OPTIMIZER 2024

Problem Statement

Motivation

As an engineer, we always try to model the manufacturing process in such a way that will optimize the output. We often have limited knowledge about the process know-how, the exact functional form of the response, and the design variables. Therefore, we perform experiments or simulate the process to gain insights. However, experiments are sometimes tedious and expensive. One way to alleviate this burden is to build an approximate model known as the surrogate model, e.g., Response Surface Method (RSM), Meta Models, and Emulators. A model is constructed based on modeling the simulator's response to a limited number of reasonably chosen data points. This approach is also known as Black-Box modeling.

Aim

The objective of this competition is to optimize one response variable while simultaneously satisfying specifications on other response variables. This competition expects the participants to leverage various mathematical and statistical models to analyze the limited number of experimental or simulated data points and achieve the desired optimum output.

Teams Specifications

1. A **maximum** of **2 participants** are allowed per team.
2. Students of different institutions can also form a team.
3. **At least one team member** must be from a **Chemical engineering** background.
2: Register for the Optimiser competition by filling the form in the link. You will be allotted a unique team ID after the registration. Team ID will be sent via email. https://www.azeotropy.org/optimiser
5. No participant can register in more than one team. In such an instance, both teams will be subjected to disqualification.

Certificates and Prizes

1. The winning team of the competition will get **cash prizes.**
2. The first four runners-up teams will be given **cash prizes**.
3. The top 10 teams will receive a **Certificate of Appreciation**, and a **Certificate of Participation** will be given to all teams making a valid final submission.

Competition Structure

The layout of the plant has a considerable impact on the plant's economics. A good plant layout must achieve **Cost Minimization, Safety Maximization (Risk Minimization)**, and other required constraints. Costs can be of several types, such as land, piping, accident, & material handling costs, etc. Safety and the associated risk are divided into two categories - Individual & Societal risk. Suppose you are part of a team designing a process plant layout. Suppose a function called **T (Total cost function)** incorporates both cost & risk factors, but its functional form is unknown. You know that T depends only on two independent variables, **C (Cost variable)**, a measure of cost and **R (Risk variable)**, a measure of risk. Your team can give you the value of T at any value of C & R, but it's tough & time-consuming to find the value of T without knowing its functional form. So, they can only give you up to **20 data points**. They expect you to minimize function T for the given range of **C [250, 300] & R [50, 60]** (T, C, and R have the same units). Your task is to find the **minimum** value of function **T** and the corresponding values of variables **C** & **R**.

Structure of Competition

Stage 1: Solving the Optimization Problem

We will provide the **simulator (Optimiser app)** for computing the value of T. You can give the values of C & R as inputs and get the corresponding value of T as the output. The link to the simulator and instructions to run the simulator will be sent to the participants through mail around a week after the competition launch. It is mandatory for each team to submit a **report** consisting of their approach and a **code** file. You can use Softwares like **MATLAB, Python, Excel, R**.

Include all the data points used to obtain the desired response in a tabular form in the report. Your report should be neat, clean & include necessary plots, tables, calculations, and mathematical equations. You need to number all tables and figures, state clearly what each figure aims to convey, and add appropriate supporting textual explanations of the results. Based on submissions, teams will be shortlisted for the event day competition.

A mail regarding the team's selection will be sent. Prepare a final PDF file of your report and a code file & rename them as follows "**Optimiser_Team ID**". Upload the report and code files in this submission link: https://www.azeotropy.org/optimiser

- Only one member from each team should submit the solution
- Multiple submissions are not allowed, and practicing this would lead to the cancellation of the submission The report should contain the following details:
    - Name, contact information of all the team members, and Team ID
    - **The deadline for abstract submission is February 17th, 2024, at 11.59 p.m.**

Stage 2: Viva Round

There will be a viva round for the selected teams from round 1. Detailed information for the same will be conveyed later.

Evaluation Criteria

Stage 1: This round has a weightage of 80%

A. Choosing the right set of data points: [25 marks]

- We expect the participants to choose the data points smartly. Think that every run of the simulator is equivalent to calculating the value of T without knowing its functional form. Participants' goal should be to try to minimize the number of runs.

B. Analysis of the dataset: [40 marks]

- When we have limited knowledge about the process, we rely on the available mathematical and statistical tools. Performing appropriate analysis on the right datasets can give us a good approximating model for predicting the output and lead us to the optimum response.

C. Results [15 marks]

- For getting the correct set of the total cost function, and corresponding cost & risk variables values: **5 marks**
- Within 5% interval of the total cost function: **5 marks**
- Within 10% interval of the total cost function: **3 mark**
- Report: **5 marks**

D. Bonus

- One can run the simulator a maximum of 20 times. But the lesser you run the simulator, the more you can save your time and resources. To emphasize this point, participants will be given a bonus as **(20-X)*4**, where X is the number of times a particular team has run the simulator. The upper cap for bonus marks is **20** (You can get a maximum of **20** marks as a bonus)

Stage 2: This round has a weightage of 20%.

Emphasis will be given to the approach methodology rather than the actual solution. So, it is important to list down the details of the approach and submit them.

Note:

1. AZeotropy, IIT Bombay, holds the right to change any of the above rules, and the same will be reflected on the website immediately.
2. Any updates regarding the changes in the date and time for which the link shall be live will be announced beforehand.

For any queries related to the Problem Statement or Registration, participants can contact:

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