Start Lab 02:00:00

Predicting Visitor Purchases with BigQuery ML

Lab 1 hour 20 minutes 5 Credits Introductory

Overview

Previous Next

coding.

The Google Analytics Sample Ecommerce dataset that has millions of Google Analytics records for the Google Merchandise Store loaded into BigQuery. In this lab, you will use this data to run some typical queries that businesses would want to know about their customers' purchasing habits.

Objectives

In this lab, you learn to perform the following tasks:

- Use BigQuery to find public datasets
- Query and explore the ecommerce dataset
- Create a training and evaluation dataset to be used for batch prediction
- Create a classification (logistic regression) model in BigQuery ML

Set up your environments

Lab setup

For each lab, you get a new Google Cloud project and set of resources for a fixed time at no cost.

1. Sign in to Qwiklabs using an **incognito window**.

There is no pause feature. You can restart if needed, but you have to start at the beginning.

3. When ready, click **Start lab**.

4. Note your lab credentials (**Username** and **Password**). You will use them to sign in to the Google Cloud Console.

5. Click **Open Google Console**.

6. Click **Use another account** and copy/paste credentials for **this** lab into the prompts.
   If you use other credentials, you'll receive errors or **incur charges**.

7. Accept the terms and skip the recovery resource page.

Open BigQuery Console

1. In the Google Cloud Console, select **Navigation menu** > **BigQuery**.

The **Welcome to BigQuery in the Cloud Console** message box opens. This message box provides a link to the quickstart guide and lists UI updates.

2. Click **Done**.

Access the course dataset

Once BigQuery is open, open the data-to-insights project in a new browser tab to bring

The field definitions for the **data-to-insights** ecommerce dataset are on the[UA] BigQuery Export schema page. Keep the link open in a new tab for reference.

Task 1. Explore ecommerce data

Scenario: Your data analyst team exported the Google Analytics logs for an ecommerce website into BigQuery and created a new table of all the raw ecommerce visitor session data for you to explore. Using this data, you'll try to answer a few questions.

Question: Out of the total visitors who visited our website, what % made a purchase?

2. Add the following to the New Query field:

```
#standardSQL
WITH visitors AS(
SELECT
COUNT(DISTINCT fullVisitorId) AS total_visitors
FROM `data-to-insights.ecommerce.web_analytics`
),

purchasers AS(
SELECT
COUNT(DISTINCT fullVisitorId) AS total_purchasers
FROM `data-to-insights.ecommerce.web_analytics`
WHERE totals.transactions IS NOT NULL
)
```

```
  total_purchasers,
  total_purchasers / total_visitors AS conversion_rate
FROM visitors, purchasers
```

3. Click **Run**.

The result: 2.69%

Question: What are the top 5 selling products?

4. Add the following query in the query **EDITOR**, and then click **Run**:

```
SELECT
  p.v2ProductName,
  p.v2ProductCategory,
  SUM(p.productQuantity) AS units_sold,
  ROUND(SUM(p.localProductRevenue/1000000),2) AS revenue
UNNEST(hits) AS h,
UNNEST(h.product) AS p
GROUP BY 1, 2
ORDER BY revenue DESC
LIMIT 5;
```

The result:

Row	v2ProductName	v2ProductCategory	units_sold	revenue
1	Nest® Learning Thermostat 3rd Gen-USA - Stainless Steel	Nest-USA	17651	870976.95
2	Nest® Cam Outdoor Security Camera - USA	Nest-USA	16930	684034.55
3	Nest® Cam Indoor Security Camera - USA	Nest-USA	14155	548104.47
	Alarm-USA			
5	Nest® Protect Smoke + CO White Battery Alarm-USA	Nest-USA	6340	178572.4

Question: How many visitors bought on subsequent visits to the website?

5. Run the following query to find out:

```
# visitors who bought on a return visit (could have bought on
first as well
WITH all_visitor_stats AS (
SELECT
  fullvisitorid, # 741,721 unique visitors
  IF(COUNTIF(totals.transactions > 0 AND totals.newVisits IS
NULL) > 0, 1, 0) AS will_buy_on_return_visit
  FROM `data-to-insights.ecommerce.web_analytics`
  GROUP BY fullvisitorid
)
SELECT
  COUNT(DISTINCT fullvisitorid) AS total_visitors,
  will_buy_on_return_visit
FROM all_visitor_stats
GROUP BY will_buy_on_return_visit
```

The results:

Row	total_visitors	will_buy_on_return_visit

1	729848	0
2	11873	1

Analyzing the results, you can see that (11873 / 729848) = 1.6% of total visitors will return and purchase from the website. This includes the subset of visitors who bought on their very first session and then came back and bought again.

What are some of the reasons a typical ecommerce customer will browse but not buy until a later visit? Choose all that could apply.

- [ ] The customer wants to comparison shop on other sites before making a purchase decision.
- [ ] The customer is waiting for products to go on sale or other promotion
- [ ] The customer is doing additional research

Submit

This behavior is very common for luxury goods where significant up-front research and

In the world of online marketing, identifying and marketing to these future customers based on the characteristics of their first visit will increase conversion rates and reduce the outflow to competitor sites.

Task 2. Select features and create your training dataset

Now you will create a Machine Learning model in BigQuery to predict whether or not a new user is likely to purchase in the future. Identifying these high-value users can help your marketing team target them with special promotions and ad campaigns.

Google Analytics captures a wide variety of dimensions and measures about a user's visit on this ecommerce website. Browse the complete list of fields in the [UA] BigQuery Export schema Guide and then preview the demo dataset to find useful features that will help a machine learning model understand the relationship between data about a visitor's first time on your website and whether they will return and make a purchase.

Your team decides to test whether these two fields are good inputs for your classification model:

- `totals.bounces` (whether the visitor left the website immediately)
- `totals.timeOnSite` (how long the visitor was on our website)

What are the risks of only using the above two fields?

- ( ) Whether a user bounces is highly correlated with their time on site (e.g. 0 seconds)
- ( ) Only using time spent on the site ignores other potential useful
- ( ) Both of the above

Submit

Machine learning is only as good as the training data that is fed into it. If there isn't enough information for the model to determine and learn the relationship between your input features and your label (in this case, whether the visitor bought in the future) then you will not have an accurate model. While training a model on just these two fields is a start, you will see if they're good enough to produce an accurate model.

- In the query **EDITOR**, add the following query and then click **Run**:

```
SELECT
  * EXCEPT(fullVisitorId)
FROM
  (SELECT
    fullVisitorId,
    IFNULL(totals.bounces, 0) AS bounces,
    IFNULL(totals.timeOnSite, 0) AS time_on_site
  FROM
    `data-to-insights.ecommerce.web_analytics`
  WHERE
    totals.newVisits = 1)
  JOIN
  (SELECT
    fullvisitorid,
    IF(COUNTIF(totals.transactions > 0 AND totals.newVisits IS
NULL) > 0, 1, 0) AS will_buy_on_return_visit
  FROM
      `data-to-insights.ecommerce.web_analytics`
  GROUP BY fullvisitorid)
  USING (fullVisitorId)
ORDER BY time_on_site DESC
```

Results:

Row	bounces	time_on_site	will_buy_on_return_visit
1	0	15047	0
2	0	12136	0
3	0	11201	0
4	0	10046	0
5	0	9974	0
6	0	9564	0
7	0	9520	0
8	0	9275	1
10	0	8872	0

Which fields are the model features? What is the label (correct answer)?

- The feature is will_buy_on_return_visit. The labels are bounces and time_on_site
- The features are bounces and time_on_site. The label is will_buy_on_return_visit
- The features are bounces and will_buy_on_return_visit. The label is time_on_site

Submit

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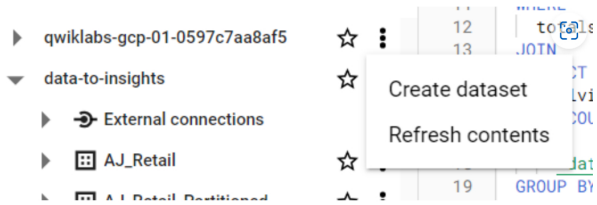
Submit

icon (three dots) and select **Create Dataset**.



2. In the **Create Dataset** dialog:

- For **Dataset ID**, type **ecommerce**.

- Leave the other values at their defaults.

3. Click **Create dataset**.

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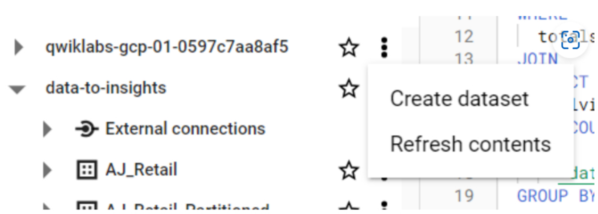

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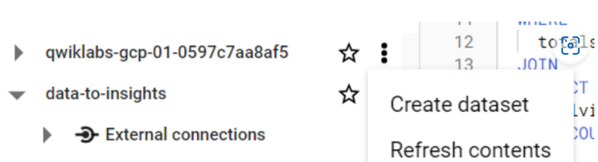

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Task 5. Evaluate classification model performance

Select your performance criteria

For classification problems in ML, you want to minimize the False Positive Rate (predict that the user will return and purchase and they don't) and maximize the True Positive Rate (predict that the user will return and purchase and they do).

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better model output is attributable to better input features and not new or different training data.

A key new feature that was added to the training dataset query is the maximum checkout progress each visitor reached in their session, which is recorded in the field `hits.eCommerceAction.action_type`. If you search for that field in the field definitions you will see the field mapping of 6 = Completed Purchase.

As an aside, the web analytics dataset has nested and repeated fields like ARRAYS which need to be broken apart into separate rows in your dataset. This is accomplished by using the UNNEST() function, which you can see in the above query.

Wait for the new model to finish training (5-10 minutes).

2. Evaluate this new model to see if there is better predictive power by running the below query:

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Wait for the new model to finish training (5-10 minutes).

2. Evaluate this new model to see if there is better predictive power by running the below query:

```
            # where the visitor came from
            trafficSource.source,
            trafficSource.medium,
            channelGrouping,

            # mobile or desktop
            device.deviceCategory,

            # geographic
            IFNULL(geoNetwork.country, "") AS country

        FROM `data-to-insights.ecommerce.web_analytics`,
           UNNEST(hits) AS h

          JOIN all_visitor_stats USING(fullvisitorid)

        WHERE 1=1
          # only predict for new visits
```

```
months

        GROUP BY
        unique_session_id,
        will_buy_on_return_visit,
        bounces,
        time_on_site,
        totals.pageviews,
        trafficSource.source,
        trafficSource.medium,
        channelGrouping,
        device.deviceCategory,
        country
      );
```

Let us now evaluate our model and see how we did:

```
SELECT
  roc_auc,
  CASE
    WHEN roc_auc > .9 THEN 'good'
    WHEN roc_auc > .8 THEN 'fair'
    WHEN roc_auc > .7 THEN 'not great'
  ELSE 'poor' END AS model_quality
FROM
  ML.EVALUATE(MODEL ecommerce.classification_model_3,  (

WITH all_visitor_stats AS (
SELECT
  fullvisitorid,
  IF(COUNTIF(totals.transactions > 0 AND totals.newVisits IS
NULL) > 0, 1, 0) AS will_buy_on_return_visit
  FROM `data-to-insights.ecommerce.web_analytics`
  GROUP BY fullvisitorid
)
```

```
SELECT * EXCEPT(unique_session_id) FROM (

  SELECT
      CONCAT(fullvisitorid, CAST(visitId AS STRING)) AS
unique_session_id,

      # labels
      will_buy_on_return_visit,

      MAX(CAST(h.eCommerceAction.action_type AS INT64)) AS
latest_ecommerce_progress,

      # behavior on the site
      IFNULL(totals.bounces, 0) AS bounces,
      IFNULL(totals.timeOnSite, 0) AS time_on_site,
      totals.pageviews,

      # where the visitor came from

      channelGrouping,

      # mobile or desktop
      device.deviceCategory,

      # geographic
      IFNULL(geoNetwork.country, "") AS country

  FROM `data-to-insights.ecommerce.web_analytics`,
     UNNEST(hits) AS h

    JOIN all_visitor_stats USING(fullvisitorid)

  WHERE 1=1
    # only predict for new visits
    AND totals.newVisits = 1
    AND date BETWEEN '20170501' AND '20170630' # eval 2 months
```

```
  unique_session_id,
  will_buy_on_return_visit,
  bounces,
  time_on_site,
  totals.pageviews,
  trafficSource.source,
  trafficSource.medium,
  channelGrouping,
  device.deviceCategory,
  country
)
));
```

Our roc_auc has increased by about .02 to around .94!

> **Note :** Your exact values will differ due to the randomness involved in the training process.

It's a small change in the roc_auc, but note that since 1 is a perfect roc_auc, it gets more difficult to improve the metric the closer to 1 it gets.

This is a great example of how easy it is in BigQuery ML to try out different model types with different options to see how they perform. We were able to use a much more complex model type by only changing one line of SQL.

One may reasonably ask "Where did the choices for these options come from?", and the answer is experimentation! When you are trying to find the best model type for your problems, then one has to experiment with different sets of options in a process known as hyperparameter tuning.

Let's finish up by generating predictions with our improved model and see how they compare to those we generated before. By using a **Boosted tree classifier model**, you can observe a slight improvement of 0.2 in our ROC AUC compared to the previous model. The query below will predict which new visitors will come back and make a purchase:

```
SELECT
*
FROM
  ml.PREDICT(MODEL `ecommerce.classification_model_3`,
   (

WITH all_visitor_stats AS (
SELECT
  fullvisitorid,
  IF(COUNTIF(totals.transactions > 0 AND totals.newVisits IS
NULL) > 0, 1, 0) AS will_buy_on_return_visit
  FROM `data-to-insights.ecommerce.web_analytics`
  GROUP BY fullvisitorid
)

  SELECT
      CONCAT(fullvisitorid, '-',CAST(visitId AS STRING)) AS
unique_session_id,

      will_buy_on_return_visit,

      MAX(CAST(h.eCommerceAction.action_type AS INT64)) AS
latest_ecommerce_progress,

      # behavior on the site
      IFNULL(totals.bounces, 0) AS bounces,
      IFNULL(totals.timeOnSite, 0) AS time_on_site,
      totals.pageviews,

      # where the visitor came from
      trafficSource.source,
      trafficSource.medium,
      channelGrouping,

      # mobile or desktop
      device.deviceCategory,


  FROM `data-to-insights.ecommerce.web_analytics`,
     UNNEST(hits) AS h

    JOIN all_visitor_stats USING(fullvisitorid)

  WHERE
```

```
    # only predict for new visits
    totals.newVisits = 1
    AND date BETWEEN '20170701' AND '20170801' # test 1 month

  GROUP BY
  unique_session_id,
  will_buy_on_return_visit,
  bounces,
  time_on_site,
  totals.pageviews,
  trafficSource.source,
  device.deviceCategory,
  country
)

)

ORDER BY
  predicted_will_buy_on_return_visit DESC;
```

The output now shows a classification model that can better predict the probability that a first-time visitor to the Google Merchandise Store will make a purchase in a later visit. By comparing the result above with the previous model shown in Task 7, you can see the confidence the model has in its predictions is more accurate when compared to the logistic_regression model type.

End your lab

When you have completed your lab, click **End Lab**. Google Cloud Skills Boost removes the resources you've used and cleans the account for you.

You will be given an opportunity to rate the lab experience. Select the applicable number of stars, type a comment, and then click **Submit**.

The number of stars indicates the following:

- 1 star = Very dissatisfied
- 2 stars = Dissatisfied
- 3 stars = Neutral
- 4 stars = Satisfied
- 5 stars = Very satisfied

You can close the dialog box if you don't want to provide feedback.

For feedback, suggestions, or corrections, please use the **Support** tab.