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Predictive Analytics for Production Systems

Assignment 2 - E-Bikes

Deliverables:

- A Jupyter notebook with explanations and commented code cells used for your analysis
- A presentation in PDF format (8-10 slides)

Deadline: December 14th, 2022, 23:59 CET

Assignment Type: Group assignment

Total Points: 10

Task 1 - Unsupervised learning for failure mode detection (10 Points in Total)

Sunflower Bikes is a leading bike manufacturer in Germany. To enhance its market position in the rapidly growing European e-bike market (see Figure 1), the company wants to improve the quality of its bikes. One of the initial steps for the quality management group of the company is to better understand the current state of the production process and its output.

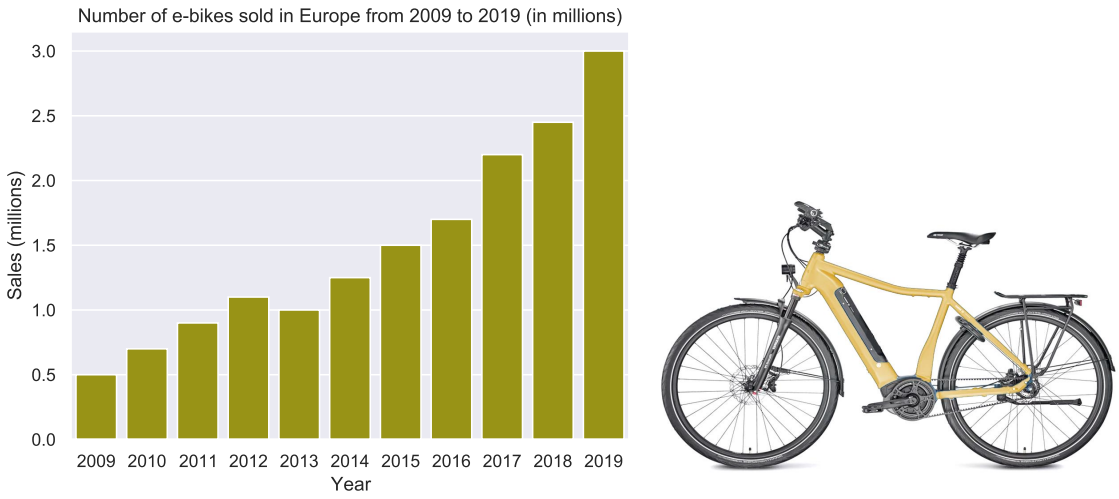

Figure 1: E-bike sales in Europe (Source Statista), SuperWatt bike

Over the last year, the company has gathered data for two key components of finished bikes of their flagship product the "*SuperWatt*" bike. The data for the first set of features is gathered after the production of the frame. The main features measured for each frame as well as their nominal values are depicted in Figure 2. Deviations from the nominal values in any direction are undesirable.

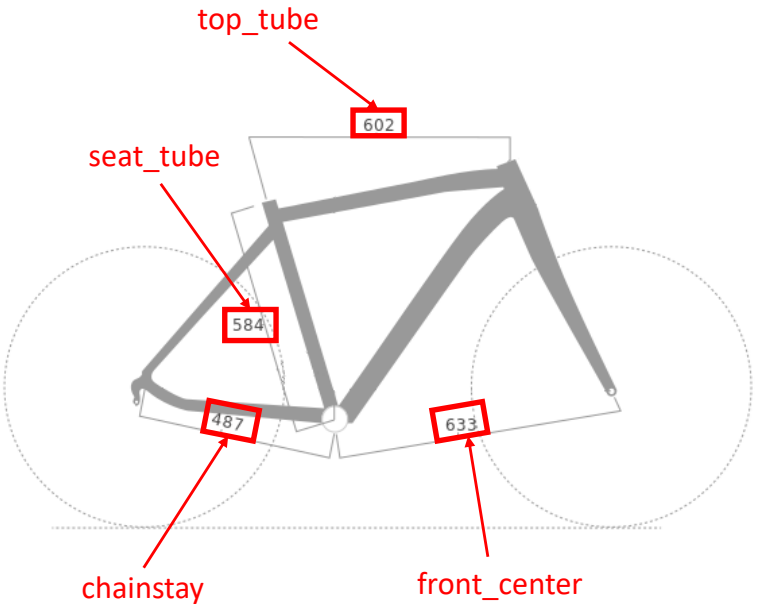

Figure 2: Main features related to the frame and their desired values (mm)

The second key component of the e-bike is the battery. The *SuperWatt* bike features a 2.8 kg battery that has a capacity of 400 Wh with 36 V. Quality measures of the battery are collected after the final assembly, namely the capacity, full-charge voltage, and weight.

In summary, the available data set *data.xlsx* consists of 9,984 records for each of which the following features are measured:

- top_tube (in mm)
- seat_tube (in mm)
- chainstay (in mm)
- front_center (in mm)
- battery_weight (in kg)
- fullcharge_voltage (in V)
- battery_capacity (in KWh)

The company wants to better understand the quality of their manufactured bikes and failures in the production process that can cause deviations from their desired quality level. Assist the quality management team of the company by applying unsupervised learning methods known from the lecture.

(a) Use the machine learning methods to reveal the patterns hidden in the data. Explain the purpose of the methods, justify the order in which you apply the methods, and the selection of parameters used for the methods.

(b) Analyze the obtained patterns quantitatively and visualize your results.

(c) Discuss the managerial implications of your findings and how they can be used to improve the quality of the manufacturing process.

(d) Create the required deliverables.

References:

- https://www.statista.com/statistics/276036/unit-sales-e-bikes-europe/