1.

We first have,

$$F = \frac{SS_{\text{exp}}/p}{SS_{\text{res}}/(n-p-1)}$$

hence

$$\frac{F}{F+c} = \frac{1}{1+c/F}$$

and

$$1 - \frac{SS_{\text{res}}}{SS_{\text{total}}} = \frac{SS_{\text{exp}}}{SS_{\text{total}}}$$

Therefore,

$$\begin{aligned}
&1 + \frac{c}{F} = \frac{SS_{\text{total}}}{SS_{\text{exp}}} \\
\Longrightarrow\ &1 + \frac{c(n-p-1)}{p}\frac{SS_{\text{res}}}{SS_{\text{exp}}} = \frac{SS_{\text{total}}}{SS_{\text{exp}}} \\
\Longrightarrow\ &SS_{\text{exp}} + \frac{c(n-p-1)}{p} SS_{\text{res}} = SS_{\text{total}} \\
\Longrightarrow\ &c = \frac{p}{n-p-1}
\end{aligned}$$

We then have

$$5 = \frac{8}{n-8-1} \implies n = 10.6$$

2.

We first have that

$$X^T X = \begin{pmatrix} n & \sum x_i \\ \sum x_i & \sum x_i^2 \end{pmatrix} = \begin{pmatrix} 45 & 0 \\ 0 & \sum x_i^2 \end{pmatrix}$$

and thus the inverse is

$$\begin{pmatrix} \frac{1}{45} & 0 \\ 0 & \frac{1}{\sum x_i^2} \end{pmatrix}$$

then we can calculate

$$\mathrm{se}(c) = \sqrt{\frac{1}{45} SS_{\mathrm{res}}/43}$$

where

$$SS_{\mathrm{res}} = \sum_{i=1}^{45} (Y_i - \hat{Y}_i)^2$$

Thus, we can find the confidence interval for c

$$\hat{c} - t_{\alpha/2,43}\sqrt{\frac{SS_{\mathrm{res}}}{1935}} < c < \hat{c} + t_{\alpha/2,43}\sqrt{\frac{SS_{\mathrm{res}}}{1935}}$$

Similarly,

$$\mathrm{se}(c) = \sqrt{\frac{1}{\sum x_i^2} SS_{\mathrm{res}}/43}$$

and the confidence for d is

$$\hat{d} - t_{\alpha/2,43}\sqrt{\frac{SS_{\mathrm{res}}}{43\sum_{i=1}^{4} 5x_i^2}} < d < \hat{d} + t_{\alpha/2,43}\sqrt{\frac{SS_{\mathrm{res}}}{43\sum_{i=1}^{4} 5x_i^2}}$$