November 25, 2024

Series 2: Comparing strategies of weighing

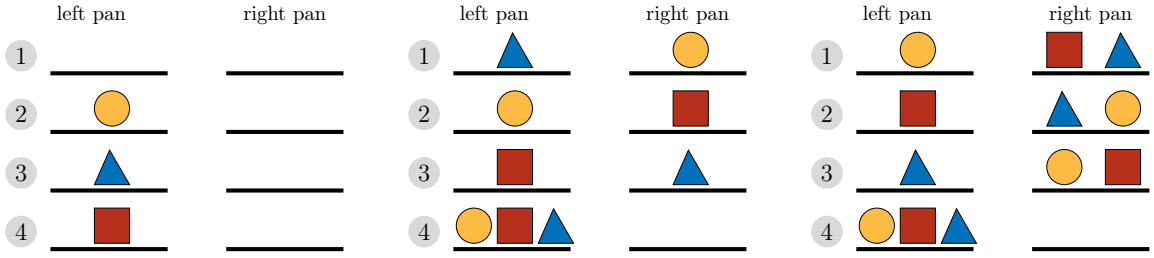
1 Experimental space of the weighing experiment with three factors

Objective

The objective of this exercise is to compare the performances of different strategies to weight three objects. It is also, in option, the possibility to learn how to draw volumes in Matlab with the patch function.

A the level of Matlab the following specific functions are potentially of interest: *array2table(), x2fx(), patch(), quiver3(), function, view(), hold* .

Figure 1 presents three possible designs. For each one, draw the position of each measurement point in the experimental space and draw a border for the used space with patches of different colors. Comment on the link between the space occupied by the data points and the accuracy of the design.



(a) one by one (b) two by two (c) three by three

Figure 1: Three weighing strategies

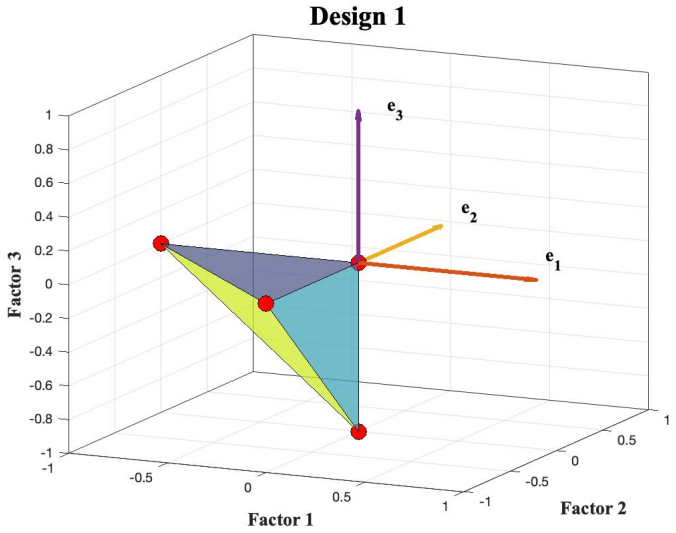


Figure 2: Example of visualization of the experimental space

2 The weighing of five factors

Objective

The objective of this exercise is to compare the performances of different strategies to weight seven objects using. It is the opportunity to train the use of the dispersion matrix, its trace and its determinant to evaluate and compare designs.

A the level of Matlab the following specific functions are potentially of interest: *rescale(), x2fx(), axis(), hadamard(), trace(), det(), function* .

A cook wants to evaluate the effects of 5 factors of the recipe of the Opera cake. Each factor can be varied in a specific range without risking to alter the process and lost a part of the production (see the table below). The effects are measured by a panel of testers : each recipe will receive several marks.

Factors	Down level	Up level
Quantity of cream	550g	650g
Quantity of ganache of chocolate	300g	350g
Cooking time for the biscuit	10min	12 min
Quantity of sirup for the punching	1dl	1.2 dl
Alcohol	Grand-Marnier	Cointreau

a) Compare the different strategies listed below by computing their matrix of dispersion $(X^TX)^{-1}$:

1. First run, all the factors at the **minimum** and then for each factor, **one** factor at the **maximum**, the other ones at the **minimum** (6 runs)
2. First run, all the factors at the **maximum** and then for each factor, **one** factor at the **maximum**, the other ones at the **minimum** (6 run)

3. First run, all the factors at the **minimum** and then for each factor, **one** factor at the **minimum**, the other ones at the **maximum** (6 runs)
4. First run, all the factors at the **minimum** and then, two by two, **two** factors at the **maximum**, the other ones at the **minimum** (6 runs)
5. First run, all the factors at the **maximum** and then, two by two, **two** factors at the **maximum**, the other ones at the **minimum** (6 runs)
6. First run, all the factors at the **minimum** and then, three by three, **three** factors at the **maximum**, the other ones at the **minimum** (6 runs)
7. First run, all the factors at the **maximum** and then, three by three, **three** factors at the **maximum**, the other ones at the **minimum** (6 runs)
8. The factors are varied using 5 columns (2 to 6), the first column is filled with '1', which is the HADAMARD design obtained with the command (*X=hadamard(8)*) (8 runs)

b) For each case, draw a bar graph of the diagonal elements, being careful to keep the same scale (axis($[x_{min}, x_{max}, y_{min}, y_{max}]$)), analyze and comment,

c) Draw a graph with the trace and the determinant of the matrix of dispersion of the different strategies,

d) Create a table with the previous results,

e) If you work with *live editor*, save the document as a pdf-file. A button on the right of the editor window allows you to hide the code. If you work with the standard editor, adapt the parameters of the *publish* tool of the PUBLISH tab so as to produce a pdf-file without the lines of code.