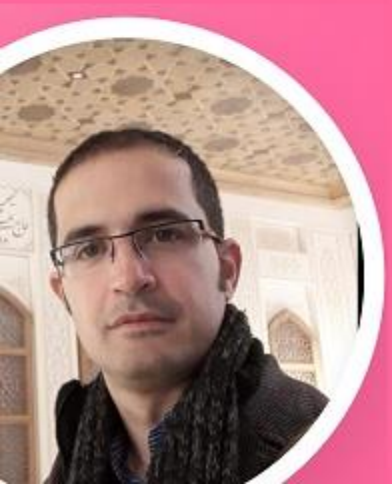
Machine Learning

Linear Regression



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Linear Regression (Ordinary)

- Regression models the relation between a dependent variable (response) and one or more independent variables (predictor)

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon$$

- Each coefficient expresses the impact of a one-unit change in a predictor variable on the mean of the response, provided that all other variables are held constant

https://statisticsbyjim.com/regression/interpret-coefficients-p-values-regression/

Regression vs. Classification

- **Classification** is the task of predicting a discrete class label.

- **Regression** is the task of predicting a quantity.

  - blood pressure, age, …

- **Logistic regression** models the probability of a class.

Coefficient of Determination (R^2)

- **R-squared** value measures how well the model predicts the response.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon$$

- The best possible score is 1.0, and score 0.0 means constant output.

```
>>> from sklearn.metrics import r2_score
>>> y_true = [3, -0.5, 2, 7]
>>> y_pred = [2.5, 0.0, 2, 8]
>>> r2_score(y_true, y_pred)
0.948...
```

https://scikit-learn.org/stable/modules/generated/sklearn.metrics.r2_score.html

Linear vs. Nonlinear Regression

- **Linear**

$$y = b_0 + b_1 x_1 + b_2 x_2$$

$$y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_1^2 + b_4 x_1 x_2 + b_5 x_2^2$$

https://realpython.com/linear-regression-in-python/

- **Nonlinear**

$$\log y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \varepsilon_i$$

$$y_i = \beta_0 + \beta_1 X_{1i} + \frac{1}{\beta_2 X_{2i}} + e^{\beta_3 X_{1i} X_{2i}} + \varepsilon_i$$

https://www.mathworks.com/help/stats/what-is-linear-regression.html