Actuaries in Advanced Business Analytics

White Paper

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Executive Summary

Analytics have been called the industrial revolution of data. The Society of Actuaries Board added a market research project on business analytics to the list of strategic initiatives in October 2010. The Board had two charges:

- Are there significant opportunities for actuaries in the area of business analytics?
- If so, what recommendations do you have for the Society of Actuaries?

The many labels, often used interchangeably, analytics, predictive modeling, infomatics, data mining, and job titles that include Director of Clinical Outcomes and Analytics, Chief of Health Care Economics, and Chief Science Officer, added to the complexity of this initiative.

In areas of underwriting, marketing, auditing, actuaries have been involved in analytics for decades. How to distinguish "Advanced Business Analytics" (the term the team agreed upon) from more familiar territory? The team built a definition for actuaries.

Advanced Business Analytics for Actuaries is a set of tools and techniques used to describe,

predict, and recommend business courses of action that take into account consumer, provider, and distributor behavior. It draws from many disciplines. It relies heavily on vast amounts of data and computing power. Practitioners use statistics, modeling, optimization, clustering, and market research. Combined with actuarial judgment, using Advanced Business Analytics provides employers with insight for decisions related to managing complex risks and optimizing product design as well as improving outcomes and value for consumers.

The team established a 3 year planning horizon. The US Department of Labor predicts significant growth in analytics through 2018. McKinsey (May 2011) predicts phenomenal growth in analytics, including a total 1.5 million managers and advanced analysts needed by 2018. The team views the opportunities for actuaries in Advanced Business Analytics:

- Current jobs, historical employers – performance improvements
- New roles, historical employers in centralized analytic departments
- Target more senior positions – leaders, overseers, makers of analytic conclusions, people who integrate results with business decisions

This approach builds on the reputation actuaries have with their current employers: trustworthy, data based decision makers, and business acumen. It offers new career options while also being a defensive move so actuaries do not lose ground to other professionals where actuaries have "home field" advantage. Success will open more doors for actuaries and attract the best to the profession.

Analytics can be useful to any organization but certain practice areas have more readily apparent applications: P&C, Health, Risk, and Life. The role of the SOA should be to provide members with the appropriate knowledge and experiences to prepare and position the profession to claim a share in the anticipated growth and to promote the value of actuaries.

This project may also enable actuaries to branch into other industries requiring related analytics; however this is not a team goal within the 3 year planning horizon.

Research

The initiative involved environmental scanning, analysis, market research, and surveys. In addition to the potential job market and other professionals competing with actuaries, we looked at what organizations are providing education. There are a substantial number of university programs and providers of continuing education for profit and not for profit alike. Members of the team developed the list and importance of the skills involved for practitioners of Advanced Business Analytics. This was compared with the current SOA syllabus and continuing education offerings for gap analysis. SOA members were surveyed on a range of issues - the sophistication of analytics in their organizations, their perception of actuaries as leaders in analytics, and their regard for the SOA as a supplier of education in analytics. Important outcomes were that a significant number of those surveyed are interested in learning more about analytics and trust the SOA as a provider of that education.

Another aspect of the project was a qualitative employer survey that provided anecdotal insights. Although several market research firms thought they could also obtain information from a large number of firms, this turned out to be impractical. As mentioned earlier, names for analytics, job titles and where the work is performed vary substantially from organization to organization. IPSOS, the firm selected for the task, performed the qualitative research successfully but not the larger employer survey.

In summary, the research identified a potential demand for actuaries in this analytics role and an interest from actuaries to develop these skills.

Recommendations

Recommendations, the second part of the charge from the Board, impact the following areas: professional development (continuing education), prequalifying education (basic education), research, and marketing. The SOA can play a role to prepare actuaries for the expected growth in analytics. The SOA can build or refresh knowledge through basic (prequalifying) and continuing education programs. The SOA can help brand actuaries as quantitative and risk management leaders.

The team is making the following recommendations:

1. In 2012 and 2013 large meetings should include an overview (new) session on Advanced Business Analytics.

2. The SOA should develop online and e-learning courses that involve case studies.

3. Development of a map for people interested in rounding out their knowledge in Advanced Business Analytics.

4. Development of an in-depth seminar in Advanced Business Analytics, available once or twice a year.

5. Additions to prequalifying education.

6. Research projects to build credibility for the SOA.

7. Develop a consistent marketing message.

The highest priority is in continuing education. This is where the SOA can respond rapidly to the changing educational needs of our membership in analytics. A key recommendation is the development of an in depth seminar that includes demonstration of mastery of the material. Next, the development of online courses in this area can assist existing practitioners as well as be used for prequalifying education. SOA research efforts can help build both the content and the reputation of actuaries in this area. And marketing a consistent message to our members about SOA offerings and the market potential will help build support. Another key recommendation is to create an ongoing analysis of job vacancies for actuaries and key words associated with them. This information can be used to guide SOA educational efforts to ensure it is providing what is valued in the marketplace.

The Advanced Business Analytics team was formed primarily to conduct marketplace research. The team will be disbanded after representatives have met with the possible implementation areas. The recommendations are frameworks, not blueprints because the team believes ultimately the decisions as to how to integrate and implement programs are best made by the volunteer and staff experts in those areas. Acceptance of its findings should mean that the ideas from this initiative are considered very seriously by the areas responsible for them. Status reports should be made to the Board through the Cultivate Opportunities Team.

Metrics

The team also recommends including metrics associated with the success of these efforts. In three years have our membership become more aware of the opportunities for them in Advanced Business Analytics? Have they participated in the education the SOA is offering? And what is the quality and quantity of the SOA offerings? The metrics should be suitable to the actions the SOA takes and have some weight in the organization.

Introduction

Since the middle of the last decade we've experience an explosion of literature - from *Moneyball* to *Analytics at Work* on the use of analytics in business and how organizations are changing the ways they make decisions.

The use of analytics in business is not new. It has been used in business operations for decades to ensure production quality and efficiency. What is new about Advanced Business Analytics is the diversity of applications, the amount and types of data, and the vast computing power that can be brought to bear on that data. Data from new sources and networked throughout organizations is a corporate asset

Actuaries have long been looked to when there was a need to perform analytics in insurance or consulting companies. Years ago there were set formulae and the extent of the analytics performed was fairly prescribed. While analytics have been used extensively in insurance for underwriting and marketing of products, starting on the Property and Casualty side and spreading to Health and Life insurance products, the uses and types of data have greatly expanded. (A well known example has been the linkage established between credit scores and driving records. Some recent examples are illustrated in the October/November issues of *The Actuary*, "Predictive Modeling with Consumer Data" pp 28-37).

At the October 2010 meeting, the Society of Actuaries Board approved a strategic initiative, **Business Analytics for Actuaries** as part of the SOA 2011 Plan. There were two components to this market research project:
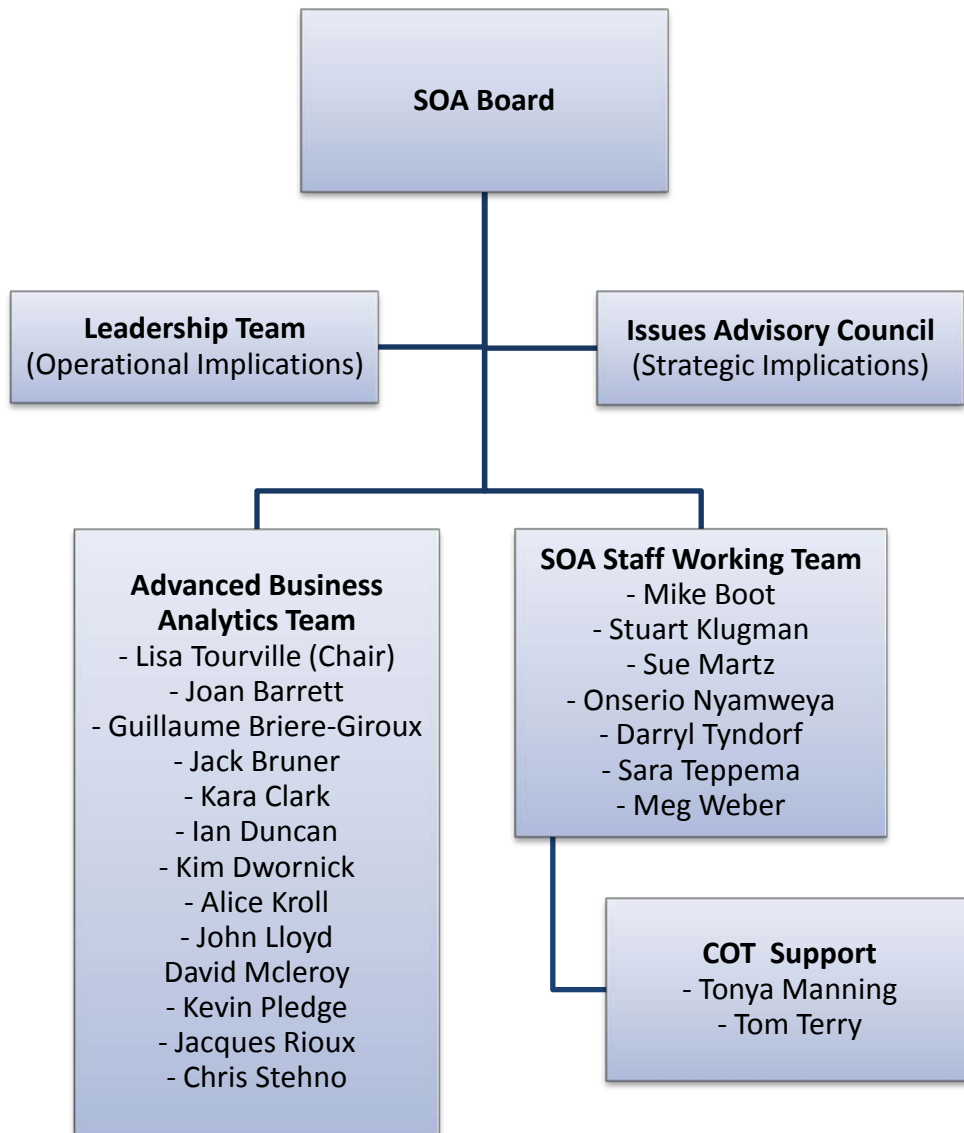
- Do significant opportunities exist for actuaries in business analytics?
- If so, what actions should the SOA should take to explore and develop these opportunities?

This initiative shares aspects of other actuarial marketplace initiatives, Untapped Opportunities for Actuaries in Health (2008) and the Personal Actuary project (2006). In both of those initiatives, marketplace research comprised the initial phase of the project. For Health, it was established there were additional career opportunities and/or educational opportunities. For the Personal Actuary, the market was deemed too limited to be pursued by the Society of Actuaries. Activity stopped at the research phase.

Team Members & Methodologies

In December it was determined the **Business Analytics for Actuaries** initiative would report to the SOA Board through the Cultivate Opportunities Team (COT. Updates have been provided to the COT on a monthly basis and have been included in the 2011 Board Consent agendas. Almost all team members actively sought to be put on this initiative. Many of these individuals use Advanced Business Analytics in their careers, educate others, and all have a passion. Some have pioneered new roles in their organizations for practitioners of Advanced Business Analytics and a few are with related but less traditional employers of actuaries. Including staff members, the team also brought the following diversity to the task:

By practice area
- o 7 Health, 4 Life, 1 Property & Casualty, 1 Retiree, and 6 non actuaries
- By employment type
  - o 5 Insurance, 3 Consulting Actuaries, 3 Staff Actuaries, 2 Software Developers, 2 "Related Industries" and others
  - o Medium, large employers and entrepreneurs
- Several team members have conducted sessions at SOA events on Advanced Business Analytics topics. One completed a research project in analytics. Several are involved in prequalifying education development.

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                        │      SOA Board       │
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  │   Leadership Team    │              │  Issues Advisory Council │
  │(Operational          │              │  (Strategic Implications)│
  │ Implications)        │              │                          │
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SOA Board

Leadership Team
(Operational Implications)

Issues Advisory Council
(Strategic Implications)

Advanced Business Analytics Team
- Lisa Tourville (Chair)
- Joan Barrett
- Guillaume Briere-Giroux
- Jack Bruner
- Kara Clark
- Ian Duncan
- Kim Dwornick
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David Mcleroy
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SOA Staff Working Team
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- Stuart Klugman
- Sue Martz
- Onserio Nyamweya
- Darryl Tyndorf
- Sara Teppema
- Meg Weber

COT Support
- Tonya Manning
- Tom Terry

The team first met face-to-face in Chicago February, 2011 to scope the project and define the concept. It met as a large team on a monthly basis. Subteams developed their own schedules.

The initiative was broken out into several steps led by subteams:

- Definition and scope
- Identify Skill Set of an Advanced Business Analytic Practitioner
- Identify the Gaps Between an Actuarial Education and Skills
- Internal Market Research
- External Market Research
- Scoping Possible SOA Responses

Other processes included environmental scanning to obtain information on the projected labor market, identifying fellow professionals in analytics, providers and types of educational programs, and job postings.

The team again met face-to-face in November, 2011 to discuss and finalize recommendations to the Board. This organization of this report is based on the outputs of these teams. The Appendix provides additional detail on a variety of topics.

Definition and Scope

Analytics, or "Advanced Business Analytics" the terminology our team preferred, has a large and evolving lexicon describing this work. Lacking common definition was a barrier to getting started. Some terms, like Data Mining and Predictive Modeling are used interchangeably to describe a specific action and other times to describe the overall field, depending on the source. The vast number of and unstable terms currently in use added to the complexity of this initiative. A partial list includes: infomatics (medinfomatics, healthinfomatics, "any prefix" infomatics), predictive modeling, predictive analytics, metrics, data mining, artificial intelligence, behavioral economics, customer dynamics, business intelligence, and, most recently "Big Data".

Another aspect of complexity is that business analytics, like "economics" is a collection of tools, techniques, and ideas. It/they don't tie to any particular job title or department. There is no industry standard. And finally, the work itself can be performed at an individual, departmental or enterprise level, again, under many different titles. To achieve some common ground, the team relied on the Davenport/Harris books: *Analytics at Work* and Competing on Analytics. Even so, it took the team several iterations to reach consensus on a definition. After these discussions the team appended "advanced" to the title. One reason ties to definitions and the other to scope. In terms of definitions, the team initially planned to target organizations that support Level 3-5 analytics sophistication as defined in Davenport's DELTA model. Based on our research results, Level 2 should also be concluded. Another reason was the team supports actuaries in leadership roles in Advanced Business Analytics.

See Appendix A for details of Davenport's DELTA Model.

Definition

Clearly with the considerable number of definitions and terminology associated with business analytics, a common working definition was In order to move forward with the project. The definition required a level of detail in order to communicate effectively with members and

employers as part of market research. The definition also needed to be <u>actuarial specific</u> to be meaningful to this initiative.

Advanced Business Analytics for Actuaries is a set of tools and techniques used to describe, predict, and recommend business courses of action that take into account consumer, provider, and distributor behavior. It draws from many disciplines. It relies heavily on vast amounts of data and computing power. Practitioners use statistics, modeling, optimization, clustering, and market research. Combined with actuarial judgment, using Advanced Business Analytics provides employers with insight for decisions related to managing complex risks and optimizing product design as well as improving outcomes and value for consumers.

Methodology

Project Scope

We have established analytical activity goes by many names. Any organization can use analytics. Our member survey showed most actuaries see themselves as active in analytics. The applications are wide. Deloitte Analytics, for example, offers industry insights for: Banking, Federal (Agencies), Insurance, Life Sciences, Oil and Gas, and Retail. The possibilities to investigate really are endless. The team determined the following scope for the project:

1. We have employment predictions that forecast to 2018. Our planning horizon for the SOA is 2-3 years.
2. Focus on the "home turf" first – current employers.
    a. We agreed to focus on actuaries in **current jobs, current employers**. Job listings from current employers of actuaries frequently note analytics as a plus or even a requirement for actuarial vacancies. Proficiency in Advanced Business Analytics provides actuaries with the ability to better manage risk. Casualty, life and health actuaries use analytics for pricing, underwriting, marketing, distribution analysis. *Note: Of a 12/21/2011 listing of 36 actuarial job openings, 6 specifically requested "informatics" or "predictive modeling" expertise and leadership.*
    b. Another focus is actuaries in **new roles with current employers**, especially insurance and consulting companies. The new roles may be in research and centers of excellence and non-insurance related applications.
    c. Why "home turf" first?
        i. Current employers of actuaries are familiar with actuaries' reputations for: trustworthiness, data based decision making, and business acumen.
        ii. Feedback of interest from our membership and employers surveyed.
        iii. A defensive move so as not to lose ground with other professionals.
        iv. Successes will attract qualified candidates to the profession.
        v. Successes may be leveraged into opportunities in related industries.
3. Focus on leadership, supervisory, and decision making roles (vs. running the models)
    a. Perhaps not on an individual basis but overall the other professionals in business analytics are typically compensated less than actuaries. Other professionals are less costly than hiring actuaries to run models.
    b. Even with a substantial increase in the number of actuaries, the need for analysts far exceeds the capacity to fill the jobs with actuaries.
4. Our initiative emphasizes solutions based on tools and techniques that are transferable across disciplines, vs. digging deeply in one particular practice area. People with strong interpersonal skills appear to be more successful in Advanced Business Analytics but that will not be the focus of team recommendations. The team viewed this as a general career challenge not specific to Advanced Business Analytics.

Research Conducted

The team carried out research covering the current and potential market for analytics and the perception of actuaries in this role.

Initial Research

Market Potential   The team surveyed various labour statistics giving a macro perspective of growth of demand for analytics.

Skills Needed   A subteam developed an internal survey to assess which skills are most important to Advanced Business Analytics. Once completed this was reviewed and discussed with the main team to develop a short list of skills needed.

Other Providers of Education   The team conducted a literature search of courses offered and how they are offered, in order to assess who else is providing training in analytics.

Market Research

The team determined there would be two groups to survey, our members and employers of actuaries. The research objectives were to understand the familiarity of both groups with advanced analytical techniques, determine how widely spread they are actually being applied in familiar business environments, and find out how receptive members were to some proposed approaches by the SOA under consideration by the team.

Market Research - Quantitative

In October, 2011 we reached out to several thousand SOA members and received approximately 10% response or 332 responses. Although a cross section of members was included, the survey also went to actuaries who had attended SOA continuing education in analytics in recent years.

Employer research –IPSOS Public Affairs

In late fall 2011; the SOA engaged the market research firm **IPSOS Public Affairs** to conduct both qualitative and quantitative studies of current employers of actuaries. IPSOS is a market research firm that the SOA has successfully used on other projects. They are familiar with the work and the actuarial *brand*. Initially the plan was to have several dozen employer interviews followed by surveys up to 150 employers. Our goal was to learn more about the current and future landscape for actuaries using analytics. A concern from the outset was the "maturity" levels of organizations vis à vis Davenport's DELTA model.

Results

Market Potential

Although it can't be linked to specific opportunities for actuaries, significant growth in analytic jobs in all industries is anticipated from now through 2018. The US Department of Labor **Appendix B** includes actuaries in the job titles associated with this growth. Others include statisticians, operations research analysts, management analysts, accountants/auditors, librarians, and various IT professionals. McKinsey (May 2011) predicts phenomenal growth in analytics, including a total 1.5 million managers and advanced analysts needed by 2018 and a shortage of people with analytical expertise of 140,000 to 190,000 in the United States alone. A December 2011 review of one large recruiter indicated 15% of the open positions for actuaries specifically requested skills in data mining or predictive modeling. Some employers report they pay all practitioners in analytics regardless of background the same. Others (including one on the SOA Employers Council) reported hiring non actuaries such as economists because they cost less.

Skills Needed/SOA Education Analysis

What do actuaries know and what do they need to know to be expert in Advanced Business Analytics? Our subteam developed the following list of Skills/Techniques that are necessarily to master for persons working in Advanced Business Analytics. There are others, but the team agreed on the priorities of the following list. For detailed descriptions of these Skills/Techniques as well as other related items, see **Appendix C.**

Category	Skills/Techniques	Importance
Traditional Statistical Techniques	Ordinary Least Squares	Required
	Logistic Regression	Required
	Generalized Linear Model	Required
	Time Series	Required
	Survival/Failure Time Analysis	Good to Have
Methods That Group/Organize	Trees/Clustering	Required
	Factor Analysis	Good to Have
Prep for Analysis/Steps Applicable to Any Method	Model Validation	Required
	Data Validation/Cleaning	Good to Have
Other Methods	Neural Networks	Good to Have
	Bayesian Networks	Good to Have

What do we know about what actuaries know?

Some actuaries have taken courses in these topics as part of their undergraduate education. Many universities offer degree programs in analytics including 12 of the 19 Society of Actuaries Centers of Actuarial Excellence. Some actuaries have learned on the job, supplementing their education as needed.

Some actuaries have learned from past offerings from the SOA. Historically the SOA has offered some of the above skills and techniques as part of prequalifying/"basic" education from the SOA. From 1985-1999 the SOA had a flexible education system that included required exams and electives. One such elective was the Intensive Seminar of Applied Statistical Methods (Course 121) which was a 5 day seminar featuring lectures, a computer lab, data, a project and an exam. This offering ended when all exams became required. From 2000-2007 Course 7 offered a seminar in applied modeling. While the concepts may have been somewhat more general than what is needed for Advanced Business Analytics, it covered modeling concepts in an intensive 5 day format that included pre-work and a pretest to enroll. The largest one of those sessions had 160 registrants split into 4 groups. Because they were part of the prequalifying education of an actuary, students had to demonstrate proficiency to pass. These seminars have been cited by some SOA members as being some of the most impactful of their SOA educational experience. They were no longer offered as the syllabus changed.

Currently there is little in the prequalifying education of actuaries in the skills and techniques identified as important for Advanced Business Analytics. Additions are being made incrementally to the Health track as it is being revised.

The SOA has been offering Continuing Education in Advanced Business Analytics topics at least as far back as 2004. In 2010 there were 34 hours of "programming;" in 2011, 30 hours. For perspective, the SOA Annual Meeting alone has 142 total hours. Formats have included meeting sessions, webinars, and one day seminars. See **Appendix D.** Content has been marketed under many different labels. Over 500 individuals have attended at least one SOA Professional Development event or session on a business analytic topic in recent years.

Other Providers of Education

Many universities provide degree programs in various types of analytics. A list of the SOA Centers of Excellence that have programs appear in **Appendix E** Some programs are on campuses, others are strictly online programs. Tuition costs range from $28K-$45K. (There are open courseware topics available from MIT in various analytics topics).

Other providers of this training include nonprofit and for profit organizations. Several of the "for profit" organizations have other corporate sponsors such as IBM, Milliman, AIIMS, and SAS. Many large consulting firms that employ actuaries are also education providers. The pricing of the meetings and seminars appears to be in line with the SOA. The team was not able to assess the quality of these offerings but the instructors appear to be well qualified. This list is not intended to be exhaustive (Since becoming involved in business analytics and sending out inquiries, more brochures come each month!). The team deems there is no "pack leader" among these organizations. See **Appendix F** for sample offers.

Organization	Type	Offering(s)	Certs/Designation
APQC (American Productivity Quality Center)	Non	Webinars	No
ASQ (grants Baldridge Award)	Non	Many types	Extensive Cert Program, like CLU
World Research Group, World Congress	Profit	World Health Conferences	No
The Modeling Agency (TMA)	Profit	Conferences – Business Intel/Data Mining	3 types
SAS	Profit	Online/Classroom all levels	Yes
Informs	Profit	Seminars/Conferences	
Insurance Data Management Association (IDMA)	Non	Conferences	Exams, Yes?
Gateway Management	Profit	Many types	
Predictive Analytics World, Prediction Impact	Profit	Conferences, online courses	

It is appropriate here to provide some history about the Casualty Actuarial Society. For years they have sponsored a conference called Rate Making & Product Management that attracts 500-800 attendees annually. One full day of the conference is dedicated to predictive modeling topics. In 2008, the CAS entertained the idea of offering several certificates in continuing education, one of which was predictive modeling. The team interviewed Andy Kudera who presented the Action Paper to their Board in September 2009. Their Board decided not to enter into a certificate program for predictive modeling or any other topic at that time.

Member Research – Quantitative

Findings:

- Most of the respondents are familiar with the tools/techniques identified by the team as important for Advanced Business Analytics
  - o Some are running the models
  - o Some conduct model validation and data validation/cleaning
  - o Additional techniques being used are: Monte Carlo Simulation, ANOVA, Stochastic Analysis, trending and Bayesian techniques

- Respondents said actuaries are most often the practitioners in their companies of Advanced Business Analytics, but other professionals included statisticians, economists, accountants and other financial professionals as well as IT professionals.
- 22% of the respondents view actuaries as being better prepared than other professionals in using Advanced Business Analytics (no caveats).
- An additional 60% said actuaries were better prepared in some cases but not in all situations. A common theme was it all depended on the training and business knowledge. Statisticians and economists might be closer to the models than actuaries.
- 62% of the respondents indicated they would be interested in more analytic education. They view the SOA as an authority to offer this education.
  - Education tied to real life business situations, insurance as well as other business applications.
  - Refresher courses for mid career actuaries.
- 45% of the respondents indicated they would be interested in some type of recognition or certificate for that education.
  - Certificate could give an applicant an advantage in the hiring process.
  - Certificate could be seen as a competing credential.
- There was an interest in online formats (this question did not distinguish between virtual classrooms vs. elearning formats).

The chart in **Appendix G** shows the software programs currently being used by the respondents to our survey.

Key takeaways:

- Our members are interested. The SOA needs to use consistent terminology.
- Our members see the SOA as a reliable source for this education.
- But, it is not a topic for everyone.

Employer Research - Qualitative

There were many challenges associated with this research:

- Evolving and inconsistent terminology surrounding the type of work
- Different levels of sophistication in the organizations was another, and perhaps an urge to want to be or appear to be farther along than they really are
- Different organizational structures – centralized, decentralized, etc. The latter created challenges of whom to interview or survey to represent that organization.
- Job titles

The challenges to completing the quantitative survey proved to be too great. If an organization is decentralized, how do we find the right person to interview? In a field with no common terminology, including job titles, again, who is the right person to interview? There is nothing comparable to "Chief Actuary" or "Chief Risk Officer." The team determined it was too costly in terms of time and money to continue trying to wrestle with obtaining relevant information.

We have the following information from our qualitative interviews with employers:

- Their definition of analytics is "using mathematical tools to inform strategic decision and solve problems. "
- Employers +10,000 employers were most effective leveraging Advanced Business Analytics. One response to how they felt about analytics in their company "It's ridiculously important!"
- Frequently analytics is being used in HR departments to identify employees "likely to stay" or employees "likely to attain leadership levels." Organizations have no pattern: departments may be actuaries, HR, marketing, IT…usually decentralized.
- Currently these employers view the actuarial credential as valid for working in analytics but also mentioned Masters/PhD's in statistics, economics, finance, or engineering.
- Some employers expressed concern regarding actuaries' abilities in statistics and in communication.
- Some employers interviewed said a certificate could give an applicant priority over other applicants. Some employers desired a certificate or credential that would ensure some demonstrated mastery. Some employers look to master's degrees to serve this purpose.

Appendix H has more detailed information from IPSOS from the employer interviews.

Conclusions from IPSOS Employer Research

Not surprisingly, large companies will have more individuals dedicated to analytics. The applications will be broad. Actuaries with good communication skills, business knowledge, and understanding of the tools and techniques can lead groups in Advanced Business Analytics.

Additional SOA Employer Research

Supporting this, were results from a 2011 SOA research survey. 55 life insurance companies were asked about their use of predictive modeling. The survey results indicated many were considering using predictive modeling/Advanced Business Analytics for life insurance functions but have not started yet.

- 40% *considering* using predictive modeling to enhance sales and marketing
- 50% *considering* using for underwriting
- 1 company currently *using* predictive modeling for claims

In terms of the Davenport DELTA model, this would mean more companies, at least life insurance companies, are in the level 2 and 3 ranges, vs. 4 or 5. The team interpreted this information as a risk and an opportunity. Actuaries have the opportunity to lead efforts in their companies should the firms determine to move ahead with implementing more analytics.

Team Recommendations

The second half of the assignment from the Board was for the team to recommend possible responses to be made by the Society of Actuaries. The Advanced Business Analytics team had the responsibility to recommend to the Board but volunteers and staff associated with SOA Education, Professional Development, Research and Marketing are those who will carry these ideas forward. The team includes people with experience in these areas and who are actively moving some of the ideas forward. The team has developed some framework for each of the ideas and will be available in March and April to expand upon these ideas with the areas that can implement them.

The team recommends looking at plans for the next three years. The team believes the SOA can play a role to prepare actuaries for the anticipated boom in analytics. The SOA can build or refresh knowledge through prequalifying and continuing education programs. The SOA can help brand actuaries as quantitative and risk management leaders through research and marketing. The team envisions this effort focusing on what is needed to manage and lead efforts in advanced business applications. Actuaries should be the people making decisions about what tools to use and how to interpret and apply the results and integrate into business functions.

Ideally the efforts in education and marketing can align with actuarial career stages. See simplified grid Appendix **I.**

Professional Development (Continuing Education)

Changes to continuing education are listed first in the recommendations from the team. This is where the SOA can be the most nimble in its response. From our member survey we know not only is the SOA viewed as a respectable source of education in Advanced Business Analytics, there is a serious interest in enrolling. The Professional Development Committee will discuss these ideas at their February 2012 face-to-face meeting.

To date 11 sections have been involved in sponsoring meeting sessions, webinars, and seminars in predictive modeling, data mining, data quality, and behavioral economics to name a few. These will continue. We need to ensure the terminology is more consistent and consider building meeting tracks.

In 2012 and 2013 large meetings should include an overview (new) session on Advanced Business Analytics as an introductory course. The team envisions some similarities to the treatment Complexity Science has had in the past year. What are we talking about with "Advanced Business Analytics?" What are the applications in specific practice areas? What are some of the tools and techniques? And why should actuaries be interested? Another area to promote the concepts is through luncheon and keynote speakers. In fact, Tom Davenport will be the keynote at the 2012 Health Meeting in New Orleans.

The SOA should develop additional online and elearning courses that involve case studies. Some university programs (i.e. Northwestern University) are entirely online - see **Appendix K.** However, these online courses have an instructor affiliated with the courses. They are not self study. Another issue to be addressed with these courses is how to provide the data.

The team also recommends the development of a map for people interested in rounding out their knowledge in Advanced Business Analytics. The SOA needs to provide continuing education that corresponds to different career stages.

A different kind of seminar…

The team strongly endorses the development of an in-depth seminar oriented towards the leaders in Advanced Business Analytics. The seminar should be available annually designed to support up to 40 attendees per session. Team members have some different visions of that seminar. Some of the models include: the Nexus ALM seminars, Microsoft certification programs, and the SOA's former basic education elective Course 121. The team agrees there should be pre-work and possibly pre-tests or mastery demonstrated in some basics. There is not unanimity as to the duration of the pre-work period or the demands of "mastery." One way could be similar to the ALM courses during which attendees demonstrate mastery through team exercises and presentations. Another model is based on the Microsoft Certification Courses. These courses require the individual passes 7 or more online exams.

In order to bring this seminar online quickly, the SOA will not be able to rely on strictly volunteer resources. The PD Committee will likely create an RFP. Another option is to collaborate with another organization – our CAE's, not for profit or for profit organizations – to deliver high quality continuing education. Also, if there are tests involved, the SOA will need to determine what an appropriate pass mark is for a continuing education offering. The team recommends the PD Committee approach this as a pilot in order to test the approach prior to a long term commitment. It is likely if this seminar is successful, other topics may be considered for the same treatment. It represents a departure from how the SOA has traditionally handled continuing education. Note: Non actuaries may register for these seminars but the orientation is towards serving actuaries as the primary participants.

Recognition…

Likewise the team grappled with how to recognize actuaries with proficiency in Advanced Business Analytics. The team leans towards recognition from the SOA that is appropriate to the rigor of requirements tied to the seminar. Team members, especially hiring managers, see a certificate as being a way for employers to evaluate applicants. The membership survey did not provide guidance. Other team members had concerns regarding the meaning of the certificate. More on these considerations are listed under the topic: Considered but Not Recommended at This Time following the recommendations.

Prequalifying Education ("Basic" Education)

An actuary's education includes analytical methods but there are areas of Advanced Business Analytics that are not part of the current SOA syllabus. Much of the material is not conducive to self study and often needs a large amount of test data to work through to effectively master it. Nor are multiple choice exams suitable. The team recommends additions to the prequalifying exam syllabus for both ASAs and FSAs. For ASA education, introduce candidates to advanced business analytic concepts and applications. This could be done as part of the modeling section of the Fundamental of Actuarial Practice (FAP) course. FSA education could include track-specific

examples and readings. Case studies could be used for more hands-on training. The Health track will have some changes in 2012. Some tracks may be a more obvious fit than others. As enthusiastic as it is, the team is aware that the amount of material in the syllabus is not elastic and it will be the determination of Education committees to make the final determinations. The January 2012 Central Review meeting was their first exposure to these ideas. **Appendix J** has original notes on addressing the gaps between the syllabus and the required skills.

Research

Similar to Untapped Opportunities for Actuaries in Health, the team also recommends research projects as a way to build credibility for the SOA in Advanced Business Analytics and to provide our members with findings that help their work. Recently there have been several projects:

- 2010 Call for Papers – Predictive Modeling
- 2011 Predictive Modeling (Life Companies) Survey
- 2011 Experience Data Quality (CLIR, LIMRA)
- 2012 Call for Papers in Behavioral Economics

Since companies "compete on analytics" it may be a challenge to find a topic that is not proprietary, perhaps an example from the public sector. Advanced Business Analytics could be used in SOA experience studies – life underwriting, medical rate making, retention programs, etc. In addition to partnering with non actuarial organizations such as MIB and LIMRA, the SOA should seek to have research published in non-actuarial publications as well as actuarial and peer reviewed journals.

Marketing & Communication

Marketing and messaging are important to this recommendation. Advanced Business Analytics has evolving terminology. Marketing needs to help volunteers and event registrants see the connections and the career potential. We need consistent terms for professional development marketing, SOA publications (*SOA News Today*, *The Actuary*, and section publications), the soa.org, and other communication networks. (The February/March issue of *The Actuary* has an article by Lisa Tourville). As SOA marketing has done in the past, the team recommends success stories on individuals and applications. And finally the team would like the SOA perhaps through www.beanactuary.org, to take a proactive role with actuarial job postings and with recruiters of actuaries. What trends are recruiters seeing on job postings? What are current key skills and words being used to describe them? Presuming the information could be shared effectively throughout our organization, it would have benefits beyond the scope of this initiative for curriculum development and SOA publications.

Considered but Not Recommended at This Time

There are some actions that were brought to our attention and were seriously considered that ultimately are not part of this recommendation.

New Designation/Credential

To be clear, there are members of the team who would like to see a track or credential in Advanced Business Analytics for actuaries but it was all but unanimous the team did not want to pursue the development of a credential <u>at this time</u>. Here are some of the reasons:

- The quickest way the SOA can respond to the need for education is through continuing education vs. prequalifying programs.
- Maybe a long term idea. It took CERA several years of consideration.
- Most non university programs are offered as continuing education and without certifications.
- Establish reputation first with current employers of actuaries.
- Measure success of the in-depth seminar.
- Outside the profession, different tracks/designations are not that well known. This becomes another way the profession subdivides and becomes more difficult for non actuaries to understand.
- Like CERA, would we need an alternate pathway to the credential for established practitioners?

Section dedicated to Advanced Business Analytics

Over half of the sections are already actively supporting content through publications and continuing education in analytics topics: Actuary of the Future, Education & Research, Entrepreneurial Actuaries, Financial Reporting, Forecasting & Futurism, Health, Investment, Joint Risk Management, Marketing & Distribution, Pension, Product Development, Reinsurance, and Technology. It is not evident a separate section would increase the content or delivery systems for the SOA to its membership.

Measuring Success

How do we ensure these recommendations are not just neatly filed away? And how do we know if the actions taken by the SOA make a difference? The team has some ideas about those, too.

Prior to terminating as an entity, team members will meet with the appropriate volunteer and staff leaders in Professional Development, Education, Research, and MARCOM to discuss the opportunity and the recommendations. In several cases, some of the members of the Advanced Business Analytics team are active volunteers in Education, Professional Development, and Research. There should be a summary of the responses to those meetings delivered to the Cultivate Opportunities Team. At that time, the team as an entity disbands.

The COT should name a resource, SOA Staff or volunteer, to be responsible for periodic follow ups with these areas and on the recommendations.

Measure 1 – Attendance and satisfaction with all continuing education that is associated with Advanced Business Analytics. (There is baseline data from 2010 and 2011 for attendance and satisfaction).

Measure 2 – Compare a few key responses from the member survey over time regarding the perceptions and participation in their companies by actuaries as leaders in Advanced Business Analytics or update and expand the recent life company survey on predictive modeling to include other areas of practice.

Measure 3 – If a partnership can be established with recruiters, develop a metric pertaining to Advanced Business Analytics on actuarial vacancies.

APPENDIX A - Davenport's DELTA Model

The following model appears in <u>Analytics at Work</u>. It is a schematic of different maturity levels of organizations using business analytics.

Success Factor	Stage 1 Analytically Impaired	Stage 2 Localized Analytics	Stage 3 Analytical Aspirations	Stage 4 Analytical Companies	Stage 5 Analytical Competitors
Data	Inconsistent, poor quality and organization; difficult to do substantial analysis; no groups with strong data orientation.	Much data useable, but in functional or process silos; senior executives don't discuss data management.	Identifying key data domains and creating central data repositories.	Integrated, accurate, common data in central warehouse; data still mainly an IT matter; little unique data.	Relentless search for new data and metrics; organization separate from IT oversees information; data viewed as strategic asset.
Enterprise	No enterprise perspective on data or analytics. Poorly integrated systems.	Islands of data, technology, and expertise deliver local value.	Process or business unit focus for analytics. Infrastructure for analytics beginning to coalesce.	Key data, technology and analysts are managed from an enterprise perspective.	Key analytical resources focused on enterprise priorities and differentiation.
Leadership	Little awareness of or interest in analytics.	Local leaders emerge, but have little connection.	Senior leaders recognizing importance of analytics and developing analytical capabilities.	Senior leaders developing analytical plans and building analytical capabilities.	Strong leaders behaving analytically and showing passion for analytical competition.
Targets	No targeting of opportunities.	Multiple disconnected targets, typically not of strategic importance.	Analytical efforts coalescing behind a small set of important targets.	Analytics centered on a few key business domains with explicit and ambitious outcomes.	Analytics integral to the company's distinctive capability and strategy.
Analysts	Few skills, and those attached to specific functions.	Unconnected pockets of analysts; unmanaged mix of skills.	Analysts recognized as key talent and focused on important business areas.	Highly capable analysts explicitly recruited, developed, deployed, and engaged.	World-class professional analysts; cultivation of analytical amateurs across the enterprise.

2011 © All Rights Reserved. Analytics at Work, Thomas H. Davenport and International Institute for Analytics (IIA).

APPENDIX B – Job Titles in Analytics

US Department of Labor - Top Job Titles in Analytics 2012-2018

Job Titles	Expected Growth by 2018	Total # Expected	Projected Median Income	Top 10% Income
Librarians	8%	172,400	$52,530	$81,130
Accountants/Auditors	22%	1,570,000	$59,430	$102,380
Statisticians	13%	25,500	$72,610	$117,190
Ops Research Analysts	22%	76,900	$69,000	$118,130
Management Analysts	24%	925,200	$73,570	$133,850
Actuaries	21%	23,900	$84,810	>$160,780

This is not an exhaustive list of people working in analytics. IT Departments are often home to analytics operations but there is a wide range of IT job titles and salary ranges, none of which the DOL has mapped back to analytics. Also, a health economist may be an analytics practitioner. The DOL does not break out growth or salary by type of economist.

APPENDIX C – Tools and Techniques

Detailed Analysis of Advanced Business Analytics Tools and Techniques

Report of the subteam:

Our task is to answer the following questions:

What are the specific tools and skills needed for a person to qualify as a person doing the work above? How did individuals who are practitioners today acquire the tools and skills? What of these can be offered through course work? What qualifies actuaries as leaders in business analytics? Identify the technical and non-technical skill sets. What <u>core</u> techniques should be part of the qualifications? What are the skill gaps between what actuaries know now and what they need to know?

The process to develop the list of tools and techniques is as follows:

- The team brainstormed a list of potential tools.
- The full committee then added to the list.
- The team circulated the full list along with a description of each item.
- The full committee was asked to vote on the degree to which they believed each item belongs. Five surveys were returned.

This document indicates the tools and techniques that received significant support. They are arranged into arbitrary groups by type of tool/technique and are not presented in order of perceived importance. However, for those who made the list, a distinction is drawn between those that received clear positive support and those that were broadly perceived as good to have, but not as critical. For completeness, those that were rejected are listed at the end.

TOOLS AND TECHNIQUES THAT MAKE THE LIST

Traditional statistical techniques

Ordinary Least Squares - Required

The OLS model plays a fundamental role in various data mining applications. The goal of OLS is to minimize the sum of squared errors from the data. Its wide popularity stems from several facts. First, the OLS model offers the simplest models by using a linear functional form to quantify the relationship under study. Despite its simplicity, the linear form often implies efficiency. The parameters involved in a linear model can be easily interpreted. The OLS model is also flexible enough to incorporate interactions via cross-product terms, categorical predictors via dummy variables, and some nonlinear patterns by allowing for variable transformations. At the same time, the well-established linear model theories provide the basic foundation for many other advanced modeling tools. A simple example of the application of OLS model in healthcare is the development of a model to predict the cost of an insured member, based on independent variables such as age, sex and the presence of certain healthcare conditions.

Source – Healthcare Predictive Modeling and Risk Adjustment, I. Duncan.

Under the OLS umbrella are models such as analysis of variance and random and mixed effects.

Logistic Regression - Required

Logistic regression is used for discrete or qualitative responses. An example of discrete response is binary data; however, the methods may be extended to polytomous[1] data. Binary data occur frequently in healthcare, for example, as the status indicators of disease prevalence, payment delinquency, medical claim fraud, etc. Continuous data may also be converted into categorical responses for analysis by logistic regression by categorizing values. The logistic model applies the logit link to formulate the relationship between a binary response and its associated predictors. A typical application of logistic regression within healthcare is a two-stage model: in the first stage, the model predicts the likelihood that a member will experience healthcare claims, based on certain independent variables (typically age, sex and the presence of certain healthcare conditions). The second stage predicts the amount of the claim by using the predicted likelihood of experiencing the healthcare claims from the first stage, along with other independent variables.

Source – Healthcare Predictive Modeling and Risk Adjustment, I. Duncan.

Generalized Linear Model - Required

This is a generalization of ordinary least squares regression in two directions. First, several functions are available to express the expected dependent variable in terms of a linear function of the independent variables. Second, the distribution of the dependent variable need not be normal. As a result, the variance need not be constant. Logistic, Poisson and OLS regression are special cases.

It can be used to uncover relationships as well as to make predictions. It is covered on the CAS syllabus with "A Practitioner's Guide to Generalized Linear Models" (http://www.casact.org/library/studynotes/anderson9.pdf)

Time Series - Required

These methods analyze data that is collected through time. The major difference with regression models is that the observations are correlated. By understanding the relationship between observations at different time points, patterns can be uncovered and predictions made. The most common models used are moving average and exponential smoothing, ARIMA and regression based.

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[1] Data with categorical responses consisting of more than two classes, and/or multi-level ordinal responses.

Time series methods are commonly used to study trends such as the behavior of investments or of costs and prices through time.

Survival/Failure Time Analysis - Good to Have

The goal is to model the probability distribution for the time or age of occurrence of a specified event (such as death). Both parametric and nonparametric models are used. Methods must account for the fact that data are often censored or truncated. More complex models (for example the Cox proportional hazards model) relate the survival time to covariates such as gender or type treatment.

Methods that group or organize

Trees/Clustering - Required

The term cluster analysis designates a number of different algorithms and methods for grouping a set of observations into subsets (clusters) so that observations in the same cluster are similar in some sense. An important step in most clustering is to select a distance measure, which will determine how the similarity of two elements is calculated. This will influence the shape of the clusters, as some elements may be close to one another according to one distance and farther away according to another.

Clustering is a method of unsupervised learning. It can be used to discover structure in data without providing an explanation/interpretation. In other words, cluster analysis discovers structures in data without explaining why they exist.

Using Cluster Analysis to Define Geographical Rating Territories
http://www.casact.org/pubs/dpp/dpp08/08dpp34.pdf

Cluster analysis: A spatial approach to actuarial modeling

http://jp.milliman.com/en/publications/research/pdfs/cluster-analysis-spatial-approach-jpe-R08-01-08.pdf

Factor Analysis - Good to Have

Factor analysis is a generic term for a family of statistical techniques concerned with the reduction of a set of observable variables in terms of a small number of latent factors. It has been developed primarily for analyzing relationships among a number of measurable entities (such as survey items or test scores).

The underlying assumption of factor analysis is that there exists a number of unobserved latent variables (or "factors") that account for the correlations among observed variables, such that if the latent variables are partialled out or held constant, the partial correlations among observed variables all become zero. In other words, the latent factors determine the values of the observed variables.

This is taken verbatim from:

http://www.ats.ucla.edu/stat/sas/library/factor_ut.htm

An actuarial application:

A Multivariate Model for Predicting the Efficiency of Financial Performance for Property and Liability Egyptian Insurance Companies

http://www.casact.org/pubs/dpp/dpp08/08dpp53.pdf

Preparation for analysis and other generic steps that can apply to any method

Data Validation/Cleaning - Good to Have

Data cleansing is a process where we identify and correct errors made during data entry or data processing. The process involve correcting typos, spelling errors, remove duplicates, inconsistent data, inaccurate data and make sure the data is useful.

Data Validation involves checking the data for accuracy, validate the data with set of rules applicable. Some validation methods like Format check, check digits numerical data, post code or zip code check based on different countries like US format, UK formats , check for totals of invoices, spelling check, check for consistency, check data type etc.,

Included here could also be data management tools such as SQL.

Model Validation - Required

Model validation is possibly the most important step in the model building sequence.

There are many statistical tools for model validation, but the primary tool for most process modeling applications is graphical residual analysis. Different types of plots of the residuals from a fitted model provide information on the adequacy of different aspects of the model. Numerical methods for model validation are also useful, but usually to a lesser degree than graphical methods. Graphical methods have an advantage over numerical methods for model validation because they readily illustrate a broad range of complex aspects of the relationship between the model and the data. Numerical methods for model validation tend to be narrowly focused on a particular aspect of the relationship between the model and the data and often try to compress that information into a single descriptive number or test result.

There are also a few modeling situations in which graphical methods cannot easily be used. In these cases, numerical methods provide a fallback position for model validation. One common situation when numerical validation methods take precedence over graphical methods is when the number of parameters being estimated is relatively close to the size of the data set. In this situation residual plots are often difficult to interpret due to constraints on the residuals imposed by the estimation of the unknown parameters. One area in which this typically happens is in optimization applications using designed experiments. Logistic regression with binary data is another area in which graphical residual analysis can be difficult.

This is almost verbatim from

http://www.itl.nist.gov/div898/handbook/pmd/section4/pmd44.htm

Other methods

Neural Networks - Good to Have

Neural networks are analytical techniques modeled after the hypothesized processes of learning in the cognitive system and the neurological functions of the brain and capable of predicting new observations from other observations after executing a process of so-called learning from existing data. Neural networks are one of the data mining techniques. The resulting network developed in the process of learning represents a pattern detected in the data. The network is the functional equivalent of a model of relations between variables in the traditional model building approach. However, unlike in traditional models those relations can't be articulated in the usual terms used in statistics or methodology to describe relations between variables. Neural network techniques can be used as a component of analysis designed to build explanatory models because neural networks can help explore data sets in search for relevant variables or groups of variables, the results of such explanatory variables can facilitate the process of model building.

Source: Statsoft *Electronics Statistics Textbook*-Creators of Statistics Data Analysis Software and Services.

An actuarial application is setting groups for experience studies and in particular can help decide how many groups are needed.

Bayesian Networks - Good to Have

A Bayes net is a model that reflects the states of some part of a world that is being modeled, relating state by probabilities. Anything can be modeled by a Bayes net. All the possible states of the model represent all the possible worlds that can exist, that is, all the possible ways that the parts or states can be configured. The car engine can be running normally or giving trouble. Its tires can be inflated or flat. Your body can be sick or healthy, and so on. Typically some states will tend to occur more frequently than others. Thus, if you are sick, the chances of a runny nose are higher. If it is cloudy, the chances of rain are higher, and so on.

A simple Bayes net illustrates these concepts. In this simple world, let us say that the weather can have three states: sunny, cloudy, or rain and that the grass can be wet or dry, and that the sprinkler can be on or off. Now there are some causal links in this world. If it is rainy, then it will make the grass wet directly. But if it is sunny for a long time, that too can make the grass wet, indirectly, by causing us to turn on the sprinkler. When actual probabilities are entered into this net that reflect the reality of weather, lawn, and sprinkler-use-behavior, such a net can be made to answer a number of useful questions, such as "if the lawn is wet, what are the chances it was

caused by rain or by the sprinkler", and "if the chance of rain increases, how does that affect my having to budget time for watering the lawn?"

Bayesian Networks and Decision Graphs Jensen and Nielson (2nd Edition) Springer.

NOT INCLUDED

Epidemiology

It is not, in itself, a technique or method, but rather a collection of methods that are designed to study health-event patterns. It can be used to inform evidence-based medicine, identifying risk factors and determining optimal treatment approaches. (Adapted from Wikipedia). The following are some of the techniques used:

Case control studies – compare a groups of people with and without a disease or condition and then look back through time to see if there were factors common to one of the two subsets.

Cohort studies – Begin with a group that does not have the condition but have different risk profiles and then observe them prospectively to see which ones develop the condition.

Survey Sampling

Unlike most statistical inference problems here the population is well-defined and generalizations are made from the sample to this specific population. Sampling can be random (perhaps with stratification) but other forms (such as convenience sampling).

Sampling is frequently used for audits of claim payments.

Grouper Models/Risk Adjusters

This one seems too health oriented to get full support.

Grouper models are frequently used in healthcare analytics, where they are also referred to as predictive models or risk adjusters. Health insurance claims contain a significant amount of valuable data, including one or more of about 15,000 ICD-9 diagnosis codes. The volume of information present in claims gives rise to problems for the analyst, including the need to summarize (or "group") diagnoses into higher level conditions for efficient analysis, and redundancy (repetition of the same diagnosis in multiple claims). Grouper models are very useful for deriving useable summary conditions from the multiple diagnoses that exist within an insured member record. Two principal types of grouper models are used: condition groupers and episode groupers. Condition groupers summarize different diagnoses within the same class, while episode groupers summarize services associated with the same condition or treatment. (A similar type of grouper model performs the same sort of summarization for different types of drugs within a therapeutic class.) Groupers are used in many applications in healthcare, primarily predictive modeling (members with different diagnoses have different costs and the presence of a diagnosis(es) can be used to predict those costs) and risk adjustment (the use of diagnosis groupings and their associated costs to normalize member costs and provider and health plan reimbursement).

Source – Healthcare Predictive Modeling and Risk Adjustment, I. Duncan.

Further information can be found at: www.soa.org/files/pdf/risk-assessmentc.pdf - "A Comparative Analysis of Claims-Based Tools for Health Risk Assessment" authors R. Winkelman and S., Mehmud, *Society of Actuaries,* 2007 Apr: 1-63.

It is the process of deriving high quality information from text. Text mining usually involves the process of structuring the input text, deriving patterns within the structured data, and finally evaluating and interpreting the output. Quality information from text mining usually refers to some combination of relevance, novelty, and interest. Typical text mining tasks include text categorization, text clustering, concept/entity extraction, document summarization, and entity relation modeling. Since most data is stored as text, text mining is believed to have a high commercial potential value.

Until recently, websites often used text based searches, which only found documents containing specific user defined words or phrases. Now, through use of a semantic web, text mining can find content based on meaning and context (rather than just by a specific word). Text mining software can be used to build a large collection of files on specific people and events. For example, large datasets based on data extracted from news reports can be built to facilitate social networks analysis. Text mining software may act in a capacity similar to an intelligence analyst or research librarian.

Source: Wikipedia, the free encyclopedia.

Data Governance and Management

The previous item was about working with the data once it has been gathered. This is about what data to obtain and building the data structure.

Hypothesis Testing

 High variability in responses, partly included in Model Validation

A statistic is simply a computed value that characterizes a particular data sample. If we have some model of the theoretical probability distribution of this statistic, we can assess its significance by considering the likelihood of our statistic's value. We can set up any number of conditions to evaluate whether our statistic is significant and by how much. For example, it is common to declare that if a statistic's value is +-two standard deviations away from the hypothetical mean value expected by random chance, then it is significant. Perhaps, +-3 standard deviations is a safer tolerance; it's all in how we define significance. Hypothesis testing is the rational framework for applying statistical tests. We want to understand whether the sample data is significant based on a statistic.

If a hypothesis is stated such that it specifies the entire distribution, we call it a simple hypothesis. Otherwise, we call it a composite hypothesis. More rigorous tests can be done with a simple hypothesis, because they specify the entire distribution, from which probability values can be computed.

Source: Hypothesis Testing, University of California at San Francisco, Vincent A. Voelz

Complex Adaptive Systems

The Wikipedia definition uses a lot of jargon – "[It] is a complex, self-similar collection of interacting adaptive agents. The study … focuses on complex, emergent and macroscopic properties of the system." The main difference from other models is that it is built from the bottom up with the behavior of agents (such as consumers of health care, providers and insurers) and how they interact and adapt modeled. Simulations then reveal possible outcomes and the effect of changing aspects of the system. It is more useful for understanding systems than it is for making predictions.

The SOA published a major research study covering many of the models used and offering illustrations. It is available at http://www.soa.org/research/research-projects/health/research-complexity-science.aspx

Geographic Information Systems

From Wikipedia – "a system that captures, stores, analyzes, manages and presents data with reference to geographic location data. GIS is the merging of cartography, statistical analysis and database technology.

An example is "IMNashville, Interactive mapping of health disparities. http://www.imnashville.com/home/

A Google search of "gis health care" provides many entities supplying GIS services.

Fuzzy Logic

Fuzzy logic can be viewed as an alternative to probability theory that assigns "degrees of truth" to statements. It comes with extensions to fuzzy sets and algebras for manipulating them. There are arguments that anything that can be done with fuzzy logic can be done with Bayesian analysis and arguments that they are very different.

The SOA published a monograph on the subject: *An Investigation into Possible Applications of Fuzzy Set Methods in Actuarial Science*, Krzysztof Ostaszewski, 1993. An example paper is Cummins and Derrig "Fuzzy Financial Pricing of Property-Liability Insurance, *NAAJ*, 1997 (21-44)

APPENDIX D - SOA Continuing Education in Analytics

2011 Events

SOA#	Title	Length	Registered / Attended	Rating / Event Ave	Practice	Sponsor
Life and Annuity Symposium						
32	Automated Underwriting as Tool for Mid Market Growth	90	81 / 78	3.52 / 3.89	Life	MAD
69	Policyholder Behavior	75	149 / 107	3.62 / 3.89	Life	FR
Health Meeting						
12	Avoiding Statistical Pitfalls in Actuarial Work	90	100 / 97	3.77 / 3.95	Health	H, E&R
28	Predictive Modeling Under ACA	90	119 / 117	3.87 /3.95	Health	H
50	Predictive Modeling for Disability Insurance	90	89 / 78	3.54 / 3.95	Health	H
61	Text Mining: Approaches and Applications	90	31 / 27	3.75 / 3.95	None	Tech
65	Infomatics & Actuarial Data Marts	75	130 / 94	3.76 / 3.95	Health	H
67	Quality & Efficiency	75	86 / 66	3.48 / 3.95	Health	H
Val Act Symposium						
23	Avoiding Statistical Pitfalls in Actuarial Work	90			Life	
Annual Meeting						
90	Trends and the Future of Insurance Distribution	180	154 / 182	3.93 / 3.21		MAD
DI and LTC Insurer's Forum						
	Application of the Future: Where Technology is Taking Us	60			Health	

2011 Webinars

		Title				Profit		
118		Policyholder Behavior	450	57		$27,721	Life	PD
119		Predictive Analytics for Life Insurance	450	31		$5,655	Life	Deloitte
	29-Sep	Automatic Predictive Modeling (Life Underwriting)	90				Life	MAD

2010 Events

SOA#	Title	Length	Registered / Attended	Rating / Event Ave	Practice	Sponsor
Life and Annuity Symposium						
	Predictable or Unpredictable? Forecasting in the 21st Century	90	36 /36	3.35 / 3.82	None	
	Policyholder Behavior Predictive Modeling for Life Insurance	75	60 / 60	3.92 / 3.82	Life	
Health Meeting						
	Quality & Efficiency Update	90	46 / 48	4.17 / 3.93	Health	
	Measuring Outcomes & the Health Care Ecosystem	75	54 / 49	3.72 / 3.93	Health	
	Role of the Actuary in Quality in Evidence Based Medicine	90	151 / 120	3.92 / 3.93	Health	
Val Act Symposium						
11	Avoiding Statistical Pitfalls in Actuarial Work	90	58 / 54	4.29 / 3.88	Life	
40	Impacts of Policyholder Behavior	90	138 / 122	9.96 / 3.88	Life	

	Annual Meeting					
25	Predictive Modeling: What Can We Learn from Each Other	90	210 / 177	3.61 / 3.87	None	Tech
95	The Flaws of Large Numbers	90	150 / 132	3.02 / 3.87	None	Inv, E&R
99	Behavioral Fin in DC Plan Design	90	43 / 50	4.16 / 3.87	Ret	Pension
101	Quality Control	90	62 / 53	3.97 / 3.87	All	Tech
113	Is Prediction Possible?	90	121 / 115	3.73 / 3.87	All	F&F
125	Social Insurance Projections: Methods & Models	90	67 / 31	4.38 / 3.87	Ret	SI&PF
129	Quality & Efficiency Research	90	116 / 86	4.06 / 3.87	Health	H

2010 Webinars

	Date	Title	Length	Att		Profit		
15	31-May	Predictive Modeling for Life Insurance	450	44		$26,679	Life	Deloitte
60	2-Nov	Life Insurance Automated Underwriting Systems	90	?		$11,407	Life	MAD
65	3-Feb	Measurement of Healthcare Quality & Efficiency	90	86		$13,170	Health	H
66	3-Mar	Business Intelligence	90	42		$14,757	None	CAS & Tech
89	30-Sep	Measurement of Medical Errors	90	31		$4,391	Health	H

Length is in minutes.

APPENDIX E – University Programs

There are 140 university programs (at 99 institutions) in the US and 9 programs/institutions in Canada. Schools are diverse (Air Force Academy) and prestigious (Harvard, Princeton). Many programs are operations oriented. Others focus on IT. Programs range in price from $28K-$45K. Some programs are online only. The following programs are available at Society of Actuaries Centers of Actuarial Excellence.

- Pennsylvania State University, Industrial and Manufacturing Engineering *
- Pennsylvania State University, Smeal College (Business): Supply Chain and Information Systems *
- Temple University, School of Business and Management: Management Science/Operations Management *
- University of Connecticut, Operations and Information Management *
- University of Illinois at Urbana-Champaign, Industrial and Enterprise Systems Engineering *
- University of Iowa, Henry B. Tippie College of Business: Management Sciences *
- University of Iowa, Industrial Engineering *
- University of Michigan, Industrial and Operations Engineering *
- University of Nebraska at Lincoln, Industrial and Management Systems Engineering *
- University of Wisconsin, Madison, Industrial Engineering *
- University of Wisconsin, Madison, Optimization *
- University of Wisconsin, Madison, School of Business: Operations and Information Management *

Canada

- Université Laval (Canada), **Opérations et systèmes de décision**
- University of Manitoba (Canada), **Mechanical and Industrial Engineering**
- University of Montreal (Canada), **Computer Science and Operations Research**
- University of Toronto (Canada), **Mechanical and Industrial Engineering**
- University of Waterloo (Canada), **Combinatorics and Optimization**

25 additional countries have programs.

APPENDIX F – Sample Courses

Subject: I have all this data, now what? APQC Webinar

Hello Meg,

Throughout your benchmarking journey, you've done it all. You selected the appropriate process. You created your data collection tool. You received all this data. ***Now what?***

In Analyze This ... Data, the fourth Webinar in our Benchmarking Webinar Series, Travis Colton, APQC senior project manager, and Erin Williams, Ph.D., APQC senior analyst, will discuss what you should think about when analyzing your data.

They will explore issues and challenges involving:

- data validation—confirming the data you've collected is "good,"
- normalization—creating comparable data, and
- tools for data analysis—using common tools to turn benchmarking data into information.

Register: http://www.apqc.org/events/analyze-thisdata-benchmarking-webinar-series
Date: Wednesday, November 17
Time: 10:30 a.m. Central • 8:30 a.m. Pacific • 11:30 a.m. Eastern
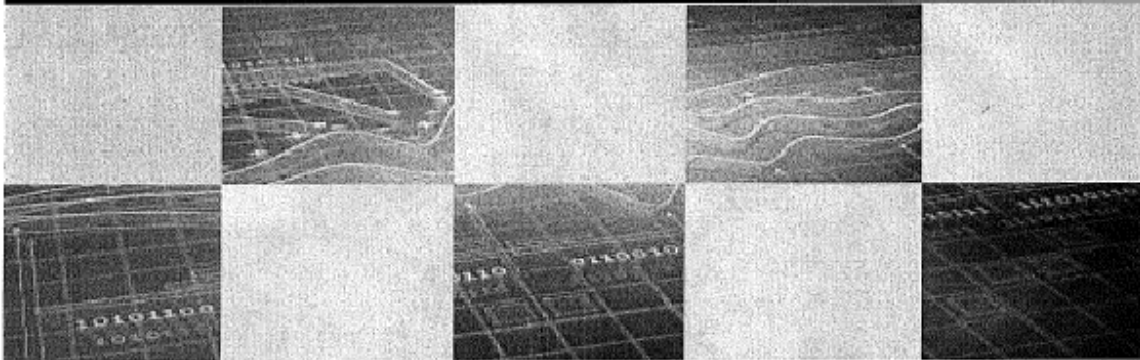**Duration**: One hour
Presenters: Travis Colton, senior project manager, APQC, and Erin Williams, Ph.D., senior analyst, APQC
Cost: Members—complimentary, Nonmembers—$75

The following is an excerpt from Gateway Management seminar oriented towards accountants (CPE credits).

Business Analytics Week

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& Business Insights

2012

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Advanced Analytics
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Program Agenda

Wednesday, February 8, 2012

12:30 pm – 7:00 pm	Pre-conference Workshops

Thursday, February 9, 2012

8:30 am — *Keynote* **Predictive Analytics for Competitive Advantage**
Leverage predictive capabilities for better organizational planning and performance management

9:30 am — *Keynote* **Evidence-Based Decision Making**
Transition data into meaningful strategic and tactical insights

11:00 am — **Analytics Enablement and Deployment**
Create a governance, usage and accountability system that aligns to strategic, analytics-based objectives

12:00 pm — Lunch and networking break

	Track A: Predictive Analytics at Work	Track B: Business Insights at Work
1:00 pm	**Predicting Customer Value** A data-driven approach to predicting the lifetime value of a customer for optimal segmentation and planning	**Competitive Analytics** Develop a comprehensive framework for analytics to deliver advantage in marketplace
1:50 pm	**Anticipating Customer Behavior** Leverage a comprehensive model for forecasting customer behaviors and trends	**Fact-Based Performance Management** Analytical metrics to measure performance and guide business planning
2:40 pm	**Customer Experience Analytics** Utilize data mining to drive highly personalized customer experiences	**Business Insights through Big Data** Improve decision making capabilities by effectively analyzing big data

3:30 pm — **The Intelligent Enterprise**
Utilize decision management to move from Business Intelligence to Predictive Analytics

4:30 pm — Networking Reception

Friday, February 10, 2012

8:30 am — *Keynote:* **Data Science for Business Growth**
Translate data into actionable information that drives product development and innovation

9:30 am — *Keynote:* **Next Generation Analytics**
The future of analytics as the ultimate decision provider

LINE COURSE:
Predictive Analytics Applied - On demand any time

Predictive Analytics Applied

100% of attendees rated instructor *Excellent* or *Very Good* (details)

Available on-demand, at your convenience - *self-paced, e-learning*
Internationally-friendly online program

Predictive analytics is business intelligence technology that produces a predictive score for each customer or prospect. Each customer's predictive score informs actions to be taken with that customer - business intelligence just doesn't get more actionable than that.

Predictive Analytics Applied is a self-paced online course of four concentrated sessions of 60 to 90 minutes each covering:

- **Applications:** Business, marketing and web problems solved with predictive analytics
- **Core technology:** How a predictive model works and how it's created
- **Evaluation:** Measuring how well a predictive model works and how much revenue it generates
- **Process:** Management and project leadership for predictive analytics
- **Illustrations:** Live demos and detailed case studies
- **Hands-on:** Get your hands dirty for 20 minutes with a revealing Excel-based exercise

Personalized support: Online training participants also receive 30 minutes of Q-and-A support with the instructor via telephone or email.

CONFERENCE:
INFORMS - BA and OR - Apr 15-17 near LA

Plan to attend the **INFORMS Conference on Business Analytics and Operations Research**, **April 15-17, 2012**, in Huntington Beach, California. This conference is well known for featuring world-class organizations showcasing the strategic use of analytics and O.R. in government and industry and how these tools are used to drive better business decisions. Present a talk or a poster and receive a reduced rate on registration. Or, act now for super-saver rates and team discounts for 3 or more. Registration covers all meals for two days. Choose from among several focused tracks including: analytics process, marketing analytics, soft skills for analysts, supply chain management and logistics, public sector analytics, forecasting and risk analysis, and decision analysis. Other features include an executive forum, premiere analytics job event, facilitated networking, software tutorials, technology workshops, and the Edelman Competition and Awards Gala, which celebrates and rewards the best analytics projects in the world.

More information: **INFORMS.org**

APPENDIX G - SOA Members Response to survey questions

What software programs do you or your department use to conduct your analytical techniques?

		Count	%
Software Programs in ABA	EMBLEM	4	1.2%
	Excel	312	96.3%
	MATLAB	19	5.9%
	Other (including @Risk, Access, Axis, FoxPro, MG-ALFA, MoSes and in-house software)	63	19.4%
	R	25	7.7%
	SAS	130	40.1%
	SPSS	9	2.8%
	S-PLUS	4	1.2%
	Stata	0	0%
	Total	324	100.0%

ABA = Advanced Business Analytics

APPENDIX H - Role of Actuaries in Advanced Business Analytics

Summary of Qualitative Findings from Ipsos.

Background – role and experience

- Few respondents reported that they were personally involved in conducting Advanced Business Analytics/running the statistics, though several mention that they used to be. Most are in more executive roles now, **managing those who do the analytics** and **presenting these analyses to management.**
- All are involved in the **hiring process** for analytical professionals, including some who are responsible for hiring very senior people.

Advanced Business Analytics within the organization

The Society of Actuaries is interested in finding out more about where Advanced Business Analytics is carried out within organizations, for what purpose, and by whom.

- Most respondents were **unsure as to how to define "Advanced Business Analytics,"** instead looking for the moderator to define it.
- "Actually, I was hoping you could define it [Advanced Business Analytics]." – Insurance exec, actuary
- However, when probed they generally define it as 'using mathematical tools to inform strategic decisions and solve problems.'
- "It's the mathematical application to business problems, a mathematical representation rather than a gut feel. It's formulating various business problems in terms of a mathematical, objective solution." – Insurance exec, actuary
- "Interpreting statistics in light of helping company make proper strategic decisions." – Insurance exec, actuary
- "For last 10 years we have become data rich companies and Advanced Business Analytics is taking advantage of that data and using that data to make smarter business decisions." Taskforce member
- "Insurance companies are data rich but information poor. Have so much data but terrible at extracting it and understanding what it tells us. Advanced analytics fits there. Can we extract data and make sense of it. Once have that step, can better manage the business -- how do we use the information to run a company?" – Insurance exec
- "Looking at key factors that drive persistency. For example building regression models that says when a policy is about to lapse… a range of sort of economic metric data mining, figuring that stuff out and figuring out how to influence it. For a direct mail campaign, usage, where to target, and looking how to cross-sell." – Insurance exec
- "The advanced piece is the differentiator. People here are involved in all sorts of analytics. I would describe it as things that report on what has historically happened -- info management; reporting on what's happening now – a real time twitter feed. And predictive modeling and optimization -- creating info that didn't exist before that tends to be forward looking and helpful in making decisions across the board. Analytics means different things to different people and it depends on who you're speaking with." – Consulting

- A few were able to name **specific tools, techniques, or models** used for this purpose.
  - One respondent cited predictive modeling, pricing, and claims management as some of the more sophisticated models used to understand risk and strengthen ERM. Another named GLMs and clustering.
- **Within the context of their companies**, business analytics are viewed and handled very differently. Some have dedicated analytics teams, while others consider it a shared responsibility across business units.
  - "We don't have dedicated employees pouring over data. It's a shared responsibility." – Insurance exec, actuary
  - "We have an analytics department and sole job is to help companies consolidate their data and based on business needs or issues use that data to make more intelligent decisions." – Taskforce member
- All respondents felt that the **SOA definition of Advanced Business Analytics** was appropriate, though some thought it related more to actuaries than to other types of professionals involved in these analytics.
  - "That's the panacea. The ultimate goal is to get a fully integrated set of tools that can give you the answers but it's not the reality." – Insurance exec

How would you describe the level of analytics conducted within your company?

- The **importance of Advanced Business Analytics** within companies seems to increase with the company size. Those from smaller firms tend to report that there is not a big emphasis placed on it and that there are no formalized processes, whereas those from larger companies are more likely report that it is important.
  - "We are not heavily statistically-oriented in our management of the company… it's not advances, not important to the company right now." – Insurance exec, actuary
  - "It's ridiculously important. We're not going to take risks unless we understand them." – Insurance exec
  - "I see it as a major client issue and need and we are making significant investments in this area ourselves." – Consulting
  - "It's incredibly important because a lot of companies are struggling with their ability to absorb all the new tools and data and then take that to apply it to address traditional business problems or new business problems that are being created." – Consulting
- Similarly, **buy-in by management** also seems to vary with the size of the company. At larger firms, interest has become more widely adopted, with analytics going down in organization to areas that might not have been as analytic driven -- e.g. HR. Still, others report that business analytics has not caught on among senior leaders.
  - "It should be extremely important, but it's not getting the full attention and backing that is required." – Insurance exec
  - "Leaders buy into importance of analytics but it's not enforced at leadership level. It needs to be sold to division heads in each group." – Insurance exec
- Some also report that it has been taking on a **larger role in recent years**, and is becoming more ingrained in the company.
  - "It has been becoming more important in the company in the last 5-7 years, the culture has changed. What used to be accepted as minimum level of analytics is no longer accepted." -- Insurance exec
  - "Now it's somewhere between interesting and important." – Insurance exec, actuary

- The **level and type of analytics** also varies a great deal, though for most, analytics have gotten more sophisticated in recent years.
  - "It has gotten more sophisticated and more people are providing analytics; it's moved from 'statistics' to 'analytics', which is broader." -- Insurance exec
  - "The type of analytics depends on product." -- Insurance exec
  - "We've gotten better and faster at getting data. We do have some more formal process of putting together key performance indicators that track things that are routinely distributed. The ad hoc stuff is harder to speak to. Analytics are not so sophisticated regarding statistics being used." – Insurance exec, actuary
  - "We are not doing much of it, not doing predictive analysis. We do some stochastic analysis for ALM within the department -- corporate projection type of analyses." – Insurance exec, actuary
  - "We are working with companies who want to extend and improve analytics. Pricing, detecting claim fraud, identifying HC risks for care management to save costs -- a wide range of business problems that these tools and analyses under the rubric of predictive modeling can help with." – Consulting
  - "We are doing some sophisticated work -- on the annuity side we're doing stochastic projections to make projections. Day to day, it's not overly sophisticated, but we do use the tools we have and do have systems to aggregate results to roll up to the corporate view to project business over next 3-5 years. There are limited pockets of advanced analytics -- projective modeling, some regression." – Insurance exec
  - "Higher level analytics are done in the clinical area -- predictive modeling and basic pre-post analytics. The most sophisticated analytics that actuaries are doing is basic linear regression. We don't use SAS too often." – Taskforce member
  - "[As far as the types of analytics]…We were one of the first insurance companies using cluster. We're now experimenting with cloud. We're trying to do as much as we can to learn from system that we've already invested in. We're definitely looking at within the vendor world as well as having built many models." – Insurance exec
  - 'We do it through predictive modeling, data mining, logistic regression, cloud computing. Some of most advanced predictive modeling is contracted out to IBM. Also have people in organization doing these analytics." – Public Sector
  - It's improving. We have a business intelligence group… Some areas in business have modeling, but wouldn't say we are sophisticated. We've still got a long way to go." Insurance exec
- Some seem to have formal processes/infrastructure for **warehousing data**, mainly managed by IT. One mentioned that they have a Query database that is centrally warehoused.
  - "It's managed by teams, though we don't have good IT support. We have data in an access database but it can't handle all of data…We're moving to a SQL environment." – Insurance exec
  - "We have a mainframe database managed by IT." – Taskforce member
  - "It depends -- sometimes it's managed by IT and sometimes teams; it depends on the functional area." – Insurance exec
  - "IT manages all the systems. IT is closely wrapped around all timelines with contractors and analysts." – Public sector
- **Analytical functions are largely silo-ed** – sometimes different departments do their own analysis, or it is silo-ed in a specific department but not widely used in the company.

- "We're looking for ways to connect data produced by one team -- e.g. accounting -- being more accessible to other teams." – Insurance exec
- "Now we have an enterprise-wide mission and we've worked hard to build collaborative team, but haven't centralized analytics… analyses that occur within group/department are looked at to see if they can be relevant across departments." – Taskforce member
- "It's more siloed by product line." – Insurance exec
- "..It's relevant at the business unit level and it's done at that level. The role of ERM is to knock down silos and get people to speak to each other as well as advance use analytic capabilities. The ERM group works across business units." – Consulting

Where is Advanced Business Analytics carried out within your organization?

- Advanced Business Analytics are being **carried out primarily by actuaries** in the areas of finance and strategic planning. However, others report that is has been **incorporated in other areas, such as HR, marketing, and especially IT.**
  - "At the top – the CFO, Chief Actuary provide info to senior team in ways that help company make appropriate decisions" – Insurance exec, actuary
  - "Actuaries doing most of it - FSAs. We don't have statisticians or economists." – Insurance exec, actuary
  - "It's changing; it used to be done within our actuarial risk practice -- all they do is build models – but we are combining actuaries and statisticians with IT folks and starting a new analytics institute -- going from 150 people to over 1000." – Consulting
  - "It's done in multiple places – it's a huge organization. Actuaries do a lot of business analytics. Each area has its own people doing relevant issue work." – Taskforce member
- Nearly all say that actuaries are primarily responsible for Advanced Business Analytics, but others also name IT professionals and statisticians.
  - "Within the actuarial department it's the assistant actuaries running the numbers -- primarily the below ASA group that's doing the leg work but occasionally the FSA level group does it." – Insurance exec, actuary
  - "Its actuaries or the IT guys primarily. No statisticians or economists." – Insurance exec, actuary
  - "The actuarial group, statisticians, IT folks. The group of 150 that are building models is about 1/3 actuaries and 2/3 statisticians, engineers and other disciplines...We are finding it harder and harder to find actuaries that have the skill sets -- statistics -- who can do the models we are doing, so we're hiring PhDs in statistics and science areas who can build the models." – Taskforce member
  - "Primarily actuaries. Also need strong tech people because we deal with large amounts of data." – Consulting
  - "Mostly actuarial students…the valuation team is actuaries, entry level students to FSAs. I also go to Capital modeling team, led by an FSA - they do the queries and analyses. No non-actuaries.
  - "Management analysts, up to level of Director. They have different levels of education and experience/backgrounds. It depends on what is needed." – Government
  - "My team of eight consists of a PhD in Physics (he's also an actuary) CFAs, MBAs, MA in Math stats." – Insurance exec
- A person's analytic function is not usually conveyed in their **job title**. Most say that actuaries primarily handle this type of work.

- "Job titles haven't changed, but jobs have…we are doing greater and more meaningful analytics but no job title change. There is no job title with the word 'analytics' in it, but there are people who are referred to as a good resource for analytics" – Insurance exec
- "Actuaries -- FSA and below. Non-actuaries -- HC economics. I don't have a sense of what other titles are - some kind of analyst in their title." – Taskforce member
- "It's mainly actuaries. We get input from marketing folks that pair up with actuaries..It's pretty ad hoc. We don't have any economists or statisticians." – Insurance exec
- "It comes down to what are the skill sets of the individual. The title of the person is almost irrelevant." – Consulting
- **Team structures seem to be somewhat fluid**, varying with the nature/scope of the project at hand. Some, however, have a core of dedicated staff.
  - "Have a pretty fluid system in company -- less structured in terms of forming teams or drawing resources to work on analytic projects." – Insurance exec, actuary
  - "Teams are small – 1 to 3 people… They are chosen mostly by availability." - Insurance
  - "Teams can be different sizes. We can bring in other resources in the company as well from other groups. We would put together team to do a project, but wouldn't call it analytical project, per se." – Insurance exec
  - "Team members are chosen by functional area; the high level folks first and then you drag in your team." – Taskforce member
  - "Each team is within a business division and then they come together to work on certain projects -- e.g. enterprise risk." – Insurance exec
  - "We have a dedicated team… The group is a couple of statisticians (have masters) and a marketing guy. Actuaries would help them on specific projects, give them business context. Actuaries don't work in the analytics division. Those same 3 people would do the work, they'd be proactive reaching out to other groups or we would go to them. So there's a lot of regular recurring stuff and some ad hoc stuff." – Insurance exec

What are the skill-sets required for Advanced Business Analytics roles within your organization?

- A strong background in mathematics is the most commonly cited **skill set** that is needed for Advanced Business Analytics. Being able to see data and trends from a more holistic business perspective is also important, as is the ability to convey data is a way that is useful to others. One also mentioned that it was important to have knowledge of different statistical software packages.
  - "It goes beyond a degree – it's being aware of analytics in the field, the industry. A higher math ability, and a broader view point to connect analytical trends which are meaningful and impact the business." – Insurance exec
  - "The actuarial exam syllabus gives the proper skill set -- traditional actuarial work. Better prep would be more than a pure math background - economics and finance would also be helpful." – Insurance exec, actuary
  - "There are three types of skills: One is business skills, which outweigh math skills. Also data skills, understanding how data is organized and understanding the restrictions on data. One thing missing for everyone is the ability to translate, to turn data into findings. The ability to explain data is … lacking, across the board. – Taskforce member
  - "Comfort with data, finding and collecting data, analyzing it… In the corporate world you also need a business context." – Insurance exec

- "The ability to understand mathematical approaches available, skills and exposure to wide range of tool sets available, and the ability to understand the business problem and put the right ones together." -- Consulting
- "Analytically inclined. Experts in statistics and stats, SAS. Can do modeling, have good professional judgment." – Taskforce member

- **Ideal characteristics** for those undertaking Advanced Business Analytics include industry knowledge and good personal/communications skills – in addition to the core quantitative skills.
  - "There are two types of people and it's hard to find someone with both skill sets. First is the pure back room programmer or modeler who knows SAS and other systems and from mathematical perspective can build models. The second is someone who understands business and can create synthetic variables -- e.g. variable to find people who lie about smoking. Thinking about it from a business perspective is important. It's hard to find people who cross between both paths. We need a Chief Analytics Officer whose job is to take models and ideas and sell them to management and the larger organization to get people to start using them -- a needed role but it doesn't exist yet." –Taskforce member
  - "At some level on a team, you also need people with strong business acumen who can connect the analysis to the business problem so that what's being driven to is an actionable, practical solution." – Consulting
  - "People need to have curiosity to analyze data. The technical piece, but they also have to have a certain amount of creativity about what's appealing to consumers…Have good ideas but can also get into data to see if the ideas will actually work. Also, they need to know how to price... Must have high level strategy ideas and the interpersonal skills to work with other departments." -- Insurance exec

- In terms of **credentials and education**, most feel that the actuarial exam process is the main certification that is needed, and that it is supplemented by on-the-job training. Others also mention Masters/PhDs in statistics, economics, finance or engineering.
  - "Actuaries pass various tests but not aware of any other designation to handle analytics." – Insurance exec
  - "There is a wide variety, from actuaries to PhDs in stats, Finance MBAs, CFAs, CERAs, other types of risk management designations. Doing heavy duty predictive modeling is for people with statistics, IT and actuarial backgrounds." – Consulting
  - "I'm not sure about credentials, but anyone who has math background has those skills that can be developed…not actuarial per se, but understanding what's going on from an insurance standpoint. Most actuarial students that I hire have the potential to do the analyses." – Insurance exec
  - "Mostly PhDs or an actuarial designation. They must have deep technical skills. They also tend to learn while on the job." – Consulting
  - "An entry level position would require MA in math or statistics. A degree in economics would be brought into an economist position, but they aren't involved in business analytics as defined. For an actuary position, they would need to pass at least 2 exams. Also have one year of experience to show that they can actually do the math and make recommendations." – Public sector

Actuaries and Advanced Business Analytics

The Society of Actuaries is interested in whether actuaries are suitable for Advanced Business Analytics roles within organizations.

- All respondents **have actuaries working at their companies**, including FSAs, ASAs, and students.
- They tend to take on a **variety of roles**, ranging from financial reporting to product development to reinsurance to pricing. Several support actuarial work outside of the more traditional departments, expanding the scope of their role.
  - "Pricing, utilization of product at what price breaks, benefits. New product development, evaluating usage and a lot on reserves to make sure we have enough money to pay claims." – Insurance exec
  - "They are responsible for financial reporting; others are more or less flexible and focused on life insurance and annuity product development. They also handle reinsurance. The Chief Actuary is a corporate liaison." – Insurance exec, actuary
  - "New products and experience studies. ALM and cash flow testing, corporate projections required for regulatory and risk. A few ASAs have moved out of actuarial roles -- e.g. employee benefits and accounting. It's helpful to have actuaries in other departments." – Insurance exec, actuary
  - "Traditional stuff…in the analytics world, pricing, reserving, audit support. We have a core team of actuaries in life insurance and health insurance in analytics – they quantify business results of models. What is the cost savings of using a predictive model…" – Consulting
  - "They are product designers and product pricers. They handle financial reporting and valuation, gap framework. For the most part we are a fairly traditional actuarial employer." – Insurance exec
  - "About half are involved in financial reporting and the other half on pricing and other products like that. Sometimes actuaries are thrown on one of the new business imitative analytic projects." – Insurance exec
  - "Actuaries work in valuation pricing, in business, in management. They help statisticians on specific projects, giving business context." – Insurance exec
  - "There needs to be more rotation at companies where actuaries go outside their norm. They are essential to risk and pricing. I advocate for actuarial placement outside of traditional actuarial products, like banking, derivatives and other highly quantitative areas where they are no longer communicating just about actuarial frameworks." – insurance exec
- Most feel that actuaries are **well suited for handing Advanced Business Analytics**, and in many cases are already doing so. However, not all feel that that actuaries are best qualified for creating models, and one mentioned than only a handful of actuaries are interested in or see the need for Advanced Business Analytics. Another questioned whether actuaries were worth the salary. Some also feel that these roles are limiting for actuaries, and that they aren't able to make use of their whole skill set.
  - "Yes. If I had to point to group that is best suited for analytics, it would be actuaries." – Insurance exec
  - "Absolutely and they are doing so -- to us it's advanced but to others it may be the dark ages. Actuaries can deal with both ends of the spectrum; they can deal with the data and put meaning to it." – Insurance exec, actuary

- "Actuaries are well placed to help in business explanation of it, but not to actually be the ones building the models. They don't have the skills/technical background to build the models. They are not getting to learn SAS or CART through actuarial exam process. Actuarial programs should be moving more toward what statisticians are doing today." – Taskforce member
- "They have the ability and skills to do it, but sometimes I wonder about the efficiency of using FSAs to do this work -- do you want to spend that kind of money on FSAs to do that kind of work?" – Insurance exec
- "There are pockets of those type of creative thinkers in actuarial roles and those people are in high demand. People get reputations that they have these skill sets and then they get picked to work on projects that use these skills. As profession we need to teach people to think creatively and strategically -- it would be a way for actuaries to add value." – Insurance exec
- "No. They could be used in a much better way. I left the actuarial office because of this. My role was limited and my skills were much broader." – Public sector
- "Actuaries could absolutely do the analytics. If you think in the actuarial spectrum, that wouldn't feel beneath them. If you rotate from area to area, you're not going into strange analytics. Maybe if you house it in the experience studies area, that might be more of a traditional route, but it's just not a normal actuarial one. If you go there you just get stuck there." – Insurance exec

- Still, they generally see real **benefit in having actuaries fulfill these roles due to their high-level of training and expertise**. They also understand risk within the context of their business.
  - "Actuaries are uniquely positioned to understand the business from a global perspective. Other departments tend to look at business from their angle only -- marketing, accounting, investments -- but the actuaries have to worry about all those things, understand them and piece it all together. Actuaries uniquely suited to ask the right questions." – Insurance exec, actuary
  - "They understand the business and they have a good understanding of the financials of the company. They have the peripheral skills to understand the data." – Insurance exec
  - "They have expertise in analytics, dealing with numbers, projections, etc. They receive more specific training in analytics." – Insurance exec
  - "They have the training to understand impact of future contingent events and to marry analysis with practical business application; this makes them well qualified and they add a lot of value in the insurance industry and perhaps beyond that." – Consulting
  - "They are business savvy and the risk savvy. They are trained to understand risk and opportunity in a business context… to bring that with high level analytics would be a really good thing." – Taskforce member
  - "Many actuaries come to table with better hands on experience, their skill sets have been tested outside environment of college coursework. It's a good measurement of one's ability to apply the skills. Many aspects of coursework would better position actuaries vs. others." – Public sector

- However, there is some **room for improvement in terms of actuaries' qualifications** and capabilities. Some think that actuaries could use more knowledge of statistical methods, while others are concerned that many actuaries are not well-rounded – i.e. they want to see individuals with strong quantitative skills, personal skills, and business acumen.

- " "There are two sides of coin. If education were strengthened in stats it would make actuaries better suited, but there is also a need for more business and communication skills, which are not isolated to advanced analytics but needed by broad actuarial community to realize its potential to having a strong impact on business." – Consulting
- "Actuaries are not always the best communicators. Sometimes that's an issue. Actuaries by their training -- self study to get through exams -- breeds individualism." – Insurance exec
- "There is far too little real statistics in exam process." – Consulting

Relevance of a new qualification for Advanced Business Analytics

The Society of Actuaries is considering the development of a new qualification for Advanced Business Analytics.

- Generally respondents think that **new qualification for Advanced Business Analytics** could be useful, but are hesitant to endorse it without knowing more. Some are concerned about including it in the exam process as CERA was, unless you are a student already going through exams.
    - "It certainly makes a lot of sense because actuaries are well suited for doing that sort of analysis. It could be used in a more general corporate environment, not specific in the insurance or employees benefits area." – Insurance exec, actuary
    - "It sounds like it could be useful and potentially interesting to actuaries." – Insurance exec, actuary
    - "Much as CERA has an experience component, I could see where such as designation would benefit the actuaries; like having a title that would help them be of higher value to company." – Consulting
    - "I don't know that you need a certificate but it would be nice." Taskforce member
    - "Once you become a fellow, I'm not sure if I'd want them doing that kind of work. If there were track that was not the fellowship track, I think there would be room for something like that. I could use those folks." – Insurance exec
    - "There would be a need for it and there are other disciplines that could benefit from it. It would be helpful for people past exams, but here's another credential that would make them more valuable. It could be something that helps move FSAs into leadership positions, not just at the point of another exam track." – Insurance exec
    - "In combination with the basic ASA courses, it would really position people well for business analytics role." – Public sector
    - "There is a tremendous need for people with these skill sets, but I'm not sure if there is a need for a piece of paper saying you have the skill sets. A lot of Masters programs are teaching these skills, so I'd question would be how the SOA would differentiate itself from the masters programs." -- Consulting
- At the same time, several – particularly those at smaller companies - do not think it would be relevant for their organization.
    - "We are such a specialized company that it wouldn't fit us well, but there are other companies that it would fit a lot better." – Insurance exec, actuary
    - "From my experience we're doing ok, but we are a smaller company and may not need it as much as larger companies." – Insurance exec, actuary

- Several feel that this type of **credential could give an applicant a leg up in the hiring process**, all other things being equal. However, others are not sure it would be much different from other credentials/degrees.
  - "All things equal with two identical people for above entry level position and one had that designation and other didn't, it would definitely be a plus in that person's favor. I would look favorably on someone with that expertise." – Insurance exec, actuary
  - "I definitely would consider it, absolutely. We have internally "para actuaries" – they are like paralegals; not really actuaries but they know what's going on. A" para actuary" type designation may be useful for business analytics." – Insurance exec
  - "Yes, but if someone comes with a Masters from Harvard in statistics, it's not much different. I know they've had a rigorous education process and they've been exposed to certain things and passed tests on these things so I wouldn't view it as different from a wide range of certifications and degrees that others would get. Unless, the program were structured in such a way that people were being exposed to unique and different things that were valuable that they weren't being exposed to in other places." – Consulting
- Respondents would like the **qualification to be applicable to real world scenarios**. Several also mention that it should cover SAS.
  - "I would have to see the material, but any qualification would need to connect the numbers to real life business situations. They need to understand what the numbers mean in a day to day business situation." – Insurance exec
  - "Start with a lot of stats and applied math classes that teach business value of analytics, working problems on real world situations." – Consulting
  - "It should have some basic stats, basic insurance knowledge, systems knowledge -- databases, SQL, data manipulation background. Programming knowledge and a little bit of business and insurance accounting." – insurance exec
  - "It should include three things -- simulation modeling; GLMs and data mining; and IT related content - how databases work and what they can do. Also multidimensional analysis." – Consulting
  - "It should include exposure to things outside insurance agency which is ahead of other industries in some areas but woefully behind in others. There's a whole world of analytics out there that is beyond risk and insurance that people need to get exposure to." – Consulting
- Many think that **actuaries would be interested in it** if it had real value, particularly since continuing education is so commonplace.
  - "In general, actuaries accept idea of continuing education so a large percentage would understand it. If it's meaningful, yes, but if it's just an ornament -- nice to have but not meaningful -- then no." -- Insurance
  - "I would hope so. Actuaries are in a unique situation – it's one of few professions that has a big picture view of what's going on and if we can help management make better decisions, that's what we should do, and this sounds like it would be more formal training to enhance that ability." – Insurance exec, actuary
  - "I would personally go to this, but it would depend on the time commitment. I would be willing to invest a week but not several months." – Taskforce member
  - "I think they could see the value in it – I'm not sure about the type of format, but as an actuary, my company and myself would see value in it -- after I have some foundation." – Insurance exec, actuary

- There is some concern about creating competing qualifications, however.
  - "It is important not to set up competing designations – maybe a joint venture with the Casualty folks, for example. I would be concerned if the Society were thinking about this on its own." – Consulting
- Several respondents also mentioned that it might be a good fit for **non-actuaries** who are interested in analytics but do not want to go through the whole credentialing process.
  - "It could also be attractive to non-actuaries -- folks that have some analytical skills but don't have a credential." – Taskforce member
  - "I don't think it's for someone going for their FSA, but someone who may be interested in a 'para-actuary' track who wants to use analytic skills but perhaps doesn't want to go through ASA or FSA track." – Insurance exec

APPENDIX I - Education and Marketing by Career Stage

	Prequalifying Ed (Basic Ed)	Professional Development (Continuing Ed)	Research	Marketing/PR
Pre-Career				New SOA HS Program
				University Outreach
				CAEs
Actuarial Students	Update ASA Syllabus			
	Update FSA Syllabus - tie to practical actuarial applications			Face-to-face, The Future Actuary
Practitioners		Continue section sponsored offerings at large meetings, webinars, seminars (i.e. Deloitte)	Experience Studies - life underwriting, medical rate making, retention programs	Develop story and establish common terminology throughout SOA
		In depth seminar oriented towards leaders requiring demonstration of mastery	Sponsor or cosponsor visible, innovative research	Publications: The Actuary, section newsletters
		Refresher seminars in tools/techniques		
		Develop online courses, elearning, case studies		Overview (CPD eligible) sessions at large meetings (like Complexity Science)
		Investigate delivery partnerships within CAEs, CAS or other orgs.		Profile success stories, pioneers on soa.org
				PR with recruiters, employers

APPENDIX J - Gaps Subteam Preliminary Recommendation

The Gaps Subteam met on August 10, 2011 to discuss how the SOA can address the gaps in education for Business Analytics. The team recommends a three-part approach to an actuarial education of the skills that were identified by the Skills subteam.

The team also discussed how to use the market research survey to understand the value to and needs of the membership.

Preliminary Recommended Approach

1. Basic Education: **Add material to Module 4 of the FAP Modules.** This material should cover:
   - Introduction of the skills and concepts. In fact the document that the Skills team developed is a great start, and would just need to be expanded. ALL the skills identified should be covered
   - Use one or two simple examples in Excel
   - Testing of the concepts may include asking candidates to apply the models to a sample business situation. For example, provide them with the outputs and ask them what it means in a particular situation.
     - Collaborative work on case studies and end-of-module exercises is encouraged. There is no assurance that these topics will occur on the interim or final assessments, which are more controlled testing environments. It should not be expected that candidates have demonstrated a level of mastery of these topics.
   - Candidates theoretically should have all the statistical background they need from the early exams.
     - Can't guarantee that they have learned or retained these, however
     - So, material needs to either be basic enough that they won't need to remember old material
     - Or, material needs to re-teach those fundamentals

2. FSA Syllabus: **Start with the Health Track,** adding BA concepts to the Health syllabi
   - The Health Track is in the process of being revamped over the next few months
   - Health actuaries are already using BA more than some other areas
   - This is an area that has already been identified by the health FSA committees.
   - New material would be added, likely on both the exams and modules.
   - Other tracks may choose to also add BA as their syllabi are adjusted over time

3. Professional Development: Develop a new seminar-based course
   - The formats from 121, 152 and Course 7 Seminars are an ideal model, although require modification
   - Blended learning probably works well
     1. Part 1 of blended learning would be extensive online pre-work

- Potentially some of the prep work would be optional if the candidate already has experience – software programs, insurance experience
- Prep may also need to contain re-teaching of some fundamentals, such as applied stats
- Could be tested along the way, or purely self-study

2. Part 2 would be an in-person seminar, probably 2-3 days
   - Work through specific applications and examples, work in groups
   - Track-specific portion? There are pros and cons to that
   - Testing component at the end
   - Certification at the end

- This will have more value with a certification, i.e. a "prize"
- Could give the option of Part 1 only (for no certification), or both parts 1 and 2 for the certification (or require Part 2, but without the testing component)
- Both parts could be offered to non-actuaries.
  1. This could be valuable – Many companies' Business Analytics staffs have a blend of actuaries and non actuaries, and managers of these staffs may appreciate a single source of education
  2. But we don't want to dilute the relevance to actuaries by offering it to others

APPENDIX K - Sample Masters Degree Program

Northwestern University

(Online) Master of Science in Predictive Analytics

Minimum 11 Courses, ~$42K

Core (all required)

- Introduction to Statistical Analysis
- Introduction to Predictive Analytics & Data Collection
- Database Systems Design and Implementation
- Data Warehousing & Data Mining
- Predictive Modeling I
- Predictive Modeling II
- Project Management

Elective (2 required)

- Advanced Modeling Techniques
- Marketing Analytics
- Risk Analytics
- Web Analytics
- Text Analytics

Leadership Course – required

Leadership, management, communication skills and strategies

Capstone Project – required

- Individual or team project