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Series 3 : Evaluation of a design

1 Essays on traction

Table 1 reproduces data from a series of experiments with steel specimens of different carbon (C) and sulfur (S) contents which were tested at different temperatures to determine the elasticity of the material. The table therefore contains on the one hand the experimental conditions as well as the experimental Young's modulus E, according to Hooke's phenomenological law :

$$\epsilon = \frac{\sigma}{E}$$

with ϵ the relative elongation, σ the longitudinal stress et E the Young's modulus.

1. *Load the data into a table (The data is in the tensile test tab of the data file ; pay attention to the units on the first line of data...you can integrate them into the table cf online help).*
2. *Critically analyze the design of experiments for a linear model and a linear model with an interaction between C and S. For each of these models determine :*
   - *the model matrix*
   - *the dispersion matrix*
   - *the correlation matrix*
   - *the variance inflation factors*
   - *the model variance (the question can be solved easily with the rutines of symbolic calculation using* syms, ezsurf, subs*) ; It is also possible to solve it numericaly with the functions* meshgrid, reshape*))*

   Organize these results and write recommendations for experimenters.
3. *Determine the main effects as well as that of interaction between the concentration of carbon and that of sulfur on the Young's modulus of the materials in the standardized system. Then translate the coefficients for the original units.*
4. *Compute the confidence intervals of these coefficients for 95% confidence*
5. *Write conclusions for the experiments by addressing the theme of the quality of the measurements.*
6. *Make recommendations for a second campaign which should also assess interactions with temperature.*

Tableau 1: Data of three sets of experiments on steel specimens

Run	C [%]	S [%]	T [°C]	E [kPa]		
1	0.04	0.4	-20	207.15	206.74	208.36
2	0.04	0.4	0	206.45	204.71	206.83
3	0.04	0.4	20	206.03	203.22	206.34
4	0.04	0.8	0	194.51	192.89	195.03
5	0.05	0.6	0	209.13	209.09	210.38
6	0.06	0.4	0	222.86	221.29	222.08
7	0.06	0.8	-20	214.56	212.06	211.84
8	0.06	0.8	0	209.52	209.86	211.35
9	0.06	0.8	20	211.89	210.2	209.24