



Article from
Risk Management
April 2020

CAS Research Paper on Economic Scenario Generators

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Editor's note: Over the past couple of years, economic scenario generators (ESGs) have been a major topic of research, with most research taking place within the life insurance industry. However, ESGs have a variety of applications that can span both life and property and casualty (P&C) industries.

The following article is adapted from the introduction to Users' Guide to Economic Scenario Generation in Property-Casualty Insurance, a new report written by Conning and published by the Casualty Actuarial Society (CAS).

The Casualty Actuarial Society (CAS) has published a new research paper titled *Users' Guide to Economic Scenario Generation in Property-Casualty Insurance*. Although there are cases in the literature about the use of economic scenario generators (ESGs) in the property and casualty (P&C) industry, they are far more commonly used for life insurance companies. The CAS paper is intended to serve as a comprehensive guide to the implementation of ESGs in the nonlife space and spark interest in research into new applications of ESGs.

An economic scenario generator is a computer-based model that provides many simulated examples of possible future values of various economic and financial variables. These scenarios, along with analysis of the stochastic distribution of scenario outcomes, illuminate the nature of risk elements within the economy that drive financial variability. As such, an ESG can provide insights into the relative advantages and disadvantages of alternative operating and strategic decisions.

Compared to deterministic economic scenarios, econometric models and macrofinance models, an ESG simulation can provide a better view of scenario probabilities, a broader range



of scenario outcomes and greater complexity of scenarios. Modeling can follow either risk-neutral or real-world approaches: Risk-neutral (or market-consistent) frameworks are required by certain regulatory authorities for valuation of insurance liabilities, whereas real-world modeling is appropriate when projecting future values of economic and financial variables.

The most common ESG-driven applications for property and casualty are asset-liability management (ALM) systems (used in assessing, establishing and monitoring investment strategies) and economic capital systems (used to calculate and monitor economic capital). ALM systems deal primarily with economic risk mitigation, in which the range of adverse economic events are narrowed or reduced while still maintaining a healthy likelihood of positive investment growth. Economic capital systems typically focus on shorter time horizons and involve significantly more scenarios in order to establish reliable tail metrics.

For P&C insurers, the ability to assess financial statement values, as well as the impact of operational or strategic decisions, requires being able to enumerate and describe a wide range of possible states of economic and financial conditions. Some of the more important variables that a P&C insurer should consider when building an ESG include the valuation of assets and liabilities,

economic capital and regulatory requirements, strategic and operational decision making, and risk management.

Investment portfolio decisions may be based on regulatory requirements as well as the need for maintaining a certain level of liquidity. General characteristics of P&C insurers, including prospective cash flows in the context of a going concern enterprise, can dictate many of their asset and liability cash flow patterns, and consequently their ALM decisions. ALM portfolio values may be influenced by financial factors such as interest rates (risk-free, risk premia and term premia), credit risk (credit rating migration, default risk intensity), inflation (general and line-of-business specific), equity returns, and mortgage delinquency and prepayment patterns. These characteristics, along with the specific attributes and business models of individual companies, and the purpose for which the model is designed, dictate the kinds of economic and financial variables that should populate an ESG.

There are several points of intersection between P&C underwriting and operational results and the economic and financial variables generated by an ESG. For example, premium volumes and losses associated with many P&C lines of business are related to economic conditions, often causally. Furthermore, underwriting and operating factors tend to undergo significant cyclicity, from periods of high premium rates and low loss ratios to low premium rates and high loss ratios. Thus, the ability to model a P&C insurer relative to a range of different economic conditions over time is critical.

Valuation of the reserves for outstanding losses (the largest liabilities of a P&C insurer) is largely the purview of actuaries. Although the reserve shown on the insurer's balance sheet is a single "best estimate" value, the loss reserve is actually a stochastic value with variability around the best estimate, and the best estimate may itself vary under different scenarios or conditions. A good ESG provides an actuary with a robust tool to build deeper insight into the potential volatility of future loss payments.

Other important factors in P&C balance sheet considerations include the volatility of assets (and the leverage of invested assets against surplus), the impact of foreign exchange models and multieconomy factors, and the effect of different time horizons on different line-of-business models with variable claims payout periods.

Some aspects of asset risk can be evaluated through a strategic asset allocation analysis. An important aspect of strategic asset allocation is developing an efficient frontier of investment classes to optimize risk and return. For example, assessing the duration behavior of the investment portfolio against the duration of liabilities on the balance sheet throughout a range of economic scenarios can lead to a deeper understanding of

the effect of interest rates and other economic factors on assets, liabilities and surplus.

Economic capital and regulatory requirements for P&C insurers tend to be influenced by extreme tail events, requiring responses in the form of stress testing. Often, extreme events can influence multiple aspects of the business—for example, catastrophic events that influence the general health of the economy—leading to a potential double impact on the P&C insurer. Inflation could also accelerate due to supply-demand issues after a major catastrophe. This is precisely the type of application at which a good ESG can excel.

Analysis of extreme events can also influence strategic and operational decision making. An ESG cannot itself make decisions about strategic or operational alternatives, but it can provide a consistent basis for evaluating the impact of a decision across a range of possible future circumstances.

The new research from CAS is intended to serve as a basic guide to economic scenario generators, with an emphasis on applications for the P&C insurance industry. The first half of the report provides more general information on the nature of ESGs, general applications and specific applications in the insurance industry. It also discusses essential features of a good ESG and provides guidance on stochastic processes and modeling of certain economic and financial variables. The importance of financial market model specification, model calibration and model validation are discussed, to assure that the ESG will produce simulation results that (1) are relevant and sufficiently robust and (2) will realistically reflect market dynamics.

The second half of the publication provides an illustration of how one group of researchers approached the development of an ESG, describing issues and decisions made in constructing and using this specific ESG. It also discusses sources of data and illustrates a validation process using the model to visualize outcomes and support recalibration. Specific considerations relating to the projection time frame (short horizons vs. longer horizons) are explored in depth. These are particularly relevant in the calibration process of ESGs in the P&C environment. Finally, a discussion of the range of choices for software in developing ESGs is presented, contrasting open-source ESGs with solutions that are available from commercial vendors.

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The paper concludes with an extensive review of the ESG literature, including descriptions of several of the major “classic” papers that deal directly with ESGs. These papers include material with which every designer, builder and probably even user of ESGs should be familiar. There is also an annotated bibliography of major papers categorized according to their particular subject matter. Deeper understanding of this material is appropriate for those involved or interested in the specific modules or aspects of an ESG. Finally, there is a list, without comments, of additional readings in ESG-related areas that provide either deeper analysis of material or alternative approaches to modeling. The

final section offers brief suggestions for where future research may likely be found as it emerges.

The paper was written by Conning. Financing and interim draft review were provided by the CAS. The full report will be available on the [CAS website](#) in mid-April 2020. ■



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