How Big Data and Artificial Intelligence Change the Game for Insurance Professionals

presented by
Jamie Bisker
Senior Analyst, P&C Insurance
Aite Group

Innovation Provocateur
November 2014
Agenda

Opening remarks: Big data, artificial intelligence, and insurance

Big Data: 4 Vs

Cognitive Computing: From Top Down to Bottom Up

Use of Learning Systems for Risk Discovery (U²-RDD)
Opening Remarks

Opening remarks: Big data, artificial intelligence, and insurance

Big Data & AI already in use in the insurance industry

Are Actuaries the Original Data Scientists?

Expert underwriting, claims decisioning, business rules

OCR, language translation, image recognition…
Agenda

Opening remarks: Big data, artificial intelligence, and insurance

Big Data: 4 Vs

Cognitive Computing : From Top Down to Bottom Up

Use of Learning Systems for Risk Discovery (U2-RDD)
The 4 V’s of Big Data:

Volume: Scale of Data
- 40 Zetabytes by 2020
- 6 billion people have 6 billion phones
- World population: 7 billion
- It’s estimated that 2.5 quintillion bytes of data are created each day
- Most companies in the U.S. have at least 100 terabytes of data stored

Variety: Different forms of data
- 30 billion pieces of content are shared on Facebook every month
- 4 billion hours of video are watched on YouTube each month
- 400 million tweets are sent per day by about 200 million monthly active users

Velocity: Analysis of streaming data
- By 2016, it is projected there will be 18.9 billion network connections
- Modern cars have close to 180 sensors that monitor items such as fuel level and tire pressure

Veracity: Uncertainty of data
- By 2015, 1.4 million IT jobs will be created globally to support big data, with 1.9 million in the United States
- 27% of respondents in one survey were unsure of how much of their data was inaccurate

As of 2011, the global size of data in healthcare was estimated to be 130 exabytes

Sources: McKinsey Global Institute, Twitter, Cisco, Gartner, EMC, SAS, IBM, MDTEC, GSS
The 4 V’s of Big Data:

- **Volume**: 40 zettabytes (43 trillion gigabytes) of data will be created by 2020, an increase of 300 times from 2005.
- **Scale of Data**: It’s estimated that 2.5 quintillion bytes (2.3 trillion gigabytes) of data are created each day.
- **6 Billion People**: 6 billion people have cell phones.
- **Most companies in the U.S.**: Most companies in the U.S. have at least 100 terabytes (100,000 gigabytes) of data stored.
- **World Population**: 7 billion.
The 4 V’s of Big Data:

Variety

DIVERSE FORMS OF DATA

As of 2011, the global size of data in healthcare was estimated to be

150 EXABYTES
[161 BILLION GIGABYTES]

By 2014, it’s anticipated there will be

420 MILLION WEARABLE, WIRELESS HEALTH MONITORS

4 BILLION+ HOURS OF VIDEO are watched on YouTube each month

30 BILLION PIECES OF CONTENT are shared on Facebook every month

400 MILLION TWEETS are sent per day by about 200 million monthly active users
The 4 V’s of Big Data:

The New York Stock Exchange captures
1 TB OF TRADE INFORMATION
during each trading session

Modern cars have close to
100 SENSORS
that monitor items such as
fuel level and tire pressure

By 2016, it is projected there will be
18.9 BILLION NETWORK CONNECTIONS
– almost 2.5 connections per person on earth
The 4 V’s of Big Data:

1 in 3 business leaders don’t trust the information they use to make decisions.

27% of respondents in one survey were unsure of how much of their data was inaccurate.

Poor data quality costs the US economy around $3.1 trillion a year.

Veracity: Uncertainty of data.
Big Data and Insurance: Home monitoring

Canary: Home sensor

- HD Camera
- Microphone
- Night Vision
- Siren
- Temperature
- Air Quality
- Motion Detection
- Humidity
Big Data and Insurance: Usage-based insurance (UBI)

Offering popular value-added services in addition to the discount increases demand

Value-added services include:
- Emergency roadside assistance
- Automatic emergency crash response
- Stolen vehicle tracking & recovery

UBI vs. UBI with value-added services
Enrollment interest @ 10% Discount

- UBI only: 54%
- UBI + Value-Added Services: 60%
Big Data and Insurance: Beyond risk mitigation

Mining social media networks for precision marketing, building predictive models of consumer behavior

IoT: Sensors for health data, video, audio, financial, appliances, etc. => Risk Wellness, Risk Discovery

High-frequency trading algorithms for Treasury and Risk

Weather Prediction not just forecasting: IBM’s Deep Thunder for CATs, Energy, Wildfires, Fleet Mgmt…
Agenda

Opening remarks: Big data, artificial intelligence, and insurance

Big Data: 4 Vs

Cognitive Computing: From Top Down to Bottom Up

Use of Learning Systems for Risk Discovery (U2-RDD)
Cognitive Computing: From Top Down To Bottom Up

True North – Neurosynaptic Chip
Why does IBM pursue ‘Grand Challenges’ such as DeepBlue, BlueGene, and now Watson?

Grand Challenges forces IBM to stretch, collaborate and grow - they are an essential element of who we are

- **Chess: IBM’s Deep Blue**
  - A finite, mathematically well-defined search space
  - Large but limited number of moves and states
  - Everything explicit, unambiguous mathematical rules

- **Human Language: DeepQA and Watson**
  - Ambiguous, contextual and implicit
  - Grounded only in human cognition
  - Seemingly innumerable number of ways to express the same meaning
The Grand Challenge that created Watson:

“Can we design a system *rivaling a human’s ability* to answer questions posed in natural language, interpreting meaning and context to retrieve, analyze and understand vast amounts of information in real-time?”
What is Watson?

Watson is a question answering information system from IBM

It was developed over several years as part of IBM’s DeepQA research, and combines several technologies & areas of research.

Why is it called Watson?

It is named after IBM’s founder, Thomas J. Watson, Sr.

Initially, Watson was a computer system designed especially to play “Jeopardy!”

It represents a significant advancement in the field of natural language processing - question answering.
What Watson Was Not ...

... a ‘supercomputer’ (like Blue Gene/P)

It does use parallel processing to achieve high levels of performance required to play Jeopardy! and a large amount of active system memory (15 terabytes)

...at the time, a generic dialogue system intended for back-and-forth conversations

However, the current physician’s assistant pilot that IBM Research’s DeepQA Team is working on does include a dialogue mechanism using speech recognition

...a reasoning system that works externally with its own answers...

Many people feel that full artificial intelligence software could be used when in fact there are several easier tools available – text mining for example
Natural language understanding: Why is it so hard for computers to understand humans? A few clues…

• Noses that run and feet that smell?
• Ship by truck and send cargo by ship?
• How can a slim chance and a fat chance be the same, while a wise man and a wise guy are opposites?
• How can a house burn up as it burns down?
• Why do we fill in a form by filling it out?
• How does an alarm go off by going on?
What Computers Find Hard

Computer programs are natively explicit, fast and exacting in their calculation over numbers and symbols….But Natural Language is implicit, highly contextual, ambiguous and often imprecise.

- Where was X born?
  One day, from among his city views of Ulm, Otto chose a water color to send to Albert Einstein as a remembrance of Einstein´s birthplace.

- X ran this?
  If leadership is an art then surely Jack Welch has proved himself a master painter during his tenure at GE.
Informed Decision Making: Search vs. Expert Q&A

**Decision Maker**
- Has Question
- Distills to 2-3 Keywords
- Reads Documents, Finds Answers
- Finds & Answers
  - Asks NL Question
  - Considers Answer & Evidence

**Search Engine**
- Finds Documents containing Keywords
- Delivers Documents based on Popularity

**Expert**
- Understands Question
- Produces Possible Answers & Evidence
- Analyzes Evidence, Computes Confidence
- Delivers Response, Evidence & Confidence
Loading Watson - automatic learning from “reading” – the system was not connected to any external network during competition

Sentence Parsing

Volumes of Text

Syntactic Frames

Semantic Frames

Vessels Sink (0.7)
Fluid is a liquid (0.6)
Liquid is a fluid (0.5)
People earn degrees at schools (0.9)
Inventors patent inventions (0.8)
Officials Submit Resignations (0.7)
People sink 8-balls (0.5) (in pool/0.8)
Once loaded with domain knowledge, the system begins its work...

DeepQA Architecture Phases:

- **Question Analysis**: Variety of NLP algorithms analyze the question to attempt to figure out what it is asking.

- **Primary Search**: Retrieve content related to the question (including both unstructured text documents/passages and structured knowledge-base entries).

- **Candidate Answer Generation**: From the retrieved content, extract the words or phrases that could be possible answers.

- **Evidence Retrieval**: For each Candidate Answer, retrieve more content that relates that answer to the question.

- **Evidence Scoring**: Many algorithms attempt to determine the degree to which the retrieved evidence supports the candidate answers.

- **Merging and Ranking**: Consider all the scored evidence to produce a final ranked list of answers with confidences.
DeepQA: The Technology Behind Watson
Massively Parallel Probabilistic Evidence-Based Architecture

DeepQA generates and scores many hypotheses using an extensible collection of Natural Language Processing, Machine Learning and Reasoning Algorithms. These gather and weigh evidence over both unstructured and structured content to determine the answer with the best confidence.
One Jeopardy! question can take 2 hours on a single 2.6Ghz Core (i.e. – a laptop).
However, when optimized & scaled out on a workload optimized IBM POWER7 HPC using UIMA-AS...

*Watson answers in 2-6 seconds!*
Smarter Insurance and Watson…Tomorrow

Today, Watson could be thought of as a very thorough, but uneducated Research Librarian:

**Speculations on Tomorrow?**

• Working on tasks that require **reasoning** about questions, the answers uncovered, and implications:
  • Holding a dialogue about the question asked
  • Does this action fit within our strategy?

• A Watson-type system could use a **business ethics** knowledge base for corporate, regional, national, or situational events:
  • reviewed project or strategic decisions
  • support an executive or a manager in review of unit/individual actions

• Extend its capabilities via use of **existing intelligent system tools**: such as IBM’s ILOG, SPSS, or Entity Analytics could empower much broader reasoning and higher quality responses.
Watson has been busy… there’s now a Watson Group

**Watson Today:** 24 times faster, smarter and 90 percent smaller; IBM has shrunk Watson from the size of a master bedroom to three stacked pizza boxes. Cloud-based, mobile enabled.

- **Watson Discovery Advisor:** Save researchers the time needed to pore though millions of articles, journals and studies. After quickly reading through, determining context and synthesizing vast amounts of data, it will help users pinpoint connections within the data that can strengthen and accelerate their work.

- **Watson Analytics:** Service that allows users to explore Big Data insights through visual representations without the need for advanced analytics training.

- **Watson Explorer:** provides a unified view of all of a user's information. The service provides data discovery, navigation and search capabilities that are secure, unified and span a broad range of applications, data sources and data formats – both inside and outside an enterprise.

- **Watson Foundations:** tools and capabilities to tap into all relevant data – regardless of source or type.
Questions ?
Agenda

Opening remarks: Big data, artificial intelligence, and insurance

Big Data: 4 Vs

Cognitive Computing: From Top Down To Bottom Up

Use of Learning Systems for Risk Discovery (U²-RDD)
Overview

There are known knowns.
   These are *things we know that we know*.

There are known unknowns.
   That is to say, *there are things that we know we don't know*.

But there are also unknown unknowns.
   There are things *we don't know we don't know*.

- Donald Rumsfeld

Read more at
http://www.brainyquote.com/quotes/quotes/d/donaldrums148142.html#mUeoxsr2YZzRBwDt.99
Discovering and connecting to UUs determine impacts

Current knowledge mining capabilities are sufficient to expose information within bodies of structured and unstructured data based on search criteria via:

- Review of emergent information sources (news feeds, web sites, periodicals, academic papers for example)
- Reviewing any corpus in a more historical context
- Web crawling programs or robots

The domains of a given Risk Discovery are established
Ex. - risks to commercial establishments, individuals, families, etc.;
Does X threaten families? Does Y limit the exposure of T?
Does contract language include…

A series of **standing DQA queries works against these corpora**: this becomes a portion of a use case.
Discovering and connecting UUs to determine impacts; reasoning about risks

- DQA’s reasoning is limited to the context of the corpora it reviews;
- Additional reasoning must be provided – or perhaps the mechanisms can be tuned to this function;
- Example: Does Fred risk death by driving to Paris? Where is Fred now? Lyon. Yes, Fred faces the risk of death when operating a motor vehicle (based on what has been read – a report on highway deaths, specific information for the routes from Paris to Lyon, etc.)
- DQA reads text that contains information on the risks in question – there would have to be explicit statements about the risk of driving and/or the risk of driving between cities, Lyon and Paris, etc.;
- GOAL: a mechanism that can establish that a risk exists or is likely to exist, and then a DQA-based mechanism could look for linkages;
- Can DQA be tuned to such that the lexicon, ontologies, etc., are sufficiently primed with risk (or any other topic for that matter) context so that causal relationships can be discovered without explicit (meaning brittle) coding to do so??
Autonomous Risk Discovery Research:

**ARDOUS:**
Autonomous Risk Discovery of Unknown Or Unlikely Scenarios

A new identification mechanism that tags risk event streams (RES) as they are automatically discovered (ex. What is trending on Twitter, news feeds, or financial markets?)

A supervisor reviews the blackboard for connectable events (those that can be connected to existing contracts for example) and scores them;

UU5s need to be themselves coded on a spectrum:
- $UU_1 = \text{discoverable unknowns}$
- $UU_3 = \text{deeply hidden unknowns}$
- $UU_5 = \text{unknowable unknowns}$

RES5s also need to be coded:
- $RES_1 = \text{easily linkable risk or event stream}$
- $RES_3 = \text{sparsely linkable}$
- $RES_5 = \text{unique risk or event streams}$
Autonomous Risk Discovery Research:

**ARDUOUS:**
Autonomous Risk Discovery of Unknown Or Unlikely Scenarios

- With Sherlock Holmes, uncanny knowledge was explained away as being a result of a lack of attention to details
- Event streams or scenarios need to compared to risk hypothesis for match potential and scoring; Can a hypothesis be created such that one element is a known thing or event and the another aspect is artificial – made up?
- Such scenarios can be positive (new markets, new opportunities) or negative (new dangers or risks)
- What does event X mean to us (our company)? What risk hypothesis will negatively impact us? Can opportunity cost be calculated on Y?
- The concept of what is unknown depends on the observer; there are things not known by anyone, but others things that are known to someone (U₂ ?) not known because a question was not asked (discoverable). I wonder if there is a large quantity of fissionable material in the Earth’s crust that will be compressed at a future date by tectonic events that will cause a natural atomic bomb to explode and cause an earthquake, tsunami, sinkhole, etc. ??
ARDUOUS - Autonomous Risk Discovery of Unknown Or Unlikely Scenarios

- Event streams or scenarios need to compared to risk hypothesis for match potential and scoring; Can a hypothesis be created such that one element is a known thing or event and the another aspect is artificial – made up?

- Such scenarios can be positive (new markets, new opportunities) or negative (new dangers or risks)

- What does event X mean to us (our company)? What risk hypothesis will negatively impact us? Can opportunity cost be calculated on Y?

- The concept of what is unknown depends on the observer; there are things not known by anyone, but others things that are known to someone (U2 ?) not known because a question was not asked (discoverable). I wonder if there is a large quantity of fissionable material in the Earth’s crust that will be compressed at a future date by tectonic events that will cause a natural atomic bomb to explode and cause an earthquake, tsunami, sinkhole, etc. ??
ARDUOUS - Autonomous Risk Discovery of Unknown Or Unlikely Scenarios

- Use "Risk Vectors" in a way that is similar to how HNC used "Context Vectors"
- Explore an identified RV for connecting context; compare connecting context and any scoring so that they bubble to the top
- Scoop top CCs and begin a context based search of static and active corpora
- Form hypothesis from this and report to a 'workbench' mechanism for additional queries and further automated discovery searches.
ARDUOUS - Autonomous Risk Discovery of Unknown Or Unlikely Scenarios

- http://senseclusters.sourceforge.net/
From the Bottom Up:
Nanotechnology meets Brain
Cognitive Systems: Atomic storage

Atomic limits of magnetic storage

96 iron atoms store one byte of data

Note: There are ~11 sextillion iron atoms in 1 gram of iron;
13,067,848,000,000,000,000 Bytes (13 Quintillion Bytes) in 1 BB
Cognitive Systems: SyNAPSE

- “Neuron” and “synapse” -like computing model – the bottom-up, biologically inspired model of computing
- Systems learn through analytics/experience
- Advantages: Ultra energy-efficient, flexible, learning

Learning Pong

Wiring diagram – monkey brain

‘True North’

Character ID
Neurosynaptic Core
Discussion
Wrap-Up, Feedback & Next Steps