Project 2: Regression Analysis

The knowledge of the heat flow curve of a material is essential for many calculations in the field of deformation technology. Certain dependencies of the flow tension k_f on deformation parameters, like the deformation φ, the deformation speed $\dot{\varphi}$ and the temperature T, have been known experimentally for a long time.

Expressing these known dependencies in the form of a mathematical function takes the general form

$$k_f = g(\boldsymbol{x}, T, \varphi, \dot{\varphi}) \,,$$

where T is the temperature of the deformed material, φ is the (amount of) deformation and $\dot{\varphi}$ is the deformation speed.

There are many possible choices for the model function g. One such model function has been introduced in the lecture:

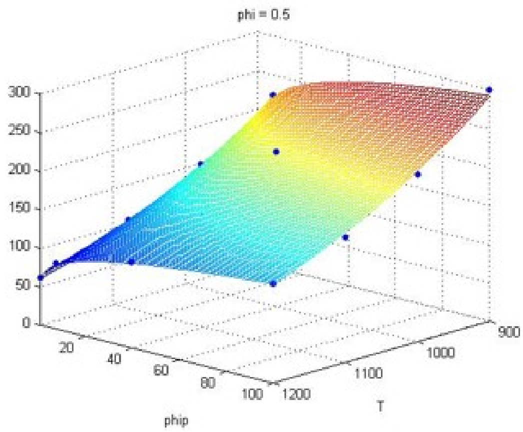
$$k_f = g(\boldsymbol{x}, T, \varphi, \dot{\varphi}) = x_6 \cdot e^{x_1 \cdot T} \cdot \dot{\varphi}^{x_2 + x_5 \cdot T} \cdot \varphi^{x_3} \cdot e^{x_4 \cdot \varphi} \,. \tag{1}$$

Another example is the model

$$k_f = x_{10} \cdot e^{x_1 \cdot T} \cdot \dot{\varphi}^{x_2 + x_5 \cdot T + x_6 \cdot \varphi} \cdot \varphi^{x_3 + x_7 \cdot T + x_8 \cdot \dot{\varphi}} \cdot e^{x_4 \cdot \varphi + x_9 \cdot \dot{\varphi}} \,. \tag{2}$$

Task

Using the experimental data provided in the moodle course, find *optimal parameters* $\boldsymbol{x}$ for the model functions given by (1) and (2). Using these parameters, determine the coefficient of determination R^2 for both of the models, compare the two models and give examples of two-dimensional and three-dimensional graphs by setting the value of one or two of the arguments to appropriate constants.



Hints

Your project solution must include

- the parameter values you determined for each of the model functions as well as an explanation of how and why these parameters were chosen,
- the coefficient of determination R^2 for both models,
- graphs of the predicted values for k_f,
- a comparison between the two models with respect to their respective prediction quality.

Solution upload

Everybody must upload the following

- the .m-files which compute your solution;
- a *presentation* of your work (containing, in particular, the results of Task 2), preferably in the `.pdf` file format, which you will use for your talk at the end of the semester;
- a list of your group colleagues.

If you prepare a presention video, it is sufficient if one group member uploads the video file. The other group members should include a comment in their solution about the video and who is responsible for the video upload.

Groups: 3–5 students. Please register your group as a solution to the Moodle assignmet "Assignment: Lab 1 – list of group colleagues (registration of groups)". If your group changes, please upload a new solution to the same assignment.

Deadline: Upload your project (.m files and pdf/presentation) by **July 19** to the Moodle assignment "Assignment: Lab 2: MATLAB code and presentation".

Presentation: Each group has to give a presentation (max. 10 minutes) on July 22 (in the last lecture).

Alternative presentation: Each group may choose to prepare a presentation video (max. 10 min) instead of giving a live presentation.