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AutoCycle™ Vehicle Residual Value Forecasting Solution

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Introduction

With auto leasing close to record highs, the need for accurate and transparent used-car price forecasts is paramount. Concerns about the effect of off-lease volume on prices have recently peaked, and those exposed to risks associated with vehicle valuations are seeking new forms of intelligence. Innovations in auto finance—products such as used-vehicle leasing and longer-term vehicle loans—rely on analytical tools that have, to date, not been widely available in the auto industry. Finally, the rise of stress-testing as a regulatory imperative demands that large financial institutions exposed to used-car price risks source transparent and accurate stress projections that can be used as a champion or challenger model for risk assessment.

With these forces in mind, Moody's Analytics AutoCycle™ has been developed to address these evolving market dynamics.

AutoCycle™ Vehicle Residual Value Forecasting Solution

BY TONY HUGHES, SAMUEL W. MALONE, MICHAEL VOGAN AND MICHAEL BRISSON

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With these forces in mind, Moody's Analytics AutoCycle™ has been developed to address these evolving market dynamics.

AutoCycle projects the wholesale prices of used cars under baseline and stressed economic conditions. The model was built using data from the National Automobile Dealers Association on more than 30 million observed vehicle auction results. The resolution of the model is at the 11-digit VIN level and covers a range of other trim features such as interior and exterior color and aspects of the car's configuration. We can distinguish between prices that may be expected in different regions of the country or, if the user is unsure of the region in which the vehicle will eventually be sold, a national average price can be provided. Importantly, we project the entire distribution of car prices, which allows users to distinguish by the condition of the vehicle upon its eventual sale. Forecasts are provided both for existing vehicles and for future versions of established brands. The full range of the Moody's Analytics regulatory and client-generated alternative macro scenarios can be applied to the model.

AutoCycle can be provided in a transparent form, allowing clients to have full access to the model specification, backtesting results, and complete documentation. The model is purely quantitative, with no subjective overlay, by design. This means that risk managers can see exactly how the model will respond to a given change in input variables. This feature means that risk managers and other business users are provided with a clean, objective, purely data-driven projection to which they can apply their own subjective overlay.

The primary applications of AutoCycle can be split into two key business use cases: pre-sale, or pre-lease, residual setting (or as a challenger to existing in-house or external residual calculators), or post-sale risk management, loss forecasting and stress-testing.

Pre-Sale (or Pre-Lease) Applications

When a lease contract is written, the predicted residual value of the vehicle at the end of the term is a key input in determining the monthly repayment. For new cars, a number of well-established analytics providers offer tables and other tools to help financiers establish the appropriate residual. These tools, while ubiquitous, are seen by many players in the industry as a "black box" in the sense that they are partly subjective in nature. The great benefit of subjective assessment is that experienced experts can consider complex, idiosyncratic factors that are difficult to quantify but that may weigh on the ultimate observed price. These factors are normally unseen, or captured only implicitly, by simpler statistical methodologies.

Purely quantitative approaches, though, provide a different set of benefits. First, they attack the problem from a polar opposite perspective so at the very least they are able to provide a counterweight, or a check, against which the subjective residual can be assessed. Users can fully examine the properties of the model both in and out of sample, conduct backtests and sensitivity analyses, and predict exactly how the model will respond to a given set of inputs. If the residual is determined, in part or in whole, by the opinions of a test driver, none of these tests can be performed. The purely statistical approach, further, is incorruptible—it does not respond to

lobbying from manufacturers wanting higher residuals for a given vehicle or from financiers wanting symmetrically lower residuals to be tabled instead.

For used vehicles, the situation with residual setting changes markedly. One key benefit of used-vehicle leasing is that no one needs to guess the level of desirability of the vehicle in the secondary market. For brand-new cars, there is always some doubt about how well the new features installed in the car will be viewed by shoppers later. If we are instead trying to project the future price of a car that has already been around for a few years, we can use data on sales of that precise vehicle to project potential future residual value. We no longer have to rely on a subjective test drive of the vehicle by a third party conducted several years ago to determine the appropriate future price.

Another key benefit of using AutoCycle for residual setting is the ability to consider different levels of condition in the vehicle. As example, AutoCycle can project a 2014 Jeep Wrangler Sport that is leased today with a three-year term. The vehicle currently has 26,453 miles on the clock and has a mileage allowance for the term of the lease of 12,000 miles per year. The vehicle has been assessed by the dealer (or a spotter) to be at the 40th percentile of its cohort in terms of condition and features. This means that of all the hypothetical 2014 Wrangler Sports with the same basic characteristics (including current mileage), the car being leased would yield a higher price than 40% and a lower price than 60%. In simple terms, the car is slightly below average in terms of its assessed condition.

In projecting the price of this vehicle, we can assume that the car will be returned at the end of the lease in a similar relative condition—better than 40% of the cohort. Conversely, if we are pessimists (a cynic would use the word "realists") we could assume that the vehicle will be returned in poorer relative condition than it is currently assessed to be. This type of reasoning can also be applied to new cars: The distribution of quality at new has zero variance; one can then vary assumptions regarding the quality of the vehicle at lease return and set residuals accordingly.

Establishing the final assumed condition level as 32% for our Jeep, and the end-of-term mileage level as 62,453, the final residual, under baseline economic conditions, can then be extracted directly from AutoCycle. AutoCycle predicts the wholesale price of this vehicle as $8,699 in May 2019 (the average condition car at this time would be expected to fetch $11,800).

A further question, though, can still be posed by our hypothetical residual setter: What if baseline conditions do not hold? In these circumstances, AutoCycle users will be able to run alternative macro scenarios involving recessions or high/low gas price scenarios and gain a fuller understanding of the risks associated with the residual being set.

Risk Management Applications

For a pre-sale user, most applications of AutoCycle will involve running individual vehicles and then producing forecasts of residual value under a variety of circumstances. For post-sale risk managers, similar exercises will still be valuable, not least for the purposes of model familiarization and expectation level setting. It is far easier to think about gas price rise implications for a specific Toyota Prius than it is to imagine their overall impact on a complex fleet of assorted vehicles.

Most risk managers will most likely, however, be looking for portfolio-level reporting tools and applications. While the output is available at the VIN level, these users will most likely want to run thousands or millions of vehicles through the model at a time, sync the results to a loan or lease level default or vehicle return model, and output various portfolio level forecasts and stress projections.

To this end, the AutoCycle output can be delivered in a variety of ways. On a simple level, the user will upload data on a fleet of vehicles—VIN numbers, current mileage, assumed future mileage, and a few other vehicle characteristics (if known). The model will run and will return a text file containing projections for each vehicle under a specific scenario (or set of scenarios). This process will, once implemented, be almost instantaneous. The text output can then be combined with data from other sources (such as default rate projections) to produce portfolio specific output.

For users of applications such as Moody's CreditCycle™, meanwhile, AutoCycle output can be seamlessly combined with existing model builds. If individual level data are available in Moody's CreditCycle, models will be able to run in the background to produce detailed individual cash flow projections that will then be aggregated so that vintage or portfolio level data can be displayed in the application. The exact method of delivery of model projections can easily be customized to suit the specific needs of the client.

While the AutoCycle is available as a off-the-shelf forecast database and model, custom engagements are also available. We have worked with a number of large banks and captive auto lenders to produce these custom specifications for specific regulatory and other requirements.

Those seeking a more technical description of the model, which includes detailed case studies and results of validation exercises, are invited to read the technical white paper by the same authors.

About the Authors

Tony Hughes is a Managing Director of research at Moody's Analytics. He serves as head of a small group of high caliber modelers, charged with identifying new business opportunities for the company. Prior to this appointment, he led the Consumer Credit Analytics team for eight years from its inception in 2007. His first role after joining the company in 2003 was as lead economist and head of the Sydney office of the company Moody's Economy.com.

Dr. Hughes helped develop a number of Moody's Analytics products. He proposed the methodology behind CreditCycle and CreditForecast 4.0, developed the pilot version of the Stressed EDF module for CreditEdge, and initiated the construction of the Portfolio Analyzer (ABS) product that provides forecasts and stress scenarios of collateral performance for structured securities worldwide. More recently, he championed and oversaw the development of AutoCycle, a tool that provides forecasts and stress scenarios for used car prices at the make/model/year level. He has a current development project related to quantifying counterparty network risks that can be applied to the assessment of systemic risk in the financial system.

In the credit field, Dr. Hughes' research has covered all forms of retail lending, large corporate loans, commercial real estate, peer-to-peer, structured finance and the full range of pre-provision net revenue elements. He has conducted innovative research in deposit modeling and in the construction of macroeconomic scenarios for use in stress-testing.

Dr. Hughes has managed a wide variety of large projects for major banks and other lending institutions. In addition, he has published widely, both in industry publications such as American Banker, Nikkei, GARP and the Journal of Structured Finance as well as several papers in peer reviewed academic journals. He obtained his PhD in econometrics from Monash University in Australia in 1997.

Samuel W. Malone is a director in the Specialized Modeling Group at Moody's Analytics. Dr. Malone has taught and consulted at top institutions in Europe and the Americas including Oxford, the University of Navarra, the European Commission, the Central Banks of Venezuela and Peru, and several large North American financial institutions. He is coauthor of the book Macrofinancial Risk Analysis, published in the Wiley Finance series with foreword by Nobel Laureate Robert Merton, as well as the author of numerous academic journal articles in economics and statistics. His articles have been published in outlets such as World Development, the Journal of Applied Econometrics, the Journal of Financial Econometrics, the International Journal of Forecasting, and the Annual Review of Financial Economics. He holds undergraduate degrees in mathematics and economics from Duke University, where he studied as an A.B. Duke scholar and graduated with summa cum laude Latin honors, and master's and PhD degrees in economics from the University of Oxford, where he studied as a Rhodes scholar.

Michael Vogan is an economist in the Credit Analytics department at Moody's Analytics. Before joining Moody's Analytics, Michael was a research analyst at the Federal Reserve Bank of Philadelphia. He holds a master's degree in applied economics and econometrics from the University of Delaware and a bachelor's degree in economics from Bloomsburg University.

Michael Brisson is an economist at Moody's Analytics. He develops state and local revenue forecasts on various consulting projects and is a frequent contributor on energy-related issues. Mike holds a PhD in Applied Economics from Northeastern University, an MS in Economics from the University of Buffalo, and a BA in Political Science from the State University of New York at Oswego.

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Concise and timely economic research by Moody's Analytics supports firms and policymakers in strategic planning, product and sales forecasting, credit risk and sensitivity management, and investment research. Our economic research publications provide in-depth analysis of the global economy, including the U.S. and all of its state and metropolitan areas, all European countries and their subnational areas, Asia, and the Americas. We track and forecast economic growth and cover specialized topics such as labor markets, housing, consumer spending and credit, output and income, mortgage activity, demographics, central bank behavior, and prices. We also provide real-time monitoring of macroeconomic indicators and analysis on timely topics such as monetary policy and sovereign risk. Our clients include multinational corporations, governments at all levels, central banks, financial regulators, retailers, mutual funds, financial institutions, utilities, residential and commercial real estate firms, insurance companies, and professional investors.

Moody's Analytics added the economic forecasting firm Economy.com to its portfolio in 2005. This unit is based in West Chester PA, a suburb of Philadelphia, with offices in London, Prague and Sydney. More information is available at www.economy.com.

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