Weaving Actuarial Stories

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Abstract: Given that actuaries are using (informal) economic theories in their work (to build useful databases, to support the implementation process of proposed policies, etc.), it is worthwhile to understand the way these (informal) theories function and to evaluate their quality. We will construct a view of economic thinking that shows that economic theories fundamentally function like stories, like narratives. With that view in hand, we will then be able to highlight common mistakes in actuarial work as well as propose alternate views for the future work of actuaries.

Keywords: Credible Worlds, Imitation of an Action, Philosophy of Science, Epistemology of Economics, Narrative Theory.

1. INTRODUCTION

During the course of my career as a ratemaking actuary for Property/Casualty insurance products, I have come to notice that the practice of actuarial pricing may rely heavily on statistical methodology, but it also depends heavily on the capacity of the actuary to make sense of the underlying economics of the purchase of insurance. For instance, when it comes time for the actuary to select which variables to examine whether in a costing model, a buying ratio predictive model, a predictive model of deviations from system rates or a model of price elasticity, the modeling actuary needs to form, at least, an informal theory of the mechanisms in play to be able to dig through immense databases to isolate and compose variables that have the potential to be informative. Moreover, since ratemaking is an activity that does not end until the prices make their way to the markets, and maybe not even then, the pricing actuary needs to worry about whether or not intermediate users of the models, such as underwriters and brokers, will accept the proposed pricing models. To pass that hurdle, the pricing actuary often will present the rationale for broad and specific elements of the model by appealing to, sometimes, informal theories that the stakeholders of the insurer have about what drives the buying and claiming behaviors of the insureds. In effect, what I have come to observe is that significant efforts of theorizing of choice behavior under risk are taken by practicing field actuaries.

While the theorizing activities mentioned above often take place at an informal level, their cumulative resulting effects can be material to the success of the activities of the insurer: largely because they are so deeply related to policy-making with regards to pricing, the key driver of
profitability (and thus solvability and existence) of the insurer.

But, for some practicing and many academic actuaries, it is not even obvious that economic modeling does or should enter their practice. To them, the actuary should be focusing on predictive modeling with an absolutely agnostic attitude regarding the nature of the processes driving the data. This attitude can be contrasted with two other ‘schools’ of statistical/probabilistic work oriented towards economic applications. One is the causal modeling orientation to estimation. Two is the structural approach to estimation. In both of these approaches, the modeler gets heavily involved with theorizing. Under the causal approach, the modeler gets involved because some form of a priori reasoning needs to take place in the selection of statistical instruments (given the humanly or economically relevant selected question of interest). Under structural modeling, the modeler needs to become quite familiar with the underlying (economic) theoretical model to be able to write down conditions the models predict would be observed in empirical reality. Either way, agnosticism about the underlying reality that generated the data is a no-go.

While we are not proposing that actuaries stop using the (predictive modeling) tools that have made them successful in their environment, we are proposing that something important is lost with such pure agnosticism. That loss even affects the statistical aspect of the work. Take the example of building and calibrating a rating algorithm. With a completely agnostic attitude, all the variables that are statistically significant would be kept. Reflecting on the underlying (economic) reality that generated the data would help the actuary (1) make reasonableness checks about the nature and strength of the relationships found, (2) avoid over-fitting of the data because of the work done in (1), and (3) go through a healthy dose of story-telling about the selected models that can help the stakeholders of the actuarial work wrap their head about the significance of the model.

We will thus explore here what makes a theoretical economics model ‘good’. We do so in the hope that actuaries will be better equipped with answering the question of whether or not the (economic) theories they are using are well constructed and relevant to the problems at hand. With that exploration in hand, we will then explore implications relating to: (1) the asymmetry between

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1 As examples of work that are much in line with the said attitude, see (Regression Modeling with Actuarial and Financial Applications 2010) and (Loss Models: From Data to Decisions 1998).
2 A good example of that type of work can be found in (Mostly Harmless Econometrics: An Empiricist’s Companion 2009). One unfortunate aspect of causal-style estimation is that it is never obvious to what extent the identified causal factor will reproduce in situations that are not exactly like the situations in which the causal factor was identified.
3 Good examples of that type of approach can be found in the examples of (Analysis of Panel Data 2003). An unfortunate aspect of structural estimation is that, at times, only factors of profoundly unrealistic models can be estimated due to mathematical tractability issues.
past and future, (2) the difference between regularity and causality, (3) why actuarial science needs to move beyond statistics and into econometrics, (4) how to identify model blind spots and comment on their importance, (5) what are alternative considerations into building a good rating system, and (6) how actuaries can get involved into the human side of claims.

1.1 RESEARCH METHODOLOGY

To explore how (many) good economic theories are constructed, we will start by relating some commonly known economic theories that actuaries sometimes share with each other. These stories relate to adverse selection, moral hazard and the pricing cycle: all subjects deep at the heart of actuarial practice.

We will then introduce the concepts of narrative causality and of the imitation of an action. On that subject, we will hear thoughts coming from different traditions: from economists reflecting on the trade of economic theorizing and its relationship to economics at large, from Paul Ricoeur (through the words of one of his commentators) reflecting on narrative theory and on the practice of the historical science, through Ricoeur’s work, from a range of thinkers that reflected on narrative theory, the historical science, the functioning of language and models, etc., and from applied mathematicians building concepts that allow them to build models relating to human activity.

With these tools in hand, we will be able to turn to the applications that we mentioned above.

1.2 Outline

The remainder of the text will go as follows. Section 2 will be dedicated to recalling commonly shared actuarial economic models: in section 2.1, we will discuss the economist’s view of adverse selection; in section 2.2, we will discuss the actuary’s view of adverse selection; in section 2.3, we will discuss moral hazard; and, in section 2.4, we will discuss the rationality of the pricing (and reserving) cycles. Section 3 will be dedicated to understanding how (many) good economic narratives work: in section 3.1, we will discuss the importance for story telling of being able to interpret human action; in section 3.2, we will discuss the inside view of the characters; as contrasted as the discussion of the outside view of the (implied) narrator we will have in section 3.3; in section 3.4, we will discuss features of fictional time; in section 3.5, we will discussed how narrative causality differs from both

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4 We will mostly use the commentary by (Dowling 2011). Another relevant commentary is (Discussion: Ricoeur on Narrative 1991).
sufficient reason and efficient cause; at that point, the reader may choose to skip to section 4 relating to a first set of applications of the work done so far and come back to section 3.6 after that; in section 3.6, we will explore how narratives serve as laboratories to identify unintended consequences; in section 3.7, we will discuss how good a story induces a (mini-)paradigm shift and how that may differ from the story being true; in section 3.8, we will explore how collective entities may properly enter economic stories; and, in section 3.9, we will mention how the mathematical language enters economic story telling. Section 4 will discuss the basic applications: in section 4.1, we will discuss how the past is not necessarily representative of the future; and, in section 4.2, we will discuss how regular succession can be quite different from causality. Section 5 will be dedicated to more advanced applications: in section 5.1, we will discuss how the statistical work of the actuary needs to be supplemented with story-telling; in section 5.2, we will discuss how a narrative approach to economic theorizing can assist the actuary in identifying model blind spots and assessing their importance; in section 5.3, we will use the framework built above to construct an alternative view of what a good rating system could look like; and, finally, in section 5.4, we will discuss why and how the actuary can get involved in the claims process.

2. ACTUARIAL STORIES

With a view of understanding how good economic theorizing functions, we propose to start by relating a couple of examples of economic models that commonly enter actuarial education and are commonly in the mind of many practitioners when going through their ratemaking exercises. The hope is that the features of good narratives that will be identified in section 3 will be readily apparent to the reader when considering how those commonly related stories were built.

2.1 The Economist's View of Adverse Selection

This particular story motivates why, even if the insurer was a monopolist, if the purchasing of coverage was not mandatory, it could happen that large sub-populations could be left out of the insurance system.

Let’s provide a typical example of adverse selection as the economic literature has considered it. The setting can be a life insurance pool in the 18th century (Bühlmann 1997). Suppose that there is initially only one insurer: basically it’s the insurer for the county, and there is no competition yet. The insurer is not sophisticated yet, so the ‘local actuary’ sets the rate such that premium cover losses: effectively, the group starts with a pooled rate. Now, for random reasons (maybe the insureds are temporarily acting less than fully rationally, maybe because of the temporary influence of preferences other than that of terminal wealth, ...), a small subset of insureds decides to leave the pool. Since rating is basically projecting past trends into the future, the rate for the next year will decrease if the proportion of high-risk individuals that left the pool is greater than that of low-risk individuals. If that’s the case, most of the people that left have no incentive to not come back in as the price for the same coverage has decreased. There’s also no reason to believe that people attracted to buy in the pool will have a significantly different proportion of high-risk/low-risk than the proportions already in the pool. But,
what if, at the more likely extreme, only low-risk people are tempted to leave? Then, the rate for the next year will increase, and most low-risk people not already in the pool won’t be tempted to get (back) in, but the high-risk people won’t feel the disincentive and the pool will actually attract more high-risk people than the rate anticipated. The insurer will have to increase rates even further the period after. The same phenomenon can apply in many successive periods. In the limit, if the insurer hasn’t filed for bankruptcy already, only high-risk individuals will be left and they will be purchasing the full amount of insurance at their own adequate rate. [Freely inspired by (Akerlof 1970)]

2.2 The Actuary’s View of Adverse Selection

This particular story motivates why rate segmentation (based on cost differentials) is a sensible action to take in a competitive insurance market.

Consider the situation in which a company (e.g., Simple Company) charges an average rate for all risks when other competing companies have implemented a rating variable that varies rates to recognize the differences in expected costs. In this case, Simple Company will attract and retain the higher-risk insureds and lose the lower-risk insureds to other competing companies where lower rates are available. This results in a distributional shift toward higher-risk insureds that makes Simple Company’s previously “average” rate inadequate and causes the company to be unprofitable. Consequently, Simple Company must raise the average rate. The increase in the average rate will encourage more lower-risk insureds to switch to a competing company, which causes the revised average rate to be unprofitable. This downward spiral will continue until Simple Company improves their rate segmentation, becomes insolvent, or decides to narrow their focus solely to higher-risk insureds and raises rates accordingly. This process is referred to as adverse selection. (Werner and Modlin 2010, 151)

2.3 Moral Hazard

This particular story motivates why, as long as the actions that the insureds take to avoid or contain losses are not observable by the insurer, including risk sharing features (like deductibles, coinsurance or limits) in insurance contracts is a sensible action to take by the insurer, even if the insured is loss averse and the insurer is basically and relatively risk neutral.

Assume that there is an insurer that approaches the market with insurance contracts. The insured, then, can accept one of the proposed contracts. Once coverage starts, the insured has a choice to follow two generic paths: (1) the insured can put in all the necessary efforts to avoid losses, or (2) the insured can stop putting in the necessary efforts to prevent losses. The insurer cannot become aware of whether or not the insured is taking the necessary steps to avoid losses. Clearly, if the insurer was able to become aware of the level of effort put in by the insured to avoid losses, the risk neutral insurer could rate accordingly and provide risk-averse insureds with contracts that they prefer and that protect them fully against insured losses. When the insured has more information than the insurer about the level of effort displayed to avoid losses, incentive compatibility forces the insurer to offer contracts where the insured faces some of the risk; for, imagine the insurer did not force the insured to face some of the risk, then the insured would receive the same coverage no matter what level of effort was put in to avoid losses, and the insured would rationally put in as low a level of costly effort as possible to avoid the loss and, thus, claim, on average, more. [Freely inspired by (Chavas 2004, 192)]

2.4 The Rationality of the Pricing (and Reserving) Cycle(s)

This story motivates why it could be the case that pricing cycles arise even in the absence of exogenous shocks to insurer capital, like large catastrophes.
Underwriting cycles, like profit fluctuations in other industries, reflect the interdependence of rival firms. Strong policyholder loyalty and demand inelasticity hold the allure of large returns for incumbent firms, but the apparent ease of entry into insurance, the lack of market concentration, and the difficulty of monitoring competitors’ prices preclude excessive profits. The interaction of these forces keeps the market in disequilibrium, with continuing price oscillations. (Feldblum 1990, 175)

The rationality of the reserving cycle could follow in an environment where rates are regulated so that charged rates are based on the insurers’ expected losses and expenses plus a set profit margin. In that case, insurers’ reserves (which are presumably set within a margin of error that is often economically material), that do enter the expected losses, are one of the only ways left for the insurer to endogenously affect insurance prices. That being said, this does not rationalize the reserving cycle in a non-rate regulated environment.

3. HOW DO (MANY) GOOD ECONOMIC NARRATIVES WORK

The question of the nature and evaluation of theories in economic theory is a question that received a fair bit of attention in the wake of some successful and some disastrous economic interventions in the recent past: whether it be the Eastern transition from a control to market economy, the massive deregulation of banking and finance markets that many suspect to be at least a contributing cause for the recent Great Recession, or the massive auctions of the cellular 3G capacity in the USA and UK. In particular, (The Puzzle of Modern Economics: Science or Ideology 2010) written by Roger E. Backhouse addresses these issues. The first part of his work deals with fact finding relating to recent involvement of economists in public policy (Backhouse 2010, 15-96), while the 6th chapter "Creating a 'Scientific' Economics" (Backhouse 2010, 99-116) and 7th chapter "The Quest for a Rigorous Microeconomics" (Backhouse 2010, 117-136) deal with the nature of modeling in economics.

As a matter of course, Backhouse will be mainly interested in macroeconomic policy; however, for our purpose which is to relate to actuarial practice, we are much more interested in microeconomic policy-making. Therefore, we will follow a different path. Our path will instead take us much closer to understanding how economic theorizing draws upon our ability to follow a story, if only indirectly at times.

It is our thesis that (many) sound economic arguments are fundamentally ‘good’ imitations of an action. We are thus very close to the view proposed by Robert Sugden in (Credible Worlds: The Status of Theoretical Model in Economics 2008) and (Credible Worlds, Capacities and Mechanisms 2009),
At the heart of an ‘imitation of an action’, we find a text (either literally written or rendered verbally) which unfolds an imaginary world for the audience: we find

(...) the idea that literary works are self-contained worlds with their own laws and their own logic (...) The best way to understand mimesis praxoes\textsuperscript{5} (...) is to begin by freeing the concept of ‘imitation’ from any narrowly conceived comparison of art work and object, as in the physical resemblance between a marble bust and its subject. (Dowling 2011, 2)

We will spend the rest of the section attempting to highlight the nature of a ‘good’ ‘imitation of an action’.

3.1 Interpreting Human Action

From the point of view of the economist, the condition of human existence exhibit four fundamental characteristics. The ends are various. The time and the means for achieving these ends are limited and capable of alternative application. At the same time the ends have different importance. Here we are, sentient creatures with bundles of desires and aspirations, with masses of instinctive tendencies all urging us in different ways to action. But the time in which these tendencies can be expressed is limited. The external world does not offer full opportunities for their complete achievement. Life is short. (...) Our fellows have other objectives. Yet we can use our lives for doing different things, our materials and the services of others for achieving different objectives. (Robbins 2008, 74)

The entry point of a ‘good’ ‘imitation of an action’ is the building of believable characters. As the passage above is made to illustrate, part of what makes characters believable is that they suffer from the human condition. For example, in the passage above, the presumption is that the large diversity of sought ends contrasted with the limited available means and time to achieve those ends is a human universal: so much so that persons from all cultures, backgrounds, ages and times are expected to recognize it to be true of themselves and of the persons that surround them.

Notice how the above characterization abstracts from a lot of the minutiae of our lives. In theorizing generally, it is commonly sound and necessary to abstract from some features of the problem at hand and instead focus (sometimes to the point of caricaturing) on other features of the problem. In fact, it was the opinion of Milton Friedman that, in the process of abstraction at the heart of modeling, some of the ‘assumptions’ may be entirely unrealistic: to the point that, very often, the most significant and useful theories are built on ‘assumptions’ that are wildly unrealistic.\textsuperscript{6} In fact, it is one of our hopes here to be able to provide guidance about which assumptions must be

\textsuperscript{5} mimesis praxoes roughly translates to the action of imitating.

\textsuperscript{6} “In so far as a theory can be said to have 'assumptions' at all, and in so far as their 'realism' can be judged independently of the validity of the predictions, the relation between the significance of a theory and the 'realism' of its 'assumptions' is almost the opposite of that suggested by the view under criticism. Truly important and significant hypotheses will be found to have 'assumptions' that are wildly inaccurate descriptive representations of reality, and, in general, the more significant the theory, the more unrealistic the assumptions (in this sense).” (Friedman 2008, 153)
realistic to drive the point of the economic narrative and which ones can be simplified, even to the point of caricature.

Despite Friedman’s insistence that assumptions about economic agents need not be realistic, significant efforts have been deployed to provide economics with a less idealized view of economic agents. Herbert Simon has been a great proponent of that view. In his essay (A Behavioral Model of Rational Choice 1955), Simon was proposing that we attempt to refine our assumptions about how human beings deal with situations of economic interest: Simon wanted us to replace the (rational) ‘economic man’ of traditional economics with a view of human beings that have preferences that may appear inconsistent from some point of view, that use inappropriate rule-of-thumbs for assessing relevant probabilities instead of Bayes’ theorem and other probability and statistics theorem, that have imperfect access to relevant information, etc. (Simon 1955, 99)

Yet, some story telling requires the author and the audience to be able to interpret human actions within a specific cultural context. Take a simple example of understanding why it might be the case that the owners of automobiles with make "Lexus", "Mercedes", "BMW" may have higher than average price elasticity with regard to their automobile insurance coverage. In that case, the actuary needs to use cultural awareness to understand that automobiles with these makes are signs of wealth and luxury. The actuary should also understand that people do become rich by ‘becoming good at negotiating prices’. Thus, the actuary could form a working hypothesis that the price elasticity for automobile insurance may be higher than average for owners of cars with those makes.

Bottom line, it is important to build believable characters that react (to hypothetical situations) in a way that we recognize as plausible "because those same reasons [to explain why we undertake an action] are necessarily the means we use to explain to ourselves the actions of other people." (Dowling 2011, 4)

3.2 The Inside View of the Characters

What makes history radically different from the physical sciences, Collingwood argues, is that historical events have an ‘inside’ - how the historical actor understood themselves and their actions - as well as an ‘outside’, meaning a subjection to external forces such as climate, geography, social institutions, and the like. Collingwood’s ‘outside’ corresponds (...) to any social and physical environment independent of consciousness, and his ‘inside’ to the thoughts and motives of human agents. (...) [T]he inside includes a great deal more than rational calculation, as when unconscious desires or undeclared animosities become, along with conscious motives, a mainspring of action. (Dowling 2011, 56)
To understand why the inside views of the characters is relevant to economic storytelling, it is relevant to contrast the intentions behind historic storytelling, as described by Collingwood, to (economic) policy-supporting story-telling. The (presumed) intention that supports discourse relating to the science of history is to say something true about the past. Contrasted with this, the (presumed) intention of (economic) policy-making understood in its positive, as contrasted with its normative, sense is to say something true about what could possibly, plausibly or probably happen if a given set of policies is implemented. In a basic way, history is aimed at the past, while policy-making is aimed at the future. Caution is required here, because a large motivation for historical science undertaking is the understanding of the past so as to avoid its pitfalls or foster its successes (in the future). But it is also the case that people need to be able to imagine how their actions will appear, in retrospect, either to their future selves or to future generations, to be able to best guide their policies about what to do.

The key to why the inside view of the characters is relevant to (economic) story-telling is that, while they are in the story, the characters are literally unable to grasp the meaning of their actions as set against the background of the whole story. To them, the situations of the story are experienced in a state of imperfect knowledge (with informational blind spots, with some elements of available information not understood at all or well, with poor forecasts about how our future selves or generations will value our current actions, etc.).

Without the inside view of the characters, one could be tempted to ask of the characters to act in sync with the ultimate lesson that a modeler may be attempting to draw out of an economic theory. But, for us, meaning and lessons are not available at the beginning of a story, but at the end. Therefore, to connect with the characters, it is important for the audience of the (economic) story to be able to traverse the story as if they were the characters in the story, with their state of imperfect knowledge and foresight.

3.3 The Outside View of the (Implied) Narrator

We will refer to the outside view in a way different from that of Collingwood as reported above. For us, the outside view is the dual of the inside view of the characters: if the inside view is the view of the story as it is experienced by the characters as they suffer the story and react accordingly, the

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7 "(...) a chain of causal implication that must be traversed in time, and in a state of partial or imperfect knowledge (...) An important point for Ricoeur is that any audience outside the horizon of the events in the story (...) must make this traversal in just the same state of imperfect knowledge as those inside it." (Dowling 2011, 8-9)
outside view corresponds to that of a narrator that has already grasped the events of the story as a whole and can thus highlight the lessons implied by the story.

In essence, we are saying that many economic narratives employ implicit omniscient narrators. Omniscient because it is quite common for the implied narrator of economic stories to be able to “say” exactly what the state of knowledge of the different characters is, what they prefer, what they are trying to do, etc. It is implicit because, as contrasted with, say, many modern novels, the narrator does not necessarily have an explicit voice within the (economic) story. For example, in the way that we presented the four actuarial stories in section 2, the narrator can be identified explicitly because the audience is being asked to consider a scenario. However, as we will comment on more later on, those stories could easily have been written almost completely with a mathematical language: as a set of assumptions and theorems. Indeed, some of those same stories from section 2 were initially related in their mathematical formulation. When that happens, the effective assumption is that the audience of the theory is able to translate the mathematical formulation into a story about people, their goals, their values, their hidden agendas, their beliefs, etc., facing situations and taking actions in accordance. When they do so, the audience is invoking a narrator that reports to them the interior discourse of the characters, the events as they truly happen without the characters being necessarily aware of them, etc.

We call this an outside view because it is a view from outside the time of the story, outside of the time that the characters would be experiencing. It is a view from which the globality of the story can be grasped. From this point of view, it is possible to extract lessons concerning the policies under consideration, because, outside of the time of the story, one can grasp together the intentions of the characters with the ultimate consequences of their chosen actions.

3.4 The Fictional Time of the Story

We live in a world in which, not only are the things that we want scarce, but their exact occurrence is a matter of doubt and conjecture. In planning for the future we have to choose, not between certainties, but rather between a range of estimated probabilities. It is clear that the nature of this range itself may vary, and accordingly there must arise not only relative valuation of the different kinds of uncertainties between themselves, but also of different ranges of uncertainty similarly compared. From such concepts may be deduced many of the most complicated propositions of the theory of economic dynamics. (Robbins 2008, 79)

The experience of time has to be one of the fundamental human universal. Across civilizations, cultures, ages, times, etc., human beings have formed wisdom about their experience of the passage of time and recorded that wisdom in idioms of their language. The quote above is meant to illustrate that, for human beings, the passage of time is not the neutral and regular swing of the pendulum.
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Time takes meaning in the worries, concerns, projects, etc. that we experience. Now, how does that translate in the stories that interest us?

3.4.1 Calendar Time in the Story

It is worthwhile to note that most cultures have a calendar: a calendar that helps them keep track of the movement of celestial bodies, of seasons, etc.; a calendar that starts at a meaningful event; a calendar which helps mark important intimate, private and public moments. Now, calendars are imminently public: if calendars were not public, they could not help people synchronize their activities. In fact, the importance of calendar time has increased dramatically with the advent of the written language, of written contracts, and, even more so, of the digital age. For example, in my own life, I keep track of pay-days that come every two weeks, of rents due at every beginning of the months, of utility bills due every month, of classes I need to teach that take place twice a week, and so on.

So, in an economic narrative, even when it is written in a mathematical language, the reference to time is not a reference to the neutral physical time of Newtonian mechanics. It is not even a reference to the warped physical time of general relativity. It is a reference to the humanly meaningful time of calendars and clocks. Admittedly, calendars are built with a view on the movements of the celestial bodies; but, calendars are meaningful to humans and not to the Sun, the Moon, ... Calendars also help us explain to ourselves the actions of other people: whether it be understanding why farmers are sowing seeds, understanding why people rush to the nearest mall to buy a pine tree, why a man spends a full morning making reservations at a local restaurant, etc. Thus, in a story, we can invoke calendar time to justify, rationalize, the actions of the characters. In effect, this is saying that calendar time lives just as much in stories as it does in our lived lives. That being said, the calendar time of the story is, by construction, fictive, while the calendar time of our lives is not. What is important is that the characters react to it in a way that we can comprehend.

3.4.2 Available Information

In natural languages, it is quite common for some verb tenses to be commonly associated with the telling of stories. Take the example of the opening of Star Wars: "A long time ago in a galaxy far, far away...." Given that this is the opening of a science-fiction movie (which would generally indicate a futuristic inclination for the movie), the invocation of the past may seem odd. In fact, the invocation of the past is more meant to indicate that a fictional story will be related. The use of the imperfect verb tense also often serves the same aim.
In effect, within natural languages, many verb tenses are used in narratives and the reason why there are many verb tenses used in narratives is to allow the narrator to reflect the position of the characters in the time of the story. Just like in real life, the characters look backward and forward in time. So, natural languages have provided us with ways to say that somebody was reflecting about the meaning of some events or was considering attempting an action or considering the consequences of said attempted action.

In economic narratives, as they are often either based on or expressible in terms of game theory, the notion of information set and of allowable actions serve substantially the same purpose. For example, in a (repeated) game theory setting, at any given point in the time of the game, a given player has access to some information relating to past and current steps in the game, but not to others; the player has properly understood the meaning of some pieces of information, but not others: thus allowing the player to form a view about the future; the player is also attempting to achieve some ends, often expressed in terms of attempting to maximize some preference function, and is allowed to take on some actions, but not others.

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8 See (Repeated Games and Reputations 2006) for an advanced introduction to repeated game theory. Another variant of game theory where dynamics are crucial is evolutionary game theory. For an introduction, see (Evolutionary Games and Equilibrium Selection 1997).
3.4.3 Disproportions and Meaningfulness

What necessarily emerges from the disproportion [between time taken to narrate and time as it passed in the story] is a structure of significance. (...) Its primary importance is that it represents a break or rupture with linear time, a transformation of Aristotle’s cosmic time into a time of human preoccupation or concern. (...) At the level of events (...) characters move forward in a world where choices must be made with only approximate guess about their consequences, where accidents might occur at any moment to alter fortunes of the individual or the community, and where people must be judged on the shifting and uncertain ground of social appearances. (Dowling 2011, 47-48)

Consider again the stories that were relayed in section 2. The stories narrate the events centering around insurer and insureds decisions. Yet, presumably, these decisions take a tiny fraction of calendar time. But, they take up almost the entirety of narrated time, the time taken to go through the story. Why is that so? Compare with plain-vanilla dramatic movies, for example. In those movies, again, much of the movie will not cover many events that occur daily to the characters: like time spent on personal hygiene, time spent eating, etc. The movie-maker is instead choosing to focus the attention of the audience on the events that relate to the story at hand: events that are significant and meaningful in the story.

So, many economic narratives will focus the attention of the audience on particular (often recurrent) decisions that need to be taken by individuals, firms, governments, etc. In effect, the entirety of the time of narration is taken to describe those moments of pondering, decision, and action.

3.5 Narrative Causality vs. Efficient Cause vs. Sufficient Reason

Ordinary life, Aristotle said, is most often made up of actions and events that take place in meaningless succession: 'one thing after another'. But narrative always involves, due to the logic of emplotment, a strong implication of causality: 'one thing because of another'. (...) Emplotment permits an intuitive grasping together (...) of otherwise heterogeneous elements (...). (Dowling 2011, 5)

At this point, we are ready to introduce the concept of narrative causality. In effect, causality is at the heart of narration because the audience needs to grasp why events occur in the sequence that they do: a story is not a (mere) temporal sequence of events.
But, what makes narrative causality different from other forms of causality that we commonly encounter: how is narrative causality different efficient cause? How is narrative causality different from sufficient reason?

Let’s first address how narrative causality incorporates argumentation by sufficient reason. Because, in a well constructed narrative, the actions of the characters make sense taking into account their motivations and their environment as they face it; necessarily, characters have to have sufficient reason to take the actions that they actually do take within the story. It is worthy to note that some economists have thought that some brands of economic arguments rest entirely on sufficient reason and, when expressing that thought, they were referring to the theory of valuation.

Still, why is it that argumentation by sufficient reason comes so naturally in economics? It is simply because economics is concerned with human choices. So doing, economic argumentation must extend itself beyond the material world and "involve links in the chain of causal explanation which are psychical, not physical, and which are, for that reason, not necessarily observable by behaviourist methods." (Robbins 2008, 85)

By way of contrast, as Ricoeur noted (Ricoeur 1983, 249-255), the explanation of the evolution of human societies (especially in the historical science) must also make room for efficient cause: it must make room for change occurring in the natural environment of human beings. This is one way that efficient cause must enter narrative causality: by providing the rules by which the natural environment of the characters is evolving. For actuarial purposes, this is especially relevant. Whether the actuary is considering the impact of epidemics, the impact of weather and climate, the impact of

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9 "The 'efficient cause' of an object is equivalent to that which causes change and motion to start or stop (such as a painter painting a house) (see Aristotle, Physics II 3, 194b29). In many cases, this is simply the thing that brings something about. For example, in the case of a statue, it is the person chiseling away which transforms a block of marble into a statue." (Wikipedia n.d.)

10 "Fourth Form: The Principle of Sufficient Reason of Acting (principium rationis sufficientis agendi); briefly known as the law of motivation. 'Any judgment that does not follow its previously existing ground or reason' or any state that cannot be explained away as falling under the three previous headings 'must be produced by an act of will which has a motive.' As his proposition in 43 states, 'Motivation is causality seen from within.' (Wikipedia n.d.)

11 "The distinctive character given to this system of theory by these postulates and by the point of view resulting from their acceptance may be summed up broadly and concisely in saying that the theory is confined to the ground of sufficient reason instead of proceeding on the ground of efficient cause." (Veblen 2008, 133)

12 Here's another take at the same basic points: "The first, inescapable in any thinking about human conduct, is fundamentally the problem of the reality of choice, or 'freedom of the will.' It involves the essence of the value problem in the sense of individual values, and is at bottom the problem of the relation between individual man and nature. The second basic problem has to do with the relation between the individual man and society. The crucial fact in connection with the first problem is that, if motive or end in any form is granted any role in conduct, it cannot be that of a cause in the sense of causality in natural science. (...) Motive cannot be treated as a natural event. A fundamental contrast between cause and effect in nature and end and means in human behaviour if of the essence of the facts which set the problem of interpreting behaviour. There seems to be no possibility of making human problems real, without seeing in human activity an element of effort, contingency, and, most crucially, of error, which must for the same reasons be assumed to be absent from natural processes." (Knight 2008, 101)
ground movements, etc., the actuary is commonly faced with taking into account how the natural world is affecting the human environment.

But efficient cause also enters narrative causality because the characters must take into account physical, chemical, biological, etc. laws in figuring out what they can do and how they will go about effecting their choices. Now, in most economic narratives, as opposed to, say, crime novels, there is generally little emphasis on the exact ways in which the characters take actions. Still, for an economic narrative to be instructive, it is often the case that the narrative must reflect, even on an abstract level, the actual potentialities that humans have to effect their intentions.

As mentioned in the outline, readers eager to get to applications of the work done so far should skip to section 4 "Basic Applications" and come back to complete this section before moving on to section 5 "Advanced Applications ".

3.6 A Laboratory to Explore Unintended Consequences

As one looks back on a completed series of events in a plot, it does seem as though there is something like unity or simultaneity in the causal chain. (...) [N]o, it was entirely unforeseeable; yes, we now see that it was inevitable after all. (...) Every story (...) is in an important sense told forward and backward (...) The forward movement, which belongs to what Ricoeur calls the syntagmatic order of discourse, links a movement from event X to event Y in an irreducibly temporal way. (...) At the same time, any continuous implication that the story has already been grasped as a whole (...) mean that events must be moving toward a conclusion so far unforeseen by its characters and by us its audience. (Dowling 2011, 9-10)

We are here getting at one fundamental reason why human beings tell each other stories: so that not everybody has to actually go through an experience to be able to draw the lessons from that experience. In effect, stories allow us to simulate reality and draw conclusions about what would really happen if we made certain choices or decisions. This is particularly valuable when the events, were they actually experienced, would induce dramatic consequences, e.g., irreparable damages, points-of-no-return, etc.

Given that we have argued that economics (and actuarial science also) are heavily grounded in policy-making, which is intrinsically forward-looking, it is quite natural to wish to be able to comment about the actual, as contrasted with intended, effects of a policy, if it were implemented. And, our daily lives inform us that what actually takes place may well be far away from what we intended: sometimes because of poor execution on our part, but sometimes because people that share the world with us form intentions to interfere with our projects. Presumably, they do so because they choose to, if only at a subliminal level. And, their choice is the result from their own
projects, their own possibilities, their own preferences, their own conjectures, etc. And, this is where stories become useful simulations: because all the characters have to act in accordance with their own beliefs and motivations, the story as a whole may unfold in a way that does not match any of the characters’ stated or hidden intentions. Thus, the story serves as a (virtual) laboratory that allows people to explore the unintended consequences of their choices and actions.

What are the stories from section 2 allowing us to experience without actually having to experience it? The story on the economist’s view of adverse selection is meant to help us understand that it may be that all the people from a population may either gain or be no worse off from having a central power mandate insurance, when the distortions from adverse selection are too severe. The story of the actuary’s view of adverse selection is meant to help us understand that, in a competitive insurance market, an insurer that does not invest in (cost and) rate segmentation may have its solvability threatened. The story about moral hazard is meant to illustrate that risk sharing is an invaluable feature of insurance contracts because, without it, claim inflation may make insurance unaffordable. And, the story about the pricing cycle is meant to illustrate that pricing cycles may not be the result of insurer irrationality and, so, suggest that education may not be the way out of the cycles. In all of the cases, the audience of the story is able to (virtually) experience the ‘bad consequences’ (unavailable coverage, insurer insolvency, claim inflation, continuing pricing cycles) without having necessarily to go through the experience themselves.

3.7 (Mini-)Paradigms Shifts vs. Truth

Are the stories of section 2 true? While the question may seem harmless, in fact, it is a source of great embarrassment. If one meant by true that there is a correspondence between the events of the stories and events in the real (empirical) world, then a sensible answer may well be that the question is undecidable as, in the real (empirical world), the setups of the stories have never actually been encountered. If one meant that, if, in the real (empirical) world, we set up a situation that is like the initial conditions of the stories, then events would unfold as in the stories, then the question may still be undecidable, not as a matter of principle, but because it may be actually impossible to effect such setups. Such is the case because to construct those stories many circumstances from life have been abstracted away (and replaced by implicit and, yet, potentially not neutral assumptions).

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13 As the stories are not intended as stories about what actually happens (or, even for that matter, what literally will or would actually happen), the question asked is not actually that far from the question of asking whether a fictional work, like War and Peace, is actually true.
A potentially more promising avenue is to think about stories as being metaphorically true. But, then one has to come up with a view about what makes a metaphor true. A metaphor is meant to highlight how a certain aspect of something is like a certain aspect of some other thing. Is the likeness then true?14

The question then becomes whether or not the above question needs to receive a definite answer to allow us to make progress. Supposing we remain agnostic about the truth of fictional narratives, which would include the stories from section 2 as they were not stories meant to relay how (real) events actually unfolded, then it may still be sensible to ask if those stories were powerful, useful, ...

Here, we are pointing towards the idea that good economic narratives induce change in perspectives in the audience that allows them to better deal with their own lives. So, we say that good economic narratives are useful and that the channel for their usefulness is a change in perspectives from which events, data, choices, policies, etc. are considered. In effect, we are saying that good economic narratives induce (mini-)paradigms shifts in their audience.

In fact, all of the stories above were presented with the shift in vision-of-reality in mind: the stories were meant to induce (mini-)paradigms shift. And, of all of the presented stories, maybe it is the story initially presented by Akerlof that had the more lasting effect. In fact, Akerlof won the Nobel prize for that work15.

### 3.8 The Place of Collective Entities

Examining the stories of section 2, we find that some of the characters are not, not even in principle, individuals: case in point, when insurers are brought in as characters of the story. What we have here is a case where a collective entity is a character in the story. But, then, how are we to make sense of assessments, motivations, intentions, etc. of collective entities? As the summary of the assessments, motivations, intentions, etc. of the composing individuals? Take the case of insurers. What is the objective of an insurer? To exist? To remain solvent? To provide insurance coverage at a fair price? To make profit? In fact, there are some groups of stakeholders of the insurer that would

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14 It is tempting to say that the likeness cannot be actually be true because truth has no degree while likeness does. And, when we say that truth has no degree, we are aware that we say things like 'half-truths': but, we say such things when the things told were literally true (and recognized to be such) but they were presented to be interpreted in a misleading way.

15 "Akerlof is perhaps best known for his article, 'The Market for Lemons: Quality Uncertainty and the Market Mechanism', published in Quarterly Journal of Economics in 1970, in which he identified certain severe problems that afflict markets characterized by asymmetrical information, the paper for which he was awarded the Nobel Prize." (Wikipedia n.d.)
focus on subsets of these possible answers. So, while it is certainly true that the way the insurer acts as a character in a story is a function of the individuals that exist in the sphere of the insurer, the insurer does not appear reducible to that of those individuals. Yet, collective entities commonly enter narratives: not just economic narratives, but fictional narratives, historic narratives, etc.

Let us examine a little bit more closely how collective entities enter historic narratives.

What gives such terms [singular collectives, like ‘Germany’, ‘Americans’, etc.] meaning is that they refer to concepts - family, tribe, clan, nation - that are constitutive of individual consciousness, and which therefore have a real existence in what Husserl called the *Lebenswelt* or ‘life world’ of men and women. (...) Taken together, Ricoeur argues, these factors [civilizational forces] generate ‘an ethics of participatory belonging,’ meaning that individuals themselves as belonging to the group (...) but as sharing a common destiny. (...) This is the category of what Ricoeur will call first-order entities, meaning that they are directly rooted in the real life of men and women. (...) Any first-order entity, Ricoeur thinks, may legitimately be treated as a quasi-character (...) in historical narrative. (...) The point is that such entities have a semi-autonomous status in historical reality.

The key point for our purposes is that it is sensible to take collective entities as characters in a story because, as people, we are able to understand how these entities enter our lives. They enter our lives by our (potentially subliminal) choices. While it is true that actuaries, many of whom are employees or contractors of insurers, have their own individual agenda, they also understand themselves to act, in their capacities as employees or contractors, for the insurer. The same can be true of many stakeholder groups of the insurer, in many circumstances. In effect, the insurer can be properly treated as character in a story because, as a collective entity, it has much of the same characteristics of individuals. It has tendencies, it processes and assesses information, it has a diversity of aim, it has limited access to resources to achieve these aims, and it suffers from internal conflict. Thus, we think of collective entities in stories in a way analogous to the way we think of individual characters.

But, contrast this with a disconnected sub-population. Take a sub-portfolio of (homogenous) insureds in an insurer’s book of business. There, it may well be sensible to think only in terms of representative individuals, because the composing individuals do not feel connected to each other: in their minds, they do not constitute a group.

### 3.9 The Place of the Mathematical Language

One clear cut distinctive feature of many economic narratives is their use of the mathematical language. In that way, they contrast themselves pretty clearly from most other forms of narratives (plays, novels, movies, etc.) where the mathematical language may be invoked incidentally, often through a character that is using mathematics. By contrast, in their published versions, economic
narratives may look more like a mathematical theory (with assumptions, lemmas and theorems) than a text like *A Midsummer Night's Dream*.

Hopefully, by now, it should be apparent that the mathematical language enters economic narratives as a secondary feature. The audience of the story is supposed to be able to take the abstractions expressed in mathematics and convert them back to characters with aspirations, views, etc., that are acting in an environment that they may be able to change.

In effect, we are saying that, even when they are expressed mathematically, economic models draw upon the capacity of its readers and users to be able to follow a story.

The remaining of section 3.9 is mainly addressed to a public that is familiar with economic theoretical work and can be safely skipped at a first reading. Example of readers that may find the remaining of the present section useful are those that are aware of the mathematical formulation of the lemons model of Akerlof or the underlying game-theoretic Industrial Organization works underlying the Feldblum article.

Now, even when the economic story is making serious allowance to the natural language narrative form, mathematics is often invoked in at least two sub-arguments: (1) in figuring out what would be best to do from the point of view of the characters and (2) in determining how the story would need to turn out so that no character would wish to change the course of action they are pursuing (when the story enters an equilibrium). These two uses of mathematics within economic narratives require specific attention.

3.9.1 Optimizing Behavior

The use of mathematics to determine the best possible reaction of a character given its motivation and beliefs requires specific attention because, in economic narratives, that use of mathematics is often associated with the two following sub-arguments: (1) the actual process used by the character to figure out what to do next is going to give exactly the same answer as the mathematically determined optimal course of action and, therefore, (2) there is no need to examine exactly how people actually select their course of action. In fact, the work that we exposed above suggests that both assumptions are problematic. Regarding (2), our work suggests that persuasive narratives allow the audience to understand why the characters are taking the actions they are taking: the audience needs the inside view. This is in direct contradiction with a proposal to not examine the way people choose a course of action. More importantly, if it is the case that people actually do end
up choosing actions that match what a mathematically constructed solution to an optimization problem would say they should do, the work done above suggests that this very fact requires an explanation in terms of the motivation of the characters, their understanding of the environment they are in, etc. This suggests that it may be worthwhile for economists to, also maybe, attempt to solve the problem at hand from the point of view of the characters in a narrative the same as the characters would tackle the problem. So doing, they would address both points.

3.9.2 Equilibrium Selection

Mathematics is often used in economic narratives to identify the conditions under which no characters would be motivated to change their course of action: thus, inducing an equilibrium. A commonly encountered problem is that there may be quite many possible ‘final situations’ in the story where the ‘no-incentive-to-change’ condition may be met. How, then, does the economist choose which of those final situations could actually be an outcome of the story? The work above suggests that it is in ‘going through the story’, many times, under many relevant initial situations, that the question may be best resolved. In effect, we are suggesting that equilibria of the story may be selected\(^\text{16}\) using the narrative causality criterion presented in section 3.5.

4. BASIC APPLICATIONS

Given the large emphasis on mathematics in actuarial training and given that a lot of efforts of mathematics arose out of problems of the natural sciences, it is common for actuaries to be indoctrinated in the natural sciences approach to deduction and causality. Two characteristics of argumentation in the natural sciences come to mind here. One, argumentation in the natural sciences often uses arguments by covering laws, or the Deductive Nomological model. It can be expressed as:

\begin{enumerate}
  \item Laws: L_1, L_2, \ldots, L_n
  \item Initial Conditions: C_1, C_2, \ldots, C_n
  \item Therefore, E (the \textit{explanandum} or phenomenon of interest) (Reiss 2012, 32)
\end{enumerate}

Two, argumentation in the natural sciences often invokes the following version of causality:

(a) X is universally associated with Y;

\(^{16}\) Note that equilibrium is not the only possible outcome of a process. For example, as in Feldblum’s model, equilibrium never arises. When that happens, mathematical structures are often convenient to characterize the outcome: does it lead to periodic behavior, does it have an attractor, is there a time scale where the solution stabilizes? Even if an equilibrium occurs, it is not necessarily obvious that only one type of equilibrium will arise for very close parameters of the problem: in effect, is the model subject to bifurcations?
With the work that has been done so far, it should be apparent that economic narratives do not function in these ways. Given that we have argued that the narrative as whole serves as the argument, it should be clear that no more than bits and pieces of the narrative can employ the Deductive Nomological model of argumentation; and, often, it will be used to allow the audience to keep track of the effects of efficient causes in the story. Also, given that we have argued that narrative causality is at work in stories, we can see that a different notion of causality is at work. (1) In stories, there is enough place left for contingency and luck for effects not to be universally associated with their causes. (2) In stories, things like simultaneous and, even, reverse causation are common. Take, for example, the case of the story that rationalizes the pricing cycle. In that case, the insurers are taking actions based on their beliefs about other insurers, and their own action induces the other insurers to act in the predicted way. Here, the phenomenon of self-confirming beliefs is an example of contemporary causation. Reverse causation arises naturally when actions are taken in a forward-looking context: e.g., a character does an action at one point in time because of a belief about what will happen in the future: the future drives the past. (3) Action at a distance is quite common in narratives: in effect, the narrative is constructed around the propagation of a cause to its effects. Next, we will inquire about the effects of these inappropriate ways of arguing on actuarial work.

4.1 The Past Is Not Necessarily Representative of the Future

(...) [Non-autonomous relations are not lawlike; they do not represent the underlying causal ordering. (...) [C]ausal ordering is a property of models that is invariant with respect to interventions within the model and structural equations are equations that correspond to the specified possibilities of intervention. (Hoover, Econometrics as Observation: The Lucas Critique and the Nature of Econometric Inference 2008, 301-302)

Here is a common mistake made by actuaries when they do not use the right concept of causality in their work: they wrongfully assume that past trends will carry forward in the future. Take, for example, loss trends. It is not an uncommon actuarial assumption to use the same loss trends for both the past as for the future. Even when they are not the same, future trends are not uncommonly selected as a carry-forward of recent trends. Now, imagine that those trends are quite high: that is, loss costs are increasing quite fast. If we were to then imagine a narrative that incorporates insureds, insurers and governments, it is not unreasonable to imagine a scenario where the insurers feel pressure to charge the loss cost trends in the premium, where insureds then pressure the government for premium reduction, and the government may have to intervene to set up measures
to contain the loss cost trend. In effect, in the story, the feedback is making it such that the past loss cost trend is unlikely to continue unabated. In effect, we are saying that regular relations are not necessarily causal and, if they are not causal, it is quite possible for the regularity to disappear quite rapidly. This suggests that, when proper causes have not been identified, it is prudent to set up regular and high frequency monitoring to validate the regularities that are being exploited in practice are still there. It is also means that, for medium- or long-term forecasting, the identification of the appropriate causal mechanisms is an integral part of a successful forecasting process.

### 4.2 The Nose of the Donkey Does Not Cause Its Tail

There was a man who sat each day looking out through a narrow vertical opening where a single board had been removed from a wooden fence. Each day a wild ass of the desert passed outside the fence and across the narrow opening — first the nose, then the head, the forelegs, the long brown back, the hindlegs, and lastly the tail. One day the man leaped to his feet with a light of discovery in his eyes and he shouted for all who could hear him: "It is obvious! The nose causes the tail!"

*Stories of the Hidden Wisdom from the Oral History of Rakis (Herbert 1984, 359)*

Another common actuarial mistake is to (sometimes implicitly) assume that what comes first in a regular succession must be the cause of a phenomenon. Take the following example. Imagine a homogeneous subportfolio of insureds that are relatively insensitive to rate increases. It could be that this is a class of insureds that values dearly their time and thus attach a high perceived cost to shopping for insurance: they do not shop much for insurance. The effect of their reduced willingness to shop will be to (1) increase their retention and (2) increase their profitability. Now, assume (price) elasticity modeling is done: by examining the impact on retention of a change in price. What the modeling actuary will find is that increased retention and increased profitability, both observed first, leads to lower price elasticity (observed second because it is a result of the price change). But, the true causal channel was exactly the opposite: reduced price elasticity leads to increased retention and increased profitability. Thus, it is not necessarily the case that what comes first in the observation of a regular succession is the cause of what follows.

### 5. ADVANCED APPLICATIONS

Finally, we can now address more involved applications of the work done above. These applications bear on the future of the training of actuaries and they bear on the future of actuarial practice.
5.1 Model Calibration and Story Telling

The first (advanced) application of our work relates to the way statistical work should be thought and conducted within the actuarial profession. One way to put the point is to say that actuarial statistical practice needs to become more like econometrics and less like statistics. That is, it is a consequence of our work that calibration (even probabilistically- or statistically-minded calibration) of models supporting policy-making needs to heavily relate to the narrative that support them. Why? Because, then, the modeling actuary is likely to fall prey to the two fatal flaws that were mentioned in section 4: inappropriately assuming that the past will carry forward in the future and inappropriately (potentially implicitly) assuming that what is observed first is the cause of what comes after.

Another way to cast the point is as follows. One of the difficulties with purely statistical strains of reasoning (e.g., predictive modeling) is that it remains agnostic about the nature of the underlying mechanisms at work. And, because of this agnostic inclination, the efforts of the modeler are then re-directed towards what is possible for the modeler: for example, the modeler then focuses on in-sample quality of fit statistics, out-of-sample model performance, information criteria, etc. Again, because of the agnosticism about causes, little if any efforts are put into understanding how come the observed results have come about. And, if actuarial science were statistics, this would be no great loss. However, actuaries do no work in a vacuum: actuaries need to convince stakeholders of the insurer that the measures that they are proposing based on the estimation/calibration work is justified, sensible, prudent, etc. Thus, actuaries need to be able to weave together their statistical work and the economic theorizing work. And, their education should reflect that requirement and not be excessively oriented towards predictive modeling.

Also, as was also mentioned in the introduction, actuaries that go through the process of theorizing about the results they obtain may be less likely to fall prey to over-fitting of the data: because they may question some of the raw results they obtain and drop some relationships or some variables from their models when the fitted relationship does not appear sensible based on their theorizing.

A (disciplined) process of storytelling about the observed relationships in the data that can be quite useful is highlighting incoherent observations coming from the model: when the actuary begins to rationalize the observations emanating from the model, some relationships may begin to appear contradictory, thus providing an opportunity to selectively revisit the model.
5.2 Understanding Model Blind Spots

Here, we intend to walk the readers through two examples of understanding model blind spots: (1) we will go through the example of three potential sources of inelasticity to insurance prices and how they lead to radically different strategies and (2) we will go through an Enterprise Risk Management exercise to understand how model blind spots imply that much caution is necessary in the use of model results. Our hope here is to highlight how (economic) theorizing can be crucial for the modeling actuary in the interpretation and application of the found results.

Let us start with the price elasticity exercise. Suppose a modeling actuary goes through an exercise like that explained in (Beyond the Cost Model: Understanding Price Elasticity and Its Applications 2013). Then, suppose that the modeling actuary identifies that the age with insurer, that is the number of years since the original inception date of the policy, is a critical variable in driving down the price elasticity of demand (for the insurance provided by the insurer). An almost immediate application of that result in premium optimization would be to attempt to increase rates (potentially moderately) for the segment of insureds that have been with the insurer a long time. Now, with further theorizing, the modeling actuary could come up with, at least, three big working hypotheses for why that segment of insureds is so price inelastic: (1) the insureds in the segment are price inelastic because the insurer has properly and better identified a large cost differential that allows the insurer to price so attractively in the segment that a mild variation in price does not lead to a material fluctuation in the buying ratio, (2) the insureds in that segment experience large search costs (e.g., they value greatly the time spent on researching a competitive offer, they loathe going through the 20 questions round with brokers and insurers to receive alternative quotes, they fear that the potentially negative perception that could arise by having many parties accessing information like credit scores, etc.), or (3) the insureds in that segment value loyalty (maybe in the hope that the length and the strength of the relationship with the insurer may induce a more understanding attitude on the part of the insurer in the event of a claim). These differing working hypotheses lead to different ‘side-predictions’ about the appropriate course of action to take in the segment. Start with the example of large search costs. This could lead the actuary to see if the rating algorithm could not be better integrated with a web on-line tool or if the algorithm could be simplified without materially affecting rate adequacy. If it were a matter of loyalty, the insurer should be seeking to strengthen the relationship with the insured as much as possible: this could lead to some concerted efforts with agents and/or brokers to meet or communicate more actively with the client. If the effect was only due to price, then all of the extra efforts (of the options laid out above) could well be wasted and should not be attempted at all. Thus, the identification of price elasticity leaves the
actuary with a puzzle leading to further questions and modeling; but, it also means that prudence is the better part of valor in the use and application of model results.

Now, let us examine an Enterprise Risk Management application. Take the framework as laid out in (Actuarial Geometry 2006). There Steve Mildenhall is attempting to build a framework for (insurer insurance operations) risk assessment that constitutes an improvement on some work of the prior generation that followed too closely the finance literature without taking into consideration the particular nature of insurance risk: e.g., non-transferrable contracts, no way to take a multiple or fractional position on a contract, etc. Our efforts thus far, though, do allow us to identify the material model blind spot of the enterprise as he lays it out: there is no theory of prices underlying the work. There is no theory of valuation. There is no theory of strategic interactions. And, here is one place where this lack of taking into account of strategic interaction becomes important. Go back to the Feldblum story about the rationality of the pricing (and reserving) cycle that we mentioned above. In that case, fluctuations in the industry Loss Ratio (thus of most insurers) are induced by strategic interactions; and, those Loss Ratio fluctuations are leading to material insurance risk, even to the point of being a material source of insolvency risk. In this case, the model blind spot can be identified: leading to prudence in model application. That being said, as opposed to the prior example, here the remedy to the blind spots of the model are not easy to implement; but, at least, the actuary can go through an exercise in imagination of thinking about which ways the model results could be biased because of the model blind spots.

5.3 An Alternative View of a Good Rating System

Let us look back at our story on the actuarial view of adverse selection. We concluded that that story was warning insurers that rate segmentation was crucial to their continued solvency. But, is that the final word on the story? What does the moral of the story become when we revisit section 3.1; what happens when we try to better understand what the insureds want from the underwriting process? Sure, insureds want available coverage. Sure, they want it cheap. Sure, they want to be able to make sense of why the price is so high. Yet, people now constantly feel pressed for time. There is a definite sense that we are bombarded with information, that we must constantly be available to

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17 For example, if loyalty was at the core of the observed price inelasticity, then increasing the number of (positive) contacts with the insured should lead to increased buying due to a price elasticity that decreases even further; while, if search costs was at the heart of the observed price inelasticity, increased communication (especially about further offers) may make the insured more price elastic as the insured may be forced to experience some of the negative effects of those search costs. Under a loyalty causal channel, increased communication can be valuable to the insured; under a search cost causal channel, the insured values minimizing shopping activities and would prefer to be left alone as much as possible. Thus, different causal channels lead to different side-predictions that can be tested.
examine and process information, ... Time feels like it is speeding up (Birnbaum and al. 2012). And, in that context, it is no wonder that insureds put a premium on not having to answer 20 questions about every minutia that an actuary may believe could be relevant to assess insurance risk. So, what can actuaries do to address that aspiration? For one, actuaries can look to answer some of the questions that they would like answered on their own. How? By peering through public records. For example, works on building have to be recorded with municipal entities. Another example: why ask an insured for neighboring exposure and why not instead do a Google search of the insured’s address. The idea is for insurers to make sure that, when they go to the insured to answer a question, it is because only the insured could have answered the question. For two, actuaries can examine more closely their predictive modeling output and reflect on whether or not the extra variables and very many variables that they would like to use for ratemaking materially contribute to (either) the insurance risk (or, the assessment of the price elasticity) of the insured. What do we mean by materially? We say that a factor is material if one’s decision would change had the factor changed. So, when an extra piece of information would affect the premium by a ‘pocket money’ amount, is it really necessary to have the variable in the rating algorithm? In effect, we are saying that simplicity is also valuable; but, more importantly, we are saying that rating algorithm simplicity is becoming more valuable in this time when people feel pressed for time.

5.4 Claims Are Not Just Numbers

The Rockefeller Corporation studied why customers defect and found the following: (...) 68% The customer believes you do not care about him or her. (Baker 2006, 163)

Another insight that can be gleaned from the work above is that a good modeler of human content must constantly make the effort to connect back with the underlying human reality that is being modeled. How tempting for actuaries to produce reports about Loss Ratios, retention, closing ratio, etc. examining the influence of variable X, Y, Z and writing a quick comment to a superior about the found relationships. Now, try the following. Think back to a time you needed to work with your insurer. You just suffered a fire. You just got into a car accident. Your possessions just got stolen. ... Now, think about how time felt right there and then. I would wager that, in some ways, time slowed down: in the sense that many concerns just took a back seat to that event. At the same time, time may have felt to speed up because, before you know it, you needed to be rushed to a hospital, or ... The point being that immediate priorities take over routine. And, this is a time of profound human vulnerability. It is a time when being treated like a person, with dignity, is profoundly valued. Actuaries need to remember that persons are at the root of the numbers they work with. And, maybe, a good way for actuaries to be reminded of that message is to get involved
in the administration of claims. Why not get actuaries involved in the modeling of the claims hotline queue? Why not get actuaries involved in attempting to understand when a claim is likely to get big enough to warrant a more senior adjuster to assist in the settlement process? In effect, why not let actuaries use their acquired skills in modeling to assist the people that will be working directly with the insureds in their time of need?

6. CONCLUSION

We would like to finish this essay with a bit of a more general reflection. We have argued that causation in the natural world is dramatically different from that in the human world. But, maybe, this is not so completely true. Recently, Ilya Prigogine has argued that the natural sciences need to make room for ‘dramatic changes of behavior’, even in deterministic systems. More generally, he was advocating a re-thinking of the laws of mechanics (whether classical or quantum) in the terms of evolution of probabilities. (Prigogine 1994, 51) Now, it appears the way that narratives function is not so completely different: in the sense that the events of a story are connected by probability and not certainty.¹⁸

Moreover, we do believe that mathematics may help in the formalizing of the modeling scheme described above. We suspect that logic could be expanded to account for an evaluation of whether the events in a story are appropriately connected. That may require logicians to formalize the notion of coherence. Perhaps that will require a probabilistic and fuzzy intentional time-tensed dynamic logic.

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4. REFERENCES


¹⁸ See (The Market as a Creative Process 2008) for another take for why modeling in natural and human sciences may be becoming more alike.
Weaving Actuarial Stories


Biography of the Author

Marc-André Desrosiers is a project manager for the Research and Development team at Intact Financial Corporation. He has completed a Bachelor degree in philosophy and one in actuarial science at Concordia University, Montréal. He also completed his MBA at University of Calgary. He is interested in all aspects of ratemaking.