Ex. 3.10

In exercise 3.1 we showed that when dropping a single coefficient the F statistic is equal to the square of the corresponding Z-score.

e.g.

$$F = \frac{RSS_0 - RSS_1}{RSS_1 / N-P-1} = Z_j^2 \qquad (*)$$

Now by definition

$$\hat{\sigma}^2 = \frac{1}{N-P-1} \sum_{i=1}^{N} (y_i - \hat{y}_i)^2 = \frac{RSS}{N-P-1}$$

So (*) becomes:

$$\frac{RSS_0 - RSS_1}{\hat{\sigma}_1^2} = Z_j^2$$

$$\Rightarrow \quad RSS_0 = \hat{\sigma}_1^2 Z_j^2 + RSS_1$$

$$\text{Thus } \operatorname{Min}(RSS_0) = \operatorname{Min}(\hat{\sigma}_1^2 Z_j^2 + RSS_1)$$

$$= \underset{j}{\operatorname{argmin}} (Z_j^2)$$

Thus the Z-score with the smallest absolute value will minimise $\underbrace{}_{\text{the increase in}}$ the residual sum of squares.