A summary of the main properties of the expected value and variance of the estimators is presented:

$E[c_1+c_2.u] = c_1+c_2.E[u]$	$V[c_1+c_2.u] = c_2.V[u].c_2^T$
1 - Random variable, ε	$\varepsilon_{n.}$ (independent)
Expected value of ε	$E[\varepsilon] = 0$.
Variance of ε	$V[\varepsilon]_{(n.n)} = E[\varepsilon.\varepsilon^T]=I.\ \sigma^2$
2 - Observed response variable y	$y = Y+\varepsilon$
Expected value of y	$E[y] = Y = X.B$.
Variance of y	$V[y]_{(n.n)} = V[\varepsilon]_{(n.n)} = I.\ \sigma^2$
3 - Estimator of B	$\hat{B} = (X^T.X)^{-1}.X^T.y$
Expected value of $\hat{B}$	$E[\hat{B}] = B$
Variance of $\hat{B}$	$V[\hat{B}]_{(k.k)} = (X^T.X)^{-1}.\ \sigma^2$
4 - Estimator of Y of the model	$\hat{Y} = X.\hat{B} = L.y$
Expected value of $\hat{Y}$	$E[\hat{Y}] = Y$.
Variance of $\hat{Y}$	$V[\hat{Y}] = L.\ \sigma^2$
5 - Residual e	$e = y-\hat{Y} = (I-L).y$
Expected value of e	$E[e] = 0$
Variance of e	$V[e] = (I-L).\ \sigma^2$

6 - Sum of squares

6.1 - Residual Sum of squares = SQ $\text{residual}_{(1.1)} = (y-\hat{Y})^T(y-\hat{Y}) = y^T(I-L)y$

This quantity indicates the residual variation of the observed values in relation to the estimated values of the model, that is, the variation not explained by the model.

6.2 - Sum of squares of the deviation of the model = SQ $\text{model}_{(1.1)} = (\hat{Y}-\bar{y})^T(\hat{Y}-\bar{y}) = y^T(L-M)y$

This quantity indicates the variation of the estimated response values of the model in relation to the mean, that is, the variation explained by the model.

6.3 - Total Sum of the squares of the deviations = SQ $\text{total}_{(1.1)} = (y-\bar{y})^T(y-\bar{y}) = y^T(I-M)\ y$

This quantity indicates the total variation of the observed values in relation to the mean.

It is easy to verify the following relation:

$SQ_{total} = SQ_{model} + SQ_{residual}$ or

$$1 = \frac{SQ_{model}}{SQ_{total}} + \frac{SQ_{residual}}{SQ_{total}}$$

or $1 = R^2 + (1 - R^2)$

where:

R^2 is the percentage of the total variation that is *explained* by the model. In matrix terms it will be:

$R^2 = [y^T(L - M)y].[\ (y^T(I - M)y]^{-1}$

$1\text{-}R^2$ is the percentage of the total variation that is not explained by the model.

The ranks of the matrices (I-L), (I-M) and (L-M) respectively equal to (n-k), (n-1) and (k-1), are the degrees of freedom associated with the respective sums of squares.