Machine Learning Exercise 0

Amélie Assmayr (12007770) Konstantinos Damanakis (12106343) Teresa Schuch (12007762)

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1 Introduction

In this Exercise we have chosen two datasets: Laptop Prices and Road Traffic Accidents. The Laptop Prices dataset will be utilized to develop models for predicting laptop prices based on various specifications, while the Road Traffic Accidents dataset will be employed to classify the severity of accidents in the capital city of Ethiopia.

We decided on those two datasets because they enable us to try various and diverse techniques within our framework as they cover different aspects. The Laptop Prices dataset is clean, with no missing values, and consists of 15 features. On the other hand, the Road Traffic Accidents dataset contains 20.057 missing values in 16 variables and includes over 30 features, making the pre-processing steps for this dataset more important and complex.

2 Dataset 1: Laptop Prices

The Laptop Price dataset contains information about various laptops and their prices in Euros. It includes detailed specifications that describe each laptop's features and capabilities. With this, we aim to build a machine learning model that can predict laptop prices based on these specifications.

The motivation of choosing the Laptop Price dataset is its importance in real-life situations, since most people today rely on laptops for work, education and entertainment. Understanding the price trends can help consumers make informed purchasing decisions, making this dataset highly relevant in today's technology-driven world. Additionally, the variety of features in the dataset, including both categorical and numeric data makes it ideal for experimenting with feature engineering and different machine learning methods.

2.1 Attribute Types

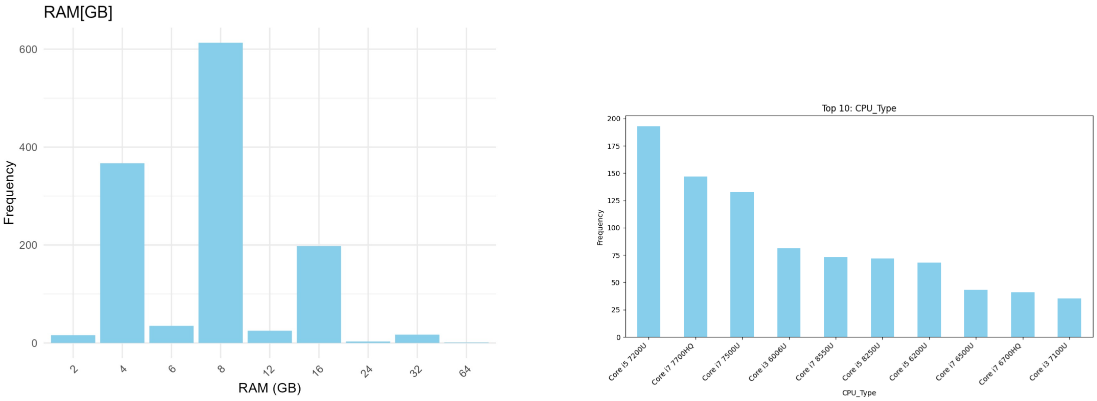
The dataset has 2275 instances and 15 variables. Among these variables, there are 8 nominal, 2 ordinal and 5 metrics. The variables together with their datatypes can be seen in the table below:

Variable	Datatype
Company	nominal
Product	nominal
Type Name	nominal
Inches	ratio quantity
Screen Resolution	ordinal
CPU Company	nominal
CPU Type	nominal
CPU Frequency (GHz)	ratio quantity

Variable	Datatype
RAM (GB)	ratio quantity
Memory	ordinal
GPU Company	nominal
GPU Type	nominal
Operating System	nominal
Weight (kg)	ratio quantity
Price (Euro)	ratio quantity

The histograms of two attributes are given below as an example, where Fig 1a shows the distribution of the RAM (numeric attribute) and Fig 1b shows the distribution of the CPU type (categorical attribute) [1]. Given that the CPU Type has many distinct values, only the top 10 values are presented to maintain clarity in visualization.

[1] Due to limited space, only a selected number of variables were displayed visually for both datasets. All additional plots generated can be viewed here



(a) Histogram RAM

(b) Barplot CPU Types

Figure 1: Examples of attributes for laptop price dataset

2.2 Target attribute

The target variable is the laptop price. Estimating this variable through regression analysis can provide retailers with crucial insights into expected revenues before official pricing is announced. The histogram below illustrates the distribution of laptop prices, revealing that most laptops are priced between 400 and 800 €. However, the mean price stands at 1135 €, with a median of 989 €. Calculating the median makes sense since we can see that there a a few laptops that cost between 5000 and 6000 € which is much higher than the rest. Still these outliers are valid values. The prices range between 174€ and 6099€.

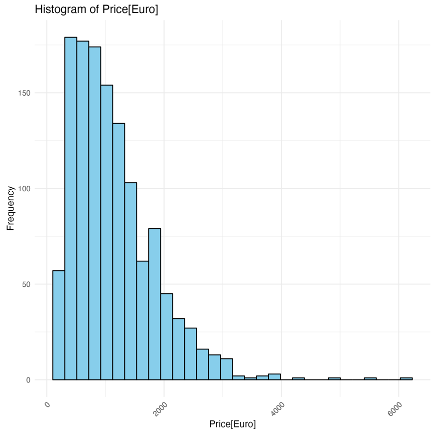


Figure 2: Histogramm Laptop Price

3 Dataset 2: Road Traffic Accidents

The Road Traffic Accidents dataset includes instances of road traffic accidents recorded in the years between 2017 and 2020 in Addis Ababa, capital city of Ethiopia. This dataset contains information regarding the number and characteristics of the vehicles and the drivers that took part in the accidents, the conditions and the casualties that happened as a result of these unfortunate events.

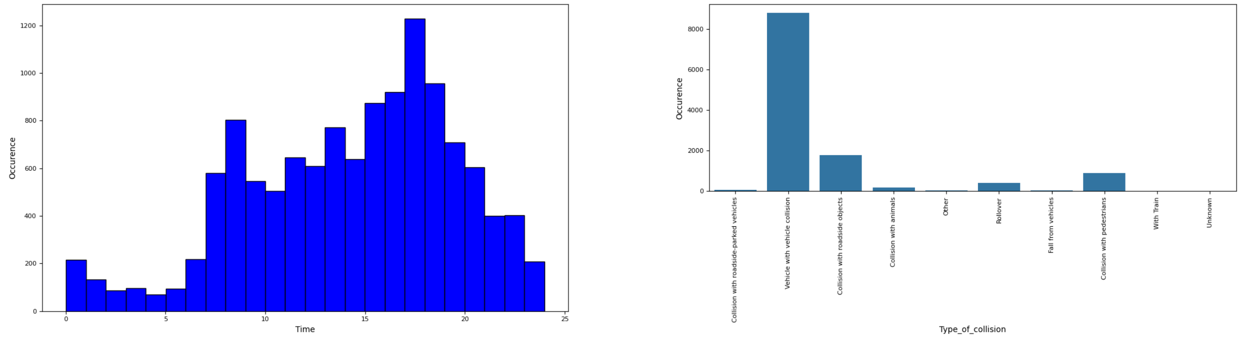
We chose this dataset because it addresses a critical public safety issue that affects many people. A study of this data and a development of a machine learning model would enable the classification and prediction of the severity of the accident based on the different features that lead to or are involved in the accident. This analysis can help identify the major causes and factors contributing to road safety, which is essential for improving transportation policies and reducing accidents.

3.1 Attribute Types

The data contains 31 attributes related to the accident and the target variable which is the severity of the accident. There are 12316 samples/cases recorded while missing data can be observed in 16 features. Among the features, there 24 nominal, 1 ordinal and 7 metric variables. Preprocessing steps are necessary to handle the missing values. In the following table all 31 attributes are presented together with their type of data and number of missing values:

Variable	Datatype	Unique	Missing
Time	ratio	/	-
Day of Week	nominal	7	-
Age of Driver	ratio	/	-
Sex of Driver	nominal	3	-
Educational Level	nominal	7	741
Vehicle-Driver Relation	nominal	4	579
Driving Experience	ratio	/	829
Vehicle Type	nominal	17	950
Vehicle Owner	nominal	4	482
Vehicle Service Year	ratio	/	3.928
Defect of Vehicle	nominal	3	4.427
Accident Area	nominal	14	239
Lanes or Medians	nominal	7	385
Road Alignment	nominal	9	142
Junction Type	nominal	8	887
Road Surface Type	nominal	4	172
Road Surface Condition	nominal	4	-
Light Condition	nominal	4	-
Weather Condition	nominal	9	-
Collision Type	nominal	10	155
Number of Vehicles	ratio	/	-
Number of Casualty	ratio	/	-
Vehicle Movement	nominal	13	308
Casualty Class	nominal	4	-
Sex of Casualty	nominal	3	-
Age of Casualty	ratio	/	-
Casualty Severity	ordinal	4	-
Work of Casualty	nominal	7	3.198
Fitness of Casualty	nominal	5	2.635
Pedestrian Movement	nominal	9	-
Cause of Accident	nominal	20	-
Severity of Accident	nominal	3	-

It should be noted that most of the numeric variables in the dataset are grouped into intervals. For example, the driving experience, although it could be considered ordinal type, it is given in intervals of years (e.g 2-5 years) converting it into a ratio variable. In Figure 3, two histograms of selected attributes are shown, namely the time of the accident and the type of collisions:



(a) Time

(b) Barplot Type of Collisions

Figure 3: Examples of attributes for road accidents dataset

3.2 Target Attribute

The target variable is the severity of the accident. It is classified into the three following classes: Light, Serious and Fatal Injury. While the severity could be considered an ordinal variable, we will treat it as nominal, framing the task as a multi-class classification problem. Figure 4 shows the distribution of these classes. It can be seen that the classes are really unevenly distributed. Most accidents fall under the ”Slight Injury” category, with 10,415 instances, followed by ”Serious Injury” with 1,743 instances, and only 158 accidents classified as ”Fatal Injury.” This imbalance is a critical factor to consider when developing and evaluating the model.

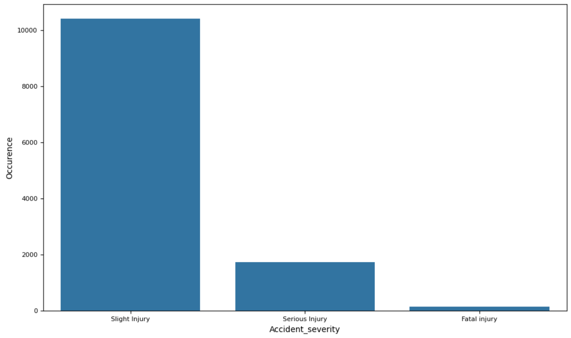


Figure 4: Barplot Accident Severity