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Validating Algorithmic Underwriting Models – Expert Panel Report

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Validating Algorithmic Underwriting Models – Expert Panel Report

Section 1: Background and Objectives

The adoption of more advanced algorithmic underwriting techniques in the life insurance industry --especially those that leverage Big Data solutions[1] -- has grown notably over the last decade. The validation of algorithmic underwriting models (AUMs) is a new and evolving challenge in the industry, with relevance to insurance companies, reinsurers, regulators, consumers, and others.

On December 11, 2019, the Actuarial Innovation and Technology Steering Committee of the Society of Actuaries (SOA) assembled an industry expert panel to discuss the key considerations and challenges of AUM validation. The panelists (listed in Section 6) included state regulators, direct writers, reinsurers, and consultants; selected to represent a range of opinions and not necessarily to form a consensus. Ernst & Young (EY) facilitated the expert panel discussion and assisted the SOA in summarizing the discussion in this report.[2]

The objectives of the panel discussion were to:

- Identify the key principles, considerations, and leading practices for validating algorithmic underwriting models[3]
- Enable a better understanding of the complexity, risks, and regulatory concerns of AUMs from the viewpoint of diverse stakeholders

While the themes covered in this report could apply to multiple jurisdictions, the panel discussion was focused on the life insurance industry and regulatory oversight in the United States.

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[1] Big Data solutions in this context are defined as technological applications able to manage and interpret complex, high-volume datasets with structured and unstructured information from a variety of sources.
[2] This report does not identify any specific views to a panelist or company. It does not reflect the viewpoint of either the SOA or EY.
[3] The focus of the panel discussion and this report is life insurance underwriting models. Property & Casualty models were not in scope.

Section 2: Introduction

Underwriting has continually evolved throughout the history of insurance. Technology advancements over time have opened, and will continue to open, new underwriting possibilities from both process automation and content standpoints. More recently, technology advancements and the emergence of Big Data solutions have accelerated the pace of change and provided an opportunity for more efficient and effective underwriting -- a process that traditionally has been seen by many as intrusive, time consuming, and costly.

In this context, algorithmic underwriting (AUW) refers to the use of computational algorithms, external data sources, and Big Data solutions to inform an underwriting decision.

As one panelist noted, the use of algorithms in underwriting should not be interpreted as the absence of human judgment, but as a progression of its role. Judicious underwriting will be as critical as ever. What algorithmic underwriting enables is the shift of human judgment from individual underwriting decisions to underwriting *strategy*, allowing the underwriter to focus on the most complex aspects of a case and save time by avoiding routine information. Algorithmic underwriting enables insurers to achieve broader business goals, such as penetrating a larger or different market segment, reducing operating costs, or improving customer experience. Another panelist noted that AUMs can be used to identify and influence key customer behaviors to reduce their risk exposure and associated insurance costs.

Algorithmic underwriting has increased significantly since 2010. Many accelerated underwriting programs incorporate algorithmic underwriting. According to a 2018 SOA industry survey[4], of 27 direct writers and five reinsurers with accelerated underwriting programs in 2018[5], the first program started in 2011. The range of products subject to algorithmic underwriting has also increased, from predominantly term products to equity indexed life, universal life, and whole life (participating and non-participating).

This surge in algorithmic underwriting models inevitably raises new risks and uncertainties. The panelists identified regulatory requirements and oversight as key focus areas, particularly the potential for unlawful discrimination and the need for customer transparency. These are discussed in Section 3 of this report. Additionally, the model development and implementation processes are also major challenges as discussed in Section 4.

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[4] Accelerated underwriting practices survey. Published December 2019. <<https://www.soa.org/globalassets/assets/files/resources/research-report/2019/accelerated-underwriting-survey.pdf>>
[5] Most of which are algorithmic to a certain degree.

Section 3: Regulatory Considerations

The rapid adoption of algorithmic underwriting using a vast array of external data sources -ranging from commonly used FCRA[6] compliant data to other individually attributable emerging data sources[7] - has created several challenges for regulators. As one regulator panelist stated, their major concern is to protect the consumer from being treated unfairly; and the nature of algorithmic underwriting, which in some cases relies on intellectual property from third-parties, makes this task difficult. Moreover, while the model may not be designed or calibrated to unfairly discriminate against consumers, without proper controls the underwriting decisions recommended by the algorithms may ultimately result in discrimination of protected classes and others.

The panel discussion included a focus on the Insurance Circular Letter No.1 (2019) from the New York State Department of Financial Services, published on January 18, 2019[8] (the "NY Insurance Circular"), which discusses the use of external consumer data and information sources in underwriting for life insurance. While the NY Insurance Circular may not be applicable to all insurance companies, it provides valuable perspectives from one key regulatory authority.

3.1 UNLAWFUL DISCRIMINATION

The NY Insurance Circular states that an insurer "should not use an external data source, algorithm or predictive model for underwriting or rating purposes unless the insurer can establish that the data source does not use and is not based in any way on race, color, creed, national origin, status as a victim of domestic violence, past lawful travel, or sexual orientation in any manner, or any other protected class." Furthermore, an insurer "may not simply rely on a vendor's claim of non-discrimination or the proprietary nature of a third-party process as a justification for a failure to independently determine compliance with anti-discrimination laws. The burden always remains with the insurer."

Panelists highlighted compliance challenges for insurers, especially those who rely on third-party risk scores. Insurers effectively need to demonstrate to themselves and regulators, by analyzing the AUM results, that they are not being unlawfully discriminatory. However, they expressed concern as the mere act of checking for unlawful discrimination bias might open insurers to liability.

Broadly speaking, panelists noted that AUMs should be viewed as an evolution of underwriting, which may augment or counter existing biases, or introduce new ones. Some panelists warned against believing that an AUM is 'always wrong' and the traditional underwriting process is 'always right'. Traditional underwriting approaches may already reflect biases. Some panelists believed that AUMs might help insurers apply better controls for testing biases in traditional underwriting that were previously undetectable.

Acknowledging the fact that fairness will matter as much as scientific validity in AUM - if not more - panelists highlighted the need to work closely with regulators to define 'fairness' and how to deal with uncovered biases. Industry and regulator panelists agreed that an independent study by a professional organization such as the SOA or the American Council of Life Insurers (ACLI) -- acting as a safe harbor -- could examine the prevalence of 'proxy discrimination' (for example, the use credit scores and their correlation to protected classes). This would aid the industry in finding effective ways to prevent such discrimination and establish guidelines.

The NY Insurance Circular also states that, "even if statistical data is interpreted to support an underwriting or rating guideline, there must still be a *valid rationale* or *explanation* supporting the differential treatment of otherwise like

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[6] Fair Credit Reporting Act
[7] Examples of new and emerging data sources include credit data, medical claims data, and purchased marketing data.
[8] Insurance Circular Letter No. 1 (2019), <<https://www.dfs.ny.gov/industry_guidance/circular_letters/cl2019_01>>

risks (emphasis added)." Panelists noted that disclosing a rationale is manageable with models such as Generalized Linear Models (GLMs), which regulators understand, but can be more challenging with more complex models.

3.2 TRANSPARENCY

Insurer obligations regarding adverse underwriting decisions are also an area of regulatory focus. The NY Insurance Circular states that "where an insurer is using external data sources or predictive models, the reason or reasons for any declination, limitation, rate differential or other adverse underwriting decision provided to the insured or potential insured should include details about all information upon which the insurer based such decision, including the specific source of the information upon which the insurer based its adverse underwriting decision."

One panelist observed that, if insurers are required to disclose, for example, why potential preferred class customers were sent for additional testing, it could complicate the customer experience and ultimately lead them to walk away from competitive products.

Panelists stressed that explaining every adverse decision driven by an AUM could be a difficult task, since the relationship between the data and the predicted outcome is less clear as models become more complex. One panelist commented that, in AUW, and in Big Data solutions more broadly, "the models you struggle the most to explain tend to be most accurate."

Nevertheless, one panelist observed that model 'explainability' and interpretability evolves over time. He expects professional bodies and regulators will eventually become more comfortable interpreting and explaining models, such as neural networks and other machine learning techniques, in the same way they have become more comfortable with GLMs in recent years.

Another panelist expects this process to take longer and that insurers will pick models with lower predictive power in the meantime rather than creating friction with a regulator over a new model. Other panelists expect insurers to look for opportunities to meet with regulators to discuss the models they are using rather than selection models with lower predictive power.

Section 4: Model Development and Implementation

AUMs emerging as Big Data solutions enabled companies to access vast amounts of identifiable customer data, such as electronic health records, data from wearables, prescription history, etc. The paradigm shift from scarcity to abundance of data does not come without challenges.

To create value from these new technologies, insurers require new skillsets and competencies. As AUMs become a material value driver for companies, model development and implementation become critical. Actuaries and other life insurance practitioners must understand AUW modeling methodology and design, testing and validation, the model's interaction with the underwriting decision process, and how enterprise model risk management should be tailored for AUMs.[9]

4.1 METHODOLOGY AND DESIGN CONSIDERATIONS

Panelists agreed it is important to distinguish the AUM methodology and design from traditional actuarial models (e.g., valuation, pricing, and ALM/hedging). AUMs rely on the latest data science innovations, whose taxonomy, complexity, and maintenance the insurance industry is still learning. As direct writers design their AUMs, panelists recommended reinsurers as a sounding board, given most of them have robust data science teams and greater back-testing capabilities.

The panel identified cross-functional education and collaboration as key aspects of AUM design and implementation. Successful AUM design would include input from data scientists, software developers, underwriters, product development and valuation actuaries, risk management, marketing and distribution agents, and information technology executives. As one panelist noted, "it is as important for actuaries and underwriters to understand data science and software development, as for data scientists and developers to understand the insurance industry."

Regarding model development, one panelist warned it is critical for insurers to enforce rigorous model development standards and governance, for example, coding guidelines and proper "DevOps."[10]

Finally, panelists advised against "following your competition" when selecting and designing an AUW program and model. Each insurer has unique value propositions, target market segments, and relationships with their distributors and underwriters. The same AUM in different companies may yield very different results, which hinge not only on model design decisions, but other key factors including setting proper expectations for stakeholders and long-term leadership commitment.

4.2 TESTING AND VALIDATION

One key challenge with financial models for long duration insurance products is that model fit issues may take a long time to manifest. Underwriting risk scores are no exception. Actuaries are familiar with underwriting wear-off and their impact on long-term expected claims. AUMs bring a new set of variables that challenge not only the existence of a wear-off period, but the definition and homogeneity of risk scores themselves. As one panelist hypothesized, "tobacco may be proven to be not as significant as the combination of other (previously unmeasured) variables."

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[9] Actuaries specifically need to review and follow Actuarial Standard of Practice (ASOP) No. 56, Modeling.
[10] "DevOps" denote the set of practices that combine software development (Dev) and information-technology operations (Ops), which aim to shorten the systems development life cycle and provide continuous delivery with high quality.

To test and validate AUMs, practitioners need to carefully weigh-in the credibility of the data consumed by the models and the correlation of model inputs. Back-testing, in this early stage of AUW, consists of reviewing AUM risk scoring decisions relative to traditional underwriting criteria.

Panelists emphasized the importance of two procedures to assess performance: (1) random holdouts, which require full underwriting for a random subset of the applications that qualified for full UW waiver; and (2) post-issue audits, which request more information from the policyholder after the policy is issued, to learn whether the underwriting decision would have been different with such information.

According to the 2018 SOA industry survey previously referenced, 75% of random holdouts and 80% of post-issue audits confirmed the accelerated underwriting decision.[11] For those cases where the decision was different, the negative results (worse risk classes) exceeded the positive results, partly since some insurers only accelerate preferred-class underwriting, which makes only negative results possible.

While the model results were consistent with traditional UW in most of the cases, the discrepancies can be problematic, especially those where the full UW decision would have been a decline. According to the survey, the implied mortality of these declines is 600% of the mortality of the risk classification suggested by AUMs. In addition to declines, a panelist also noted that substandard "sneaks" are a major financial concern, whose implied mortality is 200% of AUW suggested mortality. Insurers should conduct similar studies and inform their pricing and reserving assumptions accordingly.

A regulator panelist warned against "too much optimism on AUW" when based on limited company-specific data or analysis for some writers and highlighted the challenges of early principles-based reserves (PBR) assumption setting, noting how AUW adds a layer of complexity when setting proper conservatism margins, a challenge augmented by limited industry experience. The panelist also suggested drafting an industry standard of practice on AUW reserve conservatism margins that can aid both regulators and writers.

One panelist warned that, when conducting random holdouts and post-issue audits, insurers tend to be biased by assuming that traditional UW is always right and AUW is always wrong. Guarding against this bias is important when evaluating the performance of AUMs, especially for new adopters who would benefit from supplementing statistical analysis with qualitative criteria, benchmarking to publicly available mortality datasets, and input from reinsurers.

4.3 MODEL INTERACTION WITH THE UNDERWRITING DECISION PROCESS

The proper performance of an AUM is a critical priority. However, panelists noted it is as important for practitioners to understand how the model interacts with the underwriting decision-making process as a whole. One panelist observed that it is important to properly define the relationship between the AUM and the underwriters. He suggested "treating the model as a junior underwriter," who suggests risk scores based on the information it interprets but needs constant oversight and "teaching" (i.e., recalibration, or actual training with machine-learning models).

Another panelist noted that algorithms "never get suspicious," which makes investigation boundaries more rigid and "holes" systematically exploitable (e.g., a specific health hazard not captured by the algorithm). If undetected, this deficiency could cause anti-selection to grow materially once the market realizes it.

On the other hand, a different panelist warned against these "scare tactics" to not move forward with AUMs. Some anti-selection is to be expected, due to the loss of the sentinel effect[12] for instance, but it is not enough reason not

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[11] Not all accelerated underwriting decisions surveyed were made using algorithmic models.
[12] The tendency for human performance to improve when participants are aware that their behavior is being evaluated

to employ good AUMs and pass on the opportunities to capitalize the long-term benefits they offer. Insurers will not only improve AUMs over time, but also better extract valuable customer insights that can be leveraged beyond UW. Another panelist observed that there is also the possibility that AUMs outperform traditional underwriting, creating an adverse selection for carriers staying with traditional underwriting.

4.4 MODEL RISK MANAGEMENT

A key consideration for insurers is how to apply their enterprise risk management (ERM) programs and their associated model risk management (MRM) frameworks to AUMs. MRM frameworks establish principles and standards that can be applied across an organization to financial and market risk models, as well as underwriting and other models.

In the "Three Lines of Defense" governance model[13], common in financial industry ERM programs, the First Line of defense is the model owners, who develop, maintain, and use the model in the business process. Thus, the model owners are responsible for defining a proper business purpose, monitoring performance, and adhering to model development, user acceptance testing, implementation, operation, and change management standards.

The Second Line of defense is the Risk Management function that defines model governance, validates the conceptual soundness of the model, performs independent testing, and reviews that proper processes, controls, and data/IT infrastructure are in place. The Third Line of defense is Internal Audit, which independently tests the effectiveness of the First and Second Line controls.

Panelists noted that insurers' MRM policies tend to focus on financial risk management and financial reporting use cases. With the rapid adoption of AUMs, this is no longer viable. One panelist remarked that, just on user acceptance testing, the sheer number of system integrations makes it significantly harder to accomplish relative to financial reporting use cases.

One panelist noted that AUMs are in constant flux, which makes model stewardship, version control, and change management a critical requirement. He stressed the importance of storing all model versions to be able to reproduce every AUW decision.

A regulator panelist noted that regulators expect more scrutiny, governance, and controls in AUMs . They also expect chief risk officers (CROs) to explicitly address bias risks (for unfair or unlawful discrimination), given the reputational risk exposure is very significant. He also noted that insurers should establish review procedures to ensure that AUMs do not expand the biases inherent in traditional underwriting.

Lastly, to effectively review and challenge AUMs, strong cross-functional collaboration between actuaries, data scientists, underwriters, IT, and risk teams is imperative, since their joint skillsets and expertise are critical to interpret, implement, and validate AUMs.[14]

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[13] A working definition of the Three Lines of Defense model can be found in the Model Risk Management practice note from the American Academy of Actuaries. May 2019. <https://www.actuary.org/sites/default/files/2019-05/ModelRiskManagementPracticeNote_May2019.pdf>
[14] Practitioners can also refer to the SOA report on the ethical use of AI, where the five pillars of ethical AI are: Auditability, Incorruptibility, Predictability, Responsibility, and Transparency.
Ethical Use of Artificial Intelligence for Actuaries. <https://www.soa.org/globalassets/assets/files/resources/research-report/2019/ethics-ai.pdf>

Section 5: Closing Remarks

All panelists acknowledged AUW is here to stay and it will continue to grow alongside technology advancements. Above all else, they highlighted the value of industry players engaging in constructive dialogue to overcome key challenges and concerns.

To summarize:

- The life insurance industry is relatively new to Big Data solutions. In a sense, AUMs are a pioneering application of Big Data solutions.
- AUMs can increase the consistency and accuracy of UW decisions, shorten underwriting times, eliminate burdensome underwriting requirements, improve customer experience, and shorten the increasing life insurance gap in the US.
- There is concern that potential onerous regulatory oversight may discourage insurers from implementing complex AUMs.
- The industry, with the support of professional organizations, needs to work closely together to proactively identify and prevent unlawful discrimination when using AUMs, and define proper customer transparency standards.
- The implementation of an AUM goes beyond technical considerations. It requires proper communication and support from business users across the organization, and a long-term commitment to "learn the new language and way of working."
- Insurers need to pay close attention to those cases where the AUW would admit an application, but traditional UW would have declined it. Since algorithms never "get suspicious," there is a potential risk of anti-selection of which the market may quickly take advantage.
- Enterprise risk management policies need to address bias risk and its impact on reputational risk. Model risk management programs need to address the complexity of AUM user acceptance testing, given the large number of system interdependencies.

Section 6: Acknowledgments

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