[Course Overview](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live" \t "psplayer)

[Course Overview](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live)

[Hi. My name is Janani Ravi, and welcome to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=0) [this course on Building Machine Learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=9.668) [Models in SQL Using BigQuery ML. A little](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=11.688) [about myself. I have a Master's Degree in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=16.356) [electrical engineering from Stanford and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=18.53828571428571) [have worked with companies such as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=20.282333333333337) [Microsoft, Google, and Flipkart. At](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=22.68166666666666)[Google, I was one of the first engineers](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=24.34766666666667) [working on real-time collaborative editing](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=26.9394) [in Google Docs, and I hold four patents](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=29.242600000000003) [for its underlying technologies. I](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=32.56766666666667) [currently work on my own startup,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=34.436142857142855) [Loonycorn, a studio for high-quality video](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=36.351" \t "psplayer) [content. In this course, you will learn](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=39.972428571428566) [how to build and train machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=42.10200000000001) [models and how to employ those models for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=44.17585714285715) [prediction all with just simple SQL](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=47.056142857142845) [commands on data stored in BigQuery. We](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=49.33728571428571)[start off the course with an introduction](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=52.07899999999999) [to machine learning using BigQuery. We'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=54.24985714285714) [understand the different choices available](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=56.928399999999996) [on the GCP if you would like to build and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=58.467999999999996) [train your models and see how you can make](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=61.25377777777778) [the right choice between these services](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=63.882) [for your specific use case. We'll then](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=66.204)[work with some real-world datasets stored](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=69.10733333333333) [in BigQuery to build linear regression and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=71.17742857142856) [binary classification models. BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=74.60079999999999) [allows you to specify training parameters](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=76.8725) [to build and train your models in SQL.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=79.01785714285714) [This has the effect of making machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=81.77974999999999) [learning accessible to even those who are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=84.28783333333334) [not familiar with high-level programming](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=87.429) [languages. We'll then study how to analyze](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=89.857) [the models that we build using evaluation](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=92.70025000000003) [and feature inspection functions in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=95.41785714285714) [BigQuery. We'll also run BigQuery commands](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=98.123" \t "psplayer) [on Cloud Datalab, a Jupyter Notebook that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=100.45357142857145) [is hosted on the GCP and closely](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=103.25985714285713) [integrated with all of GCP services. At](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=105.95712499999999) [the end of this course, you will have a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=109.4749) [good understanding of how you can use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=111.391) [BigQuery ML to extract insights from your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=113.411" \t "psplayer) [data by applying linear and logistic regression models.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=5a96ec50-6074-4f4f-a885-6ad5e8778ac6&clip=0&mode=live&start=116.512)

[Introducing Google BigQuery ML](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live)

[Module Overview](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live)

[Hi, and welcome to this course on Building](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=0) [Machine Learning Models in SQL Using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=3.946) [BigQuery Machine Learning. Now so far, if](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=6.827" \t "psplayer) [you've had to work with machine learning,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=9.44922222222222) [you've had to use a high- level](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=10.8635) [programming language, such as Python,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=12.697) [Java, Scala, etc. But now it's possible to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=14.942) [build machine learning models for linear](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=18.070888888888895) [and logistic regression using just SQL](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=19.917) [queries, that is if your data lives on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=23.268000000000008) [BigQuery. BigQuery is a serverless cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=26.02374999999999" \t "psplayer) [data warehouse on the Google Cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=28.270000000000007) [Platform. The BigQuery data warehouse is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=31.208833333333335) [one of the most popular technologies on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=32.84462499999999) [the GCP, and it's widely used by business](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=35.01933333333334) [analysts, as well as data scientists.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=37.849285714285706) [BigQuery is a structured data store, which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=40.457" \t "psplayer) [can ingest data in multiple different](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=43.052) [formats, CSV files, Avro files, JSON,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=45.098) [everything. BigQuery supports structured](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=48.74771428571428) [data including complex data types, such as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=51.02760000000001) [arrays and structs. A brand new feature](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=54.25824999999999) [that has been added to BigQuery this year](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=56.451111111111096) [is the ability to build machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=58.613375000000005) [models using the SQL query language.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=61.333749999999995) [Instead of retrieving data from BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=64.453) [into a Python program in order to build](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=66.629) [and test your ML models, there is no need](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=68.82011111111113) [to leave BigQuery at all. This feature](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=71.3535555555556) [brings machine learning right to where](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=73.92066666666666) [data is stored, and it democratizes ML to an unprecedented degree.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=0&mode=live&start=75.95240000000001)

[Prerequisites and Course Outline](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live)

[Before we get into the actual course](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=1.596) [contents, let's take a look at the prereqs](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=3.371) [that you need to have so that you can make](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=5.349) [the most of your learning. This course](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=7.136) [assumes that you have a basic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=9.228250000000001) [understanding of cloud computing](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=10.675) [platforms, and it would be helpful if](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=12.7302) [you've worked on the GCP before. If you've](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=14.411999999999999) [worked on other cloud computing platforms,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=16.6185) [that's okay as well. This course also](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=18.853285714285718) [assumes that you're comfortable](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=21.380499999999998)[programming in SQL, the structure query](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=22.81425) [language. It will also be helpful if you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=26.070750000000004) [had a basic understanding of machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=28.241000000000007) [learning concepts because you'll be using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=30.218000000000004) [SQL in order to build ML models. If you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=32.1505) [feel that you don't have all of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=35.7696) [prereqs that you need for this course,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=37.136" \t "psplayer) [here are some other courses on Pluralsight](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=38.844) [that you can watch before this one. Here](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=40.603) [is a course that will help you get](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=42.94188888888889) [familiar with BigQuery on the GCP,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=44.277) [Architecting Data Warehousing Solutions](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=46.786) [Using Google BigQuery. In order to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=49.135) [understand basic machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=52.38849999999999) [concepts, Understanding Machine Learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=53.878) [is a good course for you to watch. We](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=55.36749999999999) [start this course off by discussing what](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=58.62325) [exactly BigQuery machine learning is all](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=60.757000000000005) [about and how it's useful to be able to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=62.446999999999996) [build ML models in SQL. We'll compare and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=65.20599999999999) [contrast BigQuery ML with other ML](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=68.3767142857143) [technologies available on the Google](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=70.81766666666667) [Cloud. We'll get hands on with BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=72.64471428571429) [and also take a look at Google's Data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=75.06625) [Studio to visualize your data. In the next](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=77.46133333333333) [module, we'll see how we can build linear](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=80.41433333333332)[and logistic regression machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=82.51939999999999) [models. Linear regression tries to fit the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=84.741) [best- fitting straight line on your data,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=87.0611428571429) [and logistic regression is used for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=89.385) [classification. It tries to find the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=92.17157142857143) [best-fitting S-curve on your underlying](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=94.29814285714282) [data. We'll build both of these kinds of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=96.43375) [models using just SQL. We'll then move on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=98.90412500000004) [to using BigQuery on Cloud Datalab and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=101.82162499999997) [evaluating and analyzing the models that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=104.943) [we just built. We'll see how we can use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=106.93414285714287)[precision, recall, and ROC curves to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=109.456) [evaluate our classification model. All of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=112.258) [our demos assume that engineers at the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=115.18633333333332) [hypothetical online retailer called](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=117.497) [SpikySales. com are evaluating BigQuery ML](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=119.927" \t "psplayer) [for their business needs. SpikySales. com](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=123.609) [specializes in flash sales of trending](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=126.49799999999999) [products, which means they experience lots](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=129.32633333333334) [of spikes in user traffic. They're](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=131.14357142857142) [considering moving from an on- premise](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=133.49450000000002) [datacenter to the GCP. The cloud computing](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=135.2506)[model sets the build for them perfectly](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=138.22914285714282) [because they want to pay as they go. They](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=140.40112499999998) [don't want their resources to be sitting](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=142.90471428571425) [around idle during the off-sale periods.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=144.89414285714284) [As a small and upcoming organization, they](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=148.05) [don't have very many data scientists on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=150.422) [their team, which is why they want to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=152.30311111111112)[empower their analysts with machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=154.152) [learning tools. They feel that their data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=156.478) [analysts may be able to use BigQuery ML to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=159.286) [generate reports to feed business](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=161.741) [decisions, as well as extract insights](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=163.371) [that might be useful to the data science team.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=1&mode=live&start=165.7624285714285)

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Google Cloud AI, on the other](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=20.1945) [hand, is a suite of tools that has been](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=22.119714285714295) [explicitly built for the purposes of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=23.995)[machine learning on the GCP. These include](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=25.887) [tools to build your own custom models on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=28.681285714285714) [the cloud, as well as make pretrained](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=30.54766666666666) [models available to you via APIs. Let's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=32.53657142857143) [first take a look at where BigQuery fits](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=35.99875) [in in the world of data storage](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=37.984) [technologies. The GCP offers different](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=40.28000000000002) [kinds of storage options for different](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=41.938285714285705) [kinds of data. Let's say your data is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=44.06399999999999) [unstructured. You might choose to store it](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=46.87199999999999) [in cloud storage buckets or on persistent](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=48.32475000000002) [disks. If you have structured data, you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=50.944500000000005) [might want to query your data using SQL,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=53.40999999999999) [or you might want to use a NoSQL database.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=55.66866666666666) [If you want a NoSQL database, the two](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=59.309) [options available for you on the GCP are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=61.64375) [BigTable and Datastore, BigTable for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=64.2932" \t "psplayer) [columnar data, Datastore to store data in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=67.2305) [the form of objects on entities. SQL data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=69.69600000000003) [may be used for online transaction](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=73.38374999999999) [processing, that is OLTP, or online](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=75.513) [analytical processing, that is OLAP or](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=78.4785) [OLAP. For online transaction processing,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=81.716) [you can store your data in Cloud SQL,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=84.065) [which is an RDBMS on the cloud or on Cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=86.584) [Spanner, which allows you to achieve scale](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=89.214) [with relational data. For analytical](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=91.524) [processing, Google solution is BigQuery.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=93.74366666666666) [This allows you to store petabytes of data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=96.31) [and query data within seconds. BigQuery is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=98.937) [entirely serverless, which means you don't](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=102.4955) [have to instantiate nodes that hold your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=104.56228571428574) [database. The nodes holding your data and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=107.2148) [processing your queries are completely](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=109.53200000000001) [abstracted away from you. You only focus](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=111.37199999999999) [on the data itself and the actual query.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=113.42449999999997) [Google Cloud AI is a suite of offerings on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=116.816) [the GCP that allow you to harness the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=119.59209999999997) [power of machine learning. GCP offers](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=121.71683333333335) [machine learning services where you can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=124.78233333333333) [work with pretrained models and access](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=126.99271428571429) [these models using a simple API. Or you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=129.1684285714286) [can build your own custom model with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=132.23611111111111) [distributed training and prediction. If](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=134.858) [you want to use machine learning for your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=137.210125) [use case, you might choose to go with a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=138.6807777777778) [pretrained model because you don't have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=140.57271428571428" \t "psplayer) [very much data, or you might choose to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=142.527) [build your own custom model on the cloud.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=144.511) [Pretrained models are available behind ML](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=147.437" \t "psplayer) [APIs. You build custom models using three](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=150.67271428571428) [different technologies, BigQuery ML,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=153.406) [AutoML, and ML Engine. There are numerous](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=155.735" \t "psplayer) [pretrained ML APIs available though, which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=159.41249999999997" \t "psplayer) [allow even novice programmers to harness](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=162.22799999999998) [the power of machine learning,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=164.52014285714284) [speech-to-text APIs, text-to-speech,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=166.40966666666665) [visual and video-related APIs, natural](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=168.26925) [language processing, as well as translate](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=171.177) [APIs. BigQuery machine learning is where](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=174.03160000000005) [things get really interesting. Google has](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=176.01633333333328)[tried to marry these two powerful](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=178.4594285714286) [technologies, a powerful data warehouse](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=180.4822) [that can store petabytes of data with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=182.84542857142856) [powerful machine learning models that can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=185.595) [be used to harness the power of that data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=187.39377777777779) [from within SQL. Going back to this visual](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=189.952) [of all of the AI services that are offered](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=192.9915) [at Google, you can see BigQuery ML right](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=195.42566666666664) [here. This is what you'd use to build](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=198.3647142857142) [custom models in SQL. BigQuery is one of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=200.28425) [the most popular technologies on the GCP,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=203.44757142857148) [and it's widely used by both business](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=205.55542857142854) [analysts, as well as data scientists.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=207.6635) [Cloud AI, on the other hand, is used](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=209.52285714285716) [mostly by data scientists because they](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=212.49228571428574) [involve high-level programming languages.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=214.98966666666666) [However, the availability of pretrained](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=216.805) [models behind simple, easy-to-use APIs](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=219.214) [make AI accessible even to novice](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=222.51150000000004) [programmers. BigQuery ML merges the two of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=225.79349999999994) [these together to get you the best of both](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=228.56028571428564) [worlds, machine learning models built on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=231.168) [your custom data using just SQL. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=233.691) [standard use case is that you move your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=237.437) [data to the platform onto the cloud where](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=239.32829999999993)[you're building and training your machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=241.7051666666667) [learning models. BigQuery flips this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=243.92771428571422) [around. It brings machine learning to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=246.18649999999997) [where data is stored. At this point in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=248.49744444444448) [time, you can build machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=250.80149999999998) [models for regression and classification](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=252.434) [in SQL without leaving BigQuery right](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=254.582) [within the web console that BigQuery offers.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=2&mode=live&start=257.79600000000005)

[BigQuery ML vs. Other Google AI Services](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live)

[Before we get hands on with BigQuery,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=1.874) [let's see how BigQuery ML stacks up with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=3.908) [other cloud AI technologies on the GCP. We](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=6.234) [start off by comparing BigQuery ML with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=9.7605) [Google Cloud AutoML. When you use BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=12.497285714285717) [ML, you can build custom machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=15.176000000000002) [models that have been trained on your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=17.1775) [data. The models fit your data and your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=20.314400000000006) [use case. The same is true of AutoML. When](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=22.94711111111112) [you feed in data to AutoML behind the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=26.27177777777778)[scenes, it performs a neural network](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=28.446) [search in order to find the best network](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=31.49057142857144) [architecture that fits your use case. At](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=34.083) [this point in time, BigQuery ML is fairly](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=37.027499999999996) [new, and it supports only two kinds of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=39.026875000000004) [machine learning models, linear and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=41.351) [logistic regression. Google Cloud AutoML](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=43.443) [supports models for vision, natural](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=45.733) [language, and translation. If you're using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=48.275) [BigQuery ML from the web console, you'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=50.92137499999999" \t "psplayer) [only need to write SQL queries. If you're](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=53.093999999999994) [using Cloud AutoML, you might need to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=56.592600000000004) [write a little bit of Python code or use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=58.32977777777777) [it via a command line. It's also possible](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=60.781777777777776) [to work with AutoML only using the web UI.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=63.778625000000005) [Let's see how BigQuery ML stacks up](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=66.91199999999999) [against Google ML APIs, which expose](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=69.70914285714285) [prediction services on pretrained models.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=72.41040000000001) [BigQuery ML builds custom models based on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=75.0504" \t "psplayer) [your data and use case. However, when you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=78.27788888888888) [use ML APIs, you use pretrained models](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=80.67650000000002) [that have been built by Google. It's not](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=83.19442857142856) [customized to your data. In order to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=85.88100000000001) [invoke these APIs, you need to use a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=88.47324999999998) [high-level programming language, such as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=91.06528571428575) [Python or Java. You can also use the UI](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=92.848) [directly or the command line. For BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=95.5776666666667) [ML, you work with SQL. And as we discussed](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=98.14999999999999) [before, at this point in time, BigQuery ML](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=101.664) [supports just linear and logistic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=103.95233333333333) [regression models. ML APIs support models](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=106.17333333333333) [for vision, natural language, translation,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=109.05533333333335) [video, speech-to-text, and many more.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=112.0175) [Let's now compare BigQuery ML with Cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=115.027) [ML Engine. Cloud ML Engine is what you'd](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=117.22066666666669) [use if you want to build your own custom](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=119.56399999999996) [model with distributed training and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=121.91800000000002) [prediction on the cloud. When you use ML](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=123.82042857142856) [Engine, you'll write code in Python using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=126.73700000000002) [a deep learning framework, such as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=128.80685714285715) [TensorFlow. With BigQuery ML, you stick to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=130.89133333333334" \t "psplayer) [SQL. BigQuery ML seeks to make machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=133.62587499999998) [learning accessible to even those who are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=136.298) [not familiar with high-level programming](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=138.68985714285714) [languages. With Cloud ML Engine, you get](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=140.821) [distributed trained and prediction, but](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=144.02442857142853) [you have to use a programming language](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=145.578) [such as Python. With Cloud ML Engine,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=148.01700000000002) [there is no restrictions on the kind of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=150.41799999999998) [model that you can build. You simply use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=152.63812499999997) [the TensorFlow deep learning framework and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=155.13871428571431) [build a custom model for your use case.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=157.12928571428571) [The idea behind BigQuery ML is to empower](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=160.687) [those analysts who are only familiar with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=163.632) [SQL to harness the power of machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=165.977) [learning on their data. It also makes](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=168.572) [things simpler for data scientists.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=171.32162500000004) [Instead of moving huge amounts of data to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=173.031) [where their program lives, they can simply](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=175.699) [move their program to where data lives.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=177.776) [BigQuery ML is a brand new feature. It was](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=180.698" \t "psplayer) [launched on July 25, 2018. Building](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=184.15485714285717) [machine learning models is very, very](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=186.98766666666668) [simple and intuitive. You simply write the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=189.19) [correct SQL query from within the BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=192.082) [web console. At this point in time,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=195.58360000000002) [BigQuery ML supports just two kinds of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=198.29049999999995" \t "psplayer) [machine learning models, linear regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=200.61742857142852) [for prediction and logistic regression for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=202.4536) [binary classification. The pricing](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=206.33320000000003) [structure for building BigQuery machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=208.67) [learning models is still under](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=210.91) [development. The models that you build are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=213.35666666666663) [stored within datasets, just like you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=215.64225) [would store tables or views in BigQuery.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=217.78728571428567) [Just like it does with data and queries,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=220.759) [BigQuery will charge you for the actual](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=223.248" \t "psplayer) [data storage, how much data your model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=225.682) [takes up, and for querying your data. At](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=227.752) [this point in time, the first 10 GB of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=231.28220000000002) [training data per month is absolutely](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=234.173) [free. Anything over this, you'll pay $5](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=237.06242857142865) [per GB of data. If you're using your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=239.87800000000007) [trained model for prediction and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=242.3962857142857) [evaluation, you'll pay $5 per TB of data.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=244.08033333333333) [There are some additional quotas and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=247.60271428571423) [limits that you'll need to adhere to for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=249.79850000000002) [BigQuery ML. You can create a maximum of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=252.60314285714287" \t "psplayer) [100 models per day per project using the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=255.32199999999992) [CREATE MODEL SQL statement. If you or your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=258.6644444444445)[organization have flat-rate pricing on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=262.0931428571428) [BigQuery, flat-rate users can use their slots for BigQuery ML until July 31, 2019.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=3&mode=live&start=264.2316666666666" \t "psplayer)

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[In this demo, we'll log on to the Google](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=2.626) [Cloud Platform and enable the Compute](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=4.416) [Engine APIs that we'll need for demos](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=6.752) [later on in this course. You can log on to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=8.865999999999998) [the GCP at console. cloud. google. com.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=12.567874999999997) [You need to have a username and password](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=15.944) [enabled on the GCP. Any gmail account or a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=18.334)[gsuite account associated with your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=21.372) [organization will do. If you don't have an](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=23.556) [account already, you can create one for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=26.434428571428565) [free. I'm simply going to log in to an](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=28.01133333333333) [existing account, and I'm immediately](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=29.947000000000006) [taken to GCP's dashboard. You'll need to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=32.0245) [enable building on your account in order](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=34.605999999999995) [to be able to use some of the resources on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=36.180600000000005) [the GCP for this course. All resources you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=38.70249999999999) [instantiate on the Google Cloud are part](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=41.42699999999999) [of a project. A project on the GCP is a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=43.72749999999999)[logical grouping of GCP resources and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=46.862444444444456) [services. A project is also a billing](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=49.45799999999999) [unit. Different teams within your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=51.799285714285716) [organization are likely to have their own](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=53.77240000000001)[projects. You can click on the drop-down](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=56.73899999999998) [on top in order to see the current project](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=58.47999999999999) [that you're working on. You can also see](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=60.81285714285715) [other projects associated with this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=62.922499999999985) [account. In order to access all of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=65.11120000000001) [services available on the Google Cloud,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=67.33862500000001) [you can use this hamburger icon on the top](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=68.79175000000002) [left. Clicking on this will bring up a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=71.71685714285711) [navigation menu that has links to all of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=74.13587500000003) [GCP's products and services. In order to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=77.037375) [enable the Compute Engine APIs, we'll go](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=80.52074999999999) [to APIs and Services, click on Dashboard.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=83.01055555555557) [Click on the link which says ENABLE APIs](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=86.033) [AND SERVICES, and this will take you to a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=88.494) [page where you can use the search text box](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=90.247) [to search for the specific API that you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=93.05) [want to enable. Or you can scroll down and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=95.293) [find the right API from this list. I want](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=97.923) [to enable the Compute Engine API, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=100.86775) [that's what I select here. Click on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=103.3605) [big blue ENABLE button that appears on this page, and this API will be enabled.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=4&mode=live&start=105.66925)

[Uploading Reviews to Cloud Shell](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live)

[In this demo, we'll work with BigQuery.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=2.092) [We'll see how we can create a dataset, a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=4.273) [table within a dataset, and load data into](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=6.8717500000000005) [this table. We'll then see how we can use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=9.145111111111111) [Google's Data Studio to visualize this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=11.3435) [data. Click on the hamburger icon on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=14.448500000000001) [top left to bring up the navigation menu.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=16.69966666666667) [And from within this menu, go to BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=19.011) [under BIG DATA. In order to use BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=21.62) [within your project, BigQuery APIs need to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=25.129) [be enabled. However, if you've newly](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=27.65) [created this project, BigQuery APIs are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=30.103) [automatically enabled for you. What you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=32.476) [see here on screen is BigQuery's web](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=35.535250000000005) [console. This is what we'll be using to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=37.751125) [write most of the queries in this course.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=40.07977777777778) [You can also access BigQuery using the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=42.518) [command line though, and that's what we'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=44.56) [see first. Let's now activate the Cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=46.647) [Shell by clicking on this icon on the top](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=49.339) [right. The Cloud Shell is an ephemeral](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=52.22350000000002) [virtual machine running on the Google](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=54.509428571428586) [Cloud Platform, which we can access using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=56.07033333333335) [a terminal window from within our browser.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=58.66385714285716) [Using the Cloud Shell terminal window is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=62.13)[extremely useful because it comes with all](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=63.976) [of the GCP command line utilities](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=66.304) [pre-installed. Once Cloud Shell has been](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=69.39657142857143) [activated, from within here I'm going to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=71.61116666666666) [click on this pencil icon to launch code](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=73.08433333333329) [editor BETA. This is an IDE where you can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=76.53385714285713) [edit your source, as well as configuration](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=79.80100000000004) [files, from within your browser. Clicking](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=82.21499999999997) [on this will launch an Explorer window,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=84.92771428571429) [which shows all of the files present on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=86.82828571428571) [your Cloud Shell VM. Click on the three](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=89.55233333333334)[dots at the top right to bring up a menu,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=91.91179999999999) [which we'll use to upload a file to our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=94.26) [Cloud Shell VM. We'll choose a CSV file](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=97.16771428571428) [from our local machine, which contains](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=99.61412499999997) [clothing reviews for women's clothing.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=102.0634) [This is an e-commerce dataset. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=104.46) [original file for this data is available](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=106.80828571428572) [on Kaggle. All of these datasets are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=109.06033333333333) [available as downloadable resources with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=111.86299999999999) [this course in the datasets folder. Once](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=113.7045) [the CSV file has been uploaded, you can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=117.13757142857143) [view this within your Cloud Shell code](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=119.87025000000001) [editor by clicking on File, Refresh, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=122.12342857142858) [this will show you that this file is now](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=124.96622222222223) [available on Cloud Shell. Open up the CSV](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=127.1276) [file to see the kind of data that it](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=129.72079999999997) [contains. I'm going to rename this file to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=132.01475) [something more simple, like reviews. csv.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=134.21974999999992) [I now have reviews. csv stored in my Cloud Shell VM.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=5&mode=live&start=138.065)

[Creating Datasets and Tables, Loading and Querying Data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live)

[We'll now create a dataset in BigQuery and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=0) [the table within that dataset in order to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=4.127) [hold our reviews data. I've maximized the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=7.041142857142858) [Cloud Shell terminal window, and I've set](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=9.465) [the current project to be spikey-bq using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=11.780000000000001) [the gcloud command line utility. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=14.709375000000001) [access BigQuery from the command line](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=17.814999999999998)[using the bq command. This command line](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=19.5718) [utility comes preinstalled on your Cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=22.316799999999997) [Shell VM. Bq ls will show you what](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=25.143333333333334) [datasets are currently available on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=28.066499999999994) [BigQuery, and there is nothing here. Let's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=30.162499999999998" \t "psplayer) [now create a new dataset using the bq mk](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=32.538555555555554) [command. We'll call this dataset](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=35.5105)[clothing\_reviews. A dataset on BigQuery is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=37.628) [simply a container, just like a database](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=40.574) [in an RDBMS. It contains within it tables](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=42.927749999999996) [and views. After creating the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=46.48711111111109) [clothing\_reviews dataset, if you run the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=48.788000000000004" \t "psplayer) [bq ls command, you'll see this dataset](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=50.664874999999995" \t "psplayer) [listed. In order to get additional](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=53.65580000000001) [information about this dataset, you can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=55.826833333333354) [run the bq show command on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=57.525875) [clothing\_reviews, and you'll see when this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=59.71399999999999" \t "psplayer) [dataset was last modified, the ACLs that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=61.400875) [apply to it, and so on. You can load data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=63.7444) [into a BigQuery table from the command](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=67.29649999999998) [line using the bq load command. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=69.82466666666666) [autodetect flag automatically detects the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=73.1296" \t "psplayer)[schema of the CSV file that you're using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=75.593625) [to load data into the table that you're](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=78.024375) [just about to create. This command will](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=80.4824) [create the reviews table under the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=83.32257142857145) [clothing\_reviews datasets. The reviews](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=86.16799999999999" \t "psplayer) [table will be loaded with the data that is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=87.98625000000001) [present in the reviews. csv file located](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=90.564375) [in the current working directory of your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=92.88766666666666) [Cloud Shell. Once the table has been](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=95.45299999999999) [created and data has been loaded into the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=97.47737500000001) [table, we can use the bq show command in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=99.59611111111109) [order to view details of the reviews table](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=102.05362499999998) [within the clothing\_reviews dataset. Here](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=104.39585714285711) [is the metadata information for the table](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=107.16657142857143) [itself. Observe that the schema for this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=109.28542857142857) [table has been automatically detected from](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=112.3755) [the reviews. csv file. This table has a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=114.843) [total of 5031 rows and occupies about 2MB](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=118.15722222222222) [of storage. You can run SQL queries on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=121.7788) [data stored in BigQuery using the bq query](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=124.52133333333336) [command from the command line. Here is a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=127.62228571428575) [simple select query to SELECT some rating](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=130.62524999999994) [information from women aged over 25 years.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=132.9826666666667) [BigQuery will process this query, and here](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=137.076" \t "psplayer) [is the rating information available to you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=139.9813333333333) [right within this terminal window. Let's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=142.28562500000004) [run one more query using the command line.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=144.6621111111111) [Here we'll find the average rating based](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=146.959) [on the clothing category. We'll group by](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=150.0092499999999) [class name. And here is the average rating](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=153.4508) [for the various clothing articles that are present on our e-commerce site.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=6&mode=live&start=156.15875)

[Running Queries and Visualizing Results Using Data Studio](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live)

[We'll now work primarily with the BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=1.468) [web console. Observe here on the left](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=3.919) [navigation pane that our current project](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=6.26) [spikey-bq. If you click on this, you'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=9.21457142857143) [see all of the datasets available within](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=10.718) [this project. We just have the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=12.550600000000001) [clothing\_reviews dataset, and this dataset](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=14.979" \t "psplayer) [holds the reviews table that we just](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=16.82314285714286) [loaded with data from our CSV file. If you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=19.237600000000004) [click on this table, you can see various](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=22.182222222222222) [information about your table right here on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=24.204333333333334)[screen. You can see the schema for your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=26.590777777777777) [data. This is the schema that was](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=28.75075) [autodetected from the CSV file. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=30.646" \t "psplayer) [Details tab will give you metadata](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=33.65457142857142)[information for this table, when the table](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=35.416) [was created, its size, the number of rows,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=37.387) [where the data is located, and so on. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=40.332) [Preview tab on BigQuery is extremely](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=43.792625) [useful. It gives you a quick look into](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=45.95037500000001) [what your data looks like. There is no](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=48.063111111111134) [charge when you view data using the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=50.814) [Preview tab on BigQuery. You can see the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=53.55677777777777) [age of the customer who gave the review,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=55.962111111111106) [the title of the review, the review text.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=57.76612499999999) [And if you scroll over to the right, you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=59.71966666666667) [can see other information about the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=61.83428571428572) [clothing as well. You can use the query](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=63.796800000000005) [editor right here on your browser window](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=66.34911111111109) [in order to run SQL queries on your data.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=68.32250000000002) [Here is the SELECT query that we saw](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=70.943) [earlier. We want the average rating for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=73.49677777777778) [clothing category. Click on the Run query](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=76.672)[button to execute this query, and the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=78.87524999999997) [results of this query will be displayed](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=80.66499999999999) [right here within your browser window.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=82.54528571428571) [Once you have the results of your query,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=84.469) [you can choose to save these results in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=87.17233333333336) [the form of a JSON or a CSV file. I'm](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=89.1260909090909) [going to download the results in the form](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=91.878125) [of a CSV file and store it on my local](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=93.89341666666667) [machine. This is just to show you what you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=96.8875833333334) [can do from within the BigQuery web](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=98.66780000000004) [console. But what's really interesting is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=101.33633333333331)[the Google Data Studio integration with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=103.4574285714286) [BigQuery. You can explore your data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=106.17959999999998" \t "psplayer) [visually and set up very complicated and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=108.548375) [beautiful charts and reports without](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=111.51966666666664) [writing any code. When you bring up Data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=113.6975) [Studio from within BigQuery, a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=116.184125) [visualization of your data will](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=117.67842857142857) [automatically be populated when Data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=119.557) [Studio is loaded. The visualization here](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=121.90783333333336) [is a simple table. You can see that the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=124.3094285714286) [first column is the class name, and the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=126.91337499999996) [second column is the number of records in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=129.35900000000004) [that particular class. This is a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=131.59425000000007) [visualization of the result of the query](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=134.1623333333333) [that you ran on BigQuery. We have exactly](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=136.62390909090905) [one record containing the average rating](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=139.3464285714286) [for each clothing category. You can view](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=141.81266666666667) [this same information in the form of a bar](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=144.65112499999998) [chart by simply clicking on the bar chart](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=146.8136666666667) [icon on the top right. This bar chart is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=149.07475000000002) [kind of boring. Let's change the metric](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=151.92557142857137) [that we view. You can simply click on Add](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=153.82542857142855) [metric on the right-hand side of your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=156.1596666666667) [screen. Instead of record count, Data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=158.493) [Studio gives us the option to view the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=160.5885714285714) [average rating in the form of a bar chart.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=163.14933333333326) [When you click on average rating, the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=165.412) [visualization is automatically updated to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=167.4252) [reflect this new metric. And with this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=169.99179999999998) [demo, we come to the very end of this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=172.2298) [introductory module on BigQuery ML. We saw](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=174.61357142857145) [that BigQuery is a serverless cloud data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=177.71574999999999) [warehouse on the GCP, and it's widely used](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=179.99487499999998) [by both business analysts, as well as data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=182.854125) [scientists. In addition to querying](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=185.15733333333333) [petabytes of data quickly, BigQuery now](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=187.709) [gives you the functionality to build](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=190.24142857142857)[machine learning models using SQL. This](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=192.204) [offers an interesting, unusual, and a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=195.306) [potentially very powerful blend of a data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=197.89600000000002) [warehouse with AI technologies. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=200.2132) [build linear regression and binary](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=203.42657142857144) [logistic classification models without](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=205.148) [leaving BigQuery at all. Machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=207.326) [models are brought to where your data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=209.97299999999998) [actually lives rather than hauling around](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=212.194) [huge datasets to where you want to build](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=214.25799999999998) [your ML models. BigQuery ML serves to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=217.34250000000003) [democratize machine learning to an](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=220.27633333333333) [unprecedented degree. In the next module,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=222.87759999999997) [we'll be very hands on. We'll see how we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=225.0786666666667) [can build linear regression, as well as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=227.34900000000005) [logistic regression models using BigQuery ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=aa394841-1505-46cb-a869-d3b34f2623ba&clip=7&mode=live&start=229.34166666666667)

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[Module Overview](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live)

[Hi, and welcome to this module where we'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=0) [see how we can use BigQuery ML to build a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=3.753) [regression, as well as classification](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=6.645) [models. As a student of machine learning,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=9.206666666666667) [these are typically the first machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=11.048) [learning models that you learn and work](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=12.635) [with. And these are the two that are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=15.182125000000001) [supported by BigQuery at this point in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=17.01055555555556) [time. Linear regression tries to find the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=19.254833333333334) [best- fit straight line that fits through](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=21.992571428571427) [your data so you can then use this linear](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=23.99085714285715)[model in order to make predictions. Binary](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=26.55844444444445) [logistic regression tries to find the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=29.344833333333334) [best-fit S-curve on your underlying data.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=31.761714285714287) [Applying a threshold on this curve allows](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=35.078) [you to use this for binary classification. Is the output true or false, 0 or 1?](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=0&mode=live&start=37.322)

[Linear Regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live)

[Now a regression model is what we'd use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=1.815) [with machine learning when the output of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=3.744) [our machine learning prediction is a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=6.04) [numeric value, which can be one of any](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=7.859) [values in a continuous range. When you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=10.17942857142857) [have a relationship such as this, X causes](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=12.77) [Y, you have a cause, which is the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=15.246857142857145) [independent variable, and you have the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=18.118000000000002) [effect. That is the dependent variable. If](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=20.211199999999995) [you want to model this kind of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=22.2565) [relationship, you can use regression as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=23.562) [your machine learning model. The cause](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=26.098) [here is often referred to as an](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=28.401333333333334) [explanatory variable or X variable. Now](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=29.967) [there isn't just one cause in the real](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=33.2684)[world. There can be multiple causes, which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=35.407600000000016) [means you have multiple regression.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=38.00516666666667) [Visualizing linear regression is the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=40.456) [easiest when you have just one cause and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=42.282000000000004) [effect. But remember, this can be extended](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=44.466142857142856) [to multiple X variables or causes. Now if](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=46.292857142857144) [you plot all of the data that you have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=49.5826) [available, this is the training data for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=51.502) [your model, you might get a visualization,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=53.70128571428571) [which looks like what you see on screen.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=55.452333333333335) [When you apply a linear regression model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=57.732499999999995) [to these data points, it involves finding](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=60.260333333333335) [the best-fit line that passes through this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=63.30428571428572) [data, the line that best represents the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=65.99271428571429) [underlying data points. So how do you know](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=68.90699999999998) [which line is the best- fit line, which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=71.71250000000003) [represents your machine learning model?](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=73.582) [Let's compare two lines here. We have line](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=74.99571428571429) [1 and line 2. Both of these are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=77.50242857142858) [represented by the formula, which takes on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=79.70985714285715) [the form A + Bx. Now visually, it's pretty](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=82.22166666666669) [obvious to you that line 1 is a better](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=85.34585714285716) [representation of the underlying data as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=88.03300000000004) [compared with line 2. But how do you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=90.01000000000002) [express this mathematically? The best-fit](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=93.0272857142857) [regression line through your data is found](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=94.913) [by minimizing a function called the least](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=97.10642857142857) [square error. This involves dropping](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=99.58460000000001) [vertical lines from every data point to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=101.44400000000002)[each of the two lines, line 1, as well as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=103.8547777777778) [line 2. The distances of each of these](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=107.72628571428572) [data points from the regression line are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=110.00875000000003) [referred to as errors. So the best-fit](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=112.10366666666667) [line is the one where the sum of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=114.23299999999999) [squares of the lengths of these dotted](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=116.84666666666666) [lines is minimum. The best-fit regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=119.277) [line is set to be 1. That has the minimum](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=121.50999999999999) [value for this least square error. In the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=124.10499999999999) [care of linear regression, once you have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=126.76685714285712) [this regression line, this represents your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=129.07699999999997) [machine learning model. So now in case you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=131.27899999999997) [have an unknown value of X that you feed](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=133.76500000000004) [into your ML model, you can use this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=136.48999999999995) [regression line to find the predicted value, Y.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=1&mode=live&start=139.01000000000002)

[Logistic Regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live)

[Let's now understand logistic regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=1.843) [and how you would use logistic regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=3.728) [for binary classification. You have a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=5.685) [student or an employee working to meet a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=8.487) [deadline. Now there are two extreme](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=11.015374999999997) [approaches that one could follow as far as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=12.784714285714287) [deadlines are concerned. You might choose](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=15.220333333333334) [to start work 5 minutes before the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=17.020999999999997) [deadline. Not much chance of hitting the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=19.075857142857142) [deadline then. Or, you might choose to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=21.3705) [start work 1 year before the deadline.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=23.49911111111111) [That sounds like overkill. It's pretty](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=25.82) [obvious from this example even imputably](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=28.427857142857142) [that neither approach is optimum. Now](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=30.474166666666665) [let's visualize this in the form of a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=33.54366666666667) [graph where on the X- axis you have the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=35.381727272727254) [time to deadline. This is the amount of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=38.23885714285715) [time that remains before the work is due.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=40.69062500000001) [And on the Y axis, you represent the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=42.969) [probability of meeting the deadline based](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=44.84) [on when you start. We'll now plot a few](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=47.488) [points on this graph. Let's say you start](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=50.356) [5 minutes before the deadline. Then there](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=52.929666666666655) [is a 0% probability that all your work](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=55.156) [gets done, which is why this point is off](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=57.416250000000005) [to the bottom left. On the other extreme,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=59.991) [if you start work on your project one year](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=62.25366666666666) [before the deadline, you have a 100%](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=65.14057142857143) [probability of meeting that deadline, but](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=67.56299999999997) [you might not get very much other stuff](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=69.4135) [done because you're so focused on this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=71.81785714285715) [particular job. The two extreme points](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=74.1755) [represent work fast, that is starting 5](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=76.86285714285715) [minutes before the deadline, and work hard](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=79.07514285714284) [when you start 1 year before the deadline.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=81.13600000000001) [But really, the optimal amount of work](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=84.113) [that you need to put in is when you work](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=86.53150000000001) [smart. You want to work such that you have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=89.54100000000005) [a 95% probability of meeting the deadline,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=92.05139999999996) [and you still get a lot of other work](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=94.466) [done. Now if you plot a number of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=96.91760000000004) [different points of this kind on this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=98.62762500000002) [graph, you might find that all of these](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=100.34499999999997) [points can be joined using an S-shaped](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=102.21088888888887) [curve. This is the S-curve. And if you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=105.22033333333337) [drop vertical, as well as horizontal lines](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=107.78375000000001) [from this point, you'll find that maybe 11](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=109.8928) [days is the right amount of time to spend](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=112.90144444444446) [on this particular task. And this is what](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=115.88577777777776) [logistic regression is all about. You'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=118.55733333333332) [find the best-fitting S-curve through all](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=120.8568) [of your data points with probability on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=123.71085714285715) [the Y-axis and your X features on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=125.86657142857143) [X-axis. Going back to our time to deadline](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=130.07425) [example, it's pretty obvious that on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=132.519) [very left side of this graph, there is 0%](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=134.61475000000007) [probability of you hitting the deadline.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=137.73125000000005) [You've started too late. You'll definitely](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=139.718) [miss your deadline. Similarly, on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=141.7722) [extreme right side of this graph, there is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=143.83714285714288) [100% probability that you'll meet your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=146.4554285714286) [deadline. You've started too early. You'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=148.64125)[definitely make it. Somewhere in the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=150.47975) [middle here where the S- curve curves](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=152.51562499999997) [sharply is the working smart region. This](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=154.75824999999998) [is where you have threshold where right](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=158.045) [before the threshold, you may not meet the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=159.9162857142857) [deadline. But right about the threshold,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=162.21542857142856) [you're more likely to meet the deadline](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=163.76571428571427) [than not. And this threshold is the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=165.94957142857143) [probability value to use for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=168.96885714285713) [classification. This threshold might be](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=171.05814285714285) [50%, or it could be any other probability](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=172.58444444444444) [value. If you're working on a real-word](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=175.62675000000002) [problem, for example, you want to classify](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=177.39685714285713) [incoming emails into an inbox as spam or](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=179.60157142857142) [ham. You have email characteristics on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=183.174) [X-axis. You have the probability of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=186.31525) [email being spam on the Y-axis. You'll fit](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=188.30625000000006) [a logistic regression S-curve on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=190.96099999999996) [underlying data, calculate the right](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=193.71799999999996) [threshold value. If the probability output](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=196.04360000000003) [from your machine learning logistic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=198.3585714285714) [regression classifier is a value which is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=200.68560000000002) [below the threshold, you'll classify that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=203.77157142857146) [email as ham. Or if the probability output](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=206.05749999999998) [of your machine learning model is such](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=208.72085714285714) [that it's about the value of the threshold](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=210.9894285714286) [that you've chosen, you'll classify the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=213.08971428571436) [email as spam, any classification model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=215.36228571428578) [including logistic regression, outputs, probabilities.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=2&mode=live&start=218.66520000000003)

[Building Linear and Logistic Regression Models in BigQuery ML](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live)

[We'll now take a look at the steps](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=1.885) [involved in building linear and logistic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=3.550777777777777) [regression models using BQ ML. The very](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=5.798166666666667) [first step that you might want to do is to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=8.791666666666668) [configure Datalab. This step is completely](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=11.388399999999999) [optional though. We won't be using it in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=13.411333333333332) [our first few demos. Datalab is what you'd](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=15.584600000000004) [use if you want to use a mix of Python, as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=17.487000000000005) [well as BigQuery when you build your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=20.10033333333334) [model. You'll then create a dataset within](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=22.417399999999997) [BigQuery that will house your machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=24.672" \t "psplayer) [learning models. Just like tables and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=26.543) [views are held within datasets, machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=28.815) [learning models are as well. You'll then](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=31.170333333333332) [create and train your machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=33.817857142857136) [model using SQL commands. This is the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=35.719) [CREATE MODEL command. You can also specify](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=38.61449999999999) [multiple options for training. Your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=41.26949999999999)[training results will be available in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=43.19042857142857) [BigQuery using ML. TRAINING\_INFO function.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=44.783" \t "psplayer) [Once you have a fully trained model, you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=49.413) [can then evaluate how this model performs](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=51.30428571428572) [using the ML. EVALUATE function. And](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=53.595) [finally, if you have new instances of data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=57.04325) [that you want to use in prediction, you'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=59.097625) [use the ML. PREDICT function in BigQuery.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=61.565250000000006) [We'll quickly look at each of these steps](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=65.039) [in detail so you have a big-picture](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=66.762) [understanding of how BQ ML works. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=68.555) [first step is optionally setting up Google](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=71.598) [Cloud Datalab, which is a very powerful,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=74.01312499999999) [interactive tool hosting a browser-based](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=76.51500000000001) [Jupyter Notebook. Datalab is what allows](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=79.51933333333334" \t "psplayer) [you to build ML models on the GCP. It has](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=82.31699999999998) [libraries for data exploration and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=85.69325000000003) [visualization. It runs on a special](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=87.99974999999999)[virtual machine that host Jupyter](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=90.18312499999999) [Notebooks, and it's fully integrated with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=92.03166666666667) [other GCP services, including BigQuery.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=94.67060000000001) [You can query BigQuery directly from](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=97.06899999999999) [within Datalab, create your model, and use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=100.316) [it for prediction. We're already familiar](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=103.39425) [with the BigQuery datasets. We've used it](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=105.261) [in our demo before. This is a top-level](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=107.672) [container, which is used to organize and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=110.30080000000001) [control access to tables, as well as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=112.55257142857141) [views. Your machine learning models also](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=115.19728571428574) [live within datasets. BigQuery ML assumes](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=117.1378333333333) [that your training data is already](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=120.14185714285715) [available in BigQuery. And you'll create](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=122.4494) [and train your machine learning model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=124.77714285714285) [using the CREATE MODEL command. At this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=126.79028571428572) [point in time, the size of the model that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=129.45888888888888) [you create cannot exceed 90MB. The label](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=131.9712857142857) [for your training data will be available](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=134.88550000000004) [in the form of a column in your BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=136.70133333333334) [table, and this label column cannot](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=139.39416666666668) [contain null values. The CREATE MODEL SQL](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=141.81125) [command is what you'll use to create and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=144.58749999999998) [train your machine learning model, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=146.665) [there are variants available as well. You](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=148.3) [can create or replace an existing model,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=150.449) [or you can create a model if one does not](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=152.82614285714288) [already exist. For every model that you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=156.33944444444438) [create, you need to pass in a number of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=158.39116666666672) [options. The first option is whether it's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=160.67266666666657) [a linear regression or a logistic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=162.24250000000004) [regression model, the name of the column](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=164.4853333333333) [which contains the label values for your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=166.577) [training data, whether you want to apply a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=168.92766666666665) [regularization for your machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=171.39342857142853) [model in order to penalize more complex](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=172.55049999999994)[models so that it better represents your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=174.54214285714284) [data. Regularization techniques are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=177.3695) [something you'd use to mitigate the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=179.091) [overfitting of your model on your training](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=181.28857142857146) [data, meaning you want your model to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=183.46049999999994) [perform well in prediction as well, not](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=185.7135) [just during training. You can specify a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=188.31449999999998) [value for the learning rate of your model.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=190.60150000000004) [You can also specify that your model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=193.095) [should stop early if certain conditions](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=195.54142857142858) [have been achieved. There are other](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=197.70200000000003) [options available as well. If you're](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=199.84399999999997) [starting off with a model that has already](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=201.65724999999998) [had some level of training, you might](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=203.68214285714288) [specify that warm start is equal to true](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=206.05100000000002)[by default. Warm start is set to false.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=208.1728) [Now you'll set this to true if you want to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=211.068) [retrain your model with new training data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=212.795) [or new model parameters. Once your model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=215.669) [has been trained, if you want additional](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=219.32049999999998) [information about the training process,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=221.23714285714289) [the ML. TRAINING\_INFO function will give](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=223.3174) [you this. You can see the number of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=226.21540000000002) [iterations, the loss function. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=228.30214285714294) [evaluate the loss function, check out the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=230.22128571428567) [learning rate, and how long the training](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=232.57842857142853) [process took. You can also use the ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=235.03385714285722) [EVALUATE function in BigQuery in order to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=237.53924999999998) [evaluate how good your model is. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=240.255) [evaluation parameters for linear and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=243.23950000000002) [logistic regression are, of course,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=245.197) [different. There are a number of different](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=247.1678333333334) [evaluation parameters available. All of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=249.026) [these are standard metrics that you'd use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=251.19057142857142) [to evaluate a regression model. For](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=253.22257142857143) [example, the r2\_score here indicates how](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=255.5455) [well your regression model captures the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=258.6487142857143) [variants in the underlying data. The ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=260.873) [EVALUATE function will return different](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=263.7356666666667) [evaluation metrics for logistic regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=265.94239999999996) [models that you'll use for classification.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=268.61942857142856) [These are, again, standard metrics that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=270.968) [you'll use to evaluate classifiers. We'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=272.894) [study some of these metrics in more detail](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=275.4615)[later on in this course. For logistic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=277.5896666666667) [regression classifiers, there are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=280.467) [additional details available as well using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=282.1653333333333) [the ML. ROC\_CURVE function. This is what](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=284.9086666666667) [you can use to study how the different](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=288.0303) [threshold values that you use for your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=289.67228571428575) [logistic regression classifier affects](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=292.2702) [your machine learning model. We'll study](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=294.183) [all of these terms in more detail later on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=296.94649999999996) [in this course as well. Once you're happy](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=299.44100000000003) [with the evaluation results of your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=301.712) [trained model, you'll want to use your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=303.47942857142857) [model for prediction. This is where you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=305.60020000000003) [use the ML. PREDICT function in BigQuery.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=308.22599999999994) [ML. PREDICT can be called during model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=311.247) [creation, after your model has been](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=313.756) [created, or after your model has been](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=315.862) [trained for a couple of iterations. It](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=318.118) [need not have completed its training run](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=320.6632222222222) [successfully. The ML. PREDICT will always](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=323.66777777777776) [use the model parameters from the last](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=325.8907499999999) [successful iteration during the training](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=328.86379999999997) [phase. That's what it'll use to predict](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=330.9836000000001) [your output values. The prediction result](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=333.1607142857142) [will include all of the values in the form](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=335.6099999999999) [of columns that you fed in for prediction,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=338.1547777777776) [including new columns, which are the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=341.126) [predicted values. The columns which hold](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=343.248) [predicted values always have the prefix predicted\_.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=3&mode=live&start=345.914)

[Creating and Loading a Table with Data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live)

[In this demo, we'll see how we can perform](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=1.487) [linear regression on the automobile miles](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=3.547) [per gallon dataset using BigQuery ML. Now](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=6.05) [the Automobile MPG dataset is originally](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=9.457166666666668) [available at this site. I've cleaned up](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=11.8812) [the dataset a little bit, and it's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=14.53625) [available for you in the download of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=16.2755) [resources within the datasets folder.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=18.656000000000002) [We're on the BigQuery web console within](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=20.591) [the spikey-bq project. Let's go ahead and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=22.829) [create a new dataset that will house our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=25.4395) [tables, as well as our models. We'll call](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=27.886599999999994) [this spikey\_automobile. mpg dataset, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=30.8472) [we'll choose the default location for the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=33.092333333333336) [data, which is somewhere in the US. Click](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=35.25314285714285) [on the Create button here, and a brand new](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=37.36450000000001) [dataset will be created. Once you get the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=40.15999999999999) [message that dataset creation has been](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=42.44628571428571) [complete, you can take a look at the job](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=43.861749999999994) [history from the left navigation pane. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=45.77550000000001) [jobs that you see here are from some](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=47.76414285714285) [things that I was trying out earlier. Any](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=50.139) [time you import data into BigQuery,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=52.12575) [BigQuery will run a job in order to load](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=53.94925" \t "psplayer) [in the data. Click on our automobile](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=56.631) [dataset on the left navigation pane, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=58.84499999999999) [you can see the details here on the right.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=60.547714285714285) [This gives you the metadata info for this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=63.268) [dataset. We'll use the CREATE TABLE link](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=65.94888888888893) [here in order to create a new table that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=67.77424999999998) [will house our data. We're going to load](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=69.82188888888888) [data into this table from a CSV file.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=72.50974999999997) [That's the option we'll choose. Click on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=74.899) [the Brown button here. That opens up a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=77.25866666666667) [window that allows you to browse files on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=78.9631111111111) [your local machine. Choose the training](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=81.06400000000001)[data for automobile miles per gallon, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=83.45450000000001) [choose the file format, which is CSV. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=85.79028571428572) [name of this table within this dataset is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=89.48162500000001) [going to be called train because it](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=91.3775) [contains my training data, and I'm going](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=93.201) [to have the schema autodetected from the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=95.06300000000003) [CSV file. Click on the Advanced options](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=97.80624999999999) [here and specify some more configuration.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=100.01414285714284) [Within Advanced options, you can choose to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=102.856) [write to a particular table only if the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=104.805) [original table was empty. You can choose](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=107.049) [to partition the table. Especially if it's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=109.82428571428572) [a time-based table, you might want to have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=111.62049999999999) [partitioning. BigQuery supports just](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=113.88800000000003) [time-based partitioning at this point in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=115.6465) [time. We'll go with No partitioning. If](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=117.60333333333334) [the input file that you're loading in with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=120.77374999999999) [the data has errors, you can specify how](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=122.75762499999999)[many errors you're willing to tolerate.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=124.95971428571428) [You can specify the delimiter for your CSV](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=126.806) [file. I'm going to leave it as Comma. And](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=129.09044444444447) [if your CSV file has header rows that you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=131.47266666666667) [want to skip when you're loading in data,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=133.912875) [you can indicate that here as well along](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=135.715375) [with whether you want to allow quoted](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=138.65125)[newlines or jagged rows. Jagged rows are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=140.466) [rows in your CSV file which may not have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=143.575) [the same number of fields. Click on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=146.076625) [Create table button here. This table will](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=148.51871428571428) [be created and loaded with the data from](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=150.36874999999998) [your CSV file. As you can see here,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=152.63750000000005) [creating a table is a fairly](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=154.72750000000005) [straightforward and a mechanical process.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=156.41266666666667) [For the other demos, we won't show you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=158.901) [this entire process over and over again.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=160.9063333333333) [Instead, we'll assume that the training](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=163.69) [data has been loaded within a train table.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=166.036) [I'll point you to the file that the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=169.003) [training data lives, and you can create a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=170.442) [table within a dataset on your own](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=172.617)[following these exact same steps. Now if](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=174.892) [you take a look at the job history from](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=177.5222) [the left navigation pane, you'll find that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=179.506) [BigQuery has run a new job in order to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=181.812" \t "psplayer) [load in the data into your train table.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=184.1873333333333) [Click on the train table in the left](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=186.39475) [navigation pane, and let's take a look at](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=189.26125) [the schema for our data, which is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=191.276) [available under the Schema tab. Notice all](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=193.5532857142857) [of the field names here. The mpg field](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=195.56842857142857) [that you see here, this is the column that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=198.10971428571426) [will be the label for our machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=200.44999999999996) [model. The miles per gallon for the car is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=202.94039999999995) [what we're trying to predict based on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=205.0690000000001) [other features, which are the X features.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=206.70525000000006) [We'll use values from the other fields,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=209.83) [such as cylinders, displacement,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=211.528) [horsepower, weight, acceleration, and so](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=213.042) [on in order to predict the miles per](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=215.8245) [gallon. If you click on the Preview tab](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=218.54837500000008) [here, this will give you a quick look at](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=220.16524999999993) [what the data looks like in our automobile mpg dataset.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=4&mode=live&start=222.25359999999992)

[Creating and Training a Regression Model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live)

[With our training data now available in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=1.508) [BigQuery, we are now ready to create and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=3.519" \t "psplayer) [train our linear regression model to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=5.823) [perform prediction. We'll do this using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=8.076) [SQL, and we'll use the web console. We'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=10.219) [write the query in here within the query](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=12.99975) [editor. Let's start off with the first](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=14.826857142857143) [statement where we create a new model. Our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=16.894875) [model lives within the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=19.8274) [spikey\_automobile\_mpg dataset and is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=21.005" \t "psplayer) [called spikey\_model. You can use the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=23.330599999999993) [CREATE MODEL command, or you can choose to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=26.31985714285714) [use CREATE MODEL IF NOT EXISTS or CREATE](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=28.618000000000002) [OR REPLACE MODEL. Let's first look at](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=31.893000000000004) [something that is familiar. At the bottom](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=34.15449999999999) [of the SQL statement here, we have a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=35.846999999999994) [SELECT clause. The SELECT clause queries](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=38.67779999999999) [the training data from the train table](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=41.13300000000001) [that we just created. You don't have to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=43.598499999999994) [necessarily use all of the columns in your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=45.99500000000001) [BigQuery table in order to train your ML](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=47.992000000000004" \t "psplayer) [model. You can use the SELECT clause to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=50.1694) [specify both columns that you're](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=52.41112499999999) [interested in. The labels for your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=54.21233333333332) [training data, that's what you're trying](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=56.03099999999999) [to predict here, mpg should also be](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=57.742428571428576) [present as a part of the SELECT clause. In](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=59.79720000000001) [order to make things simple for you,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=62.42142857142858) [BigQuery does a lot of data cleaning and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=64.28033333333333" \t "psplayer)[standardization behind the scenes. Any](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=66.60199999999999) [numeric column values are standardized by](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=68.95616666666668) [default during training, as well as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=71.760125) [prediction. Standardizing numeric values](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=73.93887499999998) [involves subtracting the mean and dividing](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=75.95949999999999) [all of the numbers by the standard](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=78.47485714285715) [deviation so that the resulting set of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=80.94999999999997) [values have a mean of 0 and a standard](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=82.79287499999998) [deviation of 1. When you create and train](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=85.32233333333329) [a machine learning model, the OPTIONS](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=87.32985714285711) [command allows you to configure this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=89.12633333333332)[model. This is where you specify that you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=91.20119999999999) [want to perform linear regression on this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=93.10788888888891) [data. You specify model\_type = linear\_reg.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=95.54383333333334) [You need to specify which of the columns](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=99.689) [from your table form the labels of your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=101.835) [training data. In our case, it's the mpg](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=103.825) [column. For a linear regression model in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=106.80633333333328)[BigQuery, this column should contain only](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=109.22499999999997) [real values, real numbers, and no nulls.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=111.55099999999996) [When you're creating machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=115.176) [models, you typically don't use the entire](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=116.486) [training dataset. You split your training](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=118.713) [data into training and evaluation sets.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=120.781) [You run the training process using the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=124.033) [training set and evaluate your model using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=125.791) [the evaluation set. This data splitting](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=128.299) [can be done in multiple different ways.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=131.39) [We've chosen to split our data at random.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=133.153) [30% of the data, as indicated by the 0. 3](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=136.117) [in data\_split\_eval\_fraction will be used](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=139.29881818181812) [for evaluation, the rest for training. And](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=141.74979999999996) [all you need to do to create and train](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=144.9337) [this machine learning model is to execute](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=146.389) [this query by clicking on the Run query](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=148.953) [button. You have a query validator off to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=151.17166666666665)[the right of your screen, which will tell](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=153.00300000000007) [you how much data will be processed when](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=154.50899999999996) [you create and train this model. Run this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=156.68924999999996) [query, wait for a few seconds, and you'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=159.3375) [find that your new linear regression model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=161.56071428571428) [has been created. You can click on the Go](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=163.5788) [to model button in order to view it. You](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=165.75079999999997)[can see that the left navigation pane has](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=167.8044444444444) [been updated to include this model within](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=170.2068571428572) [your spikey\_automobile\_mpg dataset. Click](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=172.35760000000002) [on the model, and you can take a look at](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=175.5872) [some of the model details available to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=177.54666666666668) [you. This will give you metadata](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=179.91033333333343) [information on the model. You can see that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=181.65442857142864) [the model type is linear regression, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=183.30833333333337) [the loss function that was used was the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=185.12085714285715) [mean squared loss. If you scroll down,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=187.91412500000004) [you'll find the options that you specified](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=189.78850000000003) [during the training phase. Many of these](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=191.6425714285714) [are default options that we didn't](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=193.82462500000003) [explicitly have to indicate. The default](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=195.5712) [number of iterations when you train your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=198.30800000000002) [model is set to 20. But the actual number](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=200.52685714285712) [of iterations that were carried out were](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=202.9708571428572) [just 10. This is because early stop has](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=204.92900000000003) [been set to true by default. Once BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=206.909) [ML felt that the loss value was under an](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=209.69985714285707) [acceptable threshold, the model stopped](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=212.64062499999997) [training. Model stats will give you more](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=215.20559999999995) [detailed information on each epoch or](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=217.5925714285715) [iteration of the training process. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=219.72528571428575) [see that the training data loss trends](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=222.23874999999998) [downward for every iteration of training,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=224.23383333333334) [and this is true of the evaluation data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=226.367) [loss as well. And the Model schema tab](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=228.7514) [will give you the schema of all of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=231.34866666666662)[training features that were fed in to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=233.77724999999998) [train your model. All of this information](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=236.41257142857145) [that we just explored is what you get when](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=238.78428571428574) [you call the ML. TRAINING\_INFO function on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=240.94600000000003) [your model. Once you create and train a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=243.88033333333334) [model using the BigQuery web console, the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=246.25299999999993) [TRAINING\_INFO is automatically available here.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=5&mode=live&start=248.58933333333337)

[Evaluating the Regression Model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live)

[We now have a fully trained model. We can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=0.52) [now see how this model performs when we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=2.7600000000000002) [run predictions on test data. Within our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=5.2355)[spikey\_automobile\_mpg, create a new table](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=8.615) [called test, and this is the table that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=10.532555555555557) [load with data from a CSV file for testing](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=13.069799999999997) [purposes. This file should be available as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=16.242) [auto-mpg-test. csv. Once this file has](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=20.245749999999994) [been chosen, indicate that this is a CSV](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=22.40833333333334) [file. Call the destination table test.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=24.807000000000002) [This is within your spikey-automobile-mpg](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=27.259) [dataset and autodetect the schema from the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=29.624) [CSV file. Click on the Create table button](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=32.017) [to create this test table. Once the table](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=34.669) [has been created and data has been](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=37.599125) [uploaded, you can view the contents of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=39.323428571428565) [this table under your dataset. This test](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=41.58214285714286) [table has exactly the same schema as our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=44.222500000000004) [training data. This is the data that we're](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=47.2145) [going to use for predictions with our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=49.19266666666668) [machine learning model. Use the Preview](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=51.369000000000014) [tab to quickly explore the data and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=53.36662500000001) [satisfy yourself that yes indeed it's the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=55.384) [same kind of data. We'll now use the query](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=57.809999999999995) [editor to run a SQL query to evaluate our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=60.732000000000006) [model. The SELECT \* indicates that we want](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=64.312) [to view all of the fields in the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=66.5025555555556) [evaluation results of our model. We select](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=68.87675000000002) [from the ML. EVALUATE function. The ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=71.09857142857145) [EVALUATE function will evaluate the model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=74.73285714285714) [that we just built and produce a single](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=77.18424999999999) [row of evaluation parameters. This is true](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=79.6782) [for both linear regression, as well as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=82.26385714285715) [logistic regression models. We have to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=84.54399999999998) [select the same columns of data that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=86.65733333333333) [fed into this model during the training](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=88.6325) [process. But this time, this data is for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=90.2578) [evaluation purposes. We use the test](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=93.37633333333335) [table. Run this query, and soon the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=95.85119999999998)[evaluation results of your machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=98.53128571428574) [learning model will be available to you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=99.88214285714288) [here at the bottom of your screen. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=101.684) [see off to the right the r2\_score and the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=104.20044444444443) [explained\_variance metrics. R2 is a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=108.361" \t "psplayer) [measure of the variance in your underlying](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=110.67766666666667) [data has been captured using this linear](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=113.06516666666667)[regression model. And you can see that the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=115.9545) [R2 is around 63%, which isn't great, but](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=118.59880000000003) [it isn't bad either. If you click on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=121.19099999999997) [Job information tab, you'll see that these](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=123.75975000000003) [evaluation metrics are available in the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=125.70400000000001) [form of a temporary table. You can access](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=127.7568888888889) [these evaluation results in the JSON](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=130.5838571428571) [format as well by clicking on the JSON](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=132.41722222222225) [tab. The execution details will show you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=134.6707142857143) [the various stages of your query](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=137.74571428571429) [processing, model building, training, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=139.61)[prediction. You can see we had an input](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=142.11666666666662) [stage, and then there was join stage where](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=145.0032500000001) [a bunch of joins on our data were](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=146.9625555555555) [performed when the ML model was run. And finally, we have the output stage.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=6&mode=live&start=148.89575000000002)

[Predictions and Data Visualization](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live)

[Now that we evaluated our model using ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=0.844) [EVALUATE, let's use the test data for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=3.4934444444444446) [prediction. You can run prediction using a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=7.017555555555553) [previously trained model using the ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=9.267000000000001) [PREDICT function in BigQuery. This will](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=11.531571428571432) [perform predictions using the model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=13.915000000000001) [parameters from the last successful](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=15.795428571428571) [training iteration. We select the data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=18.058333333333334) [that we want to use for prediction using a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=20.511400000000002) [SELECT statement. This is from the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=23.053) [automobile\_mpg. test table that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=25.75614285714285" \t "psplayer)[created. Run this query, and the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=27.834666666666664) [prediction results from your linear](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=29.817714285714285) [regression model will be available to you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=31.227) [right from within your browser. Observe](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=33.485) [that the results here have a column called](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=35.75175) [predicted\_mpg. These are predicted mpg](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=38.329" \t "psplayer) [values that we get from our linear](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=41.05149999999999) [regression model. Right next to it is the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=43.98559999999999) [original value for the mpg that we have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=46.416) [available in our test data. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=49.042500000000004) [eyeball a few of these predictions, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=51.347) [you can see that they're pretty close. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=52.952375) [predicted\_mpg was 22. 3 when the original](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=55.07742857142857" \t "psplayer) [was 21. The prediction was 25. 9 when the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=57.918) [original was around 27 miles per gallon.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=61.73355555555556) [You can view these same prediction results](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=64.357) [in a JSON format as well by clicking on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=66.389) [the JSON tab. You can see the predicted](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=68.77940000000005) [values, as well as the original values](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=70.792) [here. If you want details on how model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=72.86837500000004) [prediction was executed, you can use the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=75.36125) [execution details page. But what's really](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=77.40728571428575) [interesting here is exploring our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=79.197) [prediction results in Data Studio. We](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=81.588) [click on the combo chart because that's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=84.589375) [what we want to display. And within the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=86.524) [dimension and metrics, we can specify what](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=88.502) [we want to view. We'll view our results](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=90.42450000000002) [using horsepower on the X-axis along the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=92.83185714285713)[horsepower dimension because we feel that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=95.80766666666668) [horsepower is an important indicator of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=97.74414285714288) [fuel efficiency or mpg. When you click on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=100.11628571428571) [horsepower, the default display is to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=103.29320000000003) [display the record counts. We'll get rid](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=104.88028571428575) [of this metric here and add a new metric.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=106.76857142857143) [We want to view the miles per gallon based](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=109.965)[on horsepower. That's the metric that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=112.835) [choose, and you can see that our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=114.749) [visualization has been updated to track](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=116.171) [horsepower on the X-axis, acceleration](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=118.306) [using the blue line, and the miles per](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=120.8026) [gallon using the red bars. We're not](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=123.83566666666664) [really interested in the acceleration that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=126.23533333333334) [was added in by default. We'll get rid of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=127.61371428571427) [that field, and instead we'll add in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=129.84066666666666) [another metric, which is the predicted](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=132.4048571428571) [miles per gallon. And this updated visual](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=135.2348571428571) [will show you how well our machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=137.71200000000005) [learning model performed on predictions.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=139.827) [You can see how closely the miles per](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=141.52871428571427) [gallon tracks the predicted miles per](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=144.21314285714283)[gallon bars. You can also see that as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=146.66150000000002) [horsepower increases, the fuel efficiency](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=149.29500000000002) [falls. Let's change the dimension of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=152.17579999999998) [X-axis. Instead of acceleration, we'll go](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=154.95642857142863) [with the weight of a car. We'll see how](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=156.9441428571429) [weight affects fuel efficiency. And once](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=159.56749999999997) [again, you can see as weight increases,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=162.2795) [fuel efficiency falls. And our predicted](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=164.02550000000002) [and actual values of miles per gallon are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=166.47885714285712) [pretty close. Instead of a combo plot, you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=169.09999999999997) [can use a scatterplot to visualize your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=171.09866666666665) [data as well. Just click on the correct](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=173.0481428571428) [icon, and here you see a scatterplot of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=175.59050000000005) [the predicted miles per gallon versus](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=177.251625) [actual miles per gallon. If you hover over](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=179.3065) [a particular point, that will give you actual values for your underlying data.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=7&mode=live&start=181.69762500000002)

[Accuracy, Precision and Recall Using the Confusion Matrix](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live)

[Before we go into how we can use BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=1.185) [ML to build logistic regression models for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=3.474) [classification, let's first see how we can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=6.099) [evaluate classifiers using the metrics](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=8.486) [accuracy, precision, and recall. Assume](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=11.255) [that you have this machine learning model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=13.91925) [that allows you to predict whether a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=15.532571428571426) [particular patient has cancer or not. You](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=17.306142857142863) [feed in a bunch of medical reports to this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=19.18977777777777) [model, but this model is basically an](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=22.188599999999994) [all-is-well classifier. It always](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=25.535750000000007) [classifies your prediction as no cancer.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=27.464499999999997) [This model, as you might imagine, is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=30.334) [pretty useless in the real world. But if](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=32.222142857142856) [you were to evaluate the accuracy of such](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=34.547666666666665)[a model for a rare kind of cancer, you'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=36.715333333333334) [find that the accuracy of this model might](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=39.49275) [be 99. 9999% because in the case of rare](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=42.06733333333333) [cancers in most instances, people do not](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=46.5878) [actually have cancer. Now let's set up a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=49.49000000000001) [confusion matrix in order to formalize](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=51.97425) [some metrics. Along the X-axis, you have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=54.071400000000004)[the predicted labels from your machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=56.73257142857141) [learning models. And along the Y-axis, you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=58.78866666666667) [have the actual labels. You've fed in a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=61.13888888888889) [bunch of different medical reports into](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=63.426000000000016) [your machine learning model, and this is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=65.08566666666667) [how your model classified all of these](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=67.45375000000001) [instances. Now depending on the number of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=69.76899999999999)[output categories for your classifier,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=72.24266666666665) [this matrix can be extended to any number](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=73.77871428571429) [of rows and columns and is called the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=76.404) [confusion matrix. In 10 instances, your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=79.2695) [model predicted that the patient had](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=82.15199999999997) [cancer, and the patient did indeed have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=84.23437500000001) [cancer. The actual label was equal to the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=86.5562857142857) [predicted label. In about five instances,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=89.27960000000002) [your model predicted cancer, but the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=91.264) [patient did not actually have cancer.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=93.56575000000001) [These are false positives where the actual](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=95.212)[label is not equal to the predicted label.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=97.837) [In about 1000 instances, your model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=100.594) [predicted no cancer, and your model was](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=103.22079999999998) [correct. The patient did not have cancer.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=105.58220000000001) [Actual label is equal to predicted label.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=107.27) [These are true negatives. And in about](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=109.566) [four cases, the model has showed us no](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=112.43374999999999) [cancer was present, but the patient indeed](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=114.48100000000001) [did have cancer. These are false](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=116.77099999999997) [negatives, actual label not equal to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=118.87999999999998) [predicted label. Once we have all of this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=121.3545)[information from your classifier, we can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=123.84725000000003) [now evaluate this model using certain](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=125.85657142857143) [metrics. We start off with the accuracy](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=128.23525) [metric. Accuracy is a measure of how many](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=130.98971428571426) [of the predictions your model got right,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=132.99466666666675) [both true positives, as well as true](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=135.957) [negatives. The formula for accuracy is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=138.55749999999998) [defined as TP + TN upon the total number](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=140.678375) [of instances that your model classified.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=143.86850000000004) [For our cancer prediction model here, the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=145.931) [accuracy works out to 99. 12%. If you only](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=148.30371428571428) [look at accuracy as a metric, you might](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=152.40599999999998) [end up being very satisfied with the model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=154.42125) [that you've built. The classifier gets it](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=156.35979999999998) [right 99. 12% of the time, but take a look](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=158.65579999999994) [at all of the miscalculations. There are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=162.41588888888893) [people on chemotherapy, radiation when](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=165.2016) [it's not really required. And there are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=167.119)[other people who require treatment, but](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=169.46442857142856) [haven't received the treatment they need.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=171.3914) [It's pretty obvious that accuracy is not](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=174.196) [really a good metric here. This is because](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=176.302) [the underlying dataset is skewed. There](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=179.05862499999998) [are more instances where people do not](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=181.61314285714286) [have cancer as compared with people who do](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=183.50975) [have cancer. When you're working with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=185.57271428571428) [skewed data, accuracy is not a good](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=187.629) [metric. An alternative metric that might](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=190.37912500000002) [work well is to use precision. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=192.39200000000005) [precision of your algorithm is basically](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=195.17316666666665) [the accuracy of your model when it flags](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=197.23971428571429) [cancer, when it predicts cancer, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=200.24285714285713) [precision can be determined by this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=202.15585714285714) [formula, true positives upon true](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=203.751) [positives plus false positives. Based on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=205.84433333333334) [this metric, the precision of your model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=209.395) [is 66. 67%. Immediately, your model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=211.5388) [doesn't look that good. One in three](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=214.69433333333333) [cancer diagnoses end up being incorrect.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=217.14566666666664) [Another metric that you could use with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=219.535)[skewed data is recall. Recall is defined](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=221.262) [as the accuracy of your model when cancer](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=224.17787499999997) [is actually present. How well is your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=227.81449999999998) [model able to detect cancer when cancer is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=230.68700000000004) [present? For this model, recall can be](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=233.4504) [defined as true positives upon true](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=235.86775000000003) [positives plus false negatives, and it's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=237.8606666666667) [71. 42%. With this recall, your model has missed two out of seven cancer cases.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=8&mode=live&start=241.24799999999993)

[Creating and Training a Classification Model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live)

[In this demo, we'll see how we can perform](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=1.87) [binary classification using logistic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=3.831) [regression in BigQuery ML. Within the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=6.305) [spikey-bq project, we are going to work](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=9.983) [with a new dataset. This dataset is called](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=11.973666666666666) [spikey\_mushroom, and we've already created](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=15.9246" \t "psplayer) [two tables within it loaded with test, as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=17.698999999999995) [well as training data. The process of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=20.438555555555553) [creating this dataset, these tables under](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=23.096500000000006) [this dataset, and loading them with data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=25.352599999999995) [is exactly the same as we've seen before](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=27.536624999999997) [in the previous example. The CSV files for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=30.35188888888889) [this data are available in mushroom\_test](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=33.06699999999999) [and mushroom\_train. csv under the datasets](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=35.898199999999996) [folder. Let's take a look at the schema](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=39.971000000000004) [for the training data and the classifier](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=41.62377777777776) [model that we are about to build. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=43.415142857142854) [see from the schema that we have various](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=45.904222222222224) [information about mushrooms in general,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=47.7804) [and we have a field called CLASS. We are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=49.936125) [going to use the various characteristics](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=53.438142857142864) [of these mushrooms in order to predict the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=54.666000000000004) [CLASS field. The CLASS field categorizes](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=57.8428) [the mushroom as poisonous or edible.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=60.258571428571415) [Exploring the data using the Preview tab](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=63.461) [will give you a better sense for this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=65.63) [data. You can see the various](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=67.61400000000003) [characteristics of mushrooms such as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=69.22128571428571) [CAP\_SHAPE, CAP\_COLOR, BRUISES, ODOR,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=71.148) [GILL\_ATTACHMENT, and so on. We'll use this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=73.18133333333333) [training data to classify mushrooms into](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=76.26714285714286) [two categories, edible or poisonous. There](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=78.61000000000001)[should be only two values when you're](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=81.83975000000001) [performing binary classification. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=83.588) [see from the characteristics of mushrooms](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=86.57914285714286) [that all of this data is present in the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=88.0915) [string format. However, machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=90.81099999999999) [models only work with numeric data. String](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=92.74350000000001) [categories of data are converted to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=96.25833333333334) [numeric form using one-hot encoding.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=98.83285714285714) [BigQuery ML will automatically one-hot](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=101.16980000000001" \t "psplayer) [encode all of this categorical data for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=103.864) [you. Categorical data refers to data which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=107.3975) [has discrete values or categories. True or](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=110.06028571428568) [false, Monday, Tuesday, Wednesday,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=113.827) [Thursday, all of these are examples of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=115.479) [categorical data. We have a field here](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=117.441) [which says whether mushrooms have bruises](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=119.942) [or not. The one-hot encoded representation](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=122.173) [of this field would look somewhat like](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=125.315)[this. If the mushroom indeed has bruises,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=127.72999999999999) [it would be represented by 1, 0. that is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=130.525) [the numeric form. If a mushroom has no](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=133.78660000000002) [bruises, the one-hot encoded feature](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=136.63362500000005) [vector is 0, 1. One-hot encoding is a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=138.83333333333334) [simple and easy technique to convert](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=142.2028571428571) [categorical data to numeric form. Each](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=144.3185) [one-hot encoded vector will have as many](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=147.30900000000003) [elements as there are categories in the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=150.12550000000005) [original field. If you take a look at the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=152.86539999999997) [data in the test table, you'll find that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=155.29863636363635) [the schema for this data is exactly the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=156.93750000000006) [same. This is data that we'll use for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=159.31599999999997) [evaluation and prediction purposes. We can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=161.78575000000004) [now use the CREATE MODEL command as before](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=165.0713333333333) [in order to create a logistic regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=167.51285714285714) [model for binary classification. The basic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=170.1478) [structure of this SQL statement is exactly](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=172.79700000000003) [the same as before with a few differences.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=174.817) [The model\_type option is logistic\_reg. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=177.597) [column that contains the labels for our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=182.476625) [classifier is the CLASS column, which we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=184.231) [examined earlier. And the maximum number](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=187.387) [of iterations that we want to run to train](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=189.21399999999997) [our model is equal to 10. Observe that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=191.54800000000006) [select the training data for this model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=194.27562500000002) [using a SELECT \*. We want all of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=196.60299999999998) [columns in our BigQuery table to be part](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=199.11533333333338) [of the training data. Creating and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=201.67449999999997) [training this logistic regression model is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=203.95499999999998) [simply a matter of executing this query.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=205.93457142857142) [The query will run for a little bit. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=208.658)[time taken to train our mushroom model is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=210.815375) [under a minute. Your model will have been](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=213.13799999999998) [created and will be present under the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=215.11925) [spikey\_mushroom dataset. This is a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=217.179" \t "psplayer) [classifier model. And if you take a look](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=220.79179999999997) [at the model details, you'll see that the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=222.279) [loss function used is different. This is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=224.25871428571426) [the mean log loss. If you scroll down,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=226.99611111111113) [you'll be able to view all of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=229.46633333333332) [parameters that we used to train our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=231.34300000000002) [model. Our classifier model was trained](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=233.66583333333335) [for 10 epochs or iterations. Clicking on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=236.70333333333335) [the model statistics will show you how the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=239.8237142857143) [loss converged to a low value during the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=242.04499999999996) [training iterations, and the model schema](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=244.9665) [will give you the input features that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=246.96750000000003) [use to train our logistic regression model.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=9&mode=live&start=249.27150000000006)

[Evaluating the Classifier and Using It for Prediction](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live)

[Now that we have a fully trained](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=1.319) [classifier model on our mushroom data, we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=3.2273750000000008) [are ready to evaluate this model using the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=5.227333333333335) [ML. EVALUATE function. The structure of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=8.580375) [the SQL query is exactly what we've seen](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=10.814250000000001) [before. We're going to use data from the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=12.958499999999999) [test table for evaluation. The one](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=15.336333333333332) [difference here for a logistic regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=17.728333333333335) [model is that we specify a threshold that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=19.714) [we use to evaluate the model. This is a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=22.230499999999996) [probability score that forms the threshold](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=25.623857142857148) [for our classification. This is what we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=28.038714285714285) [discussed when we first discussed logistic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=30.083500000000004) [regression. Tweaking this threshold score](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=32.22266666666667) [will allow you to determine what](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=34.020333333333326) [probability scores will classify a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=36.49066666666667) [mushroom as either poisonous or edible.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=38.38849999999999) [We'll choose a threshold score close to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=41.15) [50% and see how our model works for this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=43.20625000000002) [threshold. Run this query in order to view](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=46.426222222222236) [the evaluation results. And you can see](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=48.38187500000001) [that we have an accuracy metric here.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=50.98157142857145) [Accuracy predicts how many of our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=53.536) [predicted labels were equal to actual](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=55.705428571428584) [labels, how many of our predictions were](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=57.76199999999999) [correct. Our model has a very high](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=60.242999999999995) [accuracy of 99. 76%. It's a fairly simple](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=63.11100000000001) [dataset after all. The precision score](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=66.26842857142859) [here tells us what proportion of positive](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=68.18457142857142) [identifications, that is mushrooms that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=71.14525) [determine to be poisonous were correct.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=73.18937500000003) [For our model, it was 99. 48%. The recall](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=76.055) [score here tells us what proportion of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=80.01)[actual positives, that is mushrooms that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=82.5035) [were poisonous were identified correctly.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=84.77414285714283) [And here our model did extremely well.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=87.872) [Recall is equal to 1. Let's change our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=90.061) [threshold just a little bit. We'll tweak](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=92.71812499999999) [it downwards to 0. 5. Evaluate the model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=94.89800000000001) [once again, and you'll find that our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=98.1376) [accuracy has fallen just a little bit. Our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=100.37114285714289) [precision has fallen as well. Recall](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=103.17266666666666) [remains the same. What if we adjust the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=105.44024999999999) [threshold to a very high value, such as 0.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=108.23800000000001) [9, which means this classifier will be](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=110.61933333333336) [very conservative in tagging poisonous](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=113.03750000000001) [mushrooms. Let's run this query and take a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=115.78699999999999) [look at the evaluation results. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=118.17300000000003) [see here that this has caused our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=120.48) [precision to go up. When the threshold](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=122.94199999999998) [gets more conservative, you're less likely](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=125.20349999999999) [to get false positives, which means](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=127.12914285714284) [precision for your model goes up. Recall](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=129.09275000000002) [goes down. You'll have fewer false](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=131.709) [positives, but you won't correctly](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=134.145) [identify most of the poisonous mushrooms.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=136.4541666666667) [Recall has fallen. What if you tweak your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=138.732) [threshold downwards so that your model is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=141.606) [not conservative at all? We'll use a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=143.724)[threshold of 0. 1, which means you'll end](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=146.23399999999998) [up tagging many more mushrooms as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=148.56499999999994) [poisonous. When your threshold is less](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=151.10666666666668) [conservative, you're more likely to get](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=153.70666666666668) [true positives. Precision will go down.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=156.14700000000002) [Recall will go up. Precision goes down](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=158.359) [because you tend to make fewer positive](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=161.205) [identifications of poisonous mushrooms.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=163.225) [Now that we've evaluated our model under](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=166.255) [different threshold values, we can now use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=168.324) [the test data to run predictions. We use a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=170.708) [model for prediction as before using the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=174.34824999999995) [ML. PREDICT function. From the prediction](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=176.79540000000003) [results, we are interested in just three](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=179.48025) [fields, the original class which indicates](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=182.18142857142865) [whether the mushroom was poisonous or](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=184.42400000000004) [edible, the predicted class output from](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=186.97566666666663) [our model, and the predicted class output](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=189.47200000000004) [probability. And here is the ML. PREDICT](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=193.0218333333333) [function that we run on the data in the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=195.12500000000006) [test table. Execute this query, and you'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=198.12400000000002) [see the predicted results right here in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=200.15114285714282) [your browser. You can see for the very](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=202.24957142857141) [first row here, the predicted class was](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=204.56033333333338) [edible, the actual class was edible, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=206.99900000000002) [the probability score was 80%. Our model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=209.49716666666666) [says that with 80% probability, this is an](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=212.51985714285715) [edible mushroom. We can take a look at](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=216.11679999999998) [another rule here where the prediction was](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=218.21533333333326) [poisonous. You can see that our model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=220.51599999999996) [predicted that the mushroom was poisonous](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=222.90100000000004) [with 99% probability. And with this, we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=225.85485714285718)[come to the very end of this module where](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=228.39919999999995) [we built two kinds of machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=230.52912500000002) [models with BigQuery. We constructed](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=233.02120000000002) [models for regression, as well as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=235.21380000000002) [classification using just SQL statements.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=237.7395) [We first studied how linear regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=240.162) [works, which servers to find the best-fit](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=241.937) [line for your underlying data. We also](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=244.458) [studied binary logistic regression to find](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=247.40900000000002) [the best-fit S-curve. We also studied in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=250.0934) [detail how we can evaluate classifiers](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=252.61199999999997)[using metrics such as accuracy, precision,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=254.50133333333332) [and recall. In the next module, we'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=257.654) [study in more detail the effect of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=260.1343750000001) [threshold on precision and recall. And](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=262.2252857142856) [we'll also see how we can use BigQuery ML from Cloud Datalab.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=df1d5d19-eac8-4772-af94-3a8b22395c54&clip=10&mode=live&start=264.5606666666667)

[Analyzing Models Using Evaluation and Feature Inspection Functions](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live)

[Module Overview](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live)

[Hi, and welcome to this module where we'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=0) [see how we can analyze the models that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=3.457) [built using the evaluation and feature](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=5.875) [inspection functions. We'll first see how](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=8.379) [we can run machine learning models on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=10.7585) [BigQuery using Cloud Datalab. Cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=13.379857142857144" \t "psplayer) [Datalab is a VM instance on the GCP, which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=15.976222222222223" \t "psplayer) [comes preinstalled with all of the tools](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=18.836714285714287) [that you need for data science and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=20.875444444444444) [analysis. Demos from the last model showed](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=23.608555555555554) [us that ML modeling involves three phases,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=25.67433333333334) [training, evaluation, and prediction.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=28.807199999999995) [BigQuery ML has distinct functions that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=31.663" \t "psplayer) [you can use to get information for each](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=33.85471428571427) [phase. We've already seen some of these](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=37.35862499999999) [functions using BigQuery's web console. We](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=39.38414285714286) [saw hands-on examples for the ML. EVALUATE](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=42.168166666666664) [and ML. PREDICT functions. We'll see some](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=44.76199999999999) [additional functions in this module](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=47.77914285714285) [including ROC curves that we can use to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=49.53175) [evaluate classification models. ROC curves](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=52.8855)[will also allow us to study the precision and recall metrics in more detail.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=0&mode=live&start=55.546)

[Creating and Connecting to a Datalab Instance](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live)

[In this demo, we'll see how we can use](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=1.862) [Cloud Datalab to work with BigQuery ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=3.801) [We'll also see some of the feature](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=6.587) [inspection functions executed on Cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=7.955) [Datalab. Using the BigQuery web console,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=10.887500000000003" \t "psplayer) [we've already set up all of the data that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=13.136) [we need in order to build this ML model.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=15.014) [We've created a new dataset called](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=18.527) [spikey\_automobile\_price. And within that,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=20.283" \t "psplayer) [we have the test and train tables. We've](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=22.810999999999996) [loaded these tables with data, which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=25.229666666666667) [contains information for automobile price](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=27.3464) [prediction. The original source for this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=29.476666666666667) [data is this URL here. The data that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=31.46483333333333) [loaded into the test and train tables are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=34.398777777777774) [available in these CSV files under your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=36.616) [datasets folder. The schema for the test](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=39.876999999999995) [and training data are exactly the same.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=42.490374999999986) [Let's take a look at the schema of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=44.465) [training data so that we know what fields](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=45.735) [we are working with. You can see that the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=47.731) [records in this table contain information](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=49.447) [about specific automobiles.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=51.767) [Characteristics of the automobiles, such](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=53.258) [as symbolling, make, fuel type,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=55.321999999999996) [aspiration, etc. make up the features of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=57.627) [our dataset. We'll use all of this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=60.017) [information to build a regression model to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=62.41) [predict the price of these automobiles. In](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=64.924) [order to work with Cloud Datalab, we first](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=67.9437142857143) [need to create a Datalab instance, which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=70.117) [we'll do using Cloud Shell. I'll maximize](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=72.54033333333334) [the Cloud Shell terminal window and set](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=75.47866666666667)[the current project to be spikey-bq. We'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=78.21333333333334) [use the gcloud command line utility that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=81.34642857142858) [comes preinstalled on our Cloud Shell](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=83.89785714285715) [terminal to create a Datalab VM instance.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=85.871) [We'll first update all of the components](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=89.074) [installed using gcloud components update.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=90.971) [Our components are up to date. Let's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=95.006)[install the Datalab command using gloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=96.97216666666667) [components install datalab. That's present](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=99.553) [as well. We'll now create a datalab VM](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=102.4885) [instance using the datalab create command.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=105.82085714285712) [We'll call our VM instance spikey-datalab.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=108.396) [You need to specify a zone where this VM](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=112.273) [instance will be located. Choose a zone](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=114.281) [that's convenient for you. I'm just going](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=116.91614285714286) [to go with us-east1-b. I've chosen option](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=119.3977142857143) [1. I hit Enter. And you might have to wait](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=122.49950000000001) [for a couple of minutes for your Datalab](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=125.091) [instance to be up and running. GCP will](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=127.011) [create the VM instance, install Datalab,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=130.05100000000002) [and set up an SSH connection to your VM](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=132.12328571428574)[instance. All of this takes a while. And](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=135.61339999999998) [once Datalab is up, you can use this Web](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=137.71555555555554) [preview button on the top right in order](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=140.2195) [to connect to Datalab. We'll change the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=142.5586) [port and set it to 8081, and you'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=145.12100000000004) [connect to Datalab on port 8081. Datalab](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=148.2495) [will open up a Jupyter/IPython Notebook](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=151.1865) [interface on a new browser window. Let's](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=153.79500000000002) [go back to the previous browser tab where](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=157.237875) [we were logged into the GCP web console.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=159.336) [We'll use the hamburger icon on the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=161.736) [navigation menu to navigate to the VM](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=163.617) [instance's page. We'll see the VM instance](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=166.644) [where Datalab was set up. You can see that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=169.409) [one Compute Engine instance is now](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=172.20199999999997) [running. This is our Datalab instance, spikey-datalab.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=1&mode=live&start=174.515)

[Using Cloud Datalab to Build BigQuery ML Models](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live)

[If you've worked with Jupyter Notebooks on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=1.572) [your local machine before, the Datalab](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=3.362) [environment should seem very familiar to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=5.607333333333333) [you. Click on the notebooks folder here.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=7.542857142857144) [And within here, we are going to create a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=9.63) [new Jupyter Notebook. Jupyter Notebooks](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=12.1115) [are basically a browser- based interactive](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=14.076333333333334) [shell where you can execute code within](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=16.390333333333334) [cells and see the results right here on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=18.933428571428568) [screen. It's typically used with Python,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=22.238799999999998) [but it can work with other languages as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=24.010250000000006) [well. And especially if you're using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=26.09666666666667) [Datalab Notebooks, there are in-built](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=28.122166666666672" \t "psplayer) [connectors available to other GCP](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=30.687200000000004) [services, such as BigQuery as you'll see](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=32.9976) [in just a bit. Let's rename our notebook](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=34.965199999999996) [to something meaningful. I'm going to call](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=37.656) [this the Spikey\_Automobile\_Price notebook.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=39.611999999999995) [In order to access BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=42.706) [programmatically using Python client](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=44.27) [libraries, you'll need to install the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=46.491) [Google Cloud BigQuery Python package,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=48.883) [which you can do with a simple pip](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=51.321) [install. Use the exclamation point when](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=54.20099999999999) [you're running pip install from within](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=55.81516666666666) [your Jupyter Notebook. Hit Shift+Enter to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=57.383500000000005) [execute the code in this cell, and you'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=60.282) [find that this library has already been](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=62.23457142857143) [installed. Import the BigQuery module from](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=64.75766666666667) [google. cloud and instantiate a BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=67.275) [client. You'll do this using the bigquery.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=70.08642857142854) [Client function. Jupyter Notebooks allow](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=73.62174999999996) [the use of magic functions prefixed by the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=75.59499999999998) [percent sign. Now BigQuery queries can be](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=78.84300000000002) [run using these magic functions. You first](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=81.58737500000001) [need to enable them using the load\_ext](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=84.07542857142859)[magic function, %load\_ext google. cloud.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=87.30133333333335) [bigquerry. BigQuery magic functions have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=91.037" \t "psplayer) [been loaded and are ready to write some](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=93.33200000000002) [queries. All of your queries should be](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=95.92771428571425) [prefixed with a double percent and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=97.90875) [bigquery. Let's run a CREATE MODEL](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=100.93439999999998" \t "psplayer) [statement in order to set up an automobile](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=103.02012499999998) [price prediction regression model. Within](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=105.87457142857143) [OPTIONS, we specify that the model type is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=108.22625) [linear regression, and the label column is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=110.86625000000002) [the price column. The training data will](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=113.40700000000002) [include all of the fields in the train](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=116.092) [table except for the engine\_location field](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=118.431) [because we don't feel it's pertinent to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=121.228) [predicting the price of the automobile.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=123.012) [Select all fields except the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=126.021) [engine\_location from the spikey-](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=127.616" \t "psplayer) [automobile\_price dataset in the spikey-bq](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=129.645" \t "psplayer) [project. The table that you want to access](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=132.5658333333334) [is the train table. We'll use the WHERE](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=134.32600000000005) [clause to filter out all records, which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=137.302) [might have null filled values. Executing](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=139.5798571428572) [this cell using Shift+Enter will actually](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=142.67433333333338) [execute this query on BigQuery and create](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=146.15560000000005) [and train your machine learning model.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=148.7715) [Once your train model has been created,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=151.463) [you can access the training parameters](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=153.802) [using another BigQuery query. We SELECT \*](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=155.995) [from the ML. FEATURE\_INFO function. This](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=159.86274999999995) [function will return all of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=162.75042857142856) [information that you need about the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=164.049) [features used to train this model. Observe](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=165.727) [that the result of this query contains all](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=169.455) [of the input features from our train](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=171.63524999999998) [table. ML. FEATURE\_INFO also gives you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=174.26049999999998) [statistical information about all of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=177.62983333333332) [input values, such as min, max, mean,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=179.72812499999998)[standard deviation. If your features](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=181.927) [contain categorical data, you get a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=184.476) [category count for each bit of categorical](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=186.474) [data as well. You can see here that there](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=189.343) [are 16 makes of cars represented in our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=191.67) [dataset. Numeric features will contain](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=195.7215555555555) [values for min, max, mean, and standard](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=197.87133333333333) [deviation. Information about the training](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=201.4313333333333) [phase of the model can be accessed using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=203.11957142857145) [the ML. TRAINING\_INFO function. This was](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=205.38666666666663) [available directly within the BigQuery web](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=208.70533333333333) [console. Here we have to specifically run](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=210.97199999999998) [a query. The resulting table will give you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=213.63175) [all of the information for each epoch of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=215.89749999999992) [training, the loss value, the duration,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=218.90028571428576) [the learning rate, etc. We'll now evaluate](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=221.451) [the regression model that we just created](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=225.01999999999998) [on our automobile price prediction](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=227.2001428571429)[dataset. We run evaluation using the ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=229.3443333333333) [EVALUATE function, and this is something](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=232.50528571428566) [that you've seen before. The data that we](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=233.8998571428572) [use for evaluation is from the test table.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=235.89299999999997) [And here are the evaluation metrics for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=239.516) [the regression model. You can see the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=241.91699999999992) [r2\_score there, which is about. 45. Not](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=244.84342857142855) [really that great. We'll now use our test](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=247.601) [dataset for prediction using the ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=250.5938571428571) [PREDICT function, and this is a function](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=252.94900000000004) [that we are familiar with. We'll display](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=255.2875) [the information from just two fields in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=257.50899999999996) [the prediction results, the predicted](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=260.0684) [price and the actual price. The SELECT](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=261.95314285714284) [query that we'll use to feed in the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=264.78655555555554) [prediction data is very similar to the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=267.053625) [ones that we use for training, as well as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=268.822) [evaluation. We'll retrieve these records](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=272.59749999999974) [from the test table. And here are our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=275.01050000000004) [predicted results showing the predicted](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=278.19885714285726) [price versus the actual price. You can see](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=280.0707142857143) [that for this particular dataset, the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=283.22571428571433) [predictions are not really that close. You](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=284.93533333333335) [can view more details about the regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=288.1315714285715) [model that we just built using the ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=291.1187142857143) [WEIGHTS function. This is the function](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=294.2496666666666) [that you can use in order to view the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=296.14288888888893) [model parameters and the weights](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=298.34749999999997) [associated with each input feature. For](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=300.0486666666667) [each input that was processed, we'll print](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=303.0235) [out the corresponding weight. The ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=305.73333333333335) [WEIGHTS function allows you to retrieve](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=308.1954285714286) [the weights of the model parameters used](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=310.1965)[by your regression model during](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=312.7996666666666) [prediction. The resulting table will give](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=314.9472) [you the process inputs and the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=317.60999999999996) [corresponding weights. Some of the weight](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=319.404) [values are NaNs, indicating that those](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=322.1281428571429) [features were not really used during](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=324.12000000000006) [prediction. And some weights are rather](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=326.6795000000001) [high, indicating that these are important](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=328.4923333333333) [features to predict the price of an](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=330.342) [automobile. A negative weight indicates](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=332.87600000000015) [that that feature has a negative](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=334.3533333333334) [correlation with automobile price as in the case of the height of an automobile.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=2&mode=live&start=336.42299999999994)

[The ROC Curve](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live)

[When you're evaluating classifiers, the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=1.941) [ROC curve, or the receiver operating](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=4.193428571428571) [characteristic curve, is an important](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=6.626) [concept to understand, and that's what](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=8.917666666666667) [we'll study in this video. We start off](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=10.733857142857143) [with the confusion matrix that we've seen](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=12.474000000000002) [before. This is what we use to calculate](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=14.497166666666669) [precision, as well as recall. We know that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=16.732999999999997) [linear regression tries to fit an S-curve](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=19.422875) [on our data, and we use a threshold with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=21.20722222222222) [this S-curve in order to classify our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=24.093142857142855)[predictions. No cancer on one end, cancer](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=27.068) [on the other. We've seen that this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=29.674666666666667) [threshold is something that we can create](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=31.750000000000004) [in order to find the model that works well](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=33.45522222222222) [for us. Let's say that we have an always](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=36.081) [negative classifier where Pthreshold is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=38.96087499999998) [equal to 1. The threshold is very, very](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=40.645428571428575) [conservative. If you set your threshold to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=43.74333333333333) [1, this model will always predict no](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=45.80428571428573) [cancer, which means the recall for this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=48.416428571428575) [model is 0. There are no cancer cases](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=51.00533333333334) [detected by this model. The precision for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=53.68722222222221) [this model is infinite. Such a classifier](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=56.17399999999999) [at this extreme value of threshold is too](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=58.754875) [conservative. Let's take a look at a curve](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=62.50900000000001) [that will tell us how the value of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=64.50529999999999) [precision metric for our model changes](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=67.02671428571429) [with the conservativeness of the decision](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=69.16083333333333) [threshold. If the threshold is too](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=71.2455) [conservative, the precision of our model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=73.82266666666666) [will turn to infinity. Our model always](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=76.1968) [says no cancer. As the threshold becomes](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=79.056) [less conservative, the precision of our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=82.23533333333333) [model falls as more false positives are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=84.41749999999999) [identified. At the other extreme end, you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=87.68599999999999) [could have an always positive classifier](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=89.65466666666666) [where your threshold value is essentially](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=91.66799999999998) [0. Such a classifier will always see](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=94.99600000000001) [cancer. The recall for such a classifier](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=98.72614285714283) [is 100%. You would catch all of the cancer](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=101.08975) [cases, but the precision will be very,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=103.84425000000002) [very low, which makes sense because you'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=105.84949999999998) [have many, many false positives. In such a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=107.9774285714286)[case, you'll see that your classifier is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=110.969) [not conservative enough. If you plot](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=112.8906) [recall versus the conservativeness of your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=115.689) [threshold, this is what the curve looks](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=118.28175) [like. The recall value will be very, very](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=120.78999999999996) [high when your classifier is not](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=123.28728571428572) [conservative enough. As your classifier](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=125.533) [gets more conservative, recall will fall.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=127.80199999999999) [More conservative classifiers will](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=130.799) [definitely miss more instances where](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=132.765) [cancer is actually present. And here is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=134.96583333333334) [where the tradeoff lies when you're](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=137.721875) [evaluating classifiers. There is a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=139.63166666666666) [precision recall tradeoff because this is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=142.104) [how the curves look. And this is exactly](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=144.424) [what we saw when we tweaked the threshold](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=146.88933333333333) [in our logistic regression demo. As you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=149.09549999999996) [increase the Pthreshold value, precision](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=152.23100000000002) [increases, but recall falls. As you reduce](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=155.06075) [the threshold values, recall increases,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=157.59) [precision falls. If you plot recall versus](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=160.176) [precision on the X and Y-axis, the curve](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=163.403) [that you get looks like this. Given that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=166.47050000000002) [there is a tradeoff between precision and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=169.29671428571427) [recall, if you want to choose a model,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=171.23875) [there are a few heuristics that you can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=173.14925) [use. The first of these is the F1 score.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=175.15254545454547) [This is the harmonic mean of precision and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=177.927) [recall. Another possible heuristic is the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=180.89144444444455) [ROC curve. This is where we plot a curve,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=183.82700000000003) [which will allow us to maximize true](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=186.359) [positives and minimize false positives.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=188.376) [We'll quickly look at the F1 score first.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=191.633) [The F1 score is calculated using this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=193.975)[formula, precision multiplied by recall](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=196.88066666666668) [upon precision plus recall, the whole](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=199.4518) [thing multiplied by 2. This is a formula](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=202.35266666666666) [that gives us the harmonic mean of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=205.07000000000005) [precision and recall. The F1 score will be](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=207.21099999999996) [closer to the lower of the two values.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=209.79150000000004) [This favors even tradeoff. You'll pick](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=212.18057142857143) [that model which has the higher F1 score.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=214.44775) [The ROC curve is another heuristic that](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=218.595) [you can use. This involves setting up a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=220.69412499999993) [graph where you plot the false positive](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=223.30387500000006) [rate on one axis and the true positive](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=225.34150000000005) [rate on another axis. It's pretty obvious](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=228.15050000000005) [that we want our classifier to have a true](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=230.37628571428573) [positive rate as high as possible and a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=233.52125)[false positive rate that is as low as](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=236.57087500000003) [possible. We can run evaluation on our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=239.74799999999996) [model multiple times, and for different](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=242.05300000000005) [values of Pthreshold, we'll plot the true](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=244.18433333333334) [positive rate versus the false positive](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=246.93466666666671) [rate, and this will give us the ROC curve.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=249.5406666666666) [ROC stands for receiver operating](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=253.078) [characteristics. We'll evaluate the model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=256.33466666666664) [for different values of Pthreshold and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=258.42999999999995) [plot the different true positive and false](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=260.7862857142856) [positive rate. This will give us the ROC](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=263.8146666666667) [curves for different values of Pthreshold,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=266.1912500000001) [and we'll pick the top-left corner point.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=268.798) [This is the point which has the highest](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=271.625) [true positive rate and the lowest false](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=273.594)[positive rate. When we use machine](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=276.125) [learning in BigQuery, the ML. ROC\_CURVE](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=279.42385714285723) [function will give us all of this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=281.79299999999995) [information. Custom thresholds can be](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=284.73400000000004) [used, true positives, false positive rate,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=286.35420000000005) [all of that is available using the ML. ROC\_CURVE.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=3&mode=live&start=289.071)

[Exploring Adult Salary Data for Classification](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live)

[In this demo, we'll view the metrics for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=2.148) [logistic regression using the ROC curve.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=4.334) [This is the ML. ROC\_CURVE function that is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=7.479) [available in BigQuery. Under the spikey-bq](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=9.733) [project, we've created a new dataset](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=13.083749999999998) [called customer\_personal\_data. Within](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=15.225) [this, we have two tables, test and train.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=17.878333333333334) [These tables contain information that have](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=20.881) [been loaded in from the adult salary](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=22.638) [dataset, which is originally available at](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=24.924) [this URL here. We've split the dataset](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=27.261) [into test and training. Customer\_test. csv](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=30.404) [has been loaded into the test table.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=32.942571428571426) [Customer\_train. csv has been loaded into](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=35.378" \t "psplayer) [the train table. These files in your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=37.822399999999995) [datasets folder have a few additional](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=40.17099999999999) [columns that are not present in the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=41.87728571428572) [original source. Those are the columns](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=44.3165) [that we'll use in our demo. We'll quickly](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=46.42680000000001) [look at the schema of the training data.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=48.788) [You can see all of these fields that are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=50.74475) [available, the working class, education,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=53.597750000000005) [the number of years of education, marital](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=55.115142857142864) [status of adults. We'll use all of this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=57.88571428571428) [information to predict the income for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=60.55914285714287) [individuals. We'll predict whether the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=62.789599999999986) [income is greater than $50, 000 or less](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=64.19528571428572) [than $50, 000. The extra column that has](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=67.36787500000003) [been added to this data is the split](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=70.16550000000004) [column. This column pulls Boolean values,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=72.69250000000001) [and the values are used to split the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=75.402) [dataset into training and evaluation](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=77.186) [datasets. If you explore this data using](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=80.191) [the Preview tab, you'll see that the split column contains true/false values.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=4&mode=live&start=82.37974999999997)

[Evaluating Classifiers Using the ROC Curve](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live)

[We'll build a logistic regression model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=1.683) [using the adult salary dataset on Cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=3.518) [Datalab. We'll work with the Datalab](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=6.773875000000002" \t "psplayer) [Notebook named Customer\_Personal\_Data.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=8.679714285714285) [Make sure you perform a pip install on](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=11.701) [google-cloud-bigquery in order to install](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=13.587) [the Python packages that we need. Once](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=15.895) [again, we'll set up an import statement](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=18.637285714285714) [from the BigQuery module and set up a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=20.413857142857143) [BigQuery client. We'll also load in all of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=23.267500000000002" \t "psplayer) [the magic functions that will allow us to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=25.5475) [run queries from within Datalab. We'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=27.707500000000003) [build and train a logistic regression](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=30.633000000000003) [model on salary data in the usual way. We](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=32.505) [use SQL statements, the CREATE OR REPLACE](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=36.062571428571424) [MODEL. We'll create a new model if it](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=38.356375) [doesn't exist already or replace an](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=40.87271428571428) [existing one. The OPTIONS command gives us](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=42.683) [the parameters of our model. You can see](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=45.957) [that the model type is logistic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=48.082) [regression, and the label that we use for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=49.586) [this regression model is the income field.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=52.089) [We also specify some additional options](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=55.323) [here, such as the learning rate for our](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=57.266) [model, which is set to. 15 and the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=59.354) [data\_split\_method. We use a custom split](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=61.888" \t "psplayer) [mechanism to split our data into training](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=65.136) [and evaluation sets. Our custom split](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=67.46) [mechanism is based on the values that are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=70.318125) [available in the split\_col that we saw in](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=73.14871428571428) [our schema. Here are the training features](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=76.53366666666666) [that we use for our classification model,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=78.34137500000001)[the age of the person, the number of years](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=80.29428571428569) [of education, the marital status,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=82.54642857142854) [occupation, and so on. This data is](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=84.81339999999999) [received from the train table under the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=87.3016666666667) [customer\_personal\_data dataset. Hit](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=89.828" \t "psplayer) [Shit+Enter to create and train our model.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=93.06637500000001" \t "psplayer) [In order to view the features that we'll](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=95.589) [use to train our model, we use the ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=97.147) [FEATURE\_INFO function. Here are all the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=99.88266666666667) [features displayed as a table along with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=103.00900000000001) [statistical information. You can see here](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=105.31000000000002) [that marital\_status has a total of seven](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=107.50249999999998) [categories. The average number of hours](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=110.63650000000001) [that a customer worked was about 40. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=112.62925) [maximum was 99 hours per week. The](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=116.18585714285713) [training info will tell us how our model](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=119.24249999999999) [performed during the different epochs of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=121.14999999999999) [training available using ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=123.357) [TRAINING\_INFO. Our model was trained for a](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=125.0435) [total of five iterations or five epochs.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=128.88911111111113) [You can see that the loss value steadily](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=131.315) [falls. Let's now evaluate our classifier](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=134.25633333333343) [using the ROC curve. This is available](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=136.6197142857143) [using the ML. ROC\_CURVE function. The data](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=139.27300000000005) [that we'll use for evaluation is available](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=144.19475) [in the test table. You can see from the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=146.2556) [result here that the ML. ROC\_CURVE](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=149.28488888888884) [function applies a number of different](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=151.07685714285714) [threshold values on our model. And for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=153.792) [each of these threshold values, it](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=156.7952857142857) [calculates the recall, the false positive](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=158.76425) [rate, true positives, false positives, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=160.976) [all other details. The evaluation started](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=163.8015) [off at a threshold value of about. 84, and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=166.44657142857142) [it steadily falls. This table shows you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=170.25512499999996) [very clearly that as the decision](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=173.134) [threshold becomes less conservative,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=175.337) [recall improves. More of the actual](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=177.39166666666668) [positives are tagged, and the false](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=180.22671428571425) [positives also tend to increase. After](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=182.574) [having evaluated the model, let's use this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=185.1872)[model for prediction. We want the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=187.84099999999995) [predicted income and the actual income,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=189.8385) [and we'll use the data from the test](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=191.71912500000002) [table. And here are the predicted values](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=193.92700000000002) [versus the actual values, whether the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=197.0098) [income of the adult was less than 50, 000](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=199.38) [or greater than 50, 000. If you want to](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=202.30462500000004) [know which of the input features were](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=205.34888888888884) [imported or significant for this](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=206.94966666666667) [prediction, we can use the ML. WEIGHTS](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=208.84588888888888) [function. We'll select the process\_input](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=211.69411111111108) [and the weight associated with it. You can](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=213.365) [see from the weights displayed on these](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=216.69275000000002) [results that the most significant](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=218.37566666666666) [predictors of income were the age of the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=220.134) [individual, the number of years of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=222.777) [education that he or she had, and the number of hours per week they worked.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=5&mode=live&start=224.605)

[Summary and Further Study](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live)

[And with this, we come to the very end of](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=2.206) [this module where we saw how we could](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=4.268) [analyze and evaluate our models using the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=6.018) [different BigQuery functions available. We](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=8.944) [performed all of our model creation and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=11.697125) [execution using Cloud Datalab, which](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=13.567) [offers hosted Jupyter Notebooks, which are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=16.525)[integrated with other GCP services. Magic](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=19.242714285714285) [functions allow you to run SQL queries](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=21.87814285714286) [from right within Datalab Notebooks. We](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=24.195) [also studied in detail the information](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=27.362285714285715) [available using the following BigQuery](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=29.266) [functions, ML. TRAINING\_INFO, ML.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=31.543) [FEATURE\_INFO, and ML. WEIGHTS. We also](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=34.2914) [studied additional ways to evaluate](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=37.93814285714285) [classifiers using the ROC or the receiver](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=39.681) [operating characteristic curves. We saw](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=42.81) [how the precision and recall metrics](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=45.89775)[change with the change in the](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=47.844) [conservativeness of the decision](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=49.348) [threshold. And this brings us to the end](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=51.60879999999999) [of this course on BigQuery ML. If you're](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=53.8661111111111)[interested in other GCP technologies, here](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=56.420142857142864) [are a few courses on Pluralsight that you](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=58.520250000000004) [might want to watch. Designing and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=61.318000000000005) [Implementing Solutions Using Google Cloud](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=63.883199999999995) [AutoML will show you how you can build](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=65.908" \t "psplayer) [complex ML models on the cloud without](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=68.71125) [having to write any code. Designing and](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=71.08916666666667)[Implementing Solutions Using Google](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=73.9986) [Machine Learning APIs will show you how](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=75.69914285714286) [you can use APIs to access the predictions](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=78.20587499999999) [from pretrained models for vision,](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=81.06819999999999) [translation, speech, text, and more. If](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=83.4485) [you want to programmatically build your](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=86.7792857142857) [own custom machine learning models, here](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=88.299) [are a few courses that you can start off](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=90.91277777777778) [with. Understanding Machine Learning with](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=92.9706) [Python and Building Machine Learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=94.94266666666667) [Models in Python with scikit-learn are](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=96.891) [both introductory machine learning](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=98.95671428571431) [courses. And on this note, it's time for](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=101.44975000000001) [me to say good-bye. That's it from me here today. Thank you for listening.](https://app.pluralsight.com/player?course=sql-bigquery-ml-building-machine-learning-models&author=janani-ravi&name=8ab354ac-af53-48a8-879a-87e9d20aebe6&clip=6&mode=live&start=103.94081818181822)