TAMS 65 Assignment 3
Multiple linear regression - Response Surface Regression

This assignment deals with multiple linear regression as well as Response Surface Regression.

Instruction

- You are recommended to use software MATLAB to answer questions.
- Attach the project in **pdf file** and name it as **Project.pdf**.
- Make a detailed report on **2 assignments**.
- Give only solutions to the rest of **5 assignments**. Note: I have marked this part of questions in **blue**. That is, you only need to show solutions to the blue part of questions for the rest of 5 assignments.
- **Submit first version** of your report to your **teaching assistants** not later than May 1, 2020.
- **Submit final version** of your report to the lisam: **Lisam - Submissions**.
- **Deadline** for submissions is at 23:00 May 15, 2020. Note: The submission entrance will open at 0:00 May 7, 2020.
- **All codes** that you will need are given either in Lectures or 7 assignments.

Response Surface Regression

For different types of chemical systems where the response variable y depends on the explanatory variables t_1 and t_2, $y = f(t_1, t_2)$, the *response surface* f can often be appropriately described with the help of a second order of the polynomial model. Let

$$\begin{aligned} y &= \text{chemical yield}, \\ t_1 &= \text{reaction time in seconds}, \\ t_2 &= \text{reaction temperature i}^\circ C. \end{aligned}$$

We know that the time that the experiment is conducted is $80 \leq t_1 \leq 100$ and the temperature is between $140 \leq t_2 \leq 150$. For simpler analysis we want to encode the explanatory variables according to

$$x_1 = \frac{t_1 - 90}{10} \quad \text{och} \quad x_2 = \frac{t_2 - 145}{5}.$$

Now you analyze the data using Response Surface Regression.

Download and open the file **Assignment3.m**, then run it. Input the codes in the **Command Window** or **Editor** window.

Questions

(a) Scatter plot observations against x_1 and x_2. Use the code:

```
scatter3(x1,x2,y);
```

Give a suitable linear regression model with response variable y and explanatory variables x_1 and x_2. Calculate the coefficient of determination R^2.

(b) Plot the estimated plane together with the observations. You may use the following code:

```
scatter3(x1,x2,y);
hold on;
clear;
[x1,x2]=meshgrid(-1:0.1:1,-1:0.1:1);
y=79.2089+1.0631*x1+0.5477*x2;
surf(x1,x2,y);
```

(c) Consider an appropriate regression model with y as response variable and x_1, x_2 as explanatory variables, but also add variables x_1^2, x_2^2 and x_1x_2 as explanatory variables. Calculate the coefficient of determination R^2.

(d) Test if these additional variables are useful. Plot the estimated curved plane together with the observations.

(e) If you want maximum chemical yield, what time and temperature should you choose?