

Confusion Matrix in Machine Learning with Real Examples Explained

The performance of a model in machine learning can be better explained using the confusion matrix. It displays correct and incorrect predictions. Which a model is trained to improve upon by noticing where it gets something wrong So, in layman terms (as the title also suggest) – the confusion matrix in machine learning helps you to see if your model is right or wrong and how many times. It displays accuracy, precision, and recall numbers in a very simple format.

Confusion Matrix in Machine Learning

This makes the very concept of prediction an important subject to better know what is the true capability of prediction. The confusion matrix is a simple table but it says everything about your model's results.

What is a Confusion Matrix?

The confusion <u>matrix</u> is basically a table. It explains how does your machine learning model works. The table has four numbers. They are True Positive, True Negative, False Positive and False Negative. These figures give an idea of how many results are correct and how many are not.

There's a process when you train a model where it predicts. Some predictions are right. Some are wrong. You're counting each kind with a confusion matrix. If this tells how the model is performing against a test data.

For example, assume that your model predicts whether a student passes or fails. This confusion matrix will indicate the number of correct predictions of pass, correct prediction of fail, the number of wrong predictions. You can then fix the model.



	Confusion Matrix In Machine Learning Actual			
– Predicted –		Corona Positive	Corona Negative	
	Corona Positive	True Positive	False Positive	
	Corona Negative	False Negative	True Negatives	



Here is what each term means:

Term	Meaning	
True Positive (TP)	Model predicted pass, and student really passed	
True Negative (TN)	Model predicted fail, and student really failed	
False Positive (FP)	Model predicted pass, but student failed	
False Negative (FN)	Model predicted fail, but student passed	

The matrix shows all of this in one chart. That is why people use it for all kinds of models, especially in classification tasks.

Confusion Matrix Example using Real Data

To make it easier, let's take a real confusion matrix example. The real-world example of the Matrix will show you the practical use of the Matrix in real life.

Confusion Matrix in the Real World

Consider a scenario where a doctor uses a <u>model</u> to predict whether a person has a disease. Model verifies the scrutinized tests and predicts whether yes or no. Let's take this data:

Actual / Predicted	Diseas	se (Yes)	Disease	(No)
Disease (Yes)	50		10	
Disease (No)	5		35	

From this, you can get:

- True Positive (TP): 50
- False Negative (FN): 10
- False Positive (FP): 5
- True Negative (TN): 35

This means that the model got 50 actual disease cases correct. It missed 10 real cases. It falsely reported that 5 individuals had the disease, which they did not. And it had 35 healthy, and they were healthy.

This matrix gives the doctor some idea of whether the test works. Neither respect nor regrets for the nulls: If the doctor sees many False Negatives then he may lose faith in the model. That could be dangerous. So the confusion matrix case study actually aids real <u>decision making</u>!

You can use it in schools to determine whether students pass or fail according to the time spent on studying. In banks, it can determine whether someone will pay back a loan. Which lets you know if your prediction is good or bad whenever you predict.

Step-by-Step Guide to Read a Confusion Matrix



Confusion matrix is a very important topic for many beginners on Machine Learning so lets discuss how to read confusion matrix. This is not difficult at all if you follow steps. You have to know what the four numbers represent and how to use them.

Reading the Matrix One Step at a Time

So first draw the matrix with the following four quadrants:

	Predicted Yes	Predicted No
Actual Yes	TP	FN
Actual No	FP	TN

Now follow these steps:

- 1. Count the number of correct predictions (TP + TN).
- 2. Count the number of incorrect predictions (FP + FN).
- 3. Add all values to get total predictions.
- 4. Use formulas to find accuracy, precision, and recall.

Let's use the earlier example again:

- TP = 50
- TN = 35
- FP = 5
- FN = 10

Total predictions = 50 + 10 + 5 + 35 = 100Correct predictions = TP + TN = 85Wrong predictions = FP + FN = 15

Now you can read the result of the model. It was accurate 85% of the time. So you can say the model is 85% accurate.

This way, anyone can see model performance. Understanding confusion matrix helps you to rectify your model to decrease the hiccup cases.

Confusion Matrix and Metrics for Its Performance

The matrix aids in calculating various scores. These metrics are confusion matrix accuracy, precision, recall, and F1 score. These tell you more than what is good or bad.

Confusion Matrix Accuracy

To find accuracy, use:

Accuracy=(TP+TN)/(TP+TN+FP+FN)

In our example:

Thus, accuracy = (50 + 35) / (50 + 35 + 5 + 10) = 85 / 100 = 85%

The accuracy is how often the model comes with the answer. But it is not always enough.

You may be trained on data where 90% of people do not have the disease and only 10% do, which means even a model that always predicts "no disease" would achieve 90% accuracy. But that is useless.



Therefore, we also look into precision and recall.

Precision and Recall

These are the scores from the matrix:

Precision = TP / (TP + FP)

This indicates how many positive predictions were correct.

Recall = TP / (TP + FN)

This indicates how many of the real positives were captured.

In real cases, like medical or fraud checks, those are useful. That is, high precision means fewer false positives. High recall means fewer cases missed.

Taken together, these provide a clear picture of performance. That is why accuracy based on a confusion matrix is just one aspect. Always check all metrics.

Relevance to ACCA Syllabus

The <u>ACCA syllabus</u> emphasises a thorough understanding of performance measurement, audit quality, <u>risk management</u>, and data-driven decision-making. Knowledge for auditors and finance professionals about ML accuracy, model error rates, and performance diagnostics is captured through Confusion matrix in machine learning. Confusion matrices help evaluate predictive models, such as those for internal controls and data-driven financial decisions in audit analytics and risk assessment.

Confusion Matrix in Machine Learning ACCA Questions

Q1. What does confusion matrix helps to measure in the predictive modelling?

A) Net profit margin

- B) Financial leverage
- C) Classification accuracy

D) Tax compliance

Ans: C) Accuracy of classification

Q2. What does True Positive mean in a confusion matrix?

A) a correctly predicted negative case by the model

B) The model misclassified a positive case

- C) The model did not return a prediction
- D) [The data] was not included in testing

Ans: B) The model classified a negative case as positive

Q3. How do you best describe precision in a confusion matrix?

A) True Positives / True Positives + False Negatives

B) True Positives / Total Predicted Positives

C) Falsos Positivos / Total Negativos

D) True Negatives / (True Negatives + False Positives)

Ans: B) True Positives / Total Predicted Positives

Q4. ACC auditors typically rely on evidence, so why would an ACCA auditor look at a confusion matrix while risking modeling?



- A) To calculate goodwill
- B) To discover errors in the audit plan
- C) To measure the risks of misclassification of the model
- D) To measure tax benefits
- Ans: C) For assessing model misclassification risks
- Q5. What does the confusion matrix entry represent for correct negative prediction?
- A) True Positives
- B) False Positives
- C) False Negatives
- D) True Negatives

Ans: D) True Negatives

Relevance to US CMA Syllabus

The US <u>CMA syllabus</u> emphasizes analytics, internal controls, performance metrics, and strategic decision-making. The confusion matrix in machine learning allows <u>CMAs</u> to determine the accuracy of the predictive models leveraged in budgeting, forecasting and risk analysis. This can help to support ethical overall management decisions, and improve the reliability of AI-based financial models.

Confusion Matrix in Machine Learning CMA Questions

Q1. How could a CMA use data from the confusion matrix in budget forecasting?

- A) History of net income positive or negative
- E) What you can learn about predictive budget misclassification using a trading strategy
- C) Verifying balances in accounts receivable
- D) Reconciling the changes in equity
- Q: How do we measure the sin of misclassification? Ans: B) Through predictive budgets

Q2. Which performance metric, from the confusion matrix, does the CMA use to reduce forecasting errors?

- A) Gross Margin
- B) Accuracy
- C) Working Capital Ratio
- D) Depreciation Rate
- Ans: B) Accuracy

Q3. Which of the following refers to the proportion of actual positives that were missed by the model?

- A) True Positive Rate
- B) Precision
- C) Recall
- D) False Negative Rate
- Ans: D) False Negative Rate
- Q4. Justify your answer considering the definition of precision, recall, F1-score.



- A) True Negatives
- B) Specificity
- C) False Positives
- D) True Positives
- Ans: C) False Positives

Q5. Cost prediction confusion matrix showing many false positives What should a CMA do?

- A) Increase tax provision
- B) Adjust capital structure
- C) Alter thresholds of classification models
- D) Close the general ledger

Ans: C) Adjust the classification model thresholds

Relevance to US CPA Syllabus

It further contains content related to audit analytics, internal control evaluation and data-driven financial decision-making on the US <u>CPA exam</u>. Confusion Matrix of (For <u>CPA</u>s who analyze models used in fraud detection, compliance review and internal audits). It helps them assess false positives, correct classification of the financial systems, and how accurate predictions are.

Confusion Matrix in Machine Learning CPA Questions

Q1. How does a CPA use confusion matrix in fraud detection in auditing?

- A) To file tax returns
- B) For evaluating fraud classification performance
- C) To determine audit fees
- D) To compute interest expense
- Ans: B) To evaluate fraud classification efficiency

Q2. What does it mean when a model has a high rate of false positives, during audit review?

A)There was too small a number of clients reviewed

- B) Too many false fraud flags
- C) Missing receivables
- D) Proper classification
- Ans : B) Over fraud alerts

Q3. Now which part of the confusion matrix explains if we were able to catch any true frauds?

- A) True Negative
- B) False Positive
- C) True Positive
- D) Specificity

Ans: C) True Positive

Q4. PPV is the clinical utility of this test, which means:

A) False Negative Rate



- B) Recall
- C) Precision
- D) False Positive Rate
- Ans: D) False Positive Rate

Q5. Analysis of confusion matrix is very important in making CPA reports accurate.

- A) Non-financial KPI monitoring
- B) improves the classification of audit assertions
- C) It calculates depreciation methods
- D) It increases sales revenue

Ans: B) It improves classification of audit findings

Relevance to CFA Syllabus

The <u>CFA</u> training also involves extensive study in financial modeling, risk management, and <u>quantitative analysis</u>. This parallel between the CFA and machine learning can be found in that machine learning is a data science and the confusion matrix of a predictive model can be similar in portfolio management and credit scoring as key parts of the CFA body of knowledge. This helps analysts follow accuracy, overfitting, and performance variability in ML-based financial predictions.

Confusion Matrix in Machine learning CFA Questions

- Q1. Dibalar If i may ask you a question for rephrase...
- A) It records loan repayments
- B) It validates credit policy rules
- C) It measures the accuracy of model predictions
- D) It audits tax rules
- Ans: C) It measures prediction accuracy of the model

Q2. What is the value in the confusion matrix for misclassifying risky borrowers as safe?

- A) True Positive
- B) False Positive
- C) False Negative
- D) True Negative

Ans: C) False Negative

- Q3. The CFA uses a model with 92 percent accuracy. What does this reflect?
- A) Loan coverage ratio
- B) The Model was able to classify 92% of predictions correctly
- C) Each borrower paid back on time
- D) Total operating profit

Ans: B) 92% predictions had correct classification by the model.

Q4. Which of the following measures from a confusion matrix is most relevant in the context of mitigating default risk?

A) Recall



- B) Depreciation
- C) Gross Margin

D) Asset Turnover

Ans: A) Recall

Q5. What is meant by the confusion matrix high precision score?

A) The model made random predictions on data until October 2023.

B) The model predicted a low number of defaults

C) Positive predictions were mostly correct

D) Negative cases were neglected by the model

Ans: C) Majority positive predictions were true



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