# SMDE Assignment

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***Abstract*—This document is a model and instructions for LaTeX. This and the IEEEtran.cls file define the components of your paper [title, text, heads, etc.]. *CRITICAL: Do Not Use Symbols, Special Characters, Footnotes, or Math in Paper Title or Abstract.**

***Index Terms*—component, formatting, style, styling, insert**

## INTRODUCTION

This document is a model and instructions for LaTeX. Please observe the conference page limits.

## I. PROBLEM DESCRIPTION

We are provided with three marathon results, from a Keggle dataset, on the years 2015, 2016 and 2017. The data is structured in a way that we have the runners' information, the time they took to get to interest points and the time they took to finish the race. Some of the most relevant variables we are provided are: the age, the gender and the city of origin. We believe this characteristics have a direct impact on the performance of the runners.

By reading the paper [1], we concluded that, effectivelly, enviormental conditions have a direct impact on the performance of the runners. The paper states that the temperature has a positive impact (longer races) and high humidity and high wind speed have a negative impact on the performance of the runners (faster races).

## II. SYSTEM DESCRIPTION, INTRODUCTION

The system to be modeled is the "Barcelona marathon". A system refers to "A collection of entities, characterized by attributes, that act and interact together toward the accomplishment of some logical end".

In the Barcelona marathon we have runners of different levels and ages, that come from different cities and have different genres. The marathon is affected by environmental conditions such as rainfall, temperature and wind speed. The runners need supplies such as water, food and medical supplies to finish the marathon. The purpose of the system is to ensure runners complete the marathon while maintaining safety and competitivity.

This is a fairly simple linear system in which runners advance from one checkpoint to another. At certain points runners need to access resupply points which have limited capacities and an form queues if they aren't able to handle enough capacity. Runners advance from checkpoint to checkpoint until they reach the end of the race. The final times of the runners are also affected by environmental effects like temperature, rainfall and wind speed.

## III. MODEL SPECIFICATION

For this model, the entities and attributes are the following:

- **Runners**: The runners are the main entities in the system. They have attributes such as age, genre and city of origin. They interact with the system by running the marathon.
- **Rainfall**: The rainfall is an environmental attribute that affects the performance of the runners. It has attributes such as intensity and duration.
- **Temperature**: The temperature is an environmental attribute that affects the performance of the runners. It has attributes such as intensity and duration.
- **Supplies**: The supplies are the resources that the runners need to finish the marathon. They have attributes such as water, food and medical supplies.

The oparations of the model will be reduced to runners arriving at the end line. The processes of the model will be the following:

- **Generate runner**: The model will generate a runner .
- **Begins running**: The runner starts at the starting line and begins running.
- **Ends running**: The runner finishes the race.

In this procecss, the model will use a normal distributed random variable to determine the time it takes for a runner to finish. We created different time ranges to decide the level of a runner. The "Elite" runners tend to run 5 km in less than 18 minutes, the "hobby" runners take more than 18 minutes and less than 25 and "new" runners take more than 25 minuts.

The model purpose differs from the system purpose. We aim to predict the consequences of the environmental conditions on the performance of the runners. The model will help us understand how the rainfall, heat and other variables affects the performance of the runners.

### *A. Systemic Structural, Systemic Data and Simplifying Hypotheses*

- **SH_01**: The runners will keep a constant speed over the race. Only the required time to finish the race will metter.
- **SH_02**: Heat, wind and rain will be combined into a single value computed by a formula.
- **SS_01**: The runners will be spleeted in three "level" groups based on the first 5 kilometers performance.
- **SD_01**: The runners will not be affected by ethnics.
- **SD_02**: The time is transformed with a logarithm function to make it more normal. The results are shown in the figure 1 and 2. The model will ignore the outliers.

- **SD_03**: Temperature humidity and wind speed will be combined into three categorical variables (low, medium, high) based on the paper [1] shown on table I.

TABLE I
ENVIRONMENTAL IMPACT ON MARATHON PERFORMANCE

| | MAN | WOMAN |
|---|---|---|
| **Humidity** | | |
| low | 0, 0 | 0, 0 |
| medium | -1.73, -1.92, -1.54 | -1.74, -2.04, -1.45 |
| high | -2.11, -2.31, -1.90 | -0.90, -1.24, -0.57 |
| **Temperature** | | |
| low | 0, 0 | 0, 0 |
| medium | 1.19, 1.00, 1.38 | 1.38, 1.09, 1.67 |
| high | 7.73, 7.50, 7.97 | 7.78, 7.37, 8.19 |
| **Wind Speed** | | |
| low | 0, 0 | 0, 0 |
| medium | -3.18, -3.39, -2.98 | -1.90, -2.22, -1.57 |
| high | -4.92, -5.12, -4.73 | -0.87, -1.18, -0.57 |

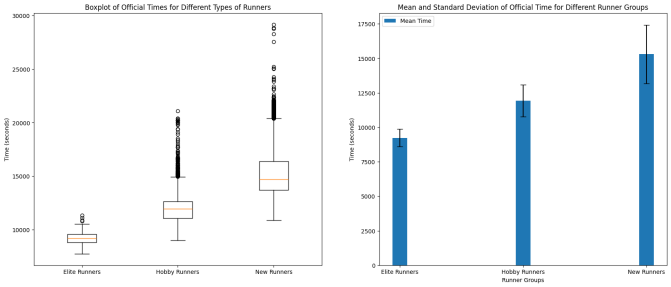


Fig. 1. Standard deviation of race times for elite, hobby, and new runners.

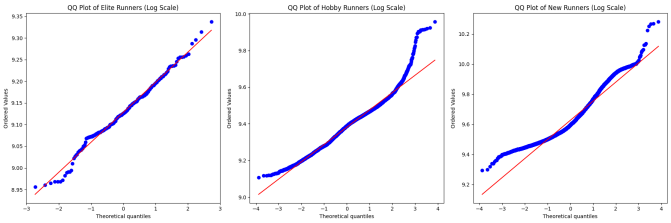


Fig. 2. Q-Q plot for new runners.

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## IV. CODING

### A. Data

## V. DEFINITION OF THE EXPERIMENTAL FRAMEWORK

## VI. MODEL VALIDATION

## VII. RESULTS/CONCLUSIONS

## REFERENCES

[1] B. Knechtle, C. McGrath, O. Goncerz, E. Villiger, P. T. Nikolaidis, T. Marcin, and C. V. Sousa, "The Role of Environmental Conditions on Master Marathon Running Performance in 1,280,557 Finishers the 'New York City Marathon' From 1970 to 2019," Frontiers in Physiology, vol. 12, 2021. [Online]. Available: https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2021.665761. DOI: 10.3389/fphys.2021.665761. ISSN: 1664-042X.