TruAudience®

REPORT

The TransUnion TruAudience Modeling Approach

The Next Generation of Marketing Mix Modeling

INTRODUCTION

Today's marketing environment has exploded in complexity.

Brands looking to understand the performance of their marketing investments need to keep up with the state of the economy and key market and business drivers — while contending with a proliferation of online and offline touchpoints, media channels and consumer devices.

They also face rising privacy regulation and the deprecation of many of the digital identifiers they've come to rely on for measurement and attribution: mobile ad IDs from Apple and Google, and Chrome's support for third-party cookies. Those market and technical challenges are leading many stakeholders to take a fresh look at an old modeling and prediction tool: marketing mix modeling (MMM).

MMM has been around since the 1960s, but it fell out of favor in the 2010s with the emergence of massive digital platforms and the granular data collection infrastructures that came with them. That new data ecosystem offered advertisers a chance to connect cross-channel media exposure to outcomes for all customers at the individual level, with models of consumer response that promised to be more precise, more agile and less expensive than MMM ever was. Whether digital attribution solutions like multi-touch attribution (MTA) achieved those lofty objectives is up for debate, but there's no denying they helped set expectations for the future of measurement.

Now, business leaders must juggle between multiple marketing measurement approaches: traditional mix models, test/control experiments, brand equity studies, and a new breed of digital attribution solutions designed around new identity paradigms. Many companies don't have the resources or know-how to keep up with those developments — let alone decide what the best approach might be to optimize their media allocations and maximize their returns from one campaign to the next. They need a partner that's fully versed in the new data ecosystem, and with strong methodological credentials to help them develop a reliable, timely and credible measurement practice.

In this TransUnion paper, you'll find a quick review of the guiding principles behind the TruAudience® modeling approach; a broad outline of our model development framework; and select methodological innovations that make our solution stand out.

In today's fast-changing economy and ultra-competitive world, robust marketing measurement is your key to success. Let's dive in.

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FUNDAMENTALS OF MMM

There are many factors that can influence a brand's success. Some are within the company's control (like its pricing strategy, marketing initiatives and media budget allocations), while others are not (like the state of the economy, supply chain pressures or unseasonal weather). MMM modelers use granular time-series data and regression techniques to examine shifts in sales volume (or any other outcome variable important to the company) and determine which factors — or combination of factors — might explain that variance, often on a week-to-week basis.

While they have great latitude in the choice of variables and regression techniques to fit a particular modeling objective, all serious MMM projects take into account the same fundamental truths about advertising and consumer behavior:

Diminishing returns

The way consumers respond to repetitive brand exposures typically follows a concave marketing response function. The initial few exposures are crucial to make an impression, but past a certain point, the marginal contribution of every new exposure gets smaller, and there's a saturation level beyond which further media investments yield no incremental benefit.

Uneven lag effects

The time between an advertising exposure and its effect on the consumer can vary greatly based on medium (e.g., TV, print, retail media), ad format (display, video, in-store) and message (brand, performance and everything in-between). Careful modeling needs to take into consideration the lag, carry-over and wear-out effects associated with leading indicators (such as search/web visits vs. long-term brand) and product cycles (pre-launch, launch, post-launch).

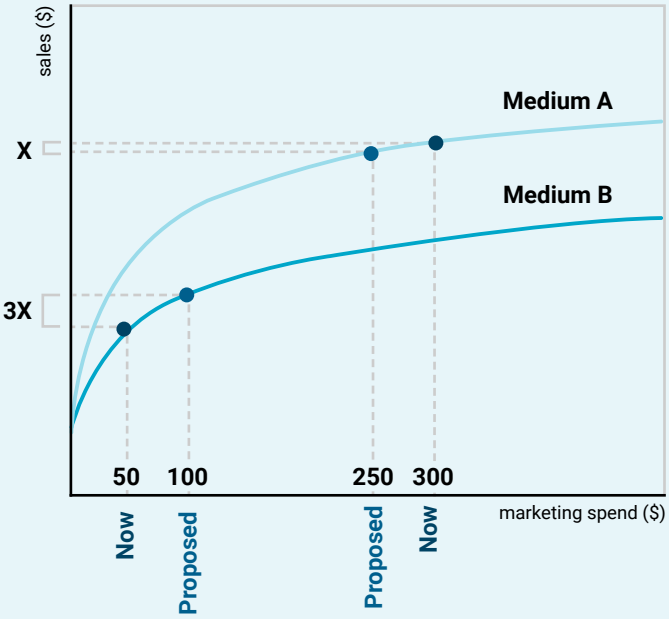
Interaction effects

Media channels don't work in a vacuum. When a consumer is exposed to a brand on one channel and sees or hears that brand's message again on a different channel and within a reasonable timeframe, those two exposures feed off one another and produce a greater effect than the sum of their parts. For brands looking to maximize the impact of their marketing campaigns, the same budget spread across multiple channels generally produces a greater lift than when concentrated on a single channel.

The models produced in an MMM initiative help marketers not just explain the past but, more importantly, make better decisions in the future — like shifting spend from one channel to the next (see Figure 1).

Let's examine how we do it at TransUnion.

FIGURE 1: Reallocating spend to optimize the overall media mix



In real-life applications, the decision to spend the next marketing dollar depends on a company's existing media mix — which may not always favor the tactic with the greatest overall lift factor.

Take the example in Figure 1: While the marketing response curve for Medium A is overall higher than Medium B (a dollar spent on Medium A would generate more sales than a dollar spent on Medium B), the marginal return of Medium B is greater at current spending levels. Reallocating $50 from Medium A to Medium B would result in a 2x increase in sales: a 3x gain thanks to greater spending on Medium B and a loss of 1x due to lower spending on Medium A.

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GUIDING PRINCIPLES

Before we get into any of the details behind the TransUnion TruAudience modeling approach, it's important to note that it's underpinned by three guiding principles:

1. Our models are built from **observed behavior**, not just theoretical aggregates, or self-reported media research data.
2. Our measurement solution is **holistic**: It accounts for business drivers and all key marketing stimuli in our clients' campaigns, both online and offline.
3. We don't think there's a silver bullet when it comes to marketing measurement solutions. MMM, MTA and marketing tests all have an important role to play. In fact, our solutions often **bring all three together**.

GUIDING PRINCIPLE #1

Observed Behaviors

In modern marketing organizations, the point of modeling is to identify the causal relationships between media investments (across all channels attached to a campaign), business drivers (like pricing, distribution, sales promotions, competitive offerings or the economy) and outcomes (such as sales, leads, signups or engagement with the contents of an app or website).

On paper, this can be done with theoretical aggregates, self-reported media research data or even simulated synthetic data, but the TransUnion TruAudience solution uses real-world, observed behaviors for both media exposure and at the granular outcome level. While less precise data can work fine for traditional, low-involvement consumer goods purchasing, it tends to introduce important error factors for higher involvement, more considered purchase categories.

There's no substitute for real-world data. That's why TransUnion maintains active partnerships with the top media platforms and an extensive identity graph in the US that brands and publishers can use to analyze individual-level data without compromising their users' privacy.

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GUIDING PRINCIPLE #2

Holistic Measurement

Consumers are exposed to advertising messages over time and on many concurrent media channels. To optimize their media allocations, marketers need to understand how those various channels combine to produce a desired outcome, both short term and long term; how much of that outcome would have happened anyway (based on people's pre-campaign dispositions towards the brand); and how prevailing business drivers (such as the state of the economy, seasonality or competitive offerings) can be factored in.

Holistic measurement isn't easy to pull off. Most channels don't capture data the same way, in the same formats or at the same frequency. An impression on one channel isn't necessarily the same thing as an impression on another, and its lag (the length of time between the impression itself and its ultimate effect on conversion) might be different too. Matching identities across separate datasets isn't trivial either. But for most brands today, a holistic measurement solution that accounts for key business drivers and cuts across all pertinent marketing channels is a must-have.

GUIDING PRINCIPLE #3

No MMM vs. MTA Dogma

At TransUnion, we approach measurement as a unified data science area. We don't subscribe to any of the methodological dogmas that have driven a wedge between MMM and MTA practitioners in the past. And with the rising use of marketing tests and experiments, marketers are faced with even more options now.

Our goal is to quantify how marketing and other key dimensions drive growth across key areas of a business. Every business has its own priorities (such as short-term profits, long-term sales, new customer acquisition, customer engagement, retention or long-term brand equity), and these priorities translate into specific KPIs. Our job is to help our clients find the right marketing mix to maximize those KPIs. Sometimes the right solution involves time-series regressions akin to those used in MMM — and other times logistic regressions more often associated with MTA.

In fact, we've found that most of the time, combining MMM, MTA, and marketing test features is key to establishing causal links between impression and conversion.

A FLEXIBLE MODELING FRAMEWORK

TransUnion uses a robust modeling framework to develop econometric marketing response models for its clients. Let's review:

1. The iterative **model development process** that guides all our client engagements.
2. How we use **Bayesian inference** to develop our regression models and improve their effectiveness.
3. How we embrace **proactive refresh cycles** to respond to the demands of a fast-changing marketplace.

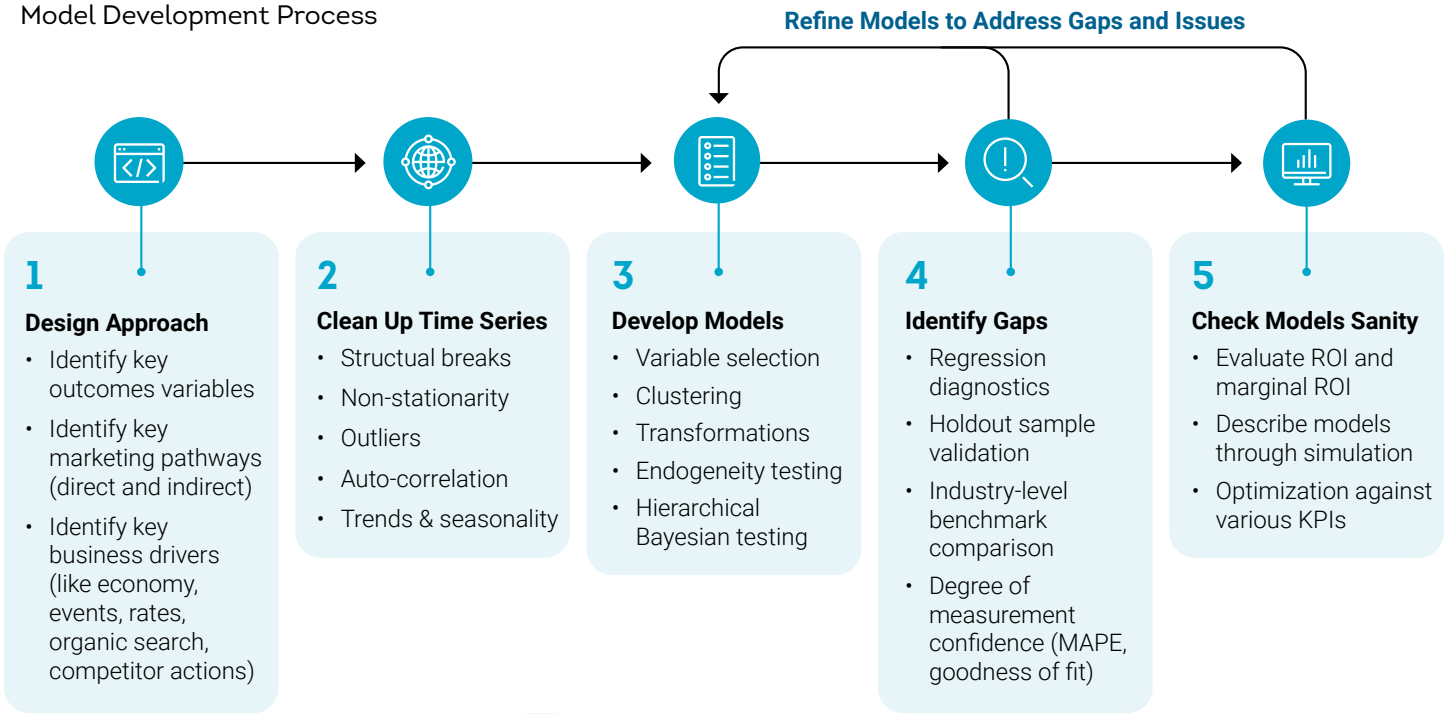
Iterative Development Process

We use an iterative process to develop models for our clients, as shown in Figure 2.

Upfront design and data cleanup are critical stages to help ensure we have the right data sources to meet the client's research objectives, solid data to draw reliable inferences, and a full picture of the many pathways consumers might follow to go from exposure to conversion. It's not uncommon for modelers to wait a long time for data to be available, and when it finally comes, they're often under pressure to start developing models without first checking for data quality and faulty assumptions. That's a recipe for disaster.

Once the game plan is in place and the data is solid to support the analysis, it's time to develop models, identify gaps and check for model sanity — and go back to the drawing board as needed to address any shortcomings and gradually refine the models. The entire process from discovery to delivery is done in close collaboration with the client team to faithfully represent the business context and validate assumptions every step of the way.

FIGURE 2: The TransUnion TruAudience Iterative Model Development Process



Bayesian inference

At the heart of our modeling approach, we use Bayesian priors to develop and improve the effectiveness of our regression models.

Classical regression models treat parameters (coefficients) as fixed but unknown, and all the information needed to develop equations is assumed to be contained in the historical data used for modeling. Bayesian regression treats parameters as random variables that have their own distributions. The distribution of a parameter depends on the historical dataset and outside information (like beliefs and opinions based on previous experience).

This approach allows us to use prior experience (built from thousands of past studies) to seed our models. We can even incorporate results from recent test/control experiments into our regressions, and account for the impression-to-conversion lags we know exist (and have previously quantified) for many critical channels like TV, print, paid search or digital video ads.

Proactive refresh cycles

In today's fast-changing business environment, marketers need models that are fast, granular and flexible to provide detailed insights — and fit a wide range of forward-looking scenarios. Our clients need to be able to accommodate dramatic changes in market conditions, consumer behaviors and media exposure without major model rebuilds. We accomplish this by making better use of model refresh opportunities.

The standard in MMM practice is to refresh models using new data at frequent intervals (monthly or quarterly), but those milestones don't typically involve updating the model's coefficients and underlying parameters, and they rarely introduce new variables and variable breakouts. At TransUnion, without revamping the entire model, we're able to offer a more responsive form of MMM at every refresh opportunity by using ML algorithms in a secondary modeling step. This allows us to manage cases with frequent mapping changes and account for new campaign-level variables that may surface along the way, including hyper-granular dimensions that often come with short history and sparse data.

We also seize opportunities in the refresh cycle to incorporate insights from MTA, test and control experiments or other external analytics into our models. For instance, we might have access to a reliable individual-level model and use the lifts coming out of that model to derive Bayesian priors for a re-estimation of some of the coefficients in a market-level model.

These enhancements make it possible for our clients to use one highly flexible MMM model to keep up with consumers, even in today's volatile business environment.

METHODOLOGICAL INNOVATIONS

Now that we're familiar with the guiding principles and broad features of the TransUnion modeling framework, let's review some key innovations:

1. To address endogeneity in explanatory variables, we apply MCMC algorithms to find **latent instrumental variables**.
2. We use **recency-weighting** algorithms and **time-varying coefficients** to address nonstationarity in time series data.
3. We can **manage hyper-granular dimensions** through a separate and complementary process.
4. We've developed new techniques to **harmonize multiple models** into one cohesive platform.

INNOVATION #1

Latent Instrumental Variables

When predictor variables are endogenous (i.e., they're correlated with the error terms of the model), the model ends up producing biased and unreliable estimates. It's not always possible to correct the problem by finding an exogenous (instrument) variable that's both correlated with the questionable endogenous variable (to preserve predictive power) and uncorrelated with the error terms of the dependent variable in the model (to remove the bias).

An alternative is to infer a latent instrumental variable from the data. At TransUnion, we use Markov chain Monte Carlo (MCMC) to estimate latent instruments that partition the endogenous variables in our models into exogenous and endogenous component variables.

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INNOVATION #2

Recency Weighting and Time-Varying Coefficients

Another source of bias comes from nonstationary variables in the model. To achieve enough degrees of freedom, time-series models must employ data over a significant time period. For weekly interval data, three years of history are typically required. But any data series is subject to considerable shifts or permanent changes in behavior over that length of time (e.g., the launch of a new product model, a new marketing channel, the COVID-19 pandemic), making the older data much less relevant for future estimates.

That's why we include recency weighting in our models — where we use an exponential function to assign more weight to the most recent observations in the data series. A more complex solution consists of defining custom time buckets to account for shifts in underlying business and market conditions, and allowing the model's coefficients for each dimension to vary over time.

In a world where new channels and marketing tactics emerge every day, no marketer can afford to wait three years for the data to stabilize enough to achieve stationarity. Recency weighting and time-varying coefficients offer important mechanisms to address dynamic data behavior while still generating historically consistent models.

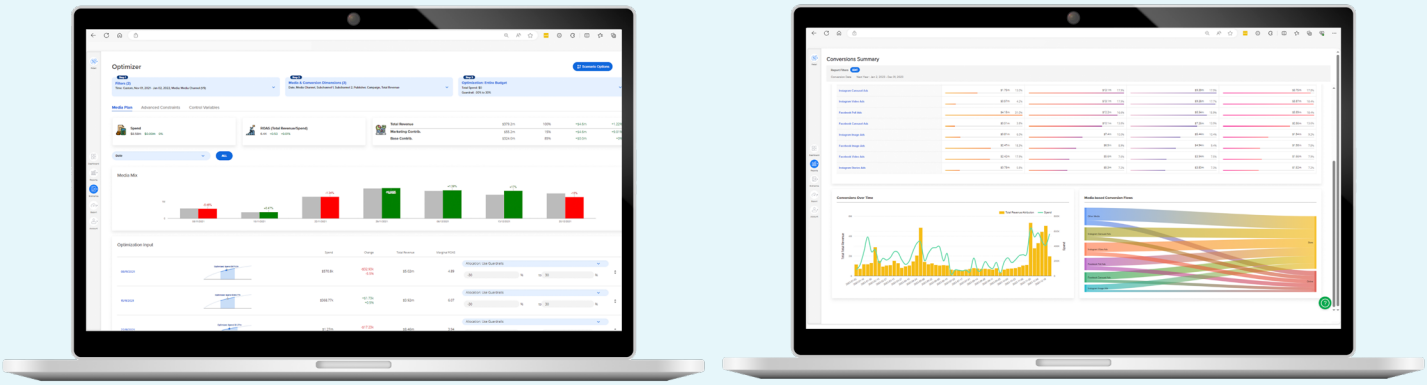
INNOVATION #3

Managing hyper-granularity

Granular measurement is essential for business leaders to assess the effectiveness of various marketing channels, campaigns and tactics for increasingly fragmented audiences. But in MMM, granularity is often problematic because it requires the introduction of many new variables into the model and leads to overfitting.

At TransUnion, we've developed a technique where we assign incrementality for granular dimensions below the main model's dimensions as a separate step, using distinct automated processes and algorithms. After the main model is built, we develop a hyper-granular model with the right mapping specifications and apply a proprietary algorithm to score granular touchpoints. We make sure the aggregate impact from this algorithm aligns with the main model results. The client can then use our TransUnion TruAudience interface to dissect any granular dimension and run simulations and optimizations. This approach allows us to account for new data without overfitting or changing the structure of the main model, adding much speed and flexibility to the overall modeling effort.

FIGURE 3: Granular optimizations visualized in the TransUnion TruAudience Optimizer Platform



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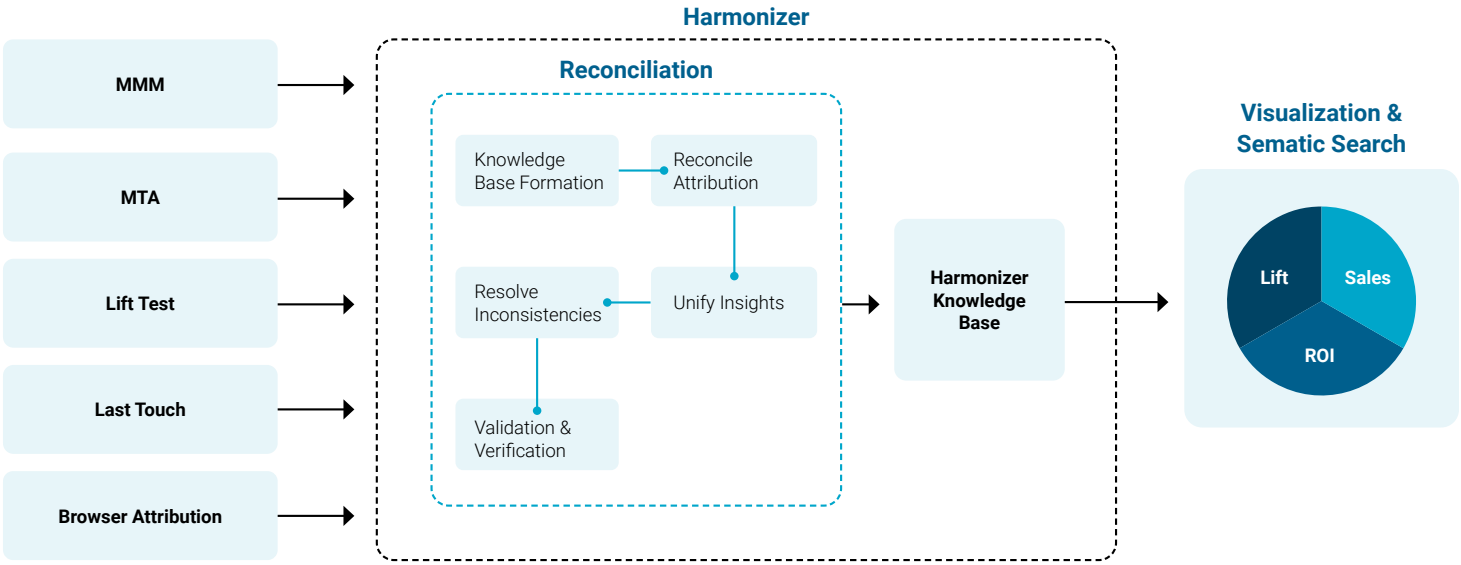
INNOVATION #4

Harmonizing multiple models

Between MMM, test and control experiments, close-loop analysis, last touch, copy testing, platform-specific attribution models and new forms of MTA, there's no shortage of options for marketers to assess the effectiveness of their campaigns. But those measurement tools are rarely in full agreement. What should brands and their agencies do when the insights don't line up?

To help our clients make sense of conflicting outputs, we created proprietary machine learning algorithms and techniques to help them design a common taxonomy, develop semantic (RDF) triples that represent model outputs as probabilistic logic expressions, and reconcile them into a unified knowledge graph. We developed a dedicated platform around those new techniques, and several top marketing organizations are already using it to harmonize their research insights and bring much-needed clarity to their modeling practices.

FIGURE 4: Model harmonization workflow example



CONCLUSION

Business leaders are under constant pressure to deliver higher returns for their marketing investments. They need to understand what levers to pull to drive growth, reach valuable audiences, control frequency and outmaneuver the competition — all with limited budgets and an ever-evolving mix of channels at their disposal. Many organizations don't have the time or resources to constantly assemble all the necessary data signals and translate them into forward-looking insights.

At TransUnion, we run an MMM practice that's dedicated to helping brands manage that complexity. We measure and optimize 40% of marketing from Ad Age's Top 50 advertisers and $100B+ in ad spend for clients across a dozen industries from banking to retail, insurance, travel and telecom. They work with our professionals to design a measurement ecosystem that meets their unique requirements, and use our platform to develop individual models and harmonize them into a singular view.

This allows them to test unlimited scenarios (budget changes, new operational constraints, economic assumptions, market conditions and the like) until they find a sweet spot that makes sense both mathematically and businesswise.

Transparent, flexible and collaborative platforms like TransUnion's are the future of marketing measurement and optimization because they provide brands and agencies access to invaluable benchmarks, industry know-how and the latest and greatest technical advances in marketing modeling without having to do all the heavy lifting.

We invite you to **connect with our experts** to learn more about the next generation of marketing mix modeling and discuss how TransUnion can help you maximize the impact of your media investments.

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ABOUT TRANSUNION MARKETING SOLUTIONS

TransUnion's (NYSE: TRU) marketing solutions business, TruAudience™, transforms marketing and media effectiveness with an end-to-end product line integrating identity resolution and enrichment, consumer insights, data onboarding, omnichannel targeting, marketing mix modeling and attribution for brands, agencies, publishers and technology providers.

ABOUT TRANSUNION (NYSE: TRU)

TransUnion is a global information and insights company that makes trust possible in the modern economy. We do this by providing an actionable picture of each person so they can be reliably represented in the marketplace. As a result, businesses and consumers can transact with confidence and achieve great things. We call this Information for Good®.

A leading presence in more than 30 countries across five continents, TransUnion provides solutions that help create economic opportunity, great experiences and personal empowerment for hundreds of millions of people.

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