Meridian-Based Budgeting and Incremental Attribution in Google Analytics

A methodology overview

Google

May 2026

Table of contents

Methodology Overview.....2
MMM Specification.....2
Parameter Estimation and Causal Inference.....3
MMM-Powered Product Experiences.....4
Incremental Attribution via Triangulation.....4
Budgeting.....5
Eligibility & Validation.....6
Eligibility.....6
Model Validation.....7

Methodology Overview

Our new offerings are fundamentally powered by MMM and specifically, we use Meridian as our MMM engine. In this section, we discuss the specific model we use and also how we leverage that model for the following use cases:

- Budgeting: Projection and Scenario Planning*
- Incremental Attribution

**Note, Google Analytics offers two budgeting models, one using data driven attribution (DDA) and another using Meridian. This whitepaper specifically focuses on the Meridian model for budgeting.*

MMM Specification

Generally, the model we use to generate Incremental Conversions has the following form:

$$y_{g,t} = \mu_t + \tau_g + \sum_{i=1}^{N_C} \gamma_{g,t} z_{g,t,i} + \sum_{i=1}^{N_M} \beta_{g,i} HillAdstock(\{x_{g,t-s,i};\ s \in [0, L]\};\ \alpha_i,\ ec_i,\ slope_i) + \varepsilon_{g,t},$$

where:

- g indexes geo and t indexes time (note that geo breakdowns are not always available; in which case we default to a single-geo or national/global model).
- $y_{g,t}$ is the total number of conversions observed by the property coming from geo g and at time t
- μ_t is an intercept which varies over time
- τ_g is an intercept which varies over geo
- $z_{g,t,i}$ is the collection of N_C control variables; each of which is associated with a parameter $\gamma_{g,t}$
- $\{x_{g,t-s,i};\ s \in [0, L]\}$ is the collection of media execution from time $t - L$ up to t for the ith media channel, of which there are N_M total

- α_i, ec_i, and $slope_i$ are channel-specific parameters to the $HillAdstock$ function which accounts for decay and saturation effects
- $\varepsilon_{g,t}$ is an error term

In terms of scope, we train separate models for each (property, conversion type) pair. This model is a special case of the more general Meridian model; please see Meridian's documentation for more details. To be more specific, we use the following data sources to fit this model to generate MMM-based outputs:

Input Descriptor	MMM Specification
KPI	Total conversions coming from Google Analytics. In this case, $y_{g,t}$ corresponds to the total number of conversion pings in geo g at time t.
Media channels	Channels associated with Google media are broken down at the campaign type granularity. Non-Google media is at the granularity of source platform x source grouping.
Media execution	Cost or Impressions (when available) for the N_M media channels. In this case, $\{x_{g,t,i}\}$ are the weekly and per-geo impressions for media channel i.
Control variables	Currently we use Google Query Volume of the property's brand (both branded and generic variants).

It is also required to specify certain configurations in the model. For example, Meridian uses a knot-based approach for estimation of μ_t; we utilize automatic knot selection to determine knot placements. We also set $L = 16$, meaning we have a maximum lookback window of 16 weeks in our model. Finally, we set

$slope_i = 1$ for all i, which ensures that we have a concave response curve; this is also the default in Meridian.

Parameter Estimation and Causal Inference

Meridian is a Bayesian model, and as such, requires prior distributions on all parameters. For the most part, we use Meridian defaults. A noteworthy exception pertains to the parameters related to ROI. The model above can be re-parameterized in terms of ROI (reference) which means that if we have prior knowledge about the ROI of each media channel, we can directly incorporate that information into the model by setting ROI priors. In the case of the Incremental Conversions model, ROI is defined as the number of incremental conversions caused by media execution on a channel, divided by the spend on that channel.

ROI calibration is a very useful feature of Meridian and this is especially true for the Incremental Conversions use-case. At Google, we have several sources of incrementality data for many advertisers. For instance, Google offers lift products such as Conversion Lift which directly provides reference points about incrementality. Our general approach to setting priors is to combine all information related to incrementality available into combined estimates which are used as MMM inputs. This may include, but is not limited to advertiser-run Conversion Lift experiments, experiments from similar advertisers within the same vertical, benchmarks from third-party incrementality providers, and others for each channel in the MMM and for similar conversion actions.

Although Meridian is an observational regression model, we primarily consider it as a tool for producing causal inference. A detailed discussion of the assumptions behind Meridian-guided causal inference can be found here. Our approach to causal inference with Meridian is two-fold. First, we include any control variables which may be confounders. Second, we inject incrementality via calibrating to ROI.

MMM-Powered Product Experiences

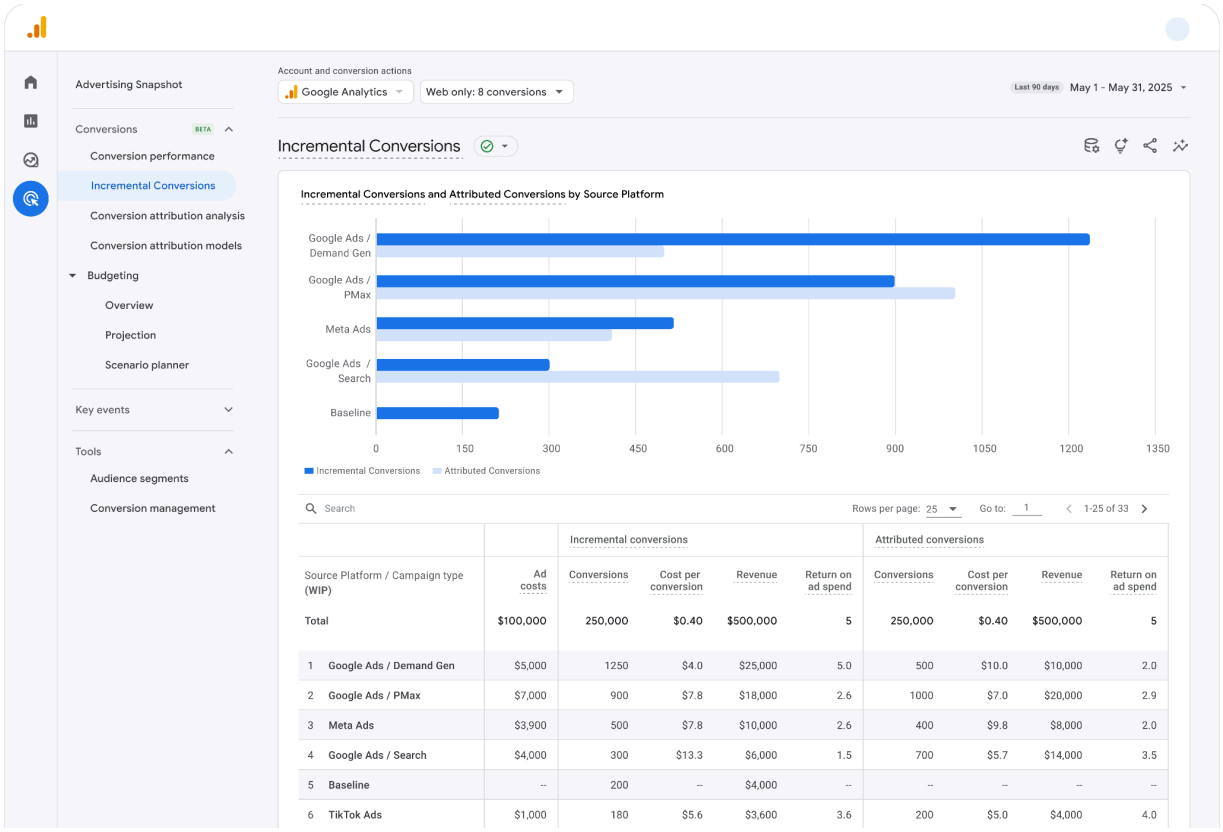
The MMM described above serves as the foundation for broad incrementality estimation which powers two new experiences in GA4: reporting on historically

estimated Incremental Conversions using an incremental attribution model, and budgeting tools based on MMM insights.

Incremental Attribution via Triangulation

Once the model has been estimated, Incremental Conversions and associated metrics including incremental revenue, incremental return on ad spend and incremental cost per acquisition, can be extracted for each channel by looking at the incremental outcome. The incremental outcome is the difference in outcomes between two scenarios: (1 - observed) observed media execution and (2 - counterfactual) zero media execution, as assessed by the model. Incremental outcomes are also key building blocks in constructing response curves, but we don't require full response curves to generate historical MMM estimates of Incremental Conversions.

In addition to historical estimates from MMM, our Incremental attribution model also incorporates inputs from cross-channel DDA. Blending these two inputs allows us to take advantage of the strengths of these: we take two different views of the same underlying data, and blend these inputs to provide a single view of historical performance.



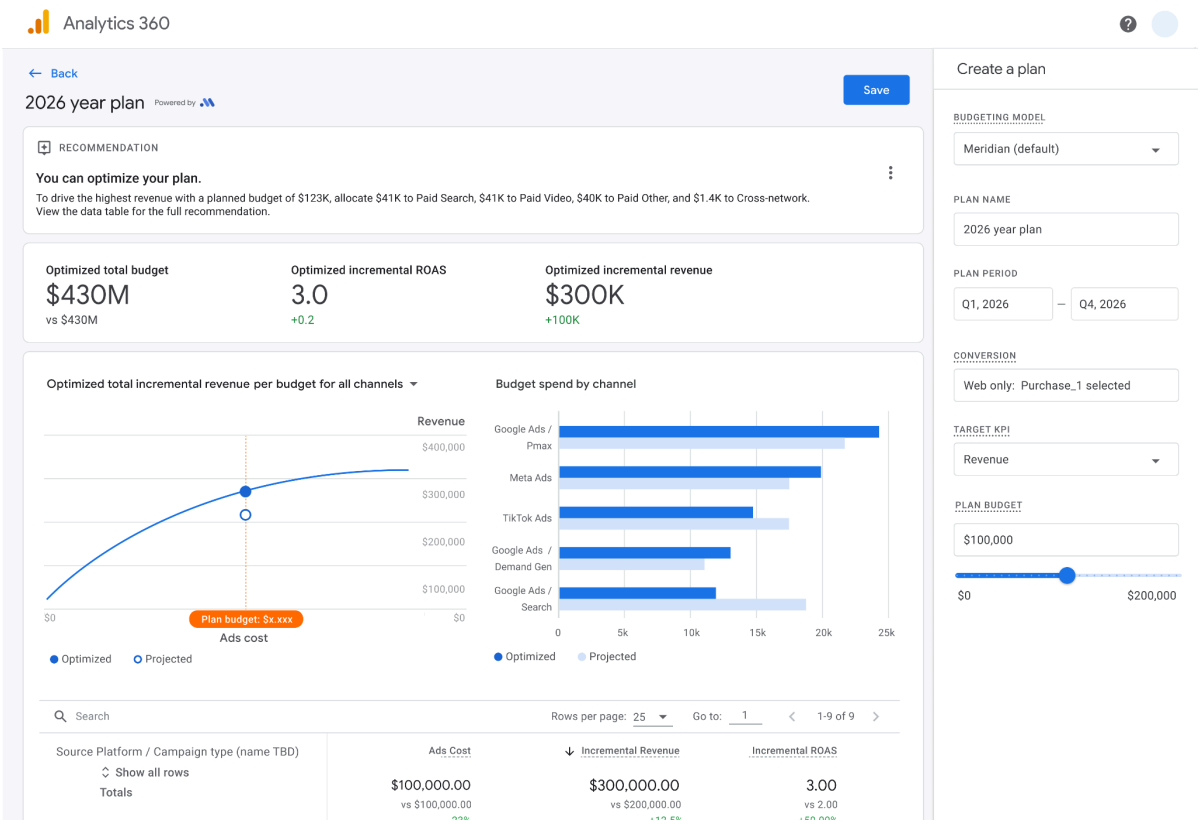
Incremental Conversions Report in GA360

Budgeting

We also offer budgeting tools which are based on our Meridian model. There are three components which enable this capability:

1. A per-channel forecast of media execution
2. Response curve generation
3. Budget optimization

We take these steps for every MMM and produce the MMM-optimal budget allocation for the forecasted period. Response curve generation and optimization is done using Meridian as well; see this documentation for more details.



Scenario Planner in GA360

Eligibility & Validation

Our MMM-based offerings are based on modeled outputs and we want to ensure that those outputs can be trusted. As a result, we cannot guarantee coverage for 100% of properties, nor (property, conversion) pairs. We issue both pre-modeling and post-modeling quality checks to ensure that the models we supply are high-quality.

Eligibility

Before model training, we conduct preliminary checks on data volume to maximize the likelihood of a successfully trained model. Meridian – and MMMs in general – are regression models with relatively few data points per estimated parameter. As such, it is unlikely to be successful in model training if the input data is of low volume. More details about Meridian's volume requirements can be

found here. Consistent with Meridian's documentation, we require at least two years of conversion data for MMM training.

Model Validation

Post-model training, the MMMs we use in our products all undergo rigorous quality evaluation checks. These checks are aligned with those defined in the Meridian library, discussed below.

Quality Category	Rationale
Convergence	The model must have converged, otherwise model estimates cannot be trusted.
Negative Baseline	Ensures that the model is not over-crediting media channels in a way that is nonsensical.
Goodness-of-Fit	The estimated model must be a reasonable description of how media and conversions are related.
ROI Checks and Prior-Posterior Shift	Ensures that the model has learned something from the data, and that ROI estimates are reasonable, given the priors.

Our goal is to provide high-quality MMM-based insights at scale. As such, the thresholds we use in quality monitoring are relatively strict to ensure that we are delivering value to GA4 users. One consequence of these quality checks is that a property may find that one or more of their conversion types has not passed model quality checks. While we strive to provide these products for as many conversions as possible, we simultaneously need to maintain a high quality bar.