The 2022 Revised U.S. Qualification Standards

BIG DATA AND ALGORITHMS IN ACTUARIAL MODELING AND CONSUMER IMPACTS

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American Academy of Actuaries

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Disclaimer

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Presenter

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Member of the Academy's Data Science and Analytics Committee

Dave Sandberg is a member of the American Academy of Actuaries' Data Science and Analytics Committee, which published *Big Data and Algorithms in Actuarial Modeling and Consumer Impacts* in November 2021, providing a framework for consumers, regulators, legislators, insurers, and actuaries seeking to better understand how the increased use of big data and algorithms is impacting insurance, and some of the challenges the changes are creating. David also chairs the Society of Actuaries InsurTech Committee, works in Minneapolis, MN, as an LLC doing expert witness work and is an advisor to SDRefinery, an AI start up company.

Agenda

- Presentation on the 2022 U.S. Qualification Standards (USQS)
- Presentation on BIG DATA AND ALGORITHMS IN ACTUARIAL MODELING AND CONSUMER IMPACTS
- Q&A

2022 USQS Agenda

- Introduction
- U.S. Qualification Standards Revisions
  - Definition of Actuary in Section 1
  - Basic Education in Section 2.1
  - Subject Area Knowledge in Section 2.1 (d)
  - Recognition of the General Insurance Track in Section 3.1.1.2
  - Bias Topics & CE—New Requirement in Section 2.2.6

USQS Introduction

Where do the U.S. Qualification Standards fit in the larger professionalism structure?

American Academy of Actuaries

Web of Professionalism: Basis of Self-Regulation

- Code of Professional Conduct
- U.S. Qualification Standards (USQS)
- Actuarial Standards of Practice (ASOPs)
- Actuarial Board for Counseling and Discipline (ABCD)

USQS are Rooted in Precept 2 of the Code

- **PRECEPT 2.** "An Actuary shall perform Actuarial Services **only when the Actuary is qualified to do so** on the basis of basic and continuing education and experience, and only when the Actuary satisfies applicable qualification standards." *[emphasis added]*

  - "It is the professional responsibility of an Actuary to **observe applicable qualification standards** that have been promulgated by a Recognized Actuarial Organization for the jurisdictions in which the Actuary renders Actuarial Services and to keep current regarding changes in these standards." *[emphasis added]* (Annotation 2-1)

Effective Date of the New USQS

- The amended *Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion in the United States* took effect Jan. 1, 2022
  - Applies to actuaries issuing statements of actuarial opinion (SAO) starting on Jan. 1, 2023
- Such actuaries will need to meet the continuing education (CE) requirements in the 2022 USQS before issuing any statement of actuarial opinion in 2023
- SAOs issued in 2022 are subject to the 2008 USQS

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U.S. Qualification Standards

The U.S. Qualification Standards were revised effective Jan. 1, 2022, to broaden their scope and strengthen the CE requirements. The standards were developed by the Academy Committee on Qualifications and approved by the Board of Directors.

New USQS

U.S. Qualification Standards
(in effect as of Jan. 1, 2022)

The Academy, which sets standards for qualification, practice, and conduct for actuaries practicing in the United States, has revised the standards defining the qualifications for actuaries who issue statements of actuarial opinion (SAOs) in the United States. The revised ***Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion in the United States*** (USQS) will replace the existing qualification standards as of Jan. 1, 2022. Changes to the USQS include a new requirement for one CE hour of bias education annually, important clarifications regarding qualifying to issue SAOs in particular subject areas, and changes related to non-U.S. actuaries and to Enrolled Actuaries issuing SAOs in the United States.

Second Exposure Draft of the U.S. Qualification Standards
(June 2021)

Exposure Draft: Qualification Standards (including Continuing Education Requirements) for Actuaries Issuing Statements of Actuarial Opinion in the United States (USQS)
(September 2020)

U.S. Qualification Standards Request for Comments
(September 2020)

"**Which CE Requirements Apply to Me?**" Infographic
(October 2013)

FAQs on the U.S. Qualification Standards

FAQs

Ask a question

Submitting Additional Questions
(use the online form to submit your additional questions about the U.S. Qualification Standards)

Actuarial Board for Counseling and Discipline

Actuarial Standards Board

QUICK LINKS

- Find an Academy Member
- Academy Committees
- Board Election Center
- Code of Professional Conduct
- U.S. Qualification Standards
- Volunteer

CALENDAR OF EVENTS

PRESIDENT'S MESSAGES
Maryellen Coggins

FEATURES

Renew Now
Annual Meeting

Why Frequently Asked Questions?

- USQS were previously last revised effective 2008
- Practitioners have asked clarifying questions
- In response, the Committee on Qualifications (COQ) created the FAQ section on the website
- FAQs currently contain over 50 questions and the COQ's carefully considered responses
- Request for guidance to ABCD

Revisions in the 2022 USQS

American Academy of Actuaries

Definition of “Actuary”

- 2008 USQS Section 1 footnote

  “The word **“actuary”*** as used herein means an actuary who is a member of the Academy, ASPPA [American Society of Pension Professionals and Actuaries], the CAS [Casualty Actuarial Society], the CCA [Conference of Consulting Actuaries], the SOA [Society of Actuaries], or a member of any actuarial organization that is not U.S.-based but requires its members to meet the Qualification Standards when practicing in the United States.”

- 2022 USQS

  “**Members of U.S.-based organizations*** that have adopted the *Code of Professional Conduct*,” whether or not they are also members of the Academy, are subject to all requirements imposed by the USQS.

**emphasis added*

Basic Education—Section 2.1(a)

- This section was modified from the 2008 USQS to focus on education (namely, a designation) instead of membership in an organization.
- 2008 USQS
  - "Be a Member of the Academy, a Fellow or Associate of the SOA or the CAS, a Fellow of the CCA, a Member or Fellow of ASPPA, or a fully qualified member of another IAA-member organization"
- 2022 USQS
  - Have achieved (through education or mutual recognition) a designation from the SOA or CAS, or achieved EA designation; or
  - For all others: Have achieved membership in the Academy
    - Provides a vetting process for actuaries that have not received an SOA, CAS, or EA designation (primarily non-U.S. actuaries).

Basic Education and Experience Only Once—Section 2.1.2

- Basic education and experience requirements must be met only once
  - Applies to an area of actuarial practice (unchanged from the 2008 USQS) or
  - In a particular subject area within an area of actuarial practice (The 2022 USQS added language about “a particular subject area” and removed language about “a specialty track”)
  - An actuary who satisfied the basic education and experience requirements to issue an SAO in an area of actuarial practice under a prior version of the USQS is not required to satisfy the requirements under any subsequent version in that same area of actuarial practice.

Subject Area Knowledge

- Section 2.1.(d): "In order to issue Statements of Actuarial Opinion in an area of actuarial practice or any particular subject within an area of actuarial practice, an actuary must meet either (1) or (2) below with respect to the particular subject of the Statement of Actuarial Opinion:"
  - On "area of practice" and "particular subject area within an area of practice"
    - Area of practice—Casualty, Health, Life, and Pension (See the Appendix 1 list of commonly issued actuarial opinions and work products)
    - Think broadly rather than narrowly when considering a particular subject area within an area of practice

Subject Area Knowledge

- Section 2.1.(d) continued
  - "(1) Attained fellowship in the CAS or SOA, or attained the highest possible actuarial designation of a non-U.S. actuarial organization. In addition, meet one of the following:" *(See Next Slide)*

    or
  - "(2) Have a minimum of three years of responsible actuarial experience in the particular subject relevant to the SAO under the review of an actuary who was qualified to issue the SAO at the time the review took place under the USQS in effect at that time."

Subject Area Knowledge

- Section 2.1.(d) (1)
  i. “Successfully completed education relevant to the subject of the SAO. Such education may have been obtained in attaining the fellowship designation or highest possible designation of a non-U.S. actuarial organization, or by completing additional education relevant to the subject of the SAO; or
  ii. Have a minimum of one year of responsible actuarial experience in the particular subject relevant to the SAO under the review of an actuary who was qualified to issue the SAO at the time the review took place under the USQS in effect at that time.”

Specific Qualification Standards

- Section 3.1.1.1
  - "*Statement of Actuarial Opinion, NAIC Life, Accident & Health, and Fraternal Annual Statement* — An actuary should successfully complete relevant examinations administered by the American Academy of Actuaries or the Society of Actuaries on the following topics: (a) policy forms and coverages, (b) dividends and reinsurance, (c) investments and valuations of assets and the relation between cash flows from assets and related liabilities, (d) statutory insurance accounting, (e) valuation of liabilities, and (f) valuation and nonforfeiture laws."

Specific Qualification Standards

- Section 3.1.1.2
  - "Statement of Actuarial Opinion, NAIC Property and Casualty Annual Statement — An actuary should successfully complete relevant examinations administered by the American Academy of Actuaries, the Casualty Actuarial Society, or the Society of Actuaries* on the following topics: (a) policy forms and coverages, underwriting, and marketing, (b) principles of ratemaking, (c) statutory insurance accounting and expense analysis, (d) premium, loss, and expense reserves, and (e) reinsurance."
    - The addition of "the Society of Actuaries" to the 2022 USQS is in recognition of the SOA General Insurance Track

**emphasis added*

Specific Qualification Standards

- Section 3.1.1.3
  - "Statement of Actuarial Opinion, NAIC Health Annual Statement — An actuary should successfully complete relevant examinations administered by the American Academy of Actuaries, the Casualty Actuarial Society, or the Society of Actuaries on the following topics: (a) principles of insurance and underwriting, (b) principles of ratemaking, (c) statutory insurance accounting and expense analysis, (d) premium, loss, expense, and contingency reserves, and (e) social insurance."

USQS—Two Topics

- Basic education and experience
- **Continuing education**

USQS continuing education requirements

- 2008 USQS
  - Generally requires 30 hours annually
  - Exemption for actuaries who are also EAs
    - Broad exemption for 2008 to 2010, narrow exemption beginning 2011
- 2022 USQS eliminates any special exemption

CE Requirements

- Goal is to remain current on emerging advancements relevant to
  - The services we provide and
  - Related disciplines
- CE is relevant if it
  - Broadens or deepens an actuary's understanding of the work,
  - Exposes an actuary to new and evolving techniques for addressing actuarial issues,
  - Expands an actuary's knowledge of practice in related disciplines, or
  - Facilitates an actuary's entry into a new area of actuarial practice
- Relevance is a good-faith determination
- An hour of CE is defined as 50 minutes and fractions of an hour may be counted
- CE for actuaries practicing in more than one area, the combined total remains at 30 hours; use good judgment

CE Requirements

- Annual CE requirement: Complete and document 30 hours of relevant CE
  - At least 3 hours on professionalism topics
  - At least 1 hour on bias topics (new for the 2022 USQS)
  - No more than 3 hours may be on general business skill topics
  - At least 6 hours of organized activities

2022 USQS Definitions

Professionalism topics include studying or reviewing the Code or ASOPs, providing input on exposure drafts, attending an actuarial professionalism webinar, serving on the ASB or a professionalism committee.

Bias topics include "content that provides knowledge and perspective that assist in identifying and assessing biases in data, assumptions, algorithms, and models that impact Actuarial Services."

General business skill topics: Content that "assists in developing client relationship management skills, presentation skills, communication skills, project management, and personnel management."

Organized activities: Interactions with other actuaries or other professionals working for different organizations.

CE Requirements

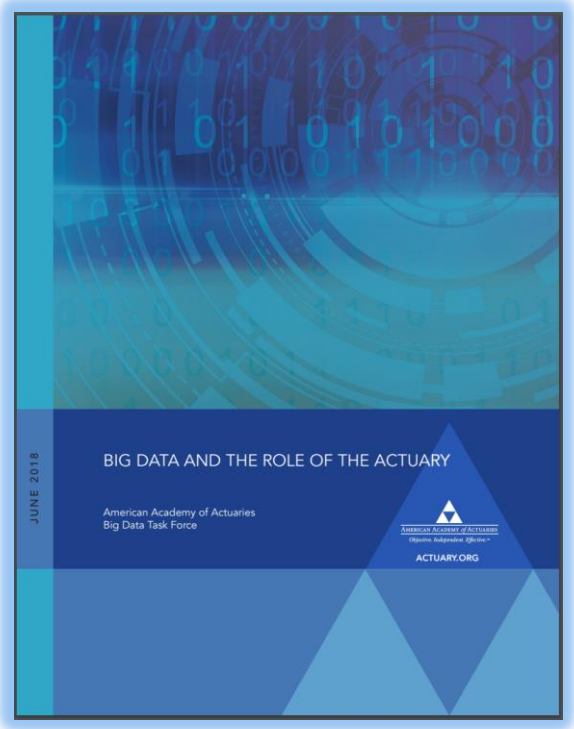
- The 30-hour requirement and the other requirements will typically be met in the calendar year preceding the year in which the actuary issues an SAO
- However, if the 30-hour requirement and the other requirements are not met in the year before the actuary issues an SAO, then the shortfall can be earned in the same year, if earned *prior* to issuing the SAO
  - The hours used to satisfy the shortfall cannot also count toward the 30 hours to be earned in the same year
- Hours that satisfy the CE requirements for the Specific Qualification Standard may also be used to satisfy the CE requirements of the General Qualification Standard
- Hours of CE in excess of the annual requirements may be carried forward one year

- BIG DATA AND ALGORITHMS IN ACTUARIAL MODELING AND CONSUMER IMPACTS:
  - Five questions this paper answers for regulators

Agenda

- ❑ The Genesis and Charge of the DSAC
- ❑ Five Question Topics
  - Importance of risk classification mechanism
  - Dangers inherent in modeling data
  - Perspectives on measuring systemic inequalities
  - Importance of professional standards in using and deciphering the black box
  - Navigating the positive transformation of insurance utilizing big data and algorithms

Data Science and Analytics Committee (DSAC) Genesis



The need for a Data Science and Analytic Committee resulted from the work of the Academy's Big Data Task Force which was charged to

- Understand the impact of big data and algorithms on the role of the actuary,
- Examine the framework of professional standards to provide guidance for working with these new tools.
- Work with policymakers and regulators to address issues related to their use.

The efforts of task force produced a monograph titled *Big Data and the Role of the Actuary*.

Our Charge

"To further the actuarial profession's involvement in the use of data science, big data, predictive models, and other advanced analytics and modeling capabilities as it relates to actuarial practice.

To monitor federal legislation and regulatory activities, and develop comments and papers intended to educate stakeholders and provide guidance to actuaries."

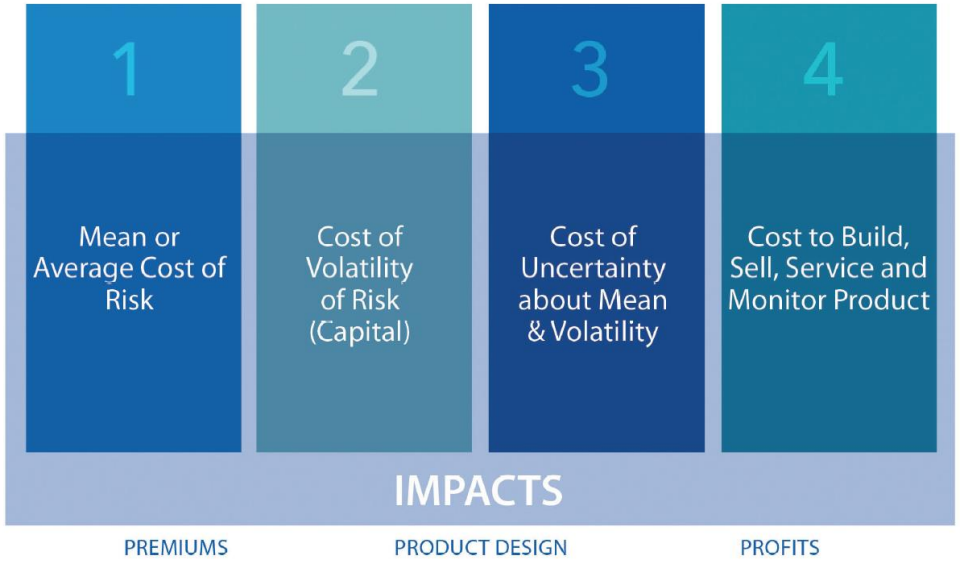
Question 1

Why is it important to preserve the risk classification mechanism in insurance?

—Mary Bahna-Nolan

Drivers of Value for Insurance Products

- Insurance covers varying exposures to loss, which can vary by:
  - Line of business
  - Target market and distribution
  - Ability to experience rate
  - Cost of capital
  - Level of uncertainty
    - Around mean
    - Volatility



Balancing Perspectives

- Setting a price for risk can incent behavior for risks under the control of the insured
- Public policy and/or business objectives of providing coverage for those when risk seems “random,” when causes of risk not known
- Pros and cons of focusing on societal or individual outcomes
  - Race, wealth, gender, genetics, age and environment might be correlated, but what causes the outcomes?

Question 2

What are some of the dangers inherent in data used in risk classifications? What are some emerging practices to address them?

—Dorothy L. Andrews

Hidden Dangers in Data

Two Sources:

- Internal Data
- External Data

Hidden Dangers in Data

- Internal Data
  - Tends to be easier to audit if structured to identify errors
  - Unstructured data is often inconsistently conveyed and may be difficult to extract meaning from
  - Data quality issues (e.g., missing, null, etc.) results in imputed values which may be biased
  - Subject to selection bias
  - Unbalanced, lack diversity, overrepresentation, (e.g., CA, TX, often dominate training data in P&C models), outliers

Hidden Dangers in Data

- External Data
  - No access to audit the data, no transparency
  - Subject to biased collection, e.g., voluntary collection
  - Based on limited exposures, lacks diversity
  - Designed for a purpose not fit for the application
  - Can be difficult to correct by the consumer
  - May be collected in a period different from the model period
  - Problems arise in joining it to internal data
  - Loaded with proxy variables correlated with protected characteristics
  - Overly complex feature engineering

Hidden Dangers in Data

- Detecting Problematic Data
  - Look for variables in the following categories
    - Socioeconomic
    - Behavioral
    - Demographic, such as ZIP code
    - Consumer-related data
    - Price optimization related such as retention
    - Nonintuitive relationship with risk
  - Look for highly correlated variables ($\rho > 0.5$) with protected attributes

Hidden Dangers in Data

- Detecting Problematic Data
  - Look for spurious correlations
    - Check the directionality of correlated pairs
    - Ask for research validating the relationship
    - Examine statistical significance in the presence of other variables
    - Check for dependency among variables:
      - If A, then B. If not A, then not B
    - Holdout testing
  - Examine variable rationales for intuitive relationship to risk, much harder than it sounds.

Question 3

What are the different perspectives that have been used to measure systemic inequalities in the conduct of insurance? Insurance is a social system, but it cannot solve all social problems.

Defining Bias

- The Oxford English Dictionary has the following definitions for the word ”bias”:
  - Prejudice in favor of or against one thing, person, or group compared with another, usually in a way considered to be unfair. *‘there was evidence of bias against foreign applicants’*
  - (Statistics) A systematic distortion of a statistical result due to a factor not allowed for in its derivation. *‘Furthermore, the statistical bias varies with the filling factor.’*
  - A direction diagonal to the weave of a fabric.
  - In some sports, such as lawn bowling, the irregular shape given to a ball. *‘This model bowl has the Traditional bias which has stood the test of time wherever Lawn Bowls is played.’*
  - (Electronics) A steady voltage, magnetic field, or other factor applied to an electronic system or device to cause it to operate over a predetermine range. *‘Semiconductor amplifying circuit having improved bias circuit for supplying a bias voltage to an amplifying FET’*
- The first two definitions of bias are of interest to us

Statistical Bias

- Biased Estimator: when the expected value of the estimator differs from the underlying value being estimated.
  - For example, estimate the incidence and loss of a claim
- Estimating the expected claims correctly and understanding claims variabilities are foundational to the pricing and sustainability of insurance.
- Biases are also related to the deviation from a best estimate of the emerging experience in setting actuarial assumptions.
  - Actuarial Standard of Practice (ASOP) No. 4 [revision effective Feb. 15, 2023], paragraph 3.8: "In addition, the actuary should assess whether the combined effect of assumptions is expected to have *no significant bias* (i.e., it is not significantly optimistic or pessimistic) except when provisions for adverse deviation are included or when alternative assumptions are used for the assessment of risk, in accordance with ASOP No. 51."

Different Types of Biases

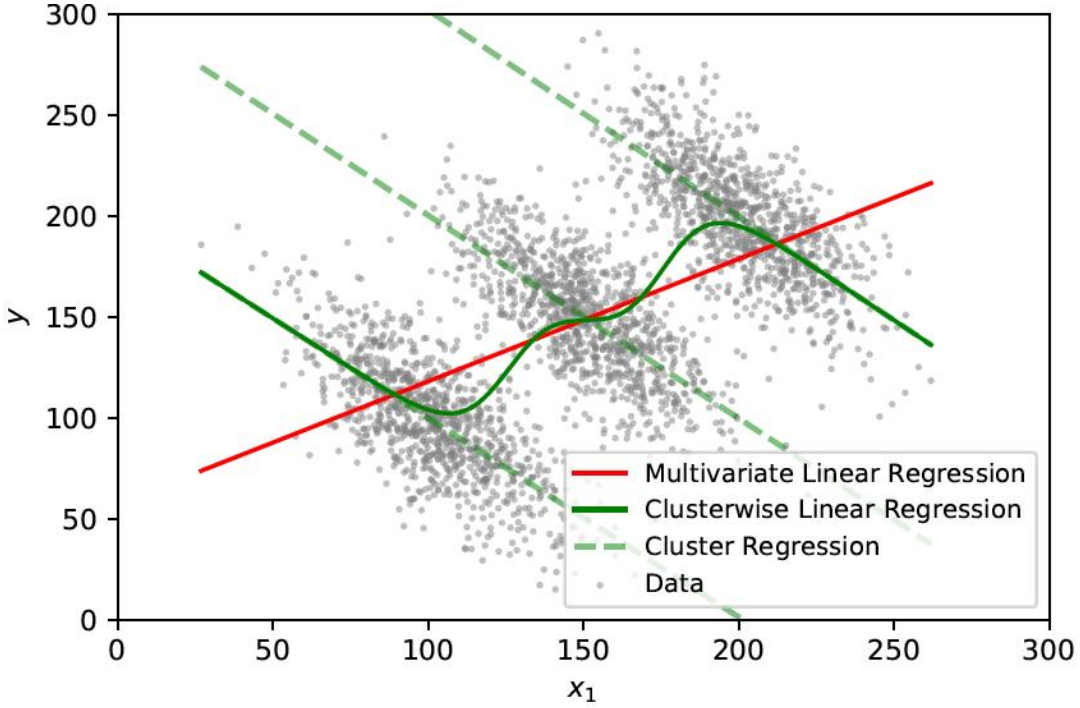
Representation Bias. Parts of the population are underrepresented or misrepresented. This can arise due to

- Inadequate sampling—for example, dataset collected from smartphone apps may under-represent lower-income and older groups; data collected from voluntary responses (response bias or self-selection bias); lack of geographical diversity; non-random sampling (sampling bias).
- The population of interest has changed since the data collection—for example, data collected in one time frame used for another (temporal bias).
- Longitudinal data fallacy—data collected from a cross-sectional snapshot of the population may consist of different cohorts which may behave differently.

Different Types of Biases

- Historical Bias. Existing biases in the world can persist in the data generation process even with a perfect sampling and feature generation.
  - For example, in 2018, 5% of Fortune 500 CEOs were women. Should a search for ”CEO” results in most male CEOs?
  - Data used to develop hiring algorithms may reflect past hiring practices that may be biased.
- Aggregation Bias. A one-size-fits-all model is used for all without recognizing differences between subgroups.
  - For example, models used for diabetes may not recognize differences between ethnicities and genders.
  - Simpson’s Paradox—a trend or characteristic observed in the underlying subgroups may be quite different when the subgroups are aggregated.

Different Types of Biases



Different Types of Biases

- Evaluation Bias. The use of inappropriate benchmarks during model evaluation.
  - For example, commercial facial recognition algorithms perform poorly for dark-skinned female, partly due to the benchmark used to evaluate the algorithms also being flawed.
- Presentation Bias. How the information is presented can impact the data collected.
  - For example, on the web users can only click on content that they can see. Items further down the list may get no clicks.
- Omitted Variable Bias. One or more important variables are left out of a model.
  - For example, a model to predict customer cancellations may fail to take into account the appearance of a competitor that offers the same solution for a lower price.
- Survivorship Bias. The collection and analysis of data fail to consider early termination of certain members.
  - For example, performance statistics for mutual funds may fail to consider the funds that discontinued due to poor performance.

Cognitive Biases

- Anchoring Bias. We tend to be influenced by the first number we see.
- Confirmation Bias. We are drawn to details that confirm our own existing beliefs.
- Availability Bias. We tend to rely on data that is more readily available.
- Hyperbolic Discounting. We favor immediate things in front of us.
- Projection Bias. We project our experiences from the past into the future.
- Mental Accounting. We simplify probabilities and numbers to make them easier to think about.
- Gambler's Fallacy. When heads appear 10 times in a roll, it is more likely that the next coin toss will be a tail.
- Apophenia. We find patterns that don't actually exist.

Measures of Fairness

- Fairness can be thought of as the absence of biases. How do we measure fairness?
- Group fairness: equal probability of assigning a favorable outcome to a protected class and an unprotected class.
- Conditional statistical parity: conditional on certain characteristics, the algorithm has equal probability of assigning a favorable outcome to a protected class and an unprotected class.
- False positive rate parity between a protected class and an unprotected class: false positive rate = false positive / true negatives
- False negative rate parity between a protected class and an unprotected class: false negative rate = false negative / true positive

Case Study on Biases

Illustrative Case Study: An actuary has been asked to develop a model to classify applicants of a new insurance product to a high-risk group using a set of modeling data. The model should not bias against members of protected classes, such as race and gender. How does he/she review the model results for systemic biases?

- First, he/she develops the model without direct discrimination
  - Variables representing protected classes are not used in the model development
  - Data fields indicating race and gender are removed
  - The end result is race- / gender-neutral model

- What about indirect discrimination?

Case Study on Biases

- First check: When he/she adds the race and gender variable to the model, they do not improve the predictive performance of the model. Should he/she be alarmed?
  - Is it because race and gender are truly irrelevant to the predictive model, or
  - The model uses power proxy variables that adding race and gender does not improve the statistical fit of the model?

- Thinks about:
  - Which features are most important in the model? How does the importance of a feature change in the presence of other features?
  - How sensitive are the model parameters to changes in data and variables? How sensitive are the model results to small changes in model parameters?
  - Is there an omitted variable bias?

Case Study on Biases

- Second check: He/she looks at the correlation of race and gender to the variables used in the model. He/she finds correlations and the dataset is not balanced. He/she decides to adjust the modeling data. How should he/she do that?
  - Matching to the society's characteristics or the characteristics of a hypothetically fair society?
  - Matching to the characteristics of the people for which this product is marketed?
  - Matching to the characteristics to the people who are expected to purchase this product?

- Thinks about:
  - Is there an imbalance in the amount of data collected for different subgroups?
  - Is there an imbalance of positive and negative outcomes in different subgroups?
  - How do the characteristics/features of the data in different subgroups compare?
  - Is there a historical bias? representation bias?

Case Study on Biases

- Third check: She/he looks at the true positive rate by gender and finds that the model captures 75% true positives for males but only 65% true positives for females. Is this a cause for concern?
  - What happens if the true positive rate is conditioned on modeling variables? Could this outcome be a consequence of the composition of the data?

- Thinks about:
  - Are the results explainable? Do we understand the reasons for a specific model outcome?
  - Is there an aggregation bias?
  - Which fairness metric to use for evaluating model results?

Case Study on Biases

- Fourth check: A colleague comments that what is really important is not whom your model gets right, but whom your model gets wrong. So, she/he looks at the probability that a normal applicant is misclassified as high-risk, split by gender, should she/he expect different results?
  - Yes, the results can look quite different.

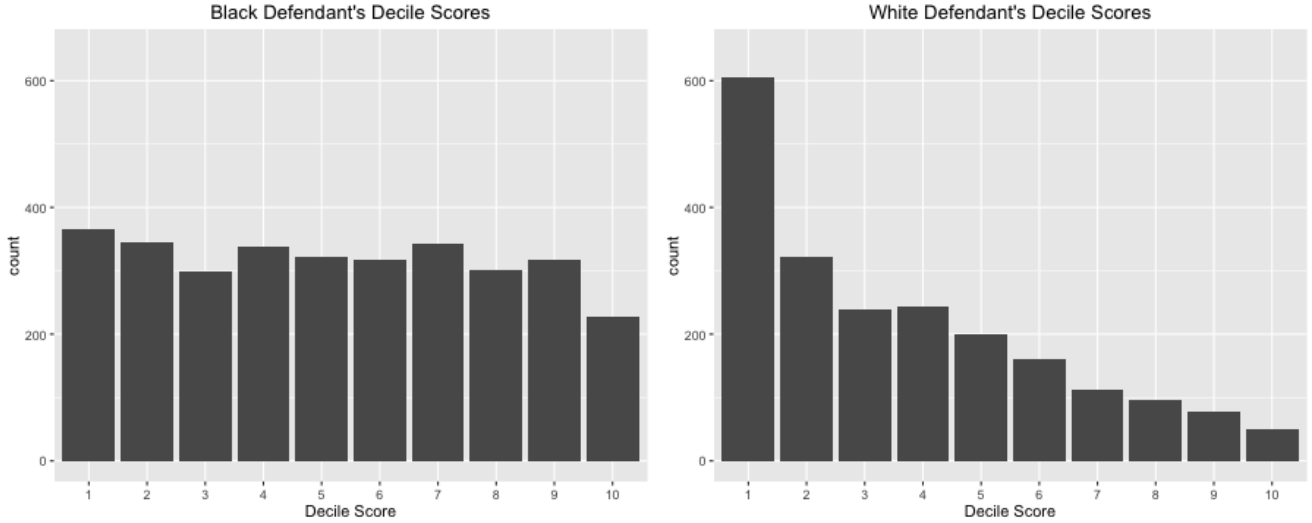
- Thinks about:
  - Do different subgroups have the same error rate?
  - Which fairness metric to use? False-positive rate or false-negative rate?
  - Are there biased outcomes not detected by quantitative measures?

Case Study: COMPAS

- COMPAS is a system that assigns a risk score of recidivism to be used by judges to decide whether defendants awaiting trial should be released on bail.
- Is the algorithm fair?
  - Probability to reoffend: when the algorithm assigns a high-risk score to defendants, is the proportion of defendants who actually reoffend similar between Black defendants and white defendants? Is the algorithm race-agnostic?
  - Misclassification: is the proportion of defendants that ultimately do not reoffend but are misclassified as high-risk similar between Black defendants and white defendants? Because misclassification can cause harm to defendants, should a fair algorithm give similar misclassification rate ?

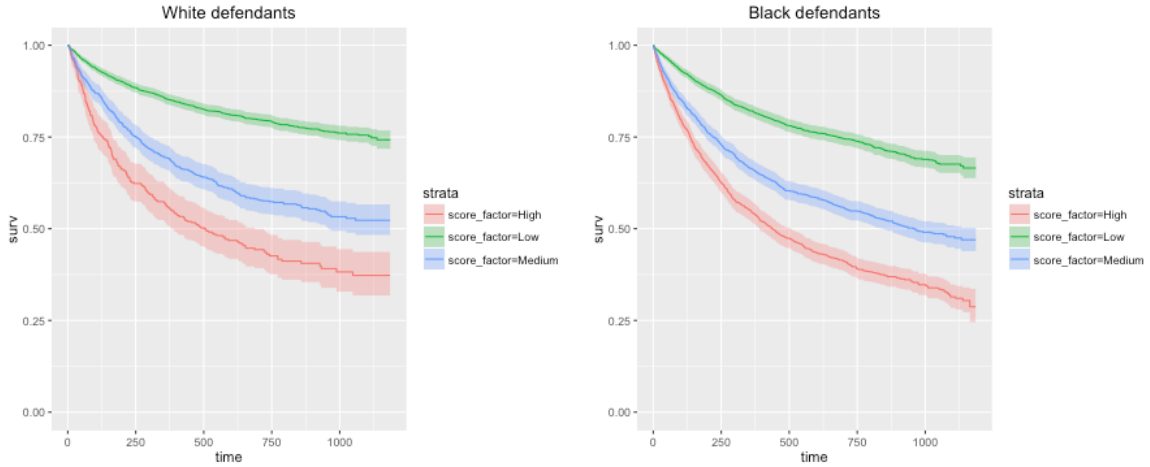
Case Study: COMPAS

- Results from a study by ProPublica (available: https://www.propublica.org/article/how-we-analyzed-the-compas-recidivism-algorithm)
- The histograms show different score distributions for Black and white defendants.



Case Study: COMPAS

- Results from a study by ProPublica (available: https://www.propublica.org/article/how-we-analyzed-the-compas-recidivism-algorithm)
- The predictive accuracy of the COMPAS recidivism score was consistent between Black and white defendants.



Case Study: COMPAS

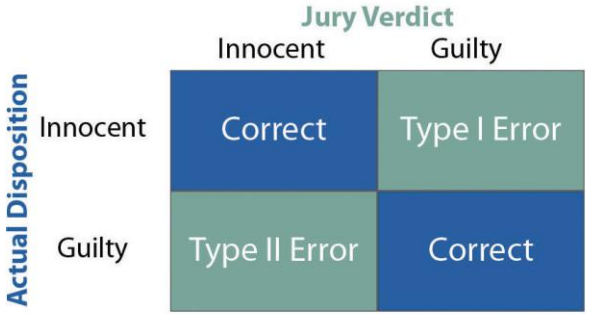
- Results from a study by ProPublica (available: https://www.propublica.org/article/how-we-analyzed-the-compas-recidivism-algorithm)
- Black defendants who do not recidivate were nearly twice as likely to be classified by COMPAS as high risk than white defendants (45 percent versus 23 percent)

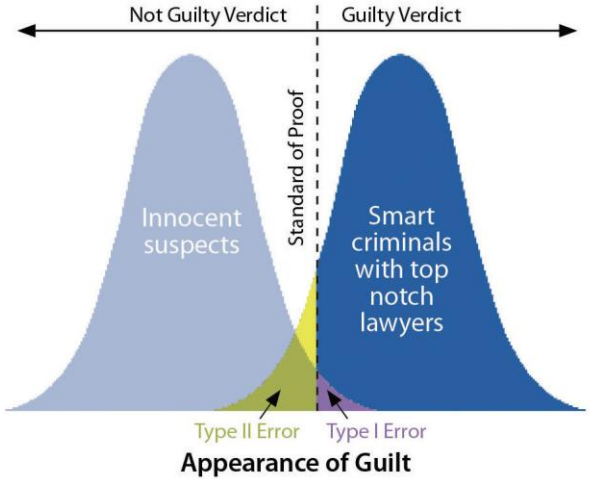
	Black Defendants			White Defendants	
	Low	High		Low	High
Survived	990	805	Survived	1,139	349
Recidivated	532	1,369	Recidivated	461	505

- Positive Predictive Value: Black 63% =1,369/(805+1,369); White 59% =505/(505+349)
- False Positive Rate: Black 45% =805/(805+990); White 23% =349/(349+1,139)

Case Study: COMPAS

- From Academy publication “Big Data and Algorithms in Actuarial Modeling and Consumer Impacts”





Case Study: COMPAS

- Is it possible to simultaneously achieve parity in positive predictive value and false negative rate?
- If Black and white defendants recidivate at different rates, it is mathematically impossible to have an algorithm that achieves parity in both positive predictive value and false negative rates.

Systemic Influences and Socioeconomics

- Checking for and removing of systemic biases is difficult.
- Systemic biases can creep in at every step of the modeling process: data, algorithms, and validation of results.
  - Human involvement in designing and coding algorithms, where there is a lack of diversity among coders
  - Biases embedded in training datasets
  - Use of variables that proxy for membership in a protected class
  - Statistical discrimination profiling shopping behavior, such as price optimization
  - Technology-facilitated advertising algorithms used in ad targeting and ad delivery

Systemic Influences and Socioeconomics

- Different perspectives on systemic inequality give different measures of biases and inequality. It is possible that different perspectives can give different pictures. Actuaries may look at a variety of measures to assess biases and systemic influences.
- There may be trade-offs between predictive accuracy and achieving fairness.
- Actuaries may want to think about the use of their models in the appropriate regulatory framework.
- Not all goals can be achieved simultaneously, so all stakeholders should be involved.
- Developing an explainable and transparent model can help communicate systemic influences and biases to its intended users.

Question 4

Importance of professional standards in using and deciphering the black box

Which ASOPs apply?

- Actuaries are responsible for determining which ASOPs apply to the task at hand.
- If no ASOPs specific to the task are applicable, the actuary may, but is not required to, consider:
  - The guidance in related ASOPs or exposure drafts
  - Actuarial literature, including practice notes
- Applicability Guidelines developed by the Council on Professionalism and Education to assist actuaries to determine which ASOPs might apply, based on the type of work.

ASOPs for all Practice Areas

- ASOP No. 12, *Risk Classification*. Applies to selection of risk classes resulting in equitable and fair rates.
- ASOP No. 23, *Data Quality*. The selection, use, review and reliance of data in performing actuarial services. Consider traditional and non-traditional source of data as well as structured and unstructured data.
- ASOP No. 41, *Actuarial Communications*. Standard applies to all actuarial communications.
- ASOP No. 56, *Modeling*. Provides guidance with respect to designing, developing, selecting, modifying, using, reviewing, or evaluating models.

Other Relevant ASOPs

- Are there applications of big data and advanced analytic techniques in performing actuarial services?
- How are the assumptions influenced by advance analytic techniques?
- How do actuaries rely on models and data provided by a third party?
- Relevant ASOPs may include
  - ASOP No. 2—*Nonguaranteed Charges or Benefits for Life Insurance and Annuity Contracts*
  - ASOP No. 7—*Analysis of Life, Health, or Property/Casualty Insurer Cash Flows*
  - ASOP No. 15—*Dividends for Individual Participating Life Insurance, Annuities, and Disability Insurance*
  - ASOP No. 54—*Pricing of Life Insurance and Annuity Products*

Question 6

What are the opportunities of using big data and algorithms to positively impact the transformation of insurance, improve the customer experience and navigate the future of insurance? What is left to be done to solve some of the problems highlighted previously?

Adapting to & Addressing the New Normal

What Ideas Changed Insurance 30 Years Ago?

1. Financial Economics
2. Modeling Principles
3. Enterprise Risk Management(ERM)/Asset and Liability Management (ALM)

These ideas led to: Own Risk and Solvency Assessment (ORSA), Econ. Capital, Three Pillars & Cat Models

Actuaries led and navigated this new world for

- Boards of Directors
- NAIC & IAIS
- SEC & FINRA
- FASB & IASB
- FED & EU & Bank of England
- Wall Street Journal & NY Times

Most Current Innovation is Outside the Box

The NEW Frontier

What are the new analytics needed by regulators and actuaries?

1. Discerning potential unicorns vs. innovations vs. expense saving
2. Rating the quality of data assets (a la S&P)
3. Rating algorithms (a la NASA technology readiness levels)
4. Assessing the skill/competence of actuaries to use and or audit data and algorithms

The FRONTIER IS Growing

Types of Data

- Structured
  - Internal company data
  - Publicly data sources “mined” by external vendors
  - Multiple-choice surveys
- Unstructured (written—freeform text, images, video, audio)
  - Underwriting files
  - Claim files
  - Suitability reviews

What's Next for the Data Sciences & Analytics Committee?

- Defining Data Biases
- Natural Experiments
- Science of Decision Making
- Valuing Data as an Asset
- Inference Methods
- Auditing for Bias in Data & Algorithms

Academy Resources

Link to Paper:
https://www.actuary.org/sites/default/files/2021-11/BigData_and_Algorithms_in_Actuarial_Modeling_and_Consumer_Impacts.pdf

American Academy of Actuaries

Professionalism Resources

- Academy Professionalism webpage
  www.actuary.org/content/professionalism
  * Code of Professional Conduct
  * Standards of practice (ASB)
  * Discussion papers
  * Webinars
  * U.S. Qualification Standards
  * Applicability Guidelines
  *Recent Articles
- Academy's Professionalism First webpage
  professionalism.actuary.org
  * Access Member Spotlights & the Academy's podcast series, "Actuary Voices"

Questions?

Save the Date

Nov. 2-3
Washington Marriott at Metro Center
Washington, D.C.

Opportunity for professionalism and other USQS CE.

American Academy of Actuaries