Lab 2 – Design of Experiments

Short course on Statistical modelling for optimization

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The first half of this lab session is dedicated to designing the best possible DoE. In the second one, we will run the actual experiments.

1 Design of experiments

The aim of this section is to define a DoE of 40 points over $(0,1)^4$ that shows good space filling properties and good projection properties. Some useful functions (such as `discrepancy`, `minimax`, `maximin`, `IMSE`) are provided in the file `lab2.py`. The file `SobolSequence.py` will also be of particular interest to generate low discrepancy sequences.

Q1. Write a function that implements a Latin Hypercube Design. The function should take as parameters the number of points n and the dimension d. It should return a np.array with shape (n, d).

Q2. Write a function that returns a Centroidal Voronoi Tesselation. You may use a k-means or a McQueen algorithm. The inputs and outputs should be as in Q1.

Q3. Generate various DoE using the functions you just wrote (you may also consider `SobolSequence`).

Q4. Choose your favourite DoE using the various space filling criteria. Do not forget to test the projections on some variables. Justify your choice in the report.

2 Running the experiments

Step 1. Convert your DoE on $(0,1)^4$ to the hyper-rectangle you defined during the last lab session.

Step 2. If you have changed the parameterization of the problem, convert the set of points to the initial space w_l, w_w, t_l, a_l. You should obtain a np.array of shape $(40, 4)$. The following constrains on the design should be respected: $w_l + t_l + a_l \leq 31.6cm$, $a_l > 2.5cm$, $t_l > 2.5cm$ and $w_w < 10.1$.

Step 3. Execute the function `writeLaTeX` for your design. It will generate a file 'helicopter.tex'.

Step 4. Run a latex compiler to transform the .tex file into a pdf. Note that the compiler must be able to deal with ps-pictures and LaTeX->PS->pdf is recommended.

Step 5. Print the pdf document and start making the helicopters! Use two paper-clips to fix the 'arms' on the 'tail'. These paper-clips are important, they also give stability to the helicopter.

Step 6. Go to the launching area and throw each helicopter 3 times. Record carefully each falling time.