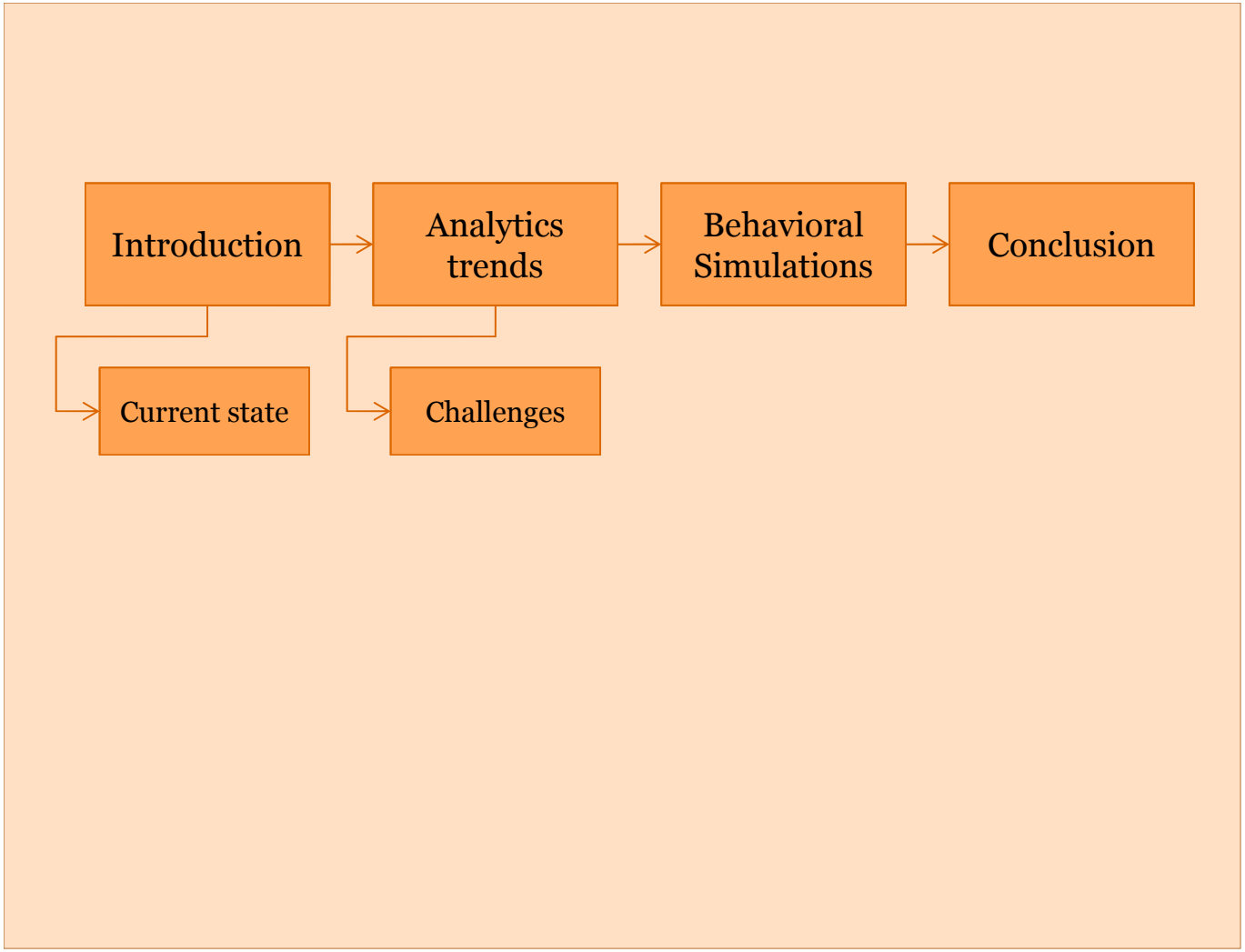
Iowa Actuaries Club Education Day

Big Data and Forward Looking Models – a life perspective

February 25, 2014

Purpose and topics

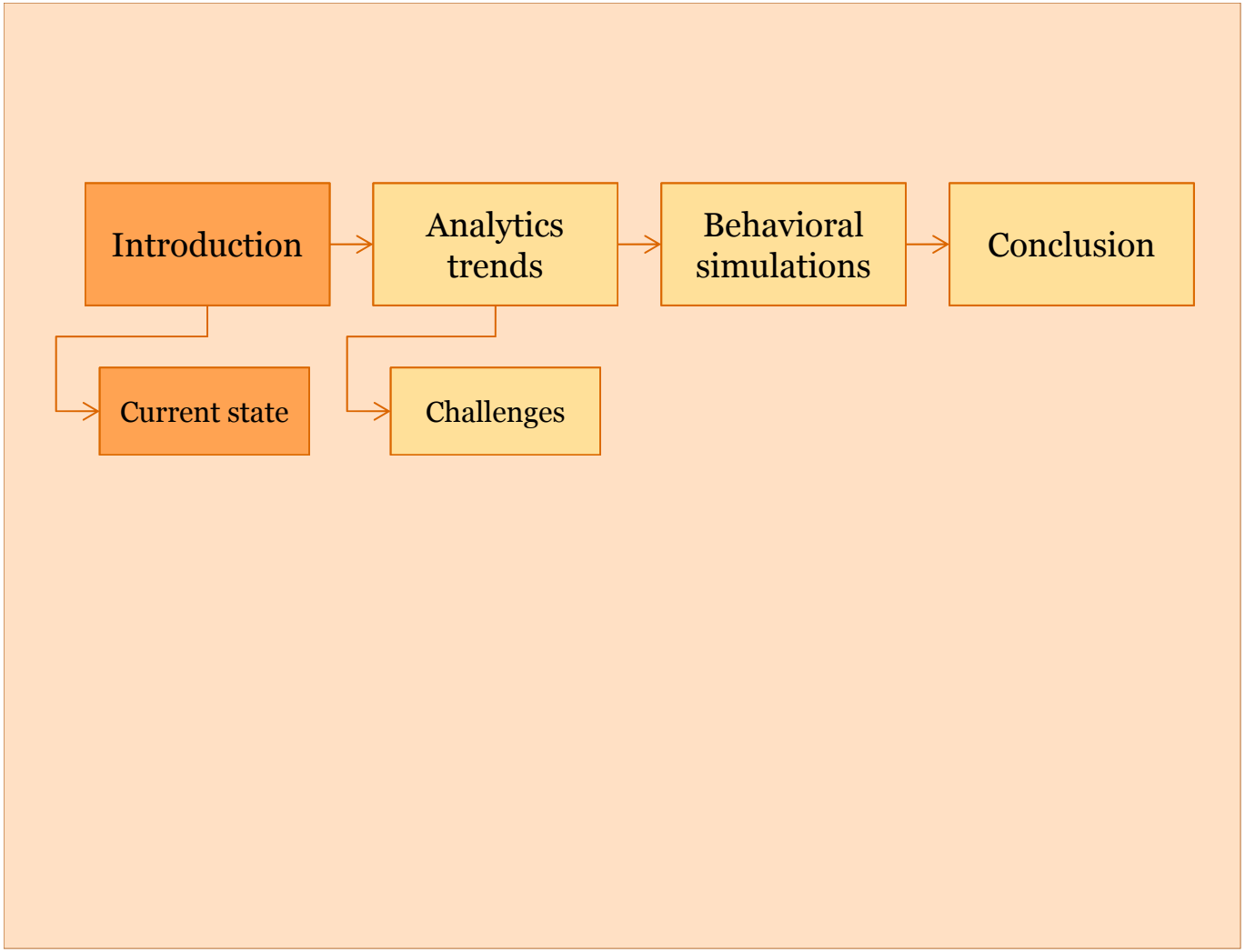
In this short presentation we'll explore where the life insurance industry stands today, what big data and forward looking models mean to the industry, and where challenges lie.



Policyholder behavior survey

PwC, together with LIMRA, conducted a survey of how companies are modeling policyholder behavior and setting assumptions.

In this section we discuss some of the key findings from the survey and our research.



Survey Design

1. **Literature Review**

Reviewed over 100 articles, papers and books in the following general areas:

1. Academic
2. Actuarial
3. Industry

2. **Quantitative Questionnaire**

An electronic survey with over fifty questions was sent to over 100 life & annuity companies.

3. **Qualitative Interviews**

Conducted in-depth qualitative interviews with:

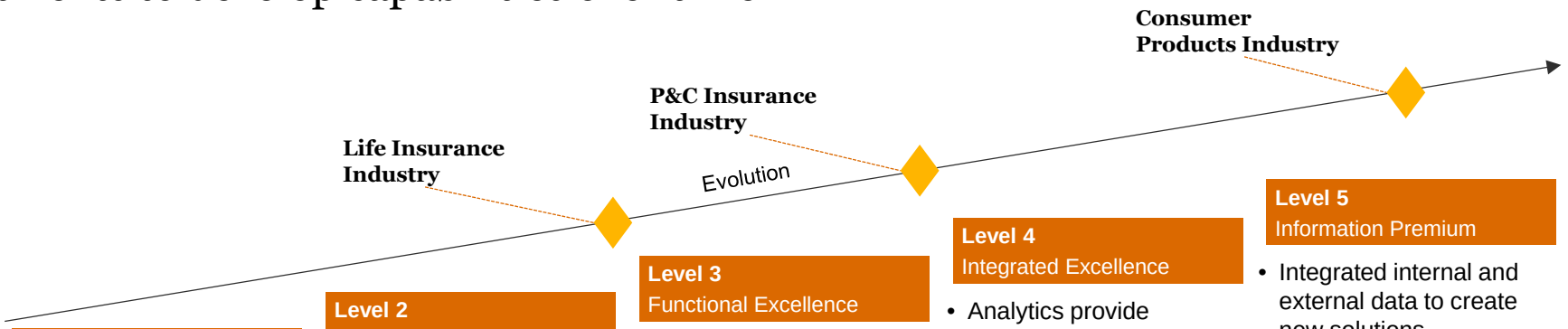
1. 8 Life insurance companies
2. 3 P&C insurance companies
3. 3 Non-insurance companies

Key Findings

1. The life insurance industry is behind the P&C insurance industry and other industries in using advanced analytical techniques to understand their customers (i.e., policyholders).

"Information Advantage" Development Stages

Building an "IA organization" is a multi-phase process that requires sequential investments to develop capabilities over time



	Level 1 Limited	Level 2 Evolving	Level 3 Functional Excellence	Level 4 Integrated Excellence	Level 5 Information Premium
Technology	• Delayed access to data • Functional integration, aggregation • Limited and delayed metrics	• Canned reports with limited usability • Little-to-no modeling functionality • Data quality reliant upon significant manual adjustments	• Some modeling ability within functional areas • Functional areas have developed high data quality within their areas • New measurement points added to operations processes	• Analytics provide enterprise wide insights in real time • Advanced modeling being used to evaluate across functional areas • Information integrated across the organization from a single, recognized source • Increased role and user based security	• Integrated internal and external data to create new solutions • Fully simulated business operations to evaluate decisions • Pervasive institution of a Service Oriented Architecture • Increased enterprise information security
Organization	• Multiple manual processes to enter, correct, extract, manipulate and analyze data	• Specialized reports pulling from multiple sources are available upon special requests	• Business users configure reports dynamically with near real time information	• New tools and training instituted to better extract business value from information	• Improved culture of innovative thinking that identifies new info. opportunities to test, learn, and scale
Decision Making	• Delayed decision-making based upon limited information and insights	• Improved insights through special projects, but not scalable	• Improved insights, decision-making and speed of decision-making within silos	• Enterprise-wide decision-making with ability to make informed trade-offs	• Consistent fact-base for use across the organization in operations, reporting and decision-making

What are the challenges?

A number of limitations were often cited:

- Companies have put a lot of reliance on historical averages, and many failed to anticipate how policyholders behave under different circumstances;
- At the same time, data credibility is a limiting factor – and is particularly challenging when there is such a reliance on historical averages;
- Actuarial resources are limited – we are increasingly being asked to do more with less;
- Nonetheless, many companies recognize the shortcomings of traditional actuarial methods, and many have at least considered implementing predictive analytics.

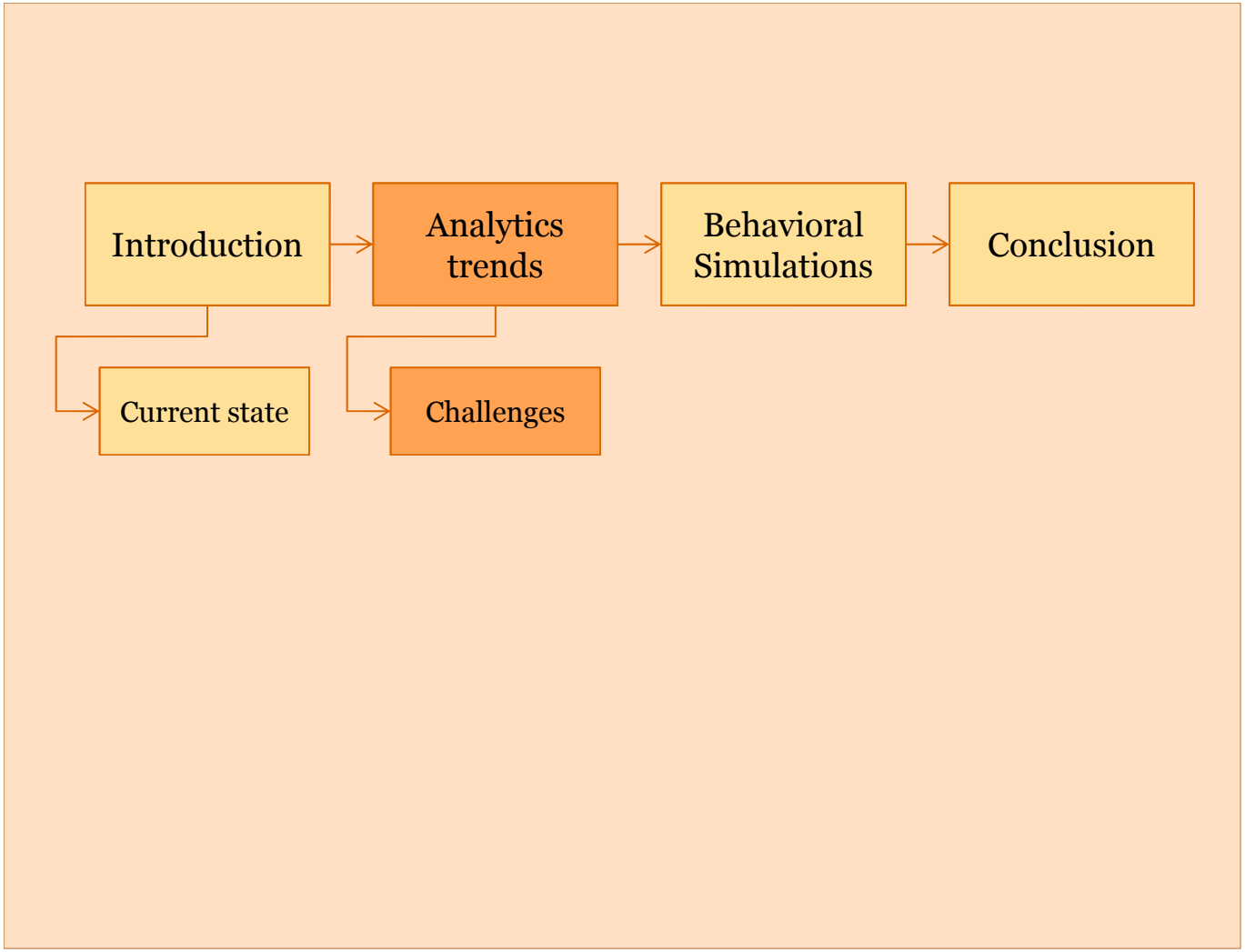
Upwards of 40% of insurance companies are using or considering using predictive modeling to better understand policyholder behavior[1]

How can we build better forward-looking models?

1. "Report of the SOA Predictive Modeling Survey Subcommittee." *Society of Actuaries.* (Jan, 2012)

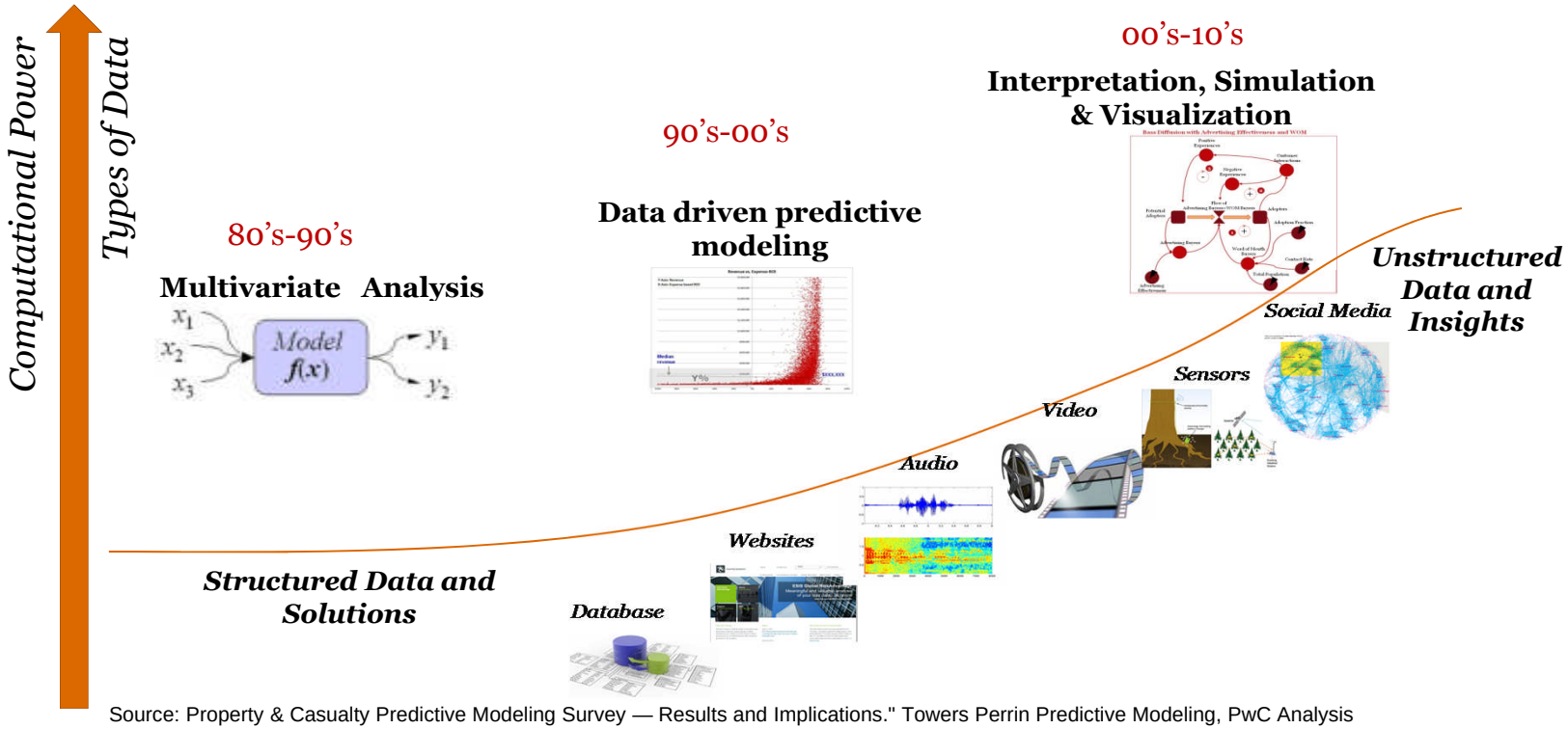
Analytics trends and the life insurance industry

In this section we'll look at some of the Big Data and analytics trends going on, and in particular we'll explore how they apply to the life insurance industry and where the challenges are.



Big Data, Smart Analytics, and Sensor Devices are changing the way industries harness information

Analytic Techniques and Data Sources – Increasing Sophistication



Source: Property & Casualty Predictive Modeling Survey — Results and Implications." Towers Perrin Predictive Modeling, PwC Analysis

Acceleration Laws Apply to Analytics & Data

Reduced Data Storage Costs
Over the last 30 yrs storage space per unit cost has doubled ~ every 14 months (increasing by an order of magnitude every 48 months)

→

More Data Generated
"Every Six Hours, the NSA Gathers as Much Data as Is Stored in the Entire Library of Congress or ~10 TBs"

→

More Analytics Power
Computing power project to surpass power of human brain by 2023

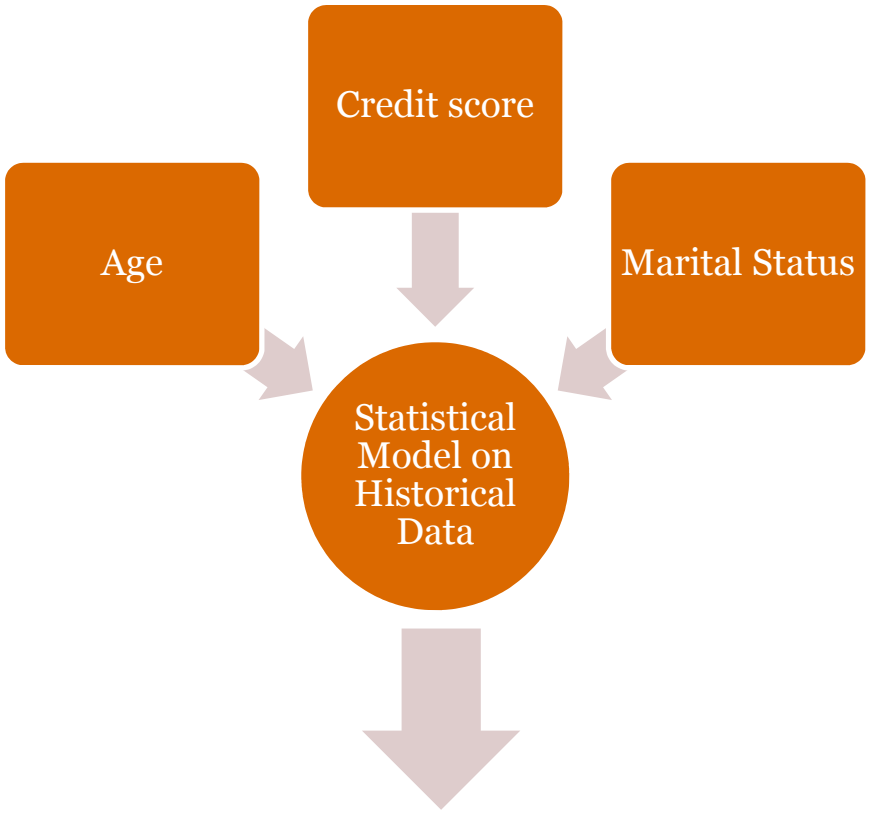
→

More Applications
Sequencing costs have dropped by a factor of 14,000 over the past decade, ~ 100 times faster than Moore's Law in semiconductors

Why has the industry been slower to embrace big data and even predictive analytics?

Predictive Modeling Relies on Historical Correlations

Overview of Predictive Modeling
(illustrative)



Lapse Rates= f(age, credit score, marital status)

Predictive modeling more effectively accounts for multiple variables compared to traditional modeling. This is particularly useful in testing for interaction effects between variables (for example, the interaction between the impact of age and income on lapsation).

In some situations, this can help a lot with data credibility issues.

However, predictive modeling relies on historical correlations to predict future results, without reflecting the actual drivers behind a policyholder's decisions.

Predictive Modeling Relies on Historical Correlations

"[Predictive modeling] is designed to rank individuals by their relative risk, but not to adjust the absolute measurement of risk when a broad shift in the economic environment is nigh."[1]

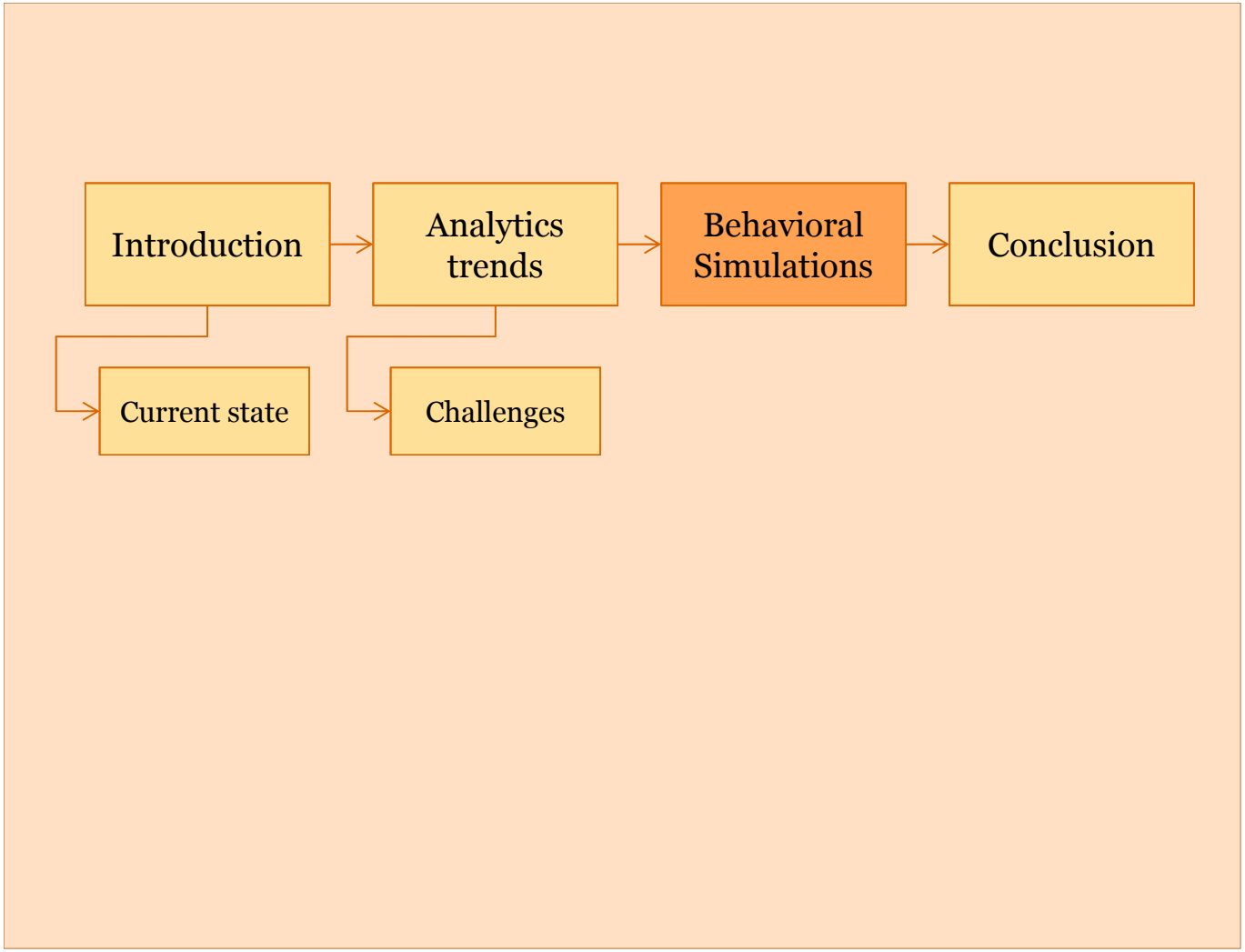
- Following the prior example, the input factors such as the individuals age, martial status and credit score don't change even as the world around the individual changes; therefore the predictive score for the lapse rate doesn't change, either.
- The predictive power of statistical models significantly decreases when there is a broad shift in the environment, which will generally happen when you are looking over longer time horizons (3-5 years).
- Being able to re-run the model frequently in the future does not obviate an insurers needs for strategic planning and decisions made today.
- This does not mean traditional actuarial methods are better –they suffer the same drawbacks. The only advantage is that they are slightly more intuitive/simple, and this transparency can help you understand the limitations of the modeling when you have a complex problem.

1. Eric Siegel, *Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie or Die,* Wiley (2013).

Behavioral Simulations

In this section we discuss how a more robust forward looking model can be built.

These modeling techniques have only recently become possible for the life insurance and annuity area and are an exciting development.



Literature Review: Agent-Based Modeling

1

Agents of Change, The Economist, July 22, 2010

- The assumptions, including efficient financial markets and rationale expectations, are considered to be too simplistic.
- A new approach called agent-based modeling is being explored to help address lessons learned from the financial crisis.

2

Mills, Alan. *Complexity Science: An introduction (and invitation) for actuaries,* Society of Actuaries (2012)

- Understands the complex nature of social systems.
- To grasp and manage the systems in which actuaries work, we must augment our tools with the new methods of Complexity Science.

3

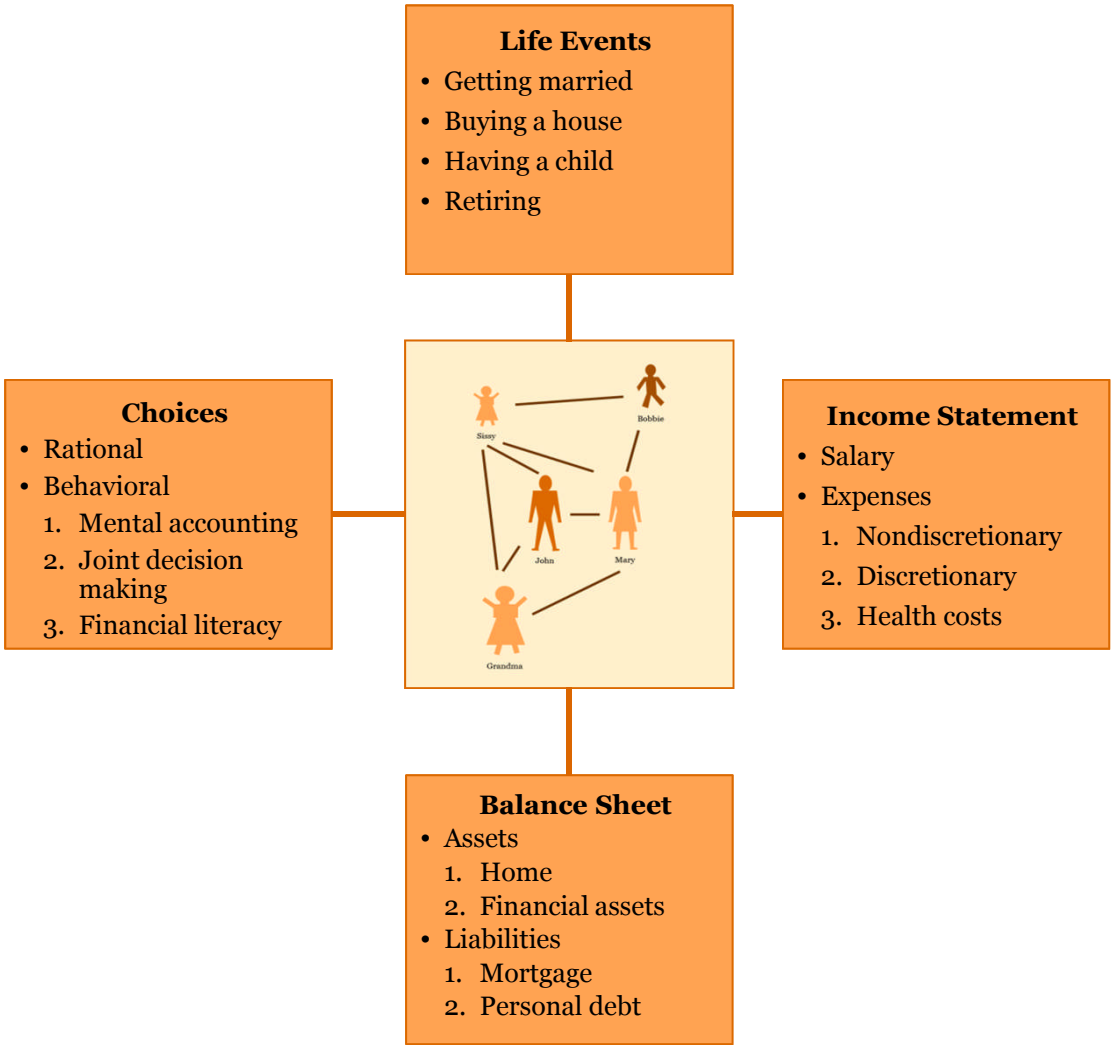
Mills, Alan. *Simulating health behavior: A guide to solving complex health system problems with agent-based simulation modeling* Society of Actuaries (2013)

- Agent-based modeling simulates agents' (e.g., individuals and companies) interactions with their environment and other agents
- The goal is to understand the emergent behavior of complex systems.

Understanding the policyholder

It is important that we view the policyholder not as a male age 40 nonsmoker, but as the member of society and part of a household with a focus on:

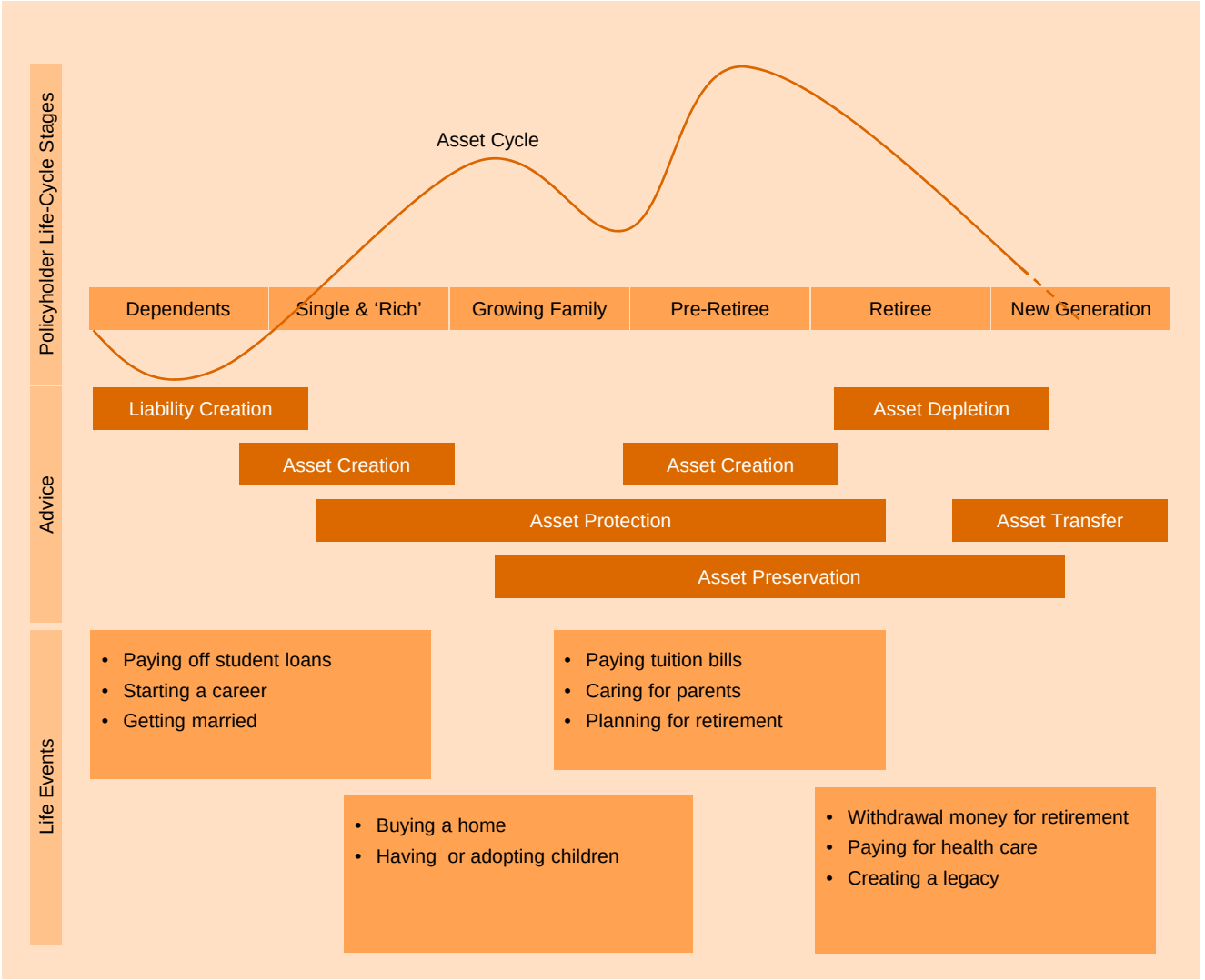
- *The composition of that household and how it changes over time;*
- *The life events that take place in the household such as having children;*
- *The household's income, spending, and savings habits;*
- *The type of assets the household owns and the liabilities the household owes; and*
- *The choices the household makes, both rational and behavioral.*



Understanding life events and choices

The goal is to understand how life events and the choices an individual make change over time such as when:

1. *He or she graduates from college and gets a job;*
2. *He or she marries;*
3. *They have children;*
4. *They become "empty nesters"; and*
5. *They retire.*



Behavioral simulation combines agent-based modeling and behavioral economics to model individual decision-making and emergent behaviors

Artificial Intelligence
Cognitive thought through machines

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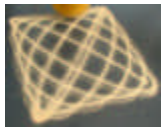
Complex Systems
Emergent system behavior from individual actions



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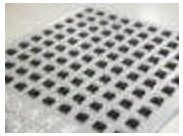
Computational Power
Rapid cycle-time for intensive calculations



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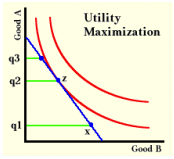
Classical Economics
Individual decision-making driven by self-interest and utility maximization



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Psychology
Scientific study of mental functions and behaviors of individuals and groups

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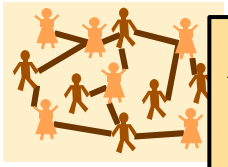
Agent Based Modeling



Sophisticated, compu
intensive modeling te
that relies upon a dec
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studies emergent beh

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Behavioral Eco

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Study of individual d
making based on cog
heuristic, emotional a
factors

Behavioral Simulation

Enabling factors:

1. **Big data** – significantly increased data available to study consumer and policyholder behaviors.
2. **Predictive analytics and machine learning** are needed to identify drivers of behaviors and to calibrate agent decision rules.
3. **Increased computing power** to simulate millions of consumer behaviors.
4. **Developments of software and user communities** for agent-based modeling beyond pure research.

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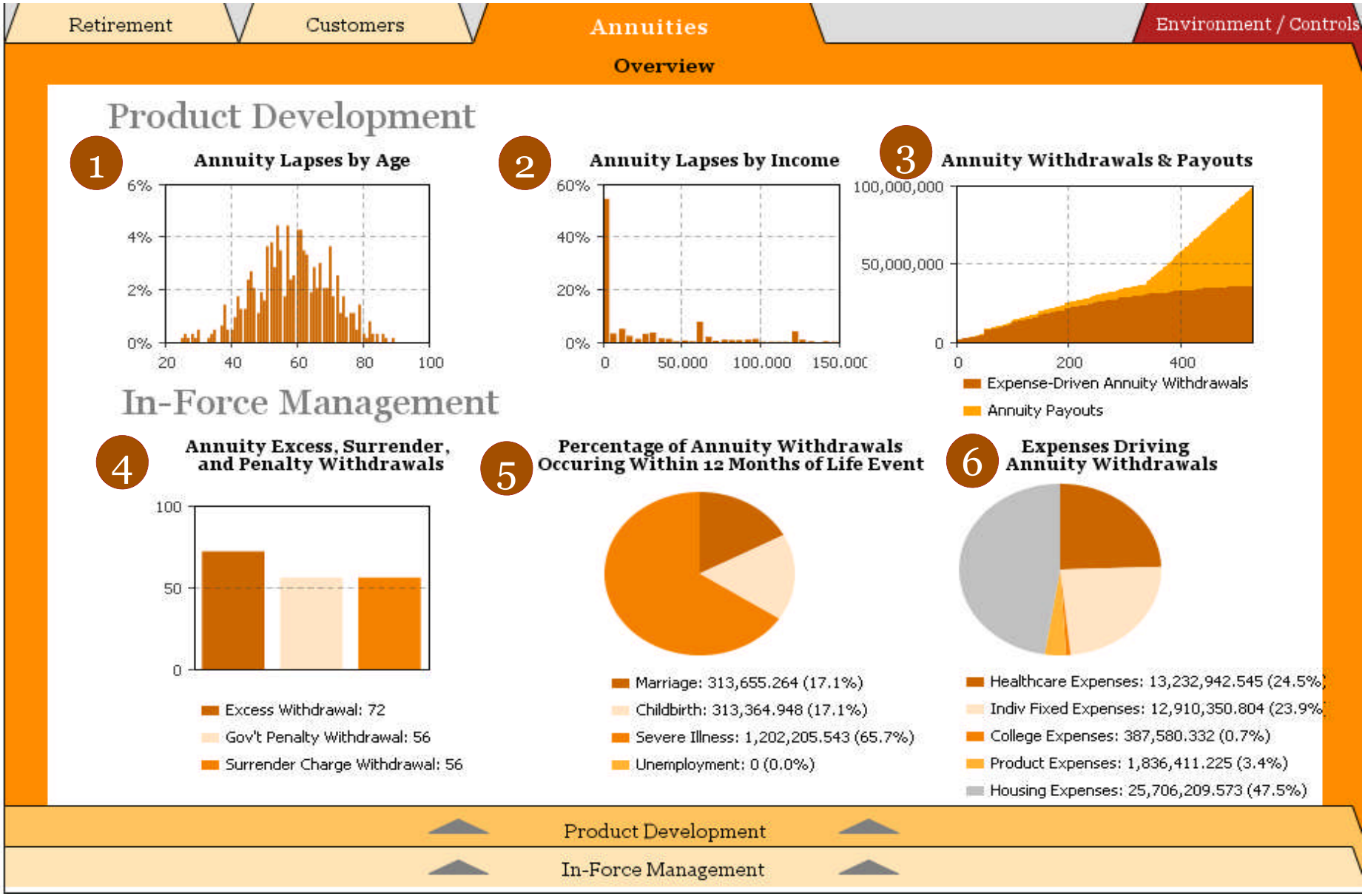
Example of annuity withdrawal and surrender drivers



Thank you!