SOCIETY OF ACTUARIES
PREDICTIVE ANALYTICS AND FUTURISM SECTION

PREDICTIVE ANALYTICS AND FUTURISM
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Seven Trends That Will Change Your Future—Part Two

By Zack Deidesheimer and Taylor Patterson

What do data, technology, offices, skills, and cultural perspectives all have in common? Significant transformation.

Technology, robotics, cognitive computing, and AI exponentially advance every year. Data constantly expands with an influx of new numbers and figures converging into a higher resolution picture of the world. Cultural perspectives are shifting alongside priorities and preferences of the population. Lastly, offices are no longer simply clusters of cubicles dotted with cabinets and desktops.

The Exponential Professional team analyzed seven trends to foresee the financial professional of the future, particularly the actuary, and how to make the most of it. These trends are Technology is Everywhere; Tsunami of Data; Artificial Intelligence (AI), Cognitive Computing, and Robotics; Jobs Vulnerable to Automation; Diversity/Generational Change; Careers 100-Year Life; and Explosion in Contingent Work. Part Two of this two-part feature focuses on the last four trends.

SECTION 4: JOBS VULNERABLE TO AUTOMATION

What's Trending

One of the industry's current hot topics is how the advancement in cognitive and robotic technology impacts the future of our current jobs. Will it eliminate jobs? Which jobs will be eliminated? Will it enhance jobs? To answer these questions, one needs to understand the advancement level in implementing these technologies. Deloitte's Global Human Capital Trends survey indicates that many organizations are exploring these technologies, but only some have fully implemented them. Of the survey respondents, 36 percent are using robotics process automation (RPA), 26 percent are using robotics, 22 percent are using AI, and 22 percent are using cognitive technologies.[1] Additionally, organizations' current view of the future is relatively optimistic. Only 38 percent of respondents believe technology will eliminate jobs within the next three years, and only 13 percent believe it will eliminate a significant number of jobs.[2] The key trend is not the elimination of jobs, but the transformation of jobs, and how to prepare today's workforce for their future roles.

10 Years From Now

These technological trends will lead to a great transformation in the actuarial profession. The focus is often on what skills will no longer be needed and become obsolete. However, there are several skills actuaries can develop to enhance their value in the future. These include influential communication, strong judgment and leadership, continuous learning, deep collaboration, creativity when faced with complex issues, and continuously evolving and upskilling oneself. These are the skills that are not vulnerable to automation, the ones that are used to solve problems actuaries have not seen before.

To solve such problems, actuaries will need to shift focus away from repetitive work and instead sharpen those uniquely human skills. Actuaries will also need to maintain a constant focus on learning and development to be tech fluent and understand emerging technologies. A successful marriage between

traditional actuarial work and emerging technology will lead to an enhanced actuarial work product, one that can provide tremendous value to business leaders. Deloitte's Human Capital Trends report discusses the advent of superjobs. These are roles that combine work and responsibilities from multiple traditional jobs, using technology to both augment and broaden the scope of the work performed and involve a more complex set of domains, technical, and human skills.[3] The future actuary is a strong candidate for a superjob, as jobs will emerge in categories that complement emerging technology, rather than substitute it. Specifically, actuaries will see an increase in jobs that require customer interaction and management, understanding of regulation and risk, industry experience and content expertise, knowledge of product and the connection to risk, capacity to anticipate emerging trends, flexibility and agility, and the ability to design the right network and partnerships.

SECTION 5: DIVERSITY/GENERATIONAL CHANGE

What's Trending

The shift in generational diversity of the workforce is apparent cross-industry. Baby boomers compose 26 percent of the workplace in 2018, 12 percent more than in 1998.[4] With the increase in average retirement age for baby boomers and Generation X, this causes downstream impact around succession planning and career development, often stunting promotion opportunities for younger generations.[5] Millennials, the largest group in the workforce, are focused on adapting and growing their skills. Meanwhile, the digitally inclined Generation Z utilize a gig-economy approach as a solution to increase opportunities and experience a wider breadth of positions.

10 Years From Now

Ten years from now, we will have six generations of actuaries in the industry. With this increased diversity, companies will develop models that meet the employee where they are. Companies will use fungible models for actuaries with 30+ years of experience enabling them to shift to a seasonal work lifestyle. Younger generations are already adopting a similar work environment, emphasizing the need for companies to shift their operating models. Deloitte's Human Capital trends indicate that 76 percent of participants rated internal talent mobility as an important issue.[6]

This alternative workforce gives managers more flexibility to form a team consisting of people with diverse approaches. Alternative workers will be incentivized to consistently perform well through shorter-term projects and frequent feedback. Companies will invest in alternative workers to increase work output and overall efficiency. It is important that the entire workforce, both alternative and traditional, be treated with respect about culture, inclusion, and work assignments. Considering the generational collaboration and increased diversity projected for the future, it is imperative for companies to adopt flexible work environments to stay afloat in the market.

SECTION 6: CAREERS 100-YEAR LIFE

What's Trending

The human lifespan incased steadily over the past decades, and average lifespans will continue to increase over time.[7] Leaders and workers now need to prepare for a career that can span 50–60 years out of a potential 100-year life. Today's actuaries will have careers that cover a wider breadth of topics and industries than past actuaries, increasing the importance of communication and collaboration skills as they expand their capabilities. Additionally, the half-life of today's technological skills shrunk to two years, caused by rapid adaptation to new relevant technologies. Longer life expectancies, longer careers, and shorter skills' life call for the need to create a diverse learning portfolio that supports a diverse workforce.

10 Years From Now

Future actuaries will experience different learning processes than current actuaries. Actuaries of the past gained experience and knowledge through three linear learning stages: college, specialization in work (typically through exams), and the post-exam portion of their career. With an increasing health span across all populations, actuaries will have longer careers that force them to broaden their scope of expertise multiple times. Actuaries will shift from the functional structure with strict hierarchies to one that is team-based or matrix oriented. They will also be encouraged to take risks and assume more strategic, nontraditional roles within the organization. Organizations can provide sabbaticals and retraining/reskilling programs to keep top actuarial talent up to date. Additionally, actuaries will have to adapt to micro-learning solutions, learning things in minutes and hours rather than months, to keep ahead of disruptors.

The future of actuarial exams will revolve around testing communication, collaboration, and problem-solving skills. Studying and taking these exams will be radically different, seen through more experiential-based credentialing and team-based processes. The traditional "natural selection" process of exams does not encourage creative and agile thinking, a skill that will be key. An actuary who combines knowledge of the actuarial domain and emerging technologies with effective communication will be more prevalent and valuable to organizations. This is even more important as actuaries branch out to non-traditional roles outside of insurance: applying the general, not industry specific, skills to their roles. Overall, the future actuary will have to adapt more often as skillsets diminish quicker and careers lengthen.

SECTION 7: EXPLOSION IN CONTINGENT WORK

What's Trending

The alternative workforce has seen major growth in recent years and is moving away from its definition as temporary contract work to a mainstream source of employment. Alternative work arrangements accounted for 95 percent of net new employment between 2005 and 2015. By 2020, 40 percent of people in the U.S. are expected to be in alternative work arrangements, and

the number of self-employed workers in the U.S. is expected to triple to 42 million.[8] In addition, the percentage of workers who mostly telecommute has quadrupled to 24 percent over the last 20 years. Given these trends, there is a great opportunity for organizations to tap into the alternative workforce going forward; however, survey results show that they are not necessarily ready to take this step. Deloitte's Human Capital Trends survey shows that only 28 percent of organizations could effectively accommodate the diverse needs of alternative workers.[9] Meanwhile, 45 percent of organizations say they are having trouble filling open positions.[10] Many countries are also seeing declining birth rates,[11] decreasing the size of the labor pool. Given these challenges, it will be essential for organizations to utilize and effectively manage the alternative workforce.

10 Years From Now

The competitive advantage for actuaries will be tapping into the crowds of non-actuaries. This alternative workforce could help develop unique product designs, develop new ways to manage risk, build predictive models to marry AI and cognitive computing, and automate broken processes that contribute to inefficient and suboptimal service delivery. Work that is not actuarial in nature will continue to be completed by non-actuaries.

Another challenge for actuarial leaders in the future will be managing an alternative workforce with different backgrounds, cultures, and motivations. Historically, entry level actuaries come in with similar mindsets and goals such as passing exams and becoming experts in an aspect of actuarial work. There will likely be a portion of actuaries who strive to become strategic business leaders, but there will also be a portion who view actuarial work as a small aspect of what they do. Deloitte's latest millennial study found that 64 percent of workers strive for "side hustles" to make extra money.[12] Down the road, actuarial work could be considered a "side hustle" for someone who doesn't necessarily have a core actuarial background but is an expert in machine learning. Consider the possibility of an app like Uber that could be utilized to hire these alternative workers during high stress seasons for actuaries. Such options will continually be presented as contingent work becomes more mainstream. Organizations that efficiently utilize and respect traditional actuaries and alternative workers will be industry leaders in managing the alternative workforce.

TAKEAWAYS

It is important to note that with these ever-evolving practices in the workplace, it is vital for companies and professionals to be adaptable and add human touches to steer the technologies used at work. With the vast amount of data available and disruptive technological forces at work, actuaries face an increasing pressure to finish more work quicker and effectively. However, this increase in change comes with an increase in possibilities if we are willing to adapt, evolve, and learn. Specifically, actuaries have a great opportunity to redefine their role to one that is more value added and strategic, with a new focus on productivity, business insights, and performance. ■

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ENDNOTES

1 2019 Deloitte Human Capital Trends Survey

2 2019 Deloitte Human Capital Trends Survey

3 2019 Deloitte Human Capital Trends, "From Jobs to Superjobs"

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5 Dimple Agarwal et al., "The longevity dividend: Work in an era of 100-year lives," Deloitte, March 28, 2018

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Explainable AI

By Carlos Brioso

There is a frequently used argument that favors using simpler model: "we need an easy model to explain to our business partners." Modelers usually buy into this argument and develop models that do not capture all the valuable relationships present in the data.

Business problems are usually complex. Expecting that linear models will handle non-linearities, data quality issues and high dimensionality is unrealistic. Should we sacrifice performance for explainability? The answer depends on the specific business problem, but I would expect that most of the time performance (that is translated in business value) is more important. There are multiple tools in data science that help us to interpret models that are considered black boxes.

There are three types of model interpretability that are useful and applicable to almost all models:

- Global interpretability: This helps us to understand how the model predictions are related to the input variables. This interpretation is concerned with a general understanding of the model's inner works and drills into an individual case example.
- Cluster explainability: This is used to explain how the model works when we control by sub-populations (cohorts).
- Local interpretability: This gives insight into how specific factors influence a single model prediction compared to a baseline prediction. This is meant to explain how observed variables influenced the prediction in a positive or negative way for a particular subject or observation.

There are three main methodologies to achieve interpretability:

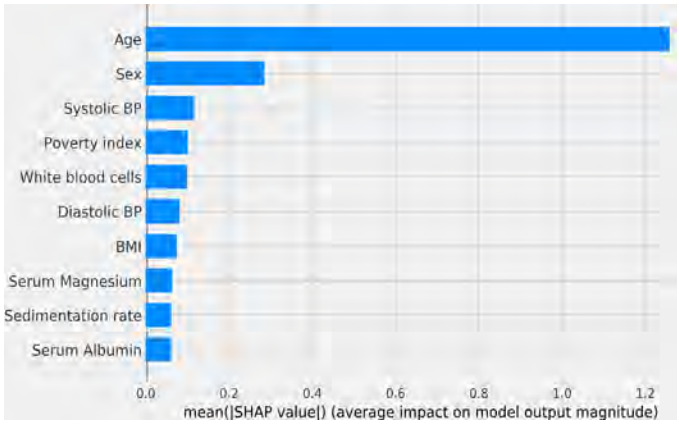
- SHAP (SHapley Additive exPlanations) is based on game theory and these values reflect the optimal way of attributing credit of a prediction.
- LIME analyzes the individual prediction and generates imaginary observations and sees whether the model changes the prediction.
- Anchor tries to generate a set of rules that will encapsulate a prediction.

I will use a problem to illustrate how to use these tools. Mortality is a problem that is clearly non-linear and very complex with many iterations between explanatory variables. You can follow the code used at *https://github.com/cbrioso/Miscellaneous/blob/main/Mortality%20Shap.py*

I use data from an Epidemiologic Follow-up Study from the CDC (*https://wwwn.cdc.gov/nchs/nhanes/nhefs/*) and fit a mortality machine learning model (Xgboost). The set of predictors are intuitive: age, gender, BMI, etc. For model explanation I use SHAP values. I won't get into details regarding how these values are derived, but will put emphasis in their interpretation. However, documentation for SHAP and LIME are readily available.

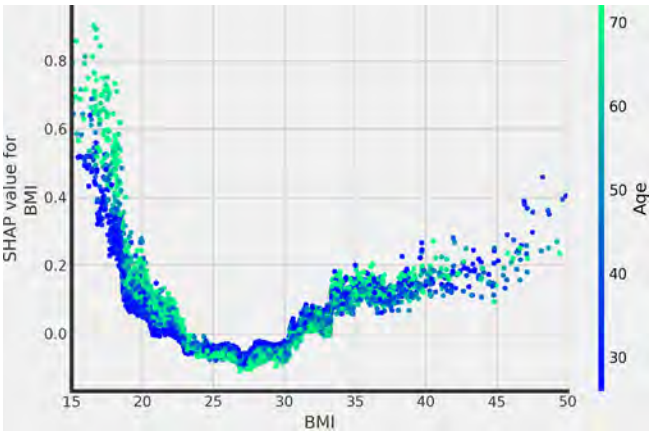
First, we want to understand what variables are the more impactful for explaining mortality. This is clearly observed in the Feature Importance plot. As expected, age and gender are the more important variables in the model. Other important variables are Systolic BP, Poverty Index, and BMI (body-mass Index). These variables make sense and concur with our understanding of mortality. (See Figure 1)

Figure 1
Feature Importance Plot (Top 10)



Once we understand the major drivers of mortality, we are interested in the relationship implied by the model. This can help us to bring intuition to relationships that we don't know or (sometimes more important) to confirm the reasonability of the relationships that we know. Let's take as an example BMI: very high and very low BMI values are related with higher mortality. This is aligned with expectations. Moreover, we observe that this relationship is different for younger and older populations. Mortality for people with low BMI is even higher for older people. (See Figure 2)

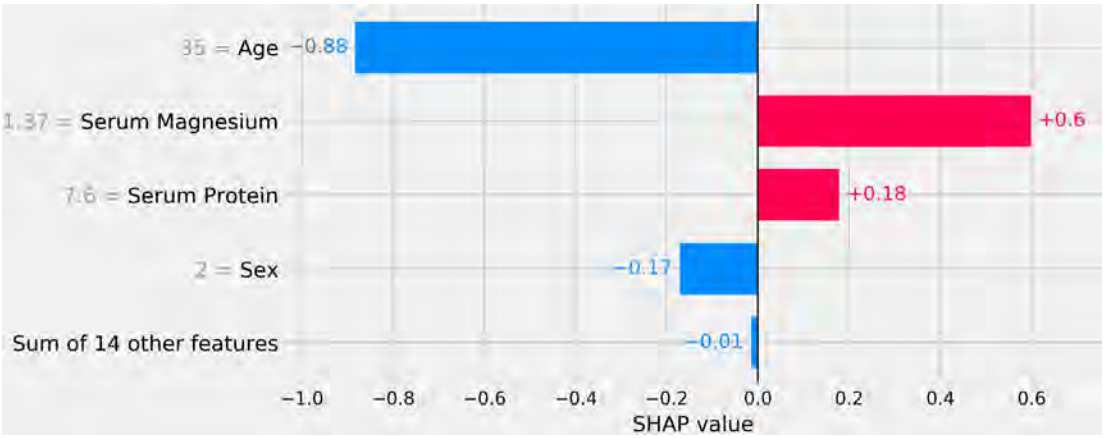
Figure 2
Relationship Between Mortality and BMI



Finally, we are interested in understanding model predictions for a specific individual relative to an average subject. In Figure 3 we observe factors that influenced the predicted mortality for the first individual in our sample. Two factors: age and gender move the prediction to be a relative lower than an average subject. However, Serum Magnesium and Serum Protein are factors that have an adverse effect in the forecast mortality for this subject.

As demonstrated in this example, a machine learning model can easily be interpreted. Tools like SHAP, LIME and Anchor can facilitate the understanding of the model and the business problem. Let's make full use of the tools that we have in hand to build better models and communicate how predictions are generated. ■

Figure 3
Individual Risk Explanation



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Risk Adjustment: Retrospective Chart Chase

By Dale Cap

PROGRAM OVERVIEW

Retrospective Chart Chase is a method that commercial and Medicare Advantage plans use to capture coding gaps and improve risk score accuracy. Although it is often a look-back program for Medicare Advantage plans, it is also an effective concurrent program that can be applied to both commercial and Medicare Advantage.

As noted, the goal is to identify coding gaps for the population of interest. A coding gap consists of the following:

- Persistent conditions, and
- suspected conditions.

A persistent condition is a diagnosis that maps to a hierarchical condition category (HCC) that has been documented in previous years but has yet to be documented in the current year. Note, it is important to filter out the acute conditions and account for hierarchal logic before pursing these codes in existing charts. In addition, for commercial plans, ensuring the condition still applies based on age, gender, and other characteristics is also important.

Suspect conditions on the other hand are those conditions identified via a predictive model (machine learning) for the member. This is typically based on a member's demographic information, drug patterns, lab results, past care, and other characteristics. A predictive model will then output a probability score as to whether they have a certain HCC.

HOW TO SUSPECT

Unlike persistent conditions, suspecting is a bit more complex. This requires a blend of actuarial and data science. Here the actuary would define the data elements, structure, and target variables in the development of a predictive model. Leveraging the machine learning skills of a data scientist, they can then determine an appropriate model for the problem. The model will then need to be hyper parametrized (tuned) and trained using a k-fold cross validation process to ensure the model generalizes the problem (not over/under fitting). The variables of importance from the model (if interoperable) can then be provided with the results based upon an agreed evaluation metric (RMSE, AUC, LOGLOSS). The actuary can then review for reasonableness and start the control cycle process for refining future iterations.

CREATING THE LIST

Once the persistent and suspected conditions have been identified, the next step is to determine which charts are most likely to contain information supporting that condition. This can be done using Bayesian statistics, where we define the overall probability of a type of chart based on provider type, place of service, and other metrics given a condition exists. We can then look at each member given a condition identified from our list and choose the most probable chart type for that member.

In some cases, a member could have a significant number of charts. To avoid pulling all charts that fit the criteria and deteriorating the ROI of the program, it is important to start the process by grabbing the top "x" most likely charts. You will also need to

remove those charts that are not in the top "y" most likely charts. The appropriate parameters here can be determined based on past performance and success from other chart chase work.

ENHANCED SUSPECTING

Other enhancements to the suspecting model could include evolving graphs. Here we look at how members evolve over time with episodes of care, and where others ended up based on this same trajectory. The benefit of this work is not only to capture the existing diagnosis, but to identify emerging conditions pre-diagnosis and intervene in advance to help manage the members along their journey.

SECOND PASS

After the chart has been pulled and coded, the use of NLP and other technology can be applied to find possible diagnoses that the coder may have missed. This is done by ingesting the structured and unstructured chart information into a system and applying probabilistic methods via n-grams (sequence of words), linguistics (meaning of phrases), and other techniques to uncover the supported codes.

SUMMARY

The following was an overly simplistic view on how to create a chart chase list for closing gaps.

Before pursuing this type of work internally, make sure the right competencies exist for carrying out the program. These include understanding how the risk adjustment program works, underlying data needed to model outcomes, what the impact of two-way-review could have on this process, as well as ensuring the technical capabilities exist to successfully suspect. ■

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