees unless specifically authorized to do so.
- **Do** leave a meeting where any anticompetitive pricing or market allocation discussion occurs.
- **Do** alert SOA staff and/or legal counsel to any concerning discussions
- **Do** consult with legal counsel before raising any matter or making a statement that may involve competitively sensitive information.

Adherence to these guidelines involves not only avoidance of antitrust violations, but avoidance of behavior which might be so construed. These guidelines only provide an overview of prohibited activities. SOA legal counsel reviews meeting agenda and materials as deemed appropriate and any discussion that departs from the formal agenda should be scrutinized carefully. Antitrust compliance is everyone's responsibility; however, please seek legal counsel if you have any questions or concerns.

Presentation Disclaimer

Presentations are intended for educational purposes only and do not replace independent professional judgment. Statements of fact and opinions expressed are those of the participants individually and, unless expressly stated to the contrary, are not the opinion or position of the Society of Actuaries, its cosponsors or its committees. The Society of Actuaries does not endorse or approve, and assumes no responsibility for, the content, accuracy or completeness of the information presented. Attendees should note that the sessions are audio-recorded and may be published in various media, including print, audio and video formats without further notice.



Innovation and Technology

PROGRAM OVERVIEW

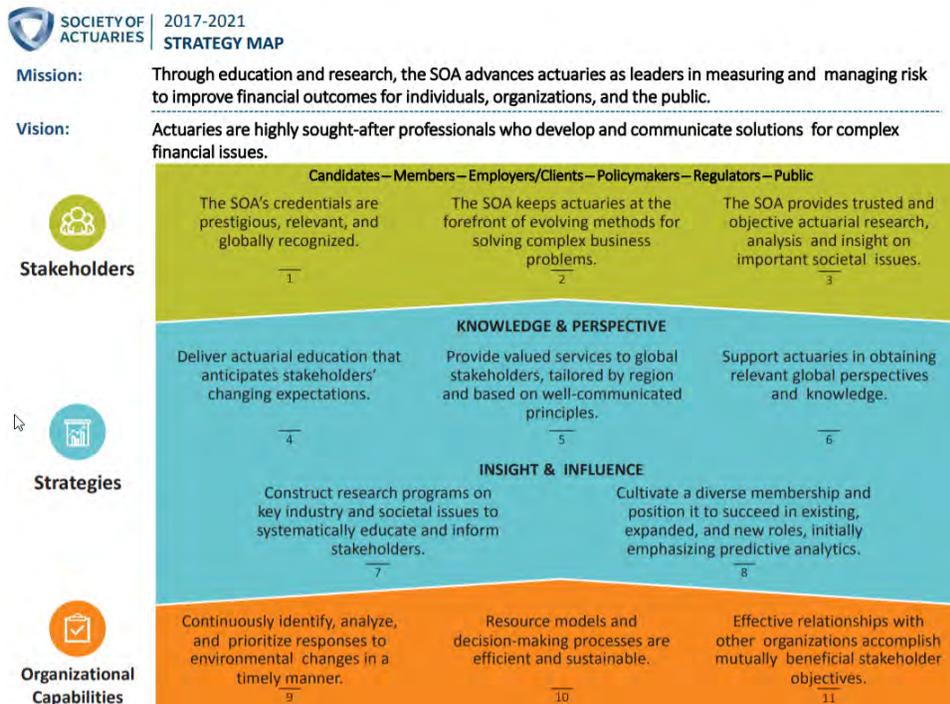


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Actuarial Innovation & Technology

- Strategic Research Program launched April 10, 2019
- SOA Strategic Plan Initiative



Construct research programs on key industry and societal issues to systematically educate and inform stakeholders.

7

Actuarial Innovation & Technology

- Outstanding activities by Sections in recent years
- Wide development of topics already brewing in SOA research committees
- Evolution of Predictive Analytics
 - SOA education syllabus
 - Meetings activities
 - Certificate programs

Program Site

<https://www.soa.org/programs/act-innov-tech/>

What you can find here:

- Research reports
- Learning resources

.... More to come

Actuarial Innovation & Technology Strategic Research

The SOA Strategic Research Programs emphasize the skillset and thought leadership of actuaries, and help provide insights to members, stakeholders, and the public on socially relevant topics.



Home

Resources

Committee

Actuarial Innovation & Technology Strategic Research



The SOA's Actuarial Innovation and Technology Strategic Research Program highlights actuarial research, surveys and papers on the use of new technology involving the actuarial profession. The program is also designed to share how actuaries develop new innovations in this space. Topics include predictive analytics, artificial intelligence, machine learning and how actuaries use computational power.

Research Reports

[A Tour of AI Technologies in Time Series Prediction](#)

In this report, we will try to provide an in-depth review of current Machine Learning and Deep Learning models and will explain how those models work and their possible applications in the actuarial field.

[Considerations for Predictive Modeling in Insurance Applications](#)

Emerging Data Analytics Techniques with Actuarial Applications

The aim of this research is to survey emerging data analytics techniques and discuss their evolution and growing use in the actuarial profession. Data analytics' applications in life and non-life insurance will also be provided.

Cancer Genomics

Traditional pillars of cancer treatment – surgery, radiation, and chemotherapy – are moving to two new efficacious approaches: tumor genomics and immunotherapy. This analysis report introduces SOA stakeholders to these brand-new areas, examines the growing clinical evidence, and sets initial projections for cost effectiveness.

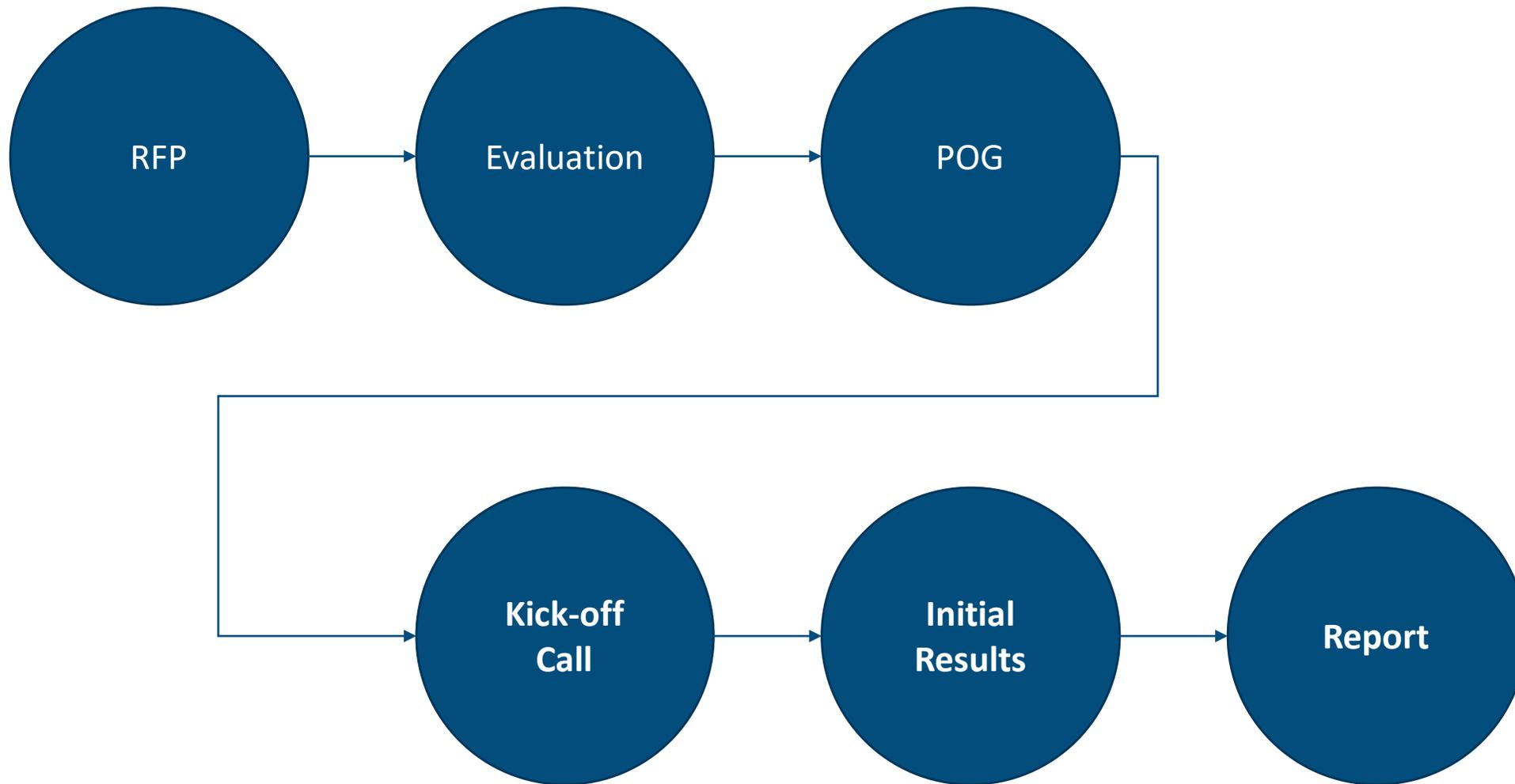
Anticipating
the Challenges
of Tomorrow

Research reports

- **Big Data** and the Future Actuary: How access to non-traditional data is unleashing innovation opportunities for the actuarial profession and insurance industry
- **Cancer Genomics**
- **Behavioral Science** (Economics) Techniques and Models in the Life Insurance Industry
- Technology in **Microinsurance**: What It Is and What It Means for Actuaries
- **Cloud Computing** and Its Impact on Furthering and Deepening Actuarial Analysis, using Models, Projects, and Machine Learning / Artificial Intelligence Techniques
- Emerging **Data Analytics** Techniques
- Tour of **AI** Technologies in Time Series Prediction
- Actuarial Work in **Artificial Intelligence**



The *Research Insight* podcast summarizes the highlights of our research reports in a digestible format – A fantastic resource for learners on the go!



Resource Repository

- Interested in how technology impacts the actuarial landscape?
- Find a list of curated articles on various topics in actuarial innovation and technology.
- We promise it's even better than Google search.
 - Selected by SOA volunteers who are passionate and knowledgeable about the topics
 - An introduction is added for each article to help readers select and digest information.

Artificial Intelligence - Introduction

[AI: Past, Present, and Future](#)

Shankar Vaidyanathan

SOA, December 2018. PDF. 7 pgs.

The purpose of this report is to demonstrate how artificial intelligence applications have grown since their infancy and invite the reader to consider the vast data at our disposal for the future.

[Bot.Me: A revolutionary partnership How AI is pushing man and machine closer together](#)

Anand Rao, Matthew Lieberman

Research & Insights. April 2017. PDF. 18 pgs.

We are right now at the human 2.0 era that AI works as a assisted intelligence, augmented intelligence and autonomous intelligence in every field. One potential exploration for AI is to become a great equalizer while it breaks the limitation of traditional service, provide better service with lower the cost at the same time.

[Reconstructing work: Automation, artificial intelligence, and the essential role of humans](#)

Peter Evans-Greenwood, Harvey Lewis, Jim Guszczka

Deloitte Review. July 2017, Iss 21. PDF. 21 pgs.

If we're to draw a line between human and machine, then it is the distinction between creating and using knowledge. Facing with the rapid development of AI industry, we are peddling in a new era, integrating human and AI.

Artificial Intelligence - Insurance Industry

[Breaking through the issues preventing AI adoption in insurance](#)

Neal Silbert

Insurance Business. February 2019.

AI has the potential to help underwriters better understand their customers, improve risk differentiation and establish substantially more accurate pricing. The development of Automated Machine Learning (Auto ML) has emerged as a multi-needed solution. This new level of automation allows actuaries to use Auto ML with fewer days of training in order to increase the capacity to solve problems.

[Commercial insurers primed for intelligent automation](#)

Day Bishop and David Ovenden

Emphasis. January 2018.

AI currently provides sophisticated automation and real-time decision support in the commercial. The most common approach is Robotic process automation (RPA), which deliver consistent, accurate and informed decisions in underwriting, pricing and claims.

Top Actuarial Technologies of 2019



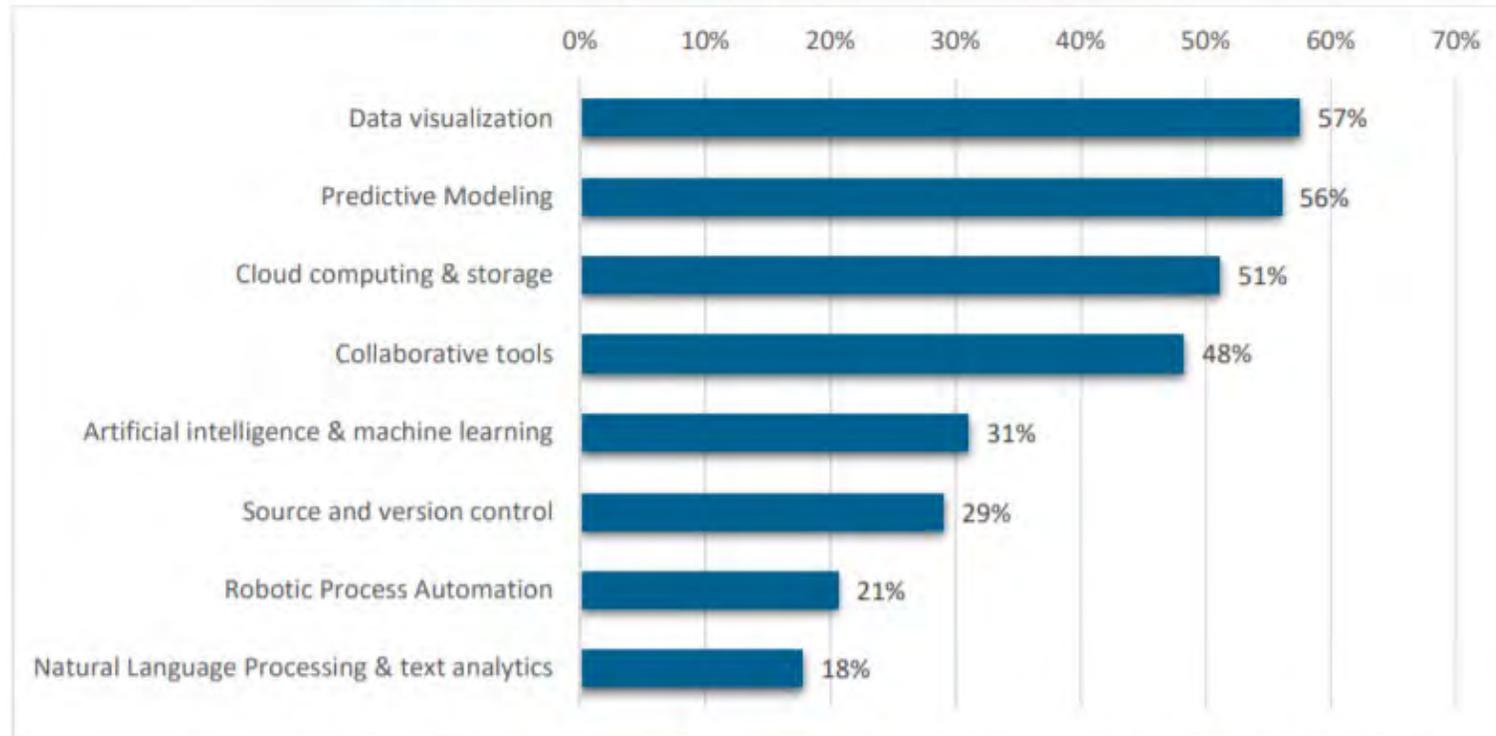
Highlights of Key Findings



Fastest-growing Actuarial Technologies

Figure 1

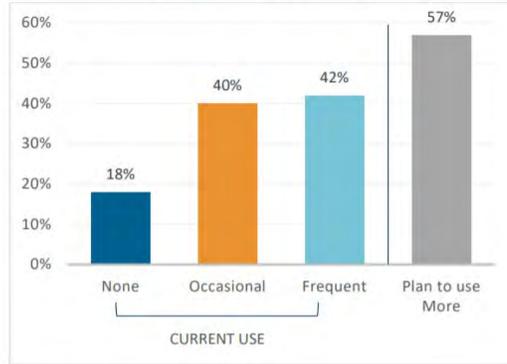
Technology Areas Expected to Grow Fastest in Use in 2019*



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

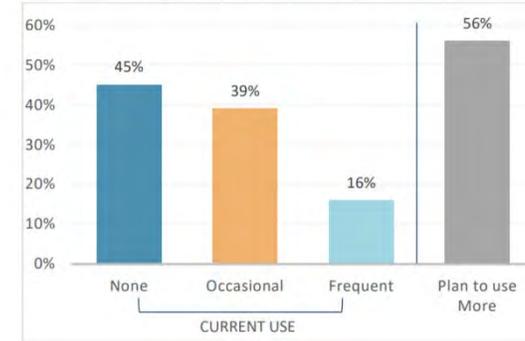
Top 4 Actuarial Technologies of 2019

Use of Data Visualization Among Actuaries



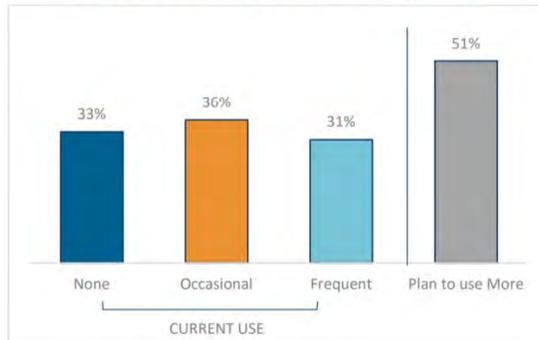
Data Visualization

Use of Predictive Analytics Among Actuaries



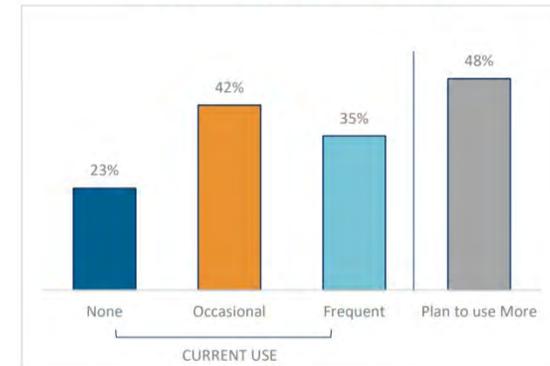
Predictive Modeling

Use of Cloud Computing and Storage Among Actuaries



Cloud Computing

Use of Collaborative Tools Among Actuaries



Collaborative Tools

Cloud Computing and Machine Learning Uses in the Actuarial Profession

Prepared for the SOA 2019 Annual Meeting

OCTOBER 2019

Background

- Actuarial modeling has become more and more complex as computational capacity has expanded
- Initial models were performed by hand, the computer gave rise to spreadsheet models, and platforms like SAS / R / Python have contributed to the increased use of predictive analytics
- The “cloud” provides another significant shift in computational capabilities through:
 - Expanded data storage
 - Expanded computational capacity
 - Enhanced model governance and controls
- These developments are currently and will continue to impact the work of actuaries
- <https://www.soa.org/globalassets/assets/files/resources/research-report/2019/cloud-computing.pdf>

What is the cloud?

What is the cloud



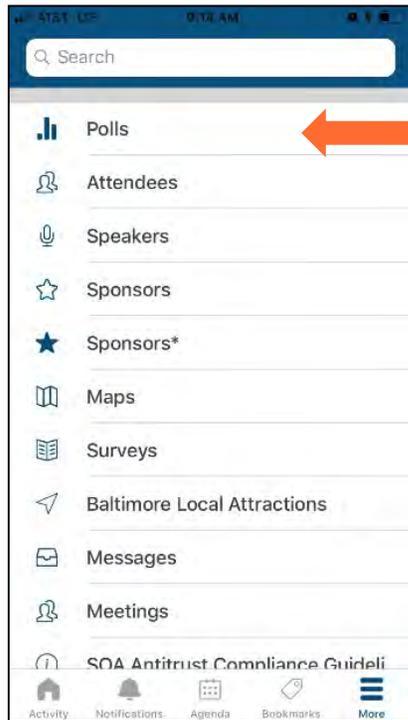
***cloud computing** is the internet-based outsourcing of digital storage along with access to a collection of resources, including software, databases, data warehouses, and computational processing*

Industry Survey

Actuarial uses of the cloud

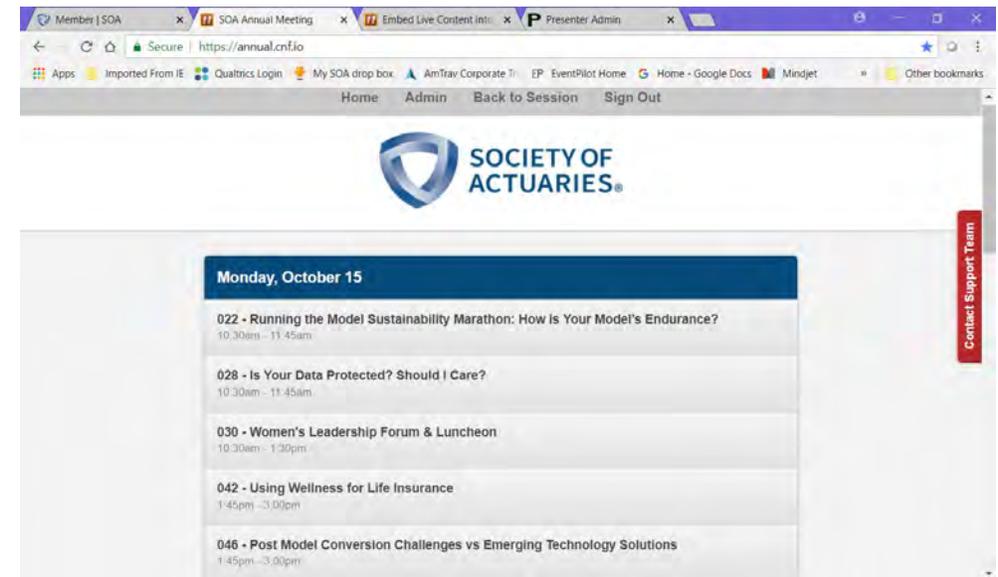
To Participate, look for Polls in the SOA Event App or visit annual.cnf.io in your browser

Find The Polls Feature Under **More** In The Event App or Under This Session in the Agenda



or

Type annual.cnf.io In Your Browser



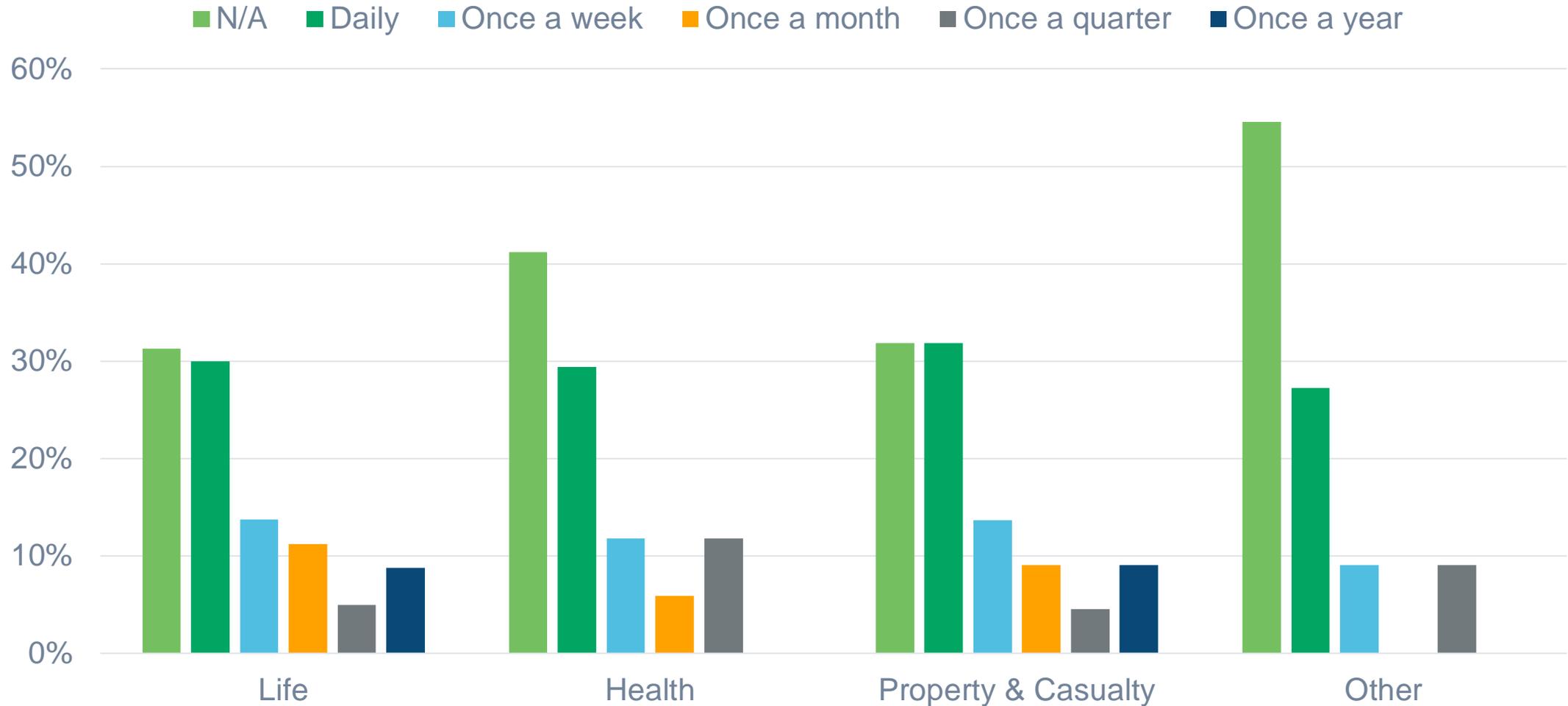
Live Content Slide

When playing as a slideshow, this slide will display live content

Poll: How frequently do you use cloud computing in your current role as an actuary?

Key Survey Results

Q4. How frequently do you use cloud computing in your current role as an actuary?



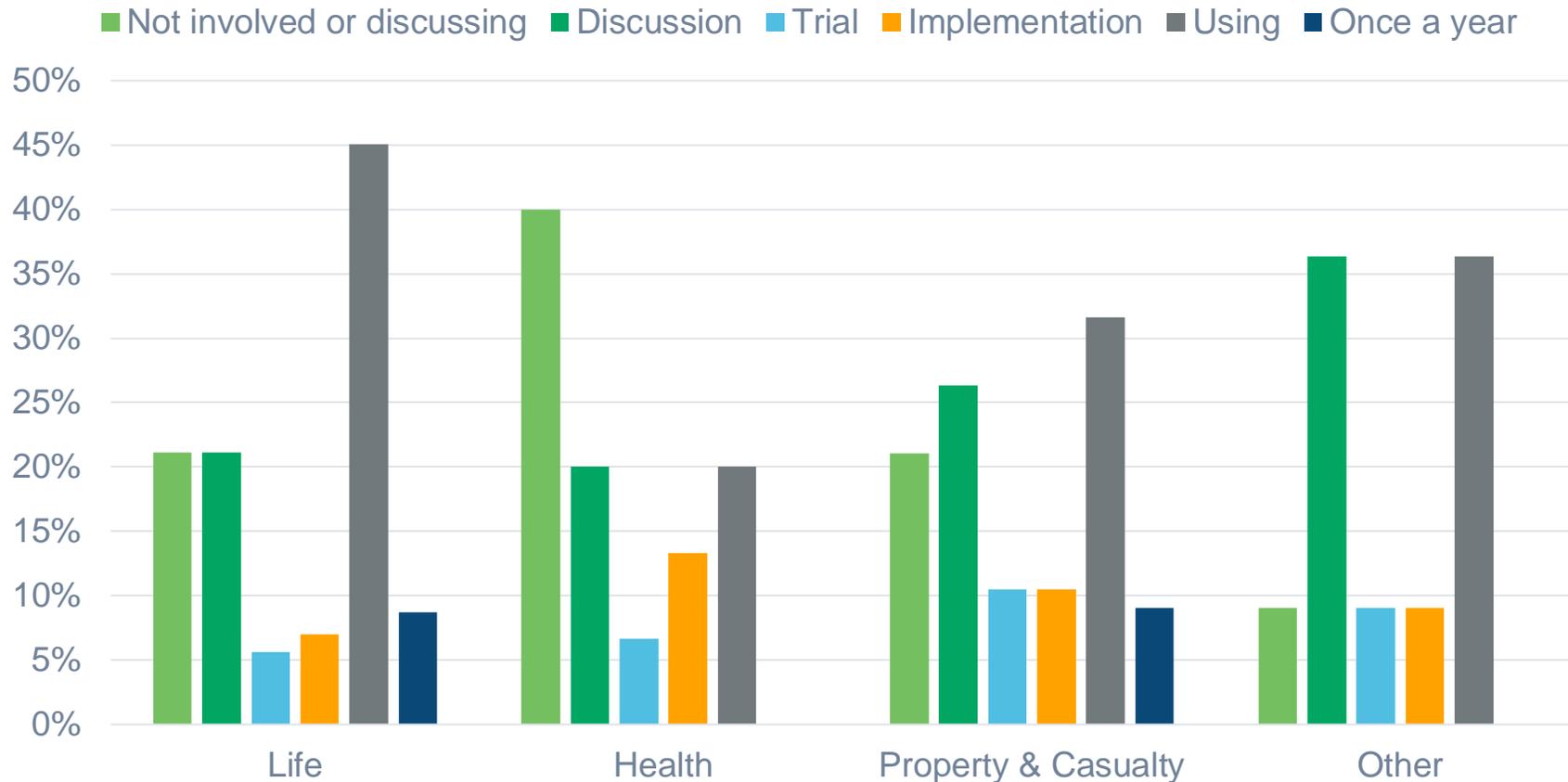
Live Content Slide

When playing as a slideshow, this slide will display live content

Poll: At what stage is the actuarial department within your organization at with regards to leveraging either cloud storage or computing for financial modeling and/or actuarial processes for your current role?

Key Survey Results

Q5. At what stage is the actuarial department within your organization at with regards to leveraging either cloud storage or computing for financial modeling and/or actuarial processes for your current role?



Live Content Slide

When playing as a slideshow, this slide will display live content

Poll: How large of an impact to actuarial work does access to the cloud offer? For this question we are referring to both cloud storage (e.g. larger data sets) and cloud computing (e.g. faster computation times)

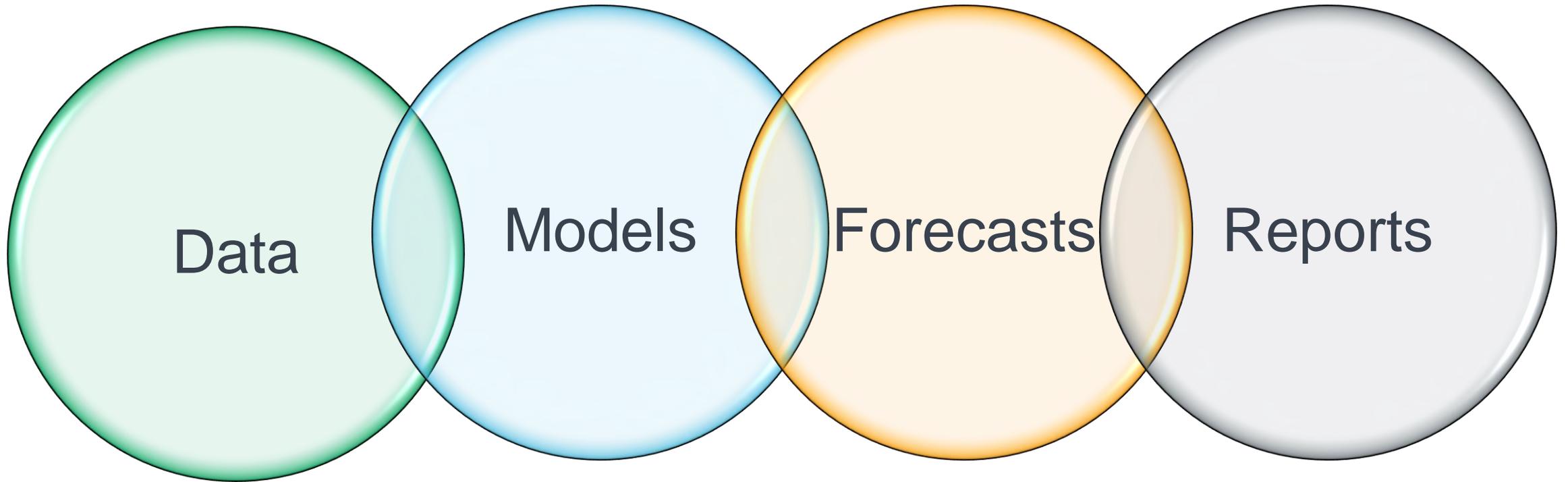
Key Survey Results

Q8. How large of an impact to actuarial work does access to the cloud offer? For this question we are referring to both cloud storage (e.g. larger data sets) and cloud computing (e.g. faster computation times). (1 being large negative impact, 5 being high positive impact)

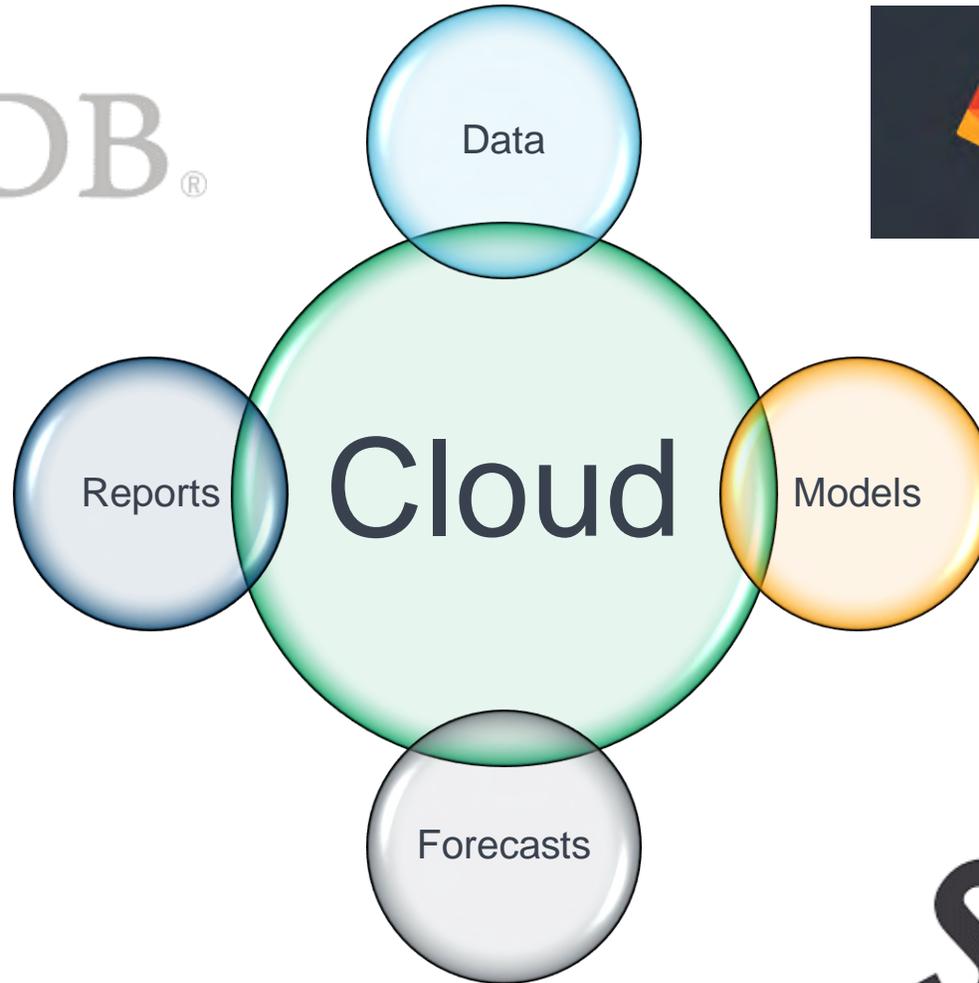


Financial modeling, actuarial processes, and the cloud

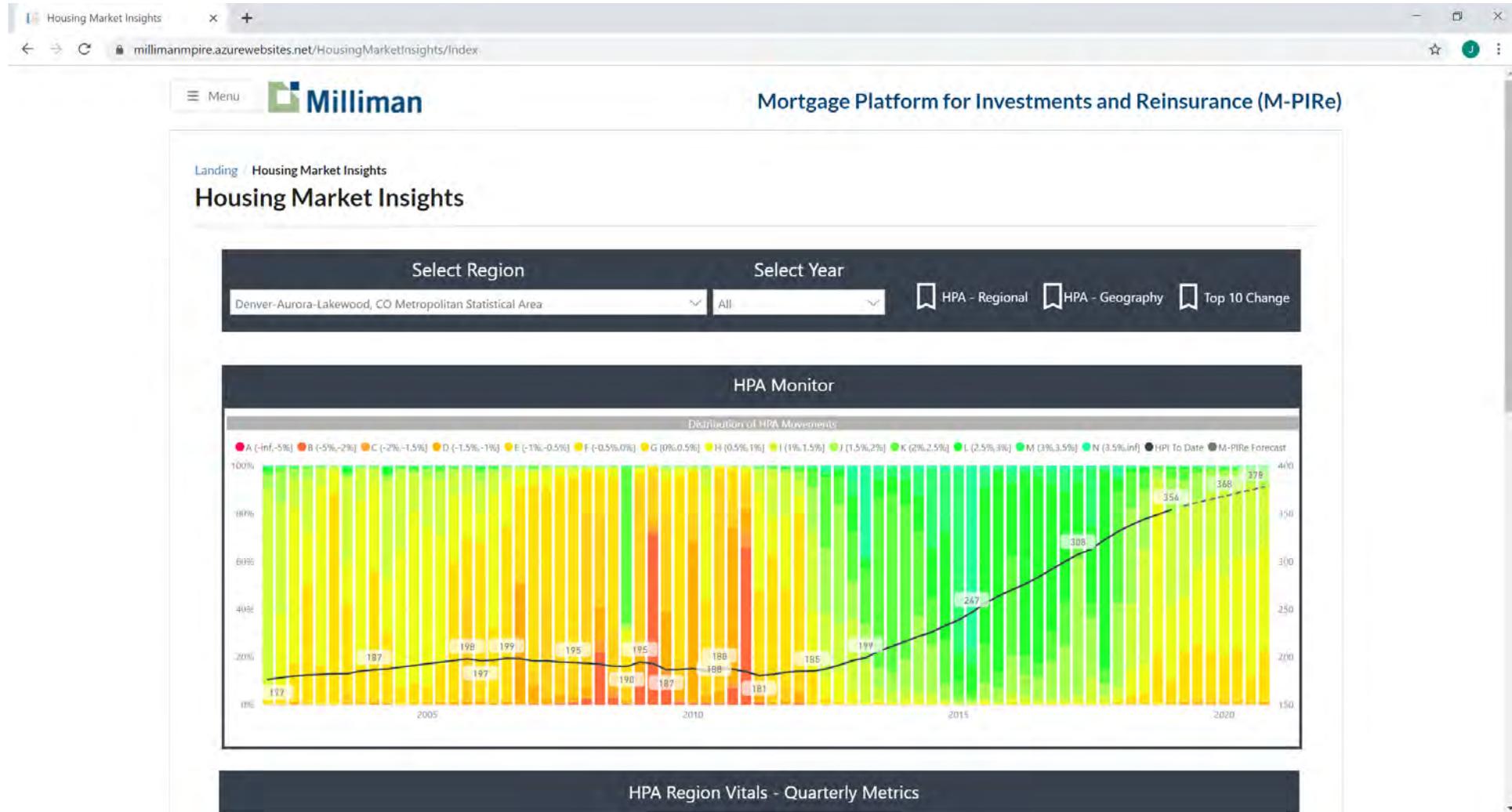
Current Process



Cloud-based Process

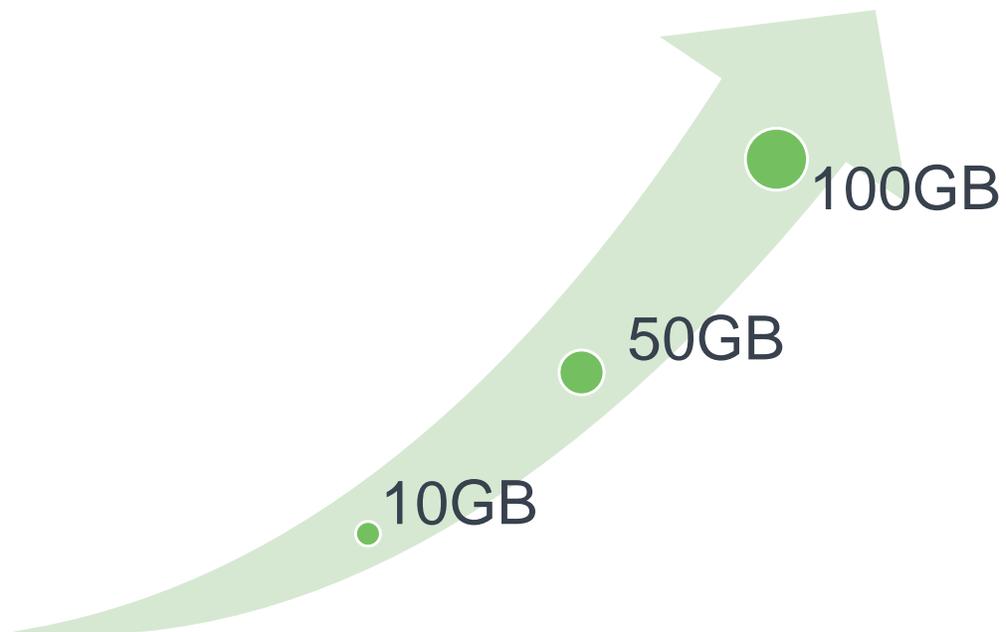


Cloud-based delivery of results



Machine Learning and AI

Data



We are getting more and more data

Storing data is cheap

Recording everything: detectors are put everywhere in your car (>100)

Analyzing and processing this huge amount of data is difficult

Cloud computing

Underwriting : Telematics

- Complex Relationships
- Large amounts of data
- Consumer demand for “price per mile” insurance
- **Machine learning can help process and price this data**

Claims Management : Healthcare

- Complex interactions for patient care
- Multiple sources of data
- **Machine learning can help interpret and group similar patients together to recommend care to reduce ultimate healthcare costs to the patient**

Credit Risk : Mortgage

- Millions of records of data with many interaction variables
- Each record has a potential 360 month exposure
- **Machine learning models better capture and outperform traditional regression based models**

**What does this mean
for actuaries?**

Resources

- *The 8 Best Places to Learn Cloud Computing*: <https://www.akraya.com/blog/the-8-best-places-to-learn-cloud-computing>
- *Cloud Computing: Concepts, Technology & Architecture*: <https://books.google.com/books?id=czCiJ6sbhpAC>
- *Best Practices for Scientific Computing*: <https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1001745>
- *An Introduction to Statistical Learning* : <http://www-bcf.usc.edu/~gareth/ISL/>
- *Kaggle*: <https://www.kaggle.com/>
- *Coursera / EdX*
<https://www.coursera.org/>
<https://www.edx.org/>



Thank you

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Ethical Use of Artificial Intelligence for Actuaries



<https://www.soa.org/globalassets/assets/files/resources/research-report/2019/ethics-ai.pdf>

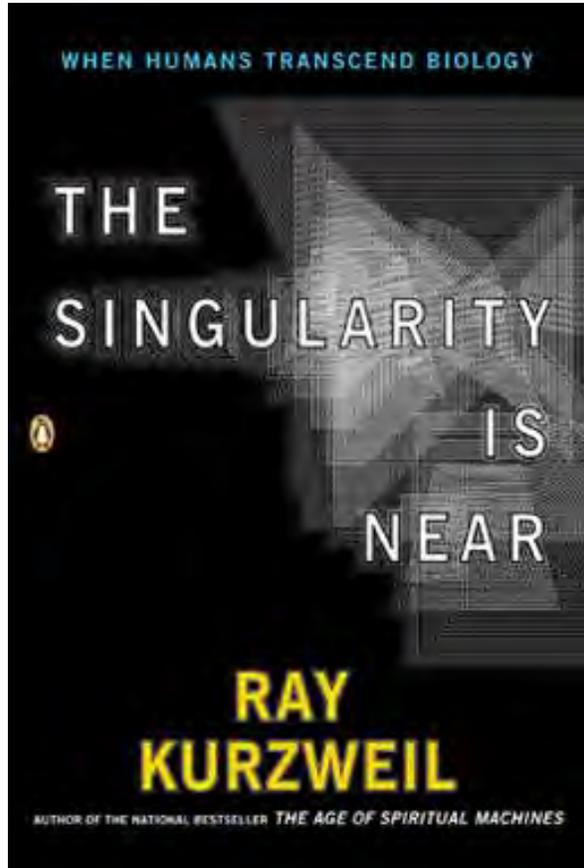
September 2019

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Neil Raden, Founder/Principal Analyst
Hired Brains Research LLC
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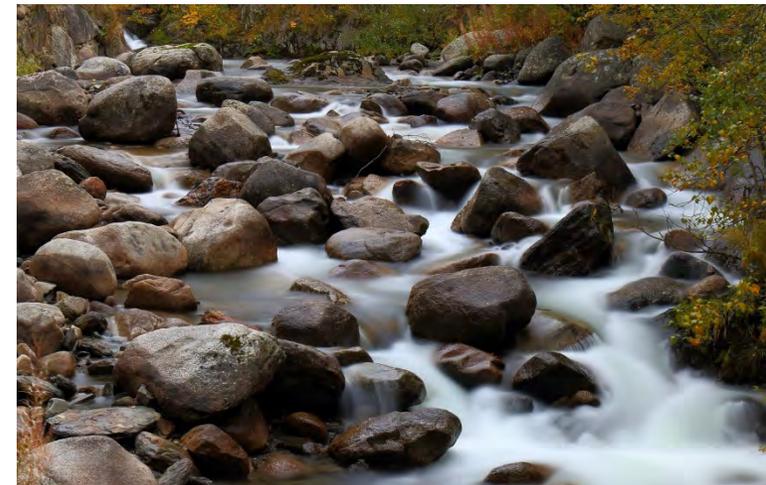
Ray Kurzweil and the 2049 Singularity



“Will people, through ethical debates thwart this ongoing exponential development?”
I strongly believe that's not the case.

These ethical debates are like stones in a stream. The water runs around them.”

Kurzweil: Machine intelligence will be infinitely more powerful than all human intelligence combined and will radiate outward from the planet until it saturates the universe. The Singularity is the point at which machines intelligence and humans would merge.



Not So Fast Ray: Consciousness Does Not Compute



Stuart Hameroff and Sir Roger Penrose

Consciousness is an emergent chaotic process that arises from the collapse of the wave function (quantum) in the microtubules of the neurons

That is the central, undeniable reason why a computer will never have consciousness. Computers are algorithmic. Computers cannot simulate chaos, and chaos is at the root of consciousness.

AI Ethics Fundamental Concept: The Social Context

Autonomous underground
Drilling Machine.



Insurance Clients



No Social
Context



Social
Context

First Principals: The Five Pillars of Ethical AI

- Creating **Responsibility** for what a developer creates and uses
- Using **Transparency** to ensure the logic of an AI is viewable
- Ensuring that output has **Predictability** and produces consistent results
- Guaranteeing **Auditability** of the outcomes
- Ensuring AI systems have **Incorruptibility**; protected from manipulation.



Transparency

Can an action be explained?

Conclusions from deep learning neural nets or genetic algorithms difficult to explain

Other methods, such as decision trees and Bayesian nets, much more transparent.

However still a gap between transparent and explainable



Transparent: I can see every step in a NN, but how can I explain it?

Some interesting work happening in explainability

Types of Bias

Bias is Fundamental

Whether it's unintentional, Implicit, data bias or insidious:

1. Performance in machine learning is achieved via minimization of a cost function (gradient ascent/descent)
2. Bias in Machine Learning: results that are systematically prejudiced due to faulty assumptions.

Example of Unintentional Bias

- Training data set masks attributes that relate to protected classes such as age, gender, race, religion.
- But a poorly constructed model leaves the algorithm loose enough to minimize (or maximize) its cost function by using “latent values” that relate exactly to those protected classes
- “The algorithm finds a way”
- Examples: skin lesions, horse pictures >>>

Amateurish: Unintentional Cases of Image Recognition Fail



Testing accuracy of detecting skin cancer
In pictures of lesions. Testers were baffled
by extraordinary high level of false positives

Solution: Dermatologists always use a standard
ruler to measure the size of the lesion. If it is
greater than 3cm, they elect for biopsy.
NN assumed every picture with a ruler was malignant



Two competing picture recognition Neural networks
were tested for speed and accuracy in identifying
Horses in the pictures.

One NN operated on the features of the photos. It took
11 hours and was accurate 76% of the time.

The other NN took 36 seconds and was accurate 100%.
Every digitized picture and metadata that you can't
See, but it did and picked the ones that said "horse.!"

Implicit Bias



Is this a farmer and his wife?
Or is it a farming couple?

Bias flavors language

Language reinforces bias

They are both farmers

Data Bias

Data Doesn't Speak for Itself



Context of data: Why and how it was collected, how it was transformed

It is the result of human decisions about what to measure, when and where and by what methods

There is no context-free data

Suggestion: get better tools to help you

Acxiom*, Epsilon, Datalogix, RapLeaf, Reed Elsevier, BlueKai, Spokeo, and Flurry

- \$156B data surveillance industry, 2x size of US intel budget.
- Optum (United Health Group) data on 150M Americans going back to 1993
- 3rd-party brokers create categories of their own:
 - Christian families, Compulsive gamblers, Zero mobility,, Hispanic Pay Day Loan Responders
- Demographic /sociographic sources, EHR, credit reports, psychographic profiling and digital phenotyping



\$156 Billion doesn't go as far as it used to

*Acxiom has struck a deal to sell a major portion of its business, a marketing unit, to **Interpublic Group** for \$2.3 billion.

Here Are the Victims. Where is the Perpetrator?

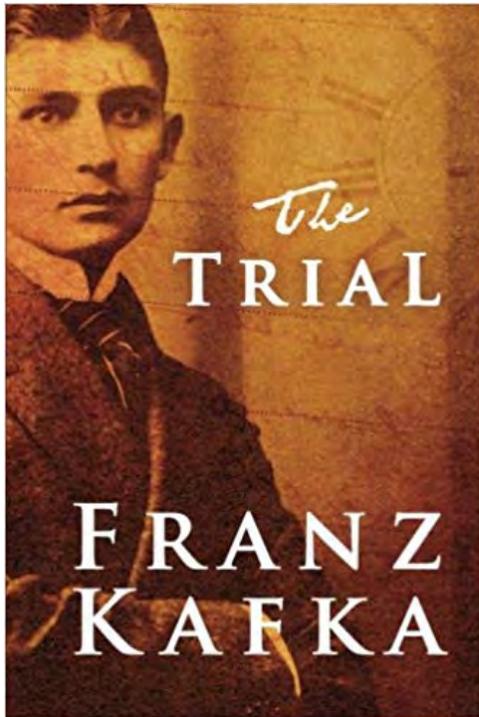
- A biased AI can quickly create a multitude of unfortunate effects
- There can be thousands or millions of victims

- Shouldn't there be laws?

- Laws ALWAYS look for the perpetrator
- In this case, there could be many victims, but no perpetrator
- There are better solutions than laws

Like Being in a Kafka Novel

Personal data that can be collected happens with hardly any regulations



A man is arrested without being informed why and only later learns that a mysterious court has a secret dossier on him, which he cannot access

Repeatable Algorithms Can Work Against People

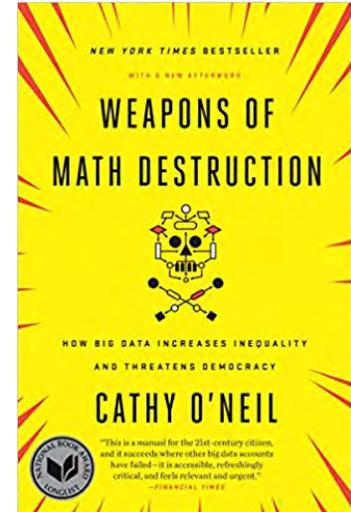
- Misconception: Algorithms accurate, make no mistakes.
- Algorithms “fire” at high cadence and repeat bias at scale.
- People comfortable accepting the algorithm’s output

Solution: Augmented Intelligence, Less biased decision-making tools by combining the capabilities of humans and AI

Closing the GAP: Group-Aware Parallelization for Online Selection of Candidates with Biased Evaluation

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3444283

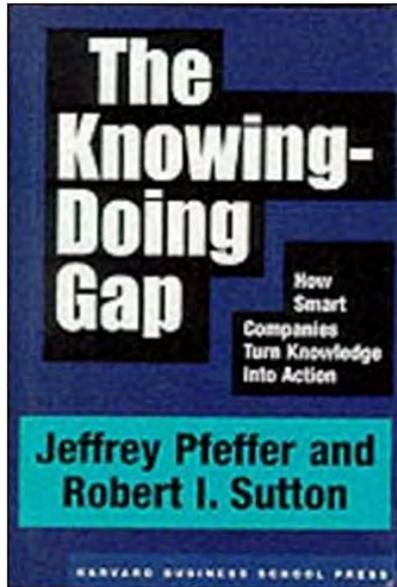
Can we create better algorithms for screening candidates - and reduce hiring bias? <https://diginomica.com/can-we-create-better-algorithms-screening-candidates-and-reduce-hiring-bias>



Some Things to Consider

Internal Ethical Review Board

Enron had a code of ethics practices 64 pages long



I don't think eliminating the knowing-doing gap depends on the amount of knowledge around. It depends much more on people's attitudes and intentions - do they actually want to turn knowledge into action, or just go through the motions of acting as if they are busy or are accomplishing something.

— Jeffrey Pfeffer —

AZ QUOTES

- It may be useful, but don't just jump into it

Organizing an Actuarial Group for AI

Data Management, at least the review and stewardship of AI-driven “data wrangling” platforms, especially when dealing with unstructured and external data sources

Ability to design ML models using AI workbenches

Translators: Explaining the design and results of AI models to others

Facility to understand the operation of embedded AI routines in software



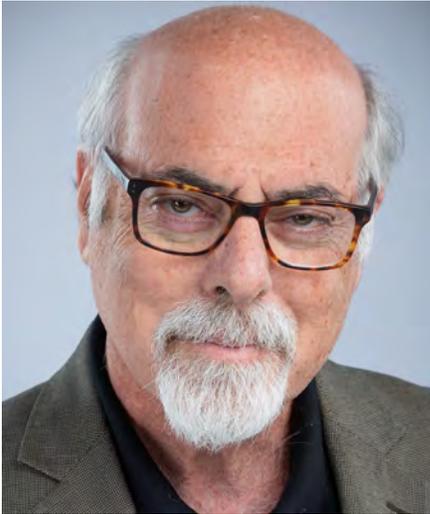
The best potion for defeating bias is diversity

From Precept 2, practical application of the SOA Code of Professional Conduct, qualification standards: “Perform actuarial services only when qualified to do so.” An ethical question might also be “how much knowledge in AI do I need to know that I’m qualified to use AI in my work?”

One Last Thing



Thank You



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