OneModel Academy

One AI

Regression Model Evaluation

Machine Learning

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Topics Covered

- Regression model evaluation overview
- An introduction to common evaluation metrics
  - Explained variance score & mean squared error (MSE)
  - Residuals plot
  - Prediction error, distribution, & comparison plots
  - Outlier dataframe
- Feature importance
- Interpretation + iteration

Learning Outcomes

You will:

- Understand & apply key regression evaluation metrics to determine model accuracy & reliability
- Analyze feature importance to identify which variables most significantly impact your model's predictions & make informed decisions about model refinement
- Recognize that model building is an iterative process, involving refinement based on evaluation, domain knowledge, & stakeholder feedback

Regression Evaluation Overview

Overview

- Evaluating performance to determine if your model is producing accurate results
  - Involves comparing the model's predictions with actual outcomes
  - Cross validation enables measurement of performance & generalizability
  - Allows you to compare different iterations & select the best one
  - Builds trust with stakeholders
- Critical to consider the broader context that the model will be applied
  - What are we using this model for?
  - Characteristics of the dataset

Regression Evaluation Metrics

Regression Evaluation Metrics

- There are many evaluation tools - each offers unique insight into various aspects of the model
    - Best practice to use several multiple metrics together to see the broader picture of performance

Explained Variance Score

- Measures the proportion of the variance in the target variable captured by the model
  - Variability in the target variable: how much the values of the target variable (outcome you're predicting) differ from each other
  - Ranges from 0-1
    - 1: the model performs perfectly
    - 0: the model performs no better than guessing the average value

$$\text{Explained Variance Score} = 1 - \frac{\text{Var}(y - \hat{y})}{\text{Var}(y)}$$

Where:

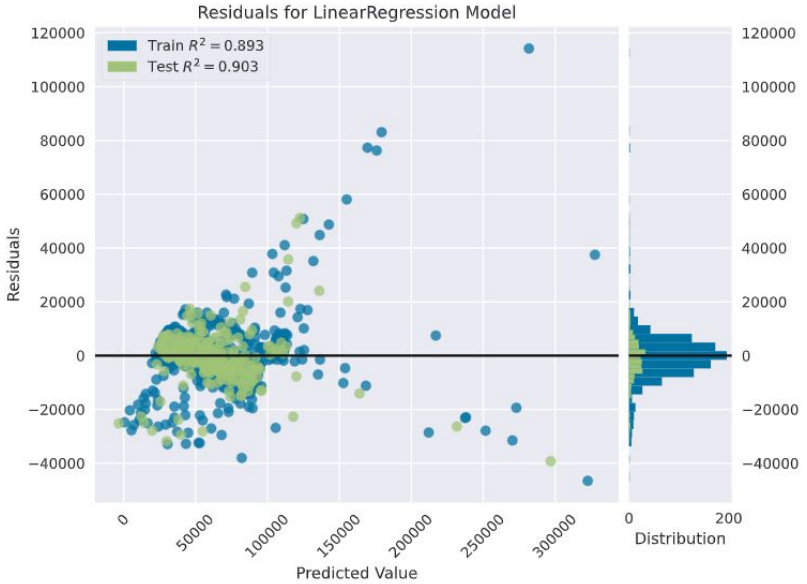
- y represents the actual values.
- $\hat{y}$ represents the predicted values.
- $\text{Var}(y - \hat{y})$ is the variance of the residuals (errors) between the actual and predicted values.
- $\text{Var}(y)$ is the variance of the actual values.

Mean Squared Error & Root Mean Squared Error

- **Mean squared error (MSE)** is the average of the squared differences between the predicted & actual values
    - Helps emphasize larger errors which helps identify models with significant outliers and/or large prediction errors
- **Root mean squared error (RMSE)** is the square root of the MSE; it converts the MSE back into the original units of the target variable
    - Gives a clear picture of the average error
- Using both provides a more comprehensive evaluation of the model

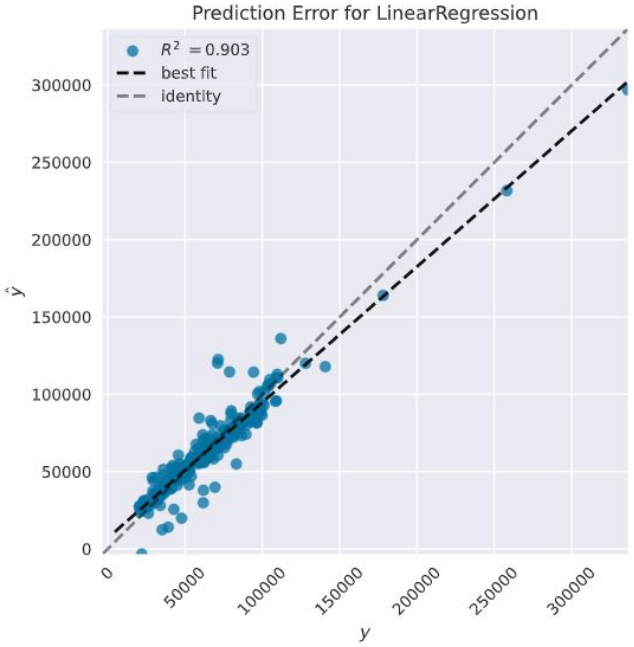
Residuals Plot

- Shows the residuals on the vertical axis and the predicted values on the horizontal axis
  - Residuals are the differences between the actual values and the predicted values by the model
- Helps visualize how well the model fits the data
  - In a good model, the residuals should be randomly scattered around the horizontal axis, showing no clear pattern



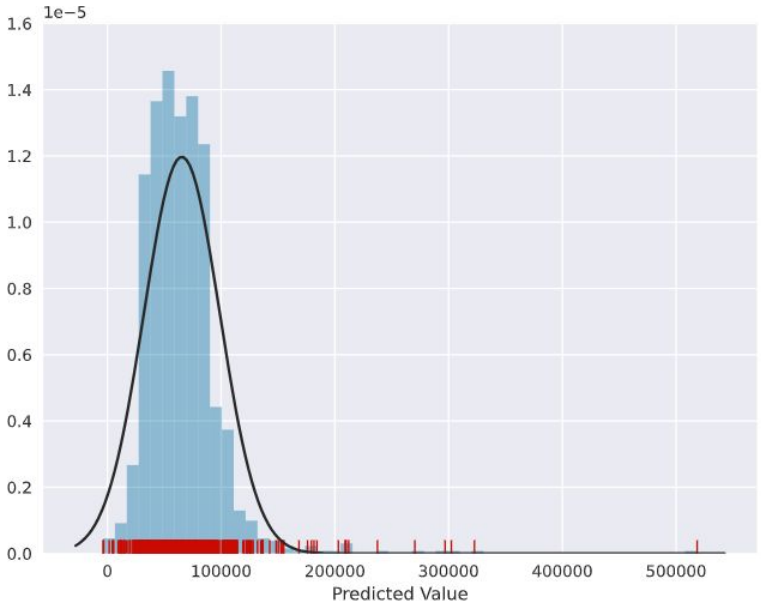
Prediction Error Plot

- Shows the predicted values against the actual values to help visualize how close the model's predictions are to the actual values
    - If predictions were perfect, all points would lie on the grey dashed 45-degree line (identity line), where the predicted value equals the actual value



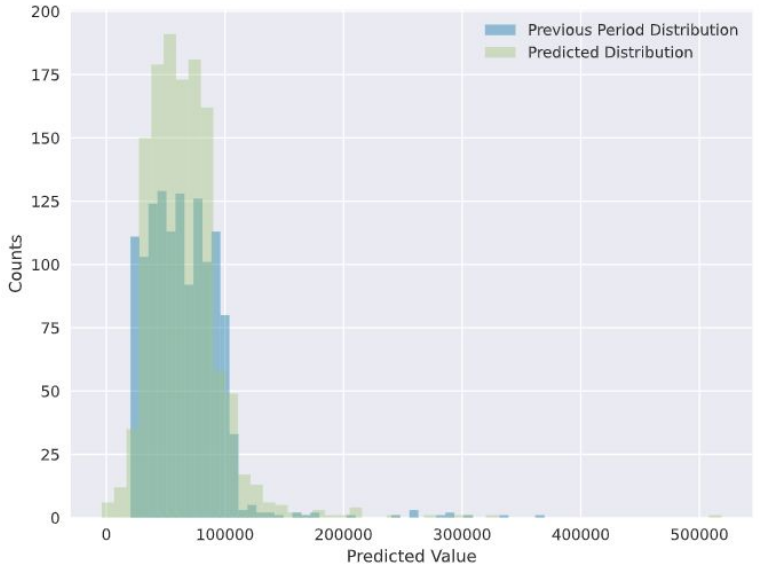
Prediction Distribution Plot

- Shows the distribution of the predicted values from the regression
  - Often compared to a normal distribution to see how the predicted values are spread out
  - Visualizes the range & frequency of the predicted values
  - Shows whether the predictions are concentrated around certain values or spread out, & if there are outliers



Prediction Comparison Plot

- Shows the distribution of the predicted values compared to the distribution of the actual values
  - Easy way to compare the distributions & see if the model captures the overall pattern & spread of the target variable



Outlier Dataframe

- Records that have unusually high/low residuals compared to the majority of data
  - These records are considered outliers because their predictions significantly deviate from their actual values
  - Utilizes Z Scores - shows how many standard deviations a residual is from the mean residual
  - Look for patterns & common features among the outliers to gain insights into potential weaknesses in the model & areas for improvement.

	Z Score	Demotions for All Time (Binary)_1.0	one.employee.annual_salary_range_other	one.employee.costcenter_sca
00006959	7.720474	0	1	0.999965
00007285	13.596820	0	1	0.000000
00009957	3.487272	0	0	0.000000
00011310	4.401603	0	0	0.000000

Feature Importance

Feature Importance

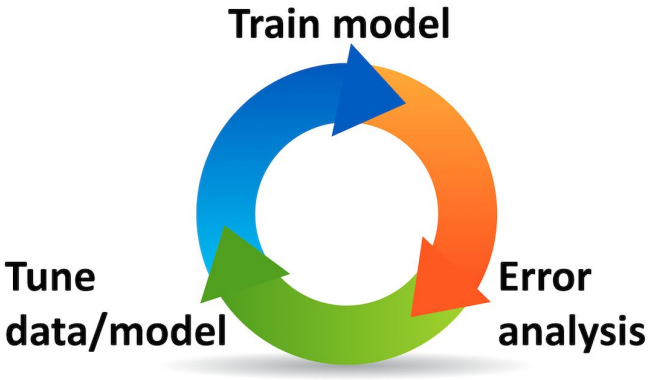
- Complements other performance metrics
- Helps identify which input variables have the most significant impact on the target variable
  - Ranks & scores the selected features to convey how important including each feature in the model is to making accurate predictions
  - Helps Reveal if the model is relying too heavily on certain features (bias/overfit)
  - Complements other performance metrics
  - Allows users to remove “bad” features

Feature Name	Values
one.employee.costcenter_scaled	96343819.72160529
one.employee.hourly_rate_scaled	327661.8442096436
one.employee.eeojob_scaled	23359.071237914886
one.employee.is_manager_M	18782.98462330541
one.employee.annual_salary_range_other	12931.827932139895
one.employee.department_scaled	12091.550258846328
one.employee.jobid_scaled	7090.706468222104
one.employee.gender_Male	2435.3490882189562
one.employee.latest_pulse_survey_Disengaged	1764.3899060554008
one.employee.safety_incidents_scaled	1442.8178583441227
one.employee.is_future_manager_1.0	1207.5867912829672
Demotions for All Time (Binary)_1.0	-3059.1238927049526
one.employee.positionid_scaled	-3673.400474592001
one.employee.reg_temp_other	-37839.217407169555
one.employee.location_404.0	-96340847.82464537

Interpretation + Iteration

Interpretation + Iteration

- Model building is an iterative process
  - Involves refining the model based on insights gained from evaluation results, domain knowledge, & feedback from stakeholders
  - Model should evolve to meet changing needs



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Thanks for watching!

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