### AMERICAN ACADEMY OF ACTUARIES ANNUAL MEETING PUBLIC POLICY FORUM NOVEMBER 5-6 CAPITAL HILTON WASHINGTON, D.C.



### Modeling in the Age of the Data Scientist

Dorothy L. Andrews, MAAA, ASA, CSPA, FCA November 6, 2019 10:15 a.m. to 11:45 a.m.

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# The sole stuff of actuarial models:

- 1. Commutation Functions
- 2. Best Estimate Assumptions
- 3. Development Triangles
- 4. Traditional Rating Variable:
  - a) Age
  - b) Gender
  - c) Medical History
  - d) Past Losses
  - e) Location, ...

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Source: https://www.jing.fm/iclip/u2q8w7q8i1o0w7w7\_calligraphy-once-upon-a-time-clipart-png-download/

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# In the words of Bob Dylan ...



### Source: https://www.youtube.com/watch?v=oQlNMqVdyKo

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The future paths are not determined and are dependent on a random variable.

The future paths are determined and are not dependent on a random variable.



# The New Basic Actuarial Need.



# A Behavior Dependent Approach.

Source: https://www.avalonconsulting.net/merlin/predictive-modeling-1-1/

# **PREDICTIVE MODELING**

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## A Key Driver of Change: Life Insurance

*"Life insurance is losing its appeal in the U.S. In 1965, Americans purchased <u>27 million</u> policies, individually or through employers."* 

In 2016, a population that was more than 50 percent larger still bought only 27 million policies.

The share of Americans with life insurance has fallen to less than 60 percent, from 77 percent in 1989. Why this is happening remains a puzzle."

- Peter R. Orszag, Vice Chairman of Investment Banking at Lazard & Bloomberg Columnist

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https://www.bloomberg.com/opinion/articles/2018-02-27/the-decline-of-life-insurance-is-a-mystery



## A Key Driver of Change: P&C Insurance

# **Competitive Pressure**



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## A Key Driver of Change: Healthcare Costs

"After more than 20 years of steady increases, healthcare expenses now represent 17.6 percent of GDP nearly \$600 billion more than the expected benchmark for a nation of the United States' size and wealth."

- McKinsey & Company



Source: https://www.datapine.com/blog/big-data-examples-in-healthcare/

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## A Key Driver of Change: Healthcare Costs

## Tim Cook says that improving people's health will be "Apple's greatest contribution to mankind."



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Source: https://www.businessinsider.com/tim-cook-says-health-will-be-apples-greatest-contribution-to-mankind-2019-1

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## A Key Driver of Change: InsurTech



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Source: https://www.startus-insights.com/innovators-guide/insurtech-innovation-map-explains-emerging-technologies-startups/

Top 6 Predictive Analytics Use Cases in Insurance

- 1. Pricing and Product Optimization
- 2. Claims Prediction and Timely Resolution
- Behavioral Intelligence and Analytics to Predict New Customer Risk and Fraud
- 4. Uncovering Agent Fraud and Policy Manipulation
- 5. Optimizing User Experience through Dynamic Engagement
- 6. Big Data Analysis

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Source: https://www.liveandwingit.com/blockchain-hype-or-hope/?doing\_wp\_cron=1572738594.0547020435333251953125

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# Where is predictive analytics on the hype cycle?

**Predictive** analytics and prescriptive analytics are now part of decision intelligence, a more general category.

**Ensemble learning** had already reached the Plateau in 2018 and has now graduated from the Hype Cycle.

### **Gartner Hype Cycle for Artificial Intelligence, 2019**



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Source: https://www.forbes.com/sites/louiscolumbus/2019/09/25/whats-new-in-gartners-hype-cycle-for-ai-2019/#2c19abbc547b





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https://dzone.com/articles/curious-case-of-actuarial-science-geocoding-and-ma

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Statistics Machine Learning Optimization

Communication Storytelling

Big Data Cloud Computing Programming CS Fundamentals

Visualization

**Off The Shelf** 

Toolboxes

Data Scientist Skillset

Business and Domain Knowledge Skills Needed To Become

# DATA SCIENTIST

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Source: https://www.dezyre.com/article/10-different-types-of-data-scientists/179

## Actuary vs. Data Scientist



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# SIGNIFICANCE

The Magazine of the American Statistical Association

Honored British actuary R.D. Clarke who worked for military intelligence during WWII, analyzing the distribution of V-1s for the Ministry of Aircraft Production.

Clarke sought to determine whether the first *Vergeltungswaffe* 1 (Vengeance Weapons, V-1s) fell in clusters due to random chance or precision guidance. He performed a Chi-Squared test to the hypothesis the pattern of V-1s falling on London followed a Poisson distribution.



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# Professional Standards Organizations

#### Justice Justice Concept Intervention Professional Concept Con

# Non-Actuary Data Scientists

- American Statistical Association

   <u>www.amstat.org</u>
- Certified Analytics Professional

   <u>www.certifiedanalytics.org</u>
- Data Science Association
   <u>www.datascienceassn.org</u>

# Actuary Data Scientists

- American Academy of Actuaries
   <u>www.actuary.org</u>
- Actuarial Standards Board

   <u>www.actuarialstandardsboard.org</u>
- Actuarial Board for Counseling & Discipline
   <u>www.abcdboard.org</u>

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Professional Standards Organizations



The ABCD is the biggest difference between the two groups of standards.



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# The GAO Report June 2019

"Data scientists who develop rating models may not fully understand insurance-specific requirements, such as setting premium rates that are not unfairly discriminatory, and may struggle to measure the impact of new variables used in the models."



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If faced with a data science modeling dilemma, ...



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# Dilemma #1:

The data scientists you are working with found the variable "number of criminal relatives within a 25-mile radius of the insured's address" to be highly predictive of loss. The data scientists insist that it be included in the rating algorithm. What would you tell the data scientist?



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# Dilemma #2:

The data scientists you are working with have built a random forest model with several variables that are highly predictive but whose relationship to the risk being insured is difficult to understand and they cannot offer an explanation as to why the variables are predictive. You are responsible for signing off on the model and explaining how it works to the regulators. What would you do?



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# Dilemma #3:

The data scientists you are working with have built a Generalized Linear Model (GLM) that has several variables that are known to be highly correlated with race. You are responsible for signing off on the model and explaining how it works to the regulators. What would you do?



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# Dilemma #4:

A regulator receives a filing containing an advanced modeling technique and calls the actuary named in the filing to ask him/her to sign off on it. The actuary states that he/she is not qualified to answer any questions about the statistical techniques in the filing and can't sign off on that part of the work. Would you have done something differently in this situation? If so, what?



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# **Big Data & The Academy**



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# Data Science and Analytics Committee

- Monitors the evolution of data science and analytics to assess impacts to professional requirements
- Assists in the development of information for the professional use of big data and algorithms
- Tracks convergence of the role of the data scientist with the role of the actuary for impact on professional requirements
- Continue to distinguish how actuaries perform these tasks from how non-actuaries do so





### Modeling in the Age of the Data Scientist



Emerging Data Sources:

Alternative data provide algorithms with the fuel to make financial decisions and predictions more accurately than ever before.

### **Alternative Data Sources**



New data providers continue to flood the emerging alternative data industry. According to AlternativeData.org, over 300 alternative data providers exist in 2018, up from 100 in 2008.[15]

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Source: https://publicpolicy.wharton.upenn.edu/live/news/2557-big-datas-big-role-in-finance-and-financial/for-students/blog/news.php

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# Emerging Data Sources:



Evan G. Greenberg, Chairman & Chief Executive Officer, Chubb Limited

"Right now, if you're a small business, to underwrite you we ask you about 30 questions.

For Chubb, over the next 18 months, that'll come down to about 7 questions, because we can just scrape the answers from data that is publicly available.

We don't need to bother you with that."

Source: https://sviaccelerator.com/new-and-emerging-data-brings-insurance-into-the-streaming-age/



# **CARPE DATA**



Max Drucker, CEO & President

"Until now, carriers have looked at data at a single point in time, at the underwriting stage or the first notice of loss or injury.

But now we live in a world where data can be accessed continuously, it's fluid—data is a stream.

So we can see when business is offering a new service, or when an apartment building added a pool as it happens, rather than waiting for the next, undetermined point of time when a carrier may check a database."

Source: https://sviaccelerator.com/new-and-emerging-data-brings-insurance-into-the-streaming-age



# The California Consumer Privacy Act of 2018

Companies that store large amounts of personal information — including major players like Google and Facebook — are required to disclose the types of data they collect, as well as allow consumers to opt out of having their data sold.



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Source: https://www.theverge.com/2018/6/28/17509720/california-consumer-privacy-act-legislation-law-vote

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**Concern #1:** "The use of external data sources, algorithms, and predictive models has a significant potential negative impact on the availability and affordability of life insurance for protected classes of consumers."

**Concern #2:** *"The use of external data sources is often accompanied by a lack of transparency for consumers."* 

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Source: https://www.theverge.com/2018/6/28/17509720/california-consumer-privacy-act-legislation-law-vote





New York Circular Letter No. 1 (2019) takes aim at accelerated underwriting

February 27, 2019

"The letter nonetheless expresses *significant concerns* about the potential for negative impact on consumers, insurers and the New York life insurance marketplace due to the *variances in the accuracy and reliability* of external data sources and the fact that *many external data sources are not subject to regulatory oversight and consumer protections.*"



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Source: https://www.theverge.com/2018/6/28/17509720/california-consumer-privacy-act-legislation-law-vote Source: https://www.jdsupra.com/legalnews/new-york-circular-letter-no-1-2019-83660/



# Is GDPRish Good 4 Big Data?

Activity among the states to enact consumer data privacy laws.

# Chart last updated 7/21/2019

Black strikethrough - bill postponed indefinitely

Gray strikethrough - task force substituted for comprehensive bill

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	State	Process	Statute/Bill	Common Name
	California		Ca. Civ. Code §§ 1798.100199	California Consumer Privacy Act
	Connecticut		<del>RB 1108</del>	
	Hawaii		SB 418	
	Illinois		HB 3358	Data Transparency and Privacy Act
	Louisiana		HB 465 <sup>1</sup>	Internet and Social Media Privacy and Protection Act
	Maine		LD 946 "	An Act To Protect the Privacy of Online Consumer Information
	Maryland		SB 613	Online Consumer Protection Act
	Massachusetts		SD 341/S 120	
	Minnesota		HF 2917/SF 2912	
	Nevada		SB220/Chapter 603A	
	New Jersey		S2834	
troducod	New Mexico		<del>SB 176</del>	Consumer Information Privacy Act
itroduced	New York		SB \$5642 <sup>III</sup>	New York Privacy Act
ommittee	North Dakota		HB 1485- <sup>IV</sup>	
Chamber	Pennsylvania		HB 1049	Consumer Data Privacy Act
ommittee	Rhode Island		S0234	Consumer Privacy Protection Act
Passed	Texas		HB 4518	Texas Consumer Privacy Act
Cigned	<del>Texas</del>		<del>НВ 4390 <sup>V</sup></del>	Texas Privacy Protection Act
Signed	Washington		SB 5376	Washington Privacy Act

Legislative

Source: https://iapp.org/media/pdf/State\_Comp\_Privacy\_Law.pdf

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# Data Privacy, New Tech & Insurance

May I Borrow Your Glasses? My Reputation Depends On It! – Anita Cava

- Identifies psychological biases that influence ethical decisionmaking and behavior
- Discusses how you are blinded by your own perspective ("cognitive biases") in defining your ethical decision making.





# Final Dilemma:

Your data science team can greatly improve the statistical fit of their model and improve its granularity by using a third-party data set. It is unclear if the use of the data set crosses any regulatory guidelines, but because of its granularity your data team can de-anonymize it with 95% confidence and determine characteristics about insureds your company is not legally allowed to collect. What would you do?



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# Modeling in the Age of Big Data

Chris Stehno Deloitte Consulting, LLC. November 6, 2019 10:15 a.m. to 11:45 a.m.

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# Social Determinants for Health Exploring Lifestyle, Behavioral and Environmental Data for Health Risks

### **Social Determinants of Health**

70% of diseases and subsequent deaths in the US are the direct result of the our lifestyles, behaviors and social influences<sup>1</sup>

- Hypertension
- Diabetes
- Dementia
- Depression
- CHF (Congestive Heart Failure)
- CAD (Coronary Artery Disease)
- Most Cancers

### <sup>1</sup> US Surgeon General

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2019



### **Evaluating the Population – Social Determinants of Health**



### • Which person will generate the highest medical claim costs?

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### **Social Determinants Analytics**



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### **Social Determinants Analytics**



The population of people who score similar to #1 are 3 times as likely to have a Depression claim, on average have an average BMI of 36 and will have a 60% chance in being underwritten as a decline or substandard

- Long commute
- Poor financial indicators
- Purchases tied to obesity indicators
- Lack of exercise

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This population of people will have **near expectations** on morbidity assumptions.

- Strong personal ties to community/locatio
- Avid outdoor enthusiast
- Avid golfer
- Average commute



The population that looks like #3 are 2.5 times less likely to have diabetes, on average have a BMI of 24 and will have an 80% chance being underwritten in a preferred category

- High activity indicators
- Good financial indicators
- Healthy food choices
- Little television consumption
- Foreign traveler



### Quick PredictRisk<sup>™</sup> Facts

New data provides significant improvements in assessing health risk characteristics



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### PredictRisk Innovative Variables Profile

The database contains many unique variables across multiple interesting categories



- Comorbidity indicators
- High output fitness indicators
  - Financial health composite

scores

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### Disease State Algorithms Build Foundation of PredictRisk

Disease state models are used as the cornerstones for PredictRisk. We have dozens of disease state models that we will test for each project that predict both the propensity to have a disease or condition and/or the severity of a condition when one exists.

Sample Disease State Models
ALCOHOL_CIRRHOSIS
ASTHMA
BACK_PAIN
CARDIOVASCULAR
CEREBROVASCULAR
DEPRESSION_MENTAL
DIABETES_OBESITY
DRUG
HERNIA
HYPERTENSION
MUSCULOSKELETAL
NEOPLASM_FEMALE
NEOPLASM_MALE
NEOPLASM_OTHER
NEOPLASM_SKIN
NEOPLASM_TOBACCO
PREGNANCY
RESPIRATORY_COPD



#### Predicted Hypertension Risk Group

- The figure above represents lift measurement (or benefit) that can be used for analyzing the disease state models' predictive power at segmenting member populations
- The model can then be used within any member subpopulations to test robustness (as displayed in figure below)



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# **One of the Biggest Advancements** Electronic Health Records

## **On-Demand EHR Solutions**

EHR solutions utilize patient portal technology allows the consumer to control the entire process using existing online portal functionality

#### **On-Demand EHR Solution**

EHR Solution cuts weeks off of initial decision timelines, reduces manual data entry and enables analytics

<ul> <li>Patient Portal</li> </ul>	Records			
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Haxtun Hespital District	Heart of the Rockies Regional Medical Center	Indian Health Service	Longmont United Hospita(BI/)/Milestone)	



By agreeing to this consent form, you are agreeing that LFG (or a third party working on their behalf) may access your medical records in order to inform life insurance underwriting

Control Plant Plant Portal Records

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### Parse

Parse the data into machine readable format



#### Analyze

Analyze the robust dataset including: Medical encounters and issues, lab and diagnostic results, medications, past medical history, vital signs, medical procedures, family medical history, etc.

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### 48 ANNUAL MEETING PUBLIC POLICY FORUM



# EHR Solutions have an unparalleled expected "hit rate" and retrieval time

We believe we can retrieve records from over 90% of hospitals / doctors, 70% of which can be retrieved instantly



We believe you can retrieve records from over 90% of hospitals / doctors

- Most of the larger / wellknown organizations are already in directories
- New providers can added within 24 hours of a request

2008 — Only 10% of doctors used any form of Electronic Medical Coding

2018 - Think how far we have come in 10 years



## EHR Solutions can be leveraged in Life Insurance Underwriting

EHR solutions have the potential to significantly reduce Life Insurance underwriting operations costs and streamline the process

### Life Insurance Underwriting

The traditional life insurance underwriting process typically includes invasive, expensive, and slow medical underwriting requirements such as para-medical exams, lab work, prescription checks, and Attending Physician Statements (APS)

EHR solutions offer the potential to replace these requirements with a single efficient and cost effective solution. The EHR solution also creates a better customer experience and can drive a long-term customer relationship for the insurance carrier.

### Differentiation



Increase in placed applications from improved placement rates due to shorter underwriting time



Decrease in underwriting requirements costs (APS, labs, para-med exam, Rx check)



An initial phase allows for testing and risk assessment before any long-term commitment is established



Improved customer experience through faster and less invasive process, & opportunity to build longterm relationship with applicants

### Anticipated Results

EHR solutions are currently in a stage where several insurance carrier clients are checking viability of the solution. Results to date have suggested:

- High quality of data the data found in the EHR solution has been rich and valuable to underwriters
- Consumer adoption is key some carriers have struggled to find the right way to engage and incent consumers and agents
- Consumer preference most carriers have seen a majority of initial participants express preference for the EHR process
- · Provider & health system specific benefits EHR especially valuable at slow or difficult providers and health systems



# Initial EHR pilots suggest that the life insurance underwriting process can be radically transformed...

...while delivering incredible value for our clients

### Initial results



### DATA AVAILABILITY:

More than **85%** of pilot participants were able to successfully retrieve data through the patient portal technology



### DATA QUALITY:

**95%** of EHR pilot participants who were able to access EHR produced underwriting data that was at least as rich<sup>\*</sup> as traditional underwriting data



### **CUSTOMER EXPERIENCE:**

More than **80%** of retrospective pilot participants reported a preference for the EHR process over the traditional underwriting process

### Lessons learned



### PROGRAM DESIGN IS CRITICAL:

Our comprehensive pilot planning led to an integrated program design with critical **stakeholder buy-in** from across the organization



### NO UNIVERSAL SOLUTION:

Because each life insurance carrier has a unique distribution, risk assessment, and communications strategy, the EHR solution needs to be **customized** for each carrier



### VALUE IS REAL:

The solution can potentially create **hundreds of dollars** of value on each life insurance application for carriers while also creating an improved customer and producer experience



# The Mobile Revolution Tracking, Recording, Nudging, 24/7/365 Coverage

### The Mobile Revolution

90% of the data in the world today was created in the last 2 years. The majority of that data was collected on mobile devices.



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### Use Case—Identifying Fraud in Disability Insurance

Location insights can be leveraged to infer potential fraud in disability claims.



Submitted Claims - Locations of "claimed" physician services

Actual digital device visits from claimant's household = 0

Location snapshot of claimant cohort aggregated over the claim period helps insurers triage suspect claims early in the claims cycle to **mitigate** costs and prevent fraud

#### Link to dashboard

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Claims submitted for physician visits

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Major V - -

Calvary Cem

Potentially Fraudulent Claims – Actual location of household parties over same time period show that no physical visits took place

### Human Body Based Sensors

We are not far of from the human body itself generating its own feedback loop.

ABILIFY MYCITE® (aripiprazole tablets with sensor): A component of the ABILIFY MYCITE® System to record drug ingestion



### The Times Are A-Changing

Usage based insurance is rapidly changing the marketplace

https://www.insurancejournal.com/news/national/2018/09/19/501747.htm

# John Hancock Will Önly Sell Interactive Life Insurance with Fitness Data Tracking

September 19, 2018 by Suzanne Barlyn

John Hancock, one of the oldest and largest North American life insurers, will stop underwriting traditional life insurance and instead sell only interactive policies that track fitness and health data through wearable devices and smartphones, the company said on Wednesday.



### Apple Takes a Shot at Health Records

Apple Health Records started in March 2018 and already has surpassed initial estimates with millions of EHRs already downloaded



## Track other important data, too.

Health makes it easy to keep tabs on a wide array of data that matters to you — from measurements of your blood pressure and blood glucose to records for your weight and reproductive health.



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