Machine Learning Reference for R

Contents

Data Preparation

Normalization

Features sometimes need to be scaled so they fit into a standard range. This involves transforming variables into a narrower or wider range than they are found in the observed data.

Two common methods for scaling features are **min-max normalization** and **z-score normalization**, each shown below:

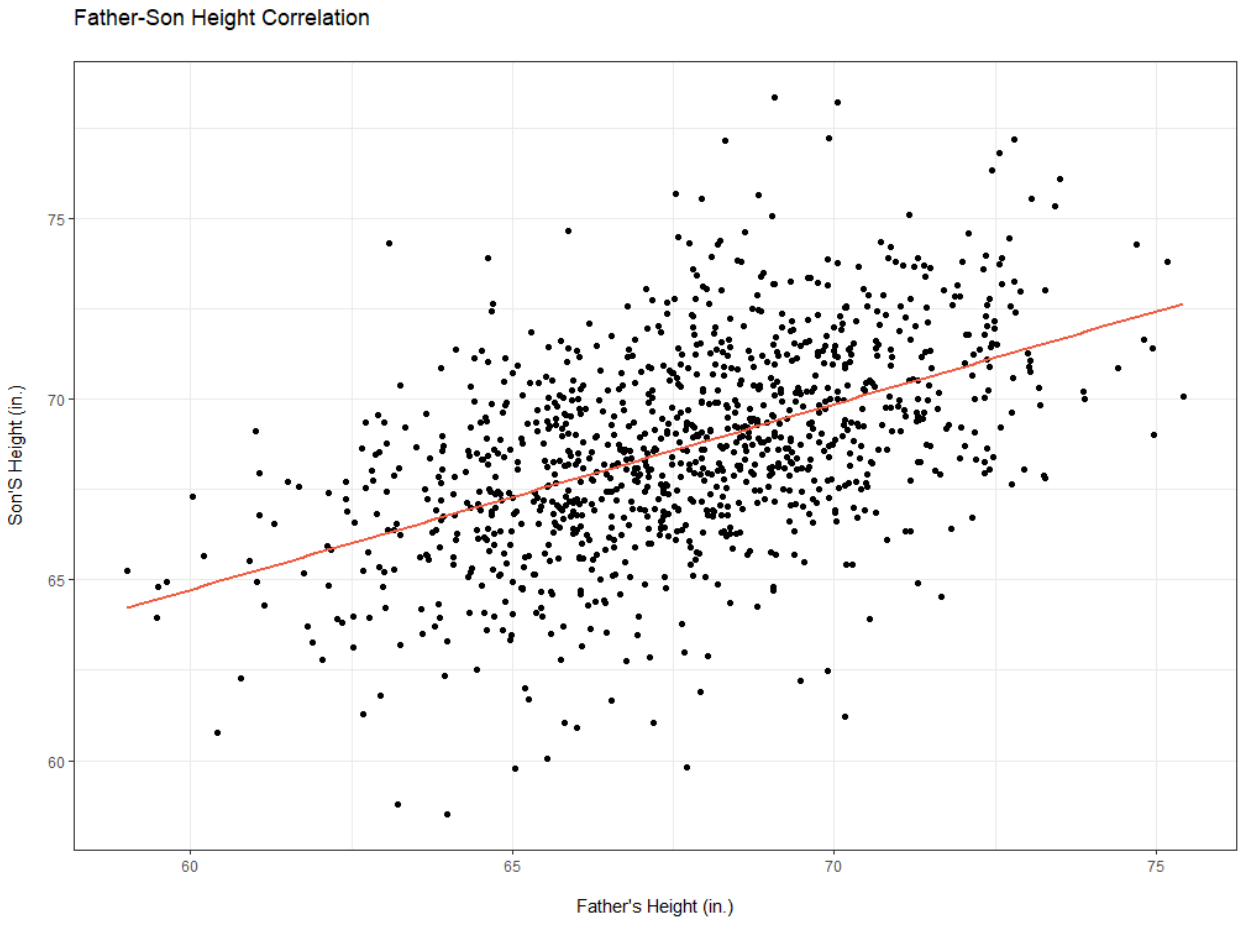
$$X_{new} = \frac{X - min(X)}{max(X) - min(X)}$$

$$X_{new} = \frac{X - \mu}{\sigma} = \frac{X - mean(X)}{StdDev(X)}$$

Algorithms

Regression Algorithms

Simple Linear Regression



Simple linear regression is a statistical method for evaluating the relationship between two continuous variables. One variable, denoted x, is the **independent variable** (also called **predictor variable**) that is used to predict the **dependent variable** (also called **response variable**), denoted y.

In linear regression, we use methods such as **ordinary least squares** to approximate the equation of a line describing the relationship between the predictor and response variables. We find a **correlation coefficient**:

$$r = \frac{1}{n-1} \sum \left(\frac{x - \bar{x}}{s_x} \right) \left(\frac{y - \bar{y}}{s_y} \right)$$

In simple linear regression, we estimate two coefficients, β_0 (the y-intercept) and β_1 (the regression slope). Because this is an estimate, there is a residual error, ϵ. These are combined to form a **line of best fit**:

$$\hat{y} = \beta_0 + \beta_1 x + \epsilon$$

Functions related to running simple linear regression models in R are:

Function	Description	Example
`cor()`	Calculate correlation coefficient.	`cor(x, y)`
`lm()`	Train a linear regression model.	`lm(sheight ~ fheight, data = father.son)`
`summary()`	Summarize a linear model.	`m <- lm(y ~ x)` `summary(m)`
`confint()`	Compute confidence interval for model parameters.	`m <- lm(y ~ x)` `confint(m)`

Classification Algorithms

Naive Bayes

The **Naive Bayes classifier** is a probabilistic machine learning algorithm that predicts class labels for a factor by using a probability found from the training data. The classifier assumes that all features contribute equally and are independent of each other. This classifier relies on **conditional probability**, or the probability of an event A occurring, given that an event B has occurred:

$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{P(B|A)P(B)}{P(A)}$$

In the Naive Bayes setting, the probability of level L for class C (denoted C_L), given feature F, is:

$$P(C_L|F) = \frac{P(F|C_L)P(F)}{P(C_L)}$$

This is generalizable to:

$$P(C_L|F_1, F_2, ..., F_n) = \frac{P(F_1, F_2, ..., F_n|C_L)P(F_1, F_2, ..., F_n)}{P(C_L)} = P(C_L) \prod_{i=1}^{n} P(F_i|C_L)$$