Linear Model

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Model Math

A linear model can be characterised by the following structural normal equation:

$$X^T X y = X^T y \beta \tag{1}$$

where X is the data or design matrix, y the dependent variable and beta the coefficient vector.

Fitting in R

A model can be fit with the following code (using the iris data):

```
linear_model <- lm(Petal.Width ~., data=iris)</pre>
```

A summary can be obtained via:

```
summary( linear_model)
```

```
##
## Call:
## lm(formula = Petal.Width ~ ., data = iris)
##
## Residuals:
       Min
                 1Q
                       Median
                                            Max
## -0.59239 -0.08288 -0.01349 0.08773 0.45239
##
## Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)
                    -0.47314
                                0.17659
                                         -2.679 0.00824 **
## Sepal.Length
                    -0.09293
                                0.04458
                                         -2.084 0.03889 *
## Sepal.Width
                     0.24220
                                0.04776
                                          5.072 1.20e-06 ***
## Petal.Length
                     0.24220
                                0.04884
                                          4.959 1.97e-06 ***
## Speciesversicolor 0.64811
                                          5.263 5.04e-07 ***
                                0.12314
                                          6.323 3.03e-09 ***
## Speciesvirginica
                     1.04637
                                0.16548
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.05 '.' 0.1 ' ' 1
## Residual standard error: 0.1666 on 144 degrees of freedom
## Multiple R-squared: 0.9538, Adjusted R-squared: 0.9522
## F-statistic: 594.9 on 5 and 144 DF, p-value: < 2.2e-16
```