

**TÜRKİYE REPUBLIC**

**YILDIZ TECHNICAL UNIVERSITY**

**FACULTY OF CHEMICAL METALLURGY**

**DEPARTMENT OF MATHEMATICS ENGINEERING**

**PROBLEM SOLUTION TECHNIQUES INTERNSHIP**

STUDENT’S

NAME SURNAME : Berkay AHİ

NUMBER : 19058042

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A person with dark hair wearing a black shirt

Description automatically generated

YILDIZ TECHNICAL UNIVERSITY

INTERNSHIPS BOOK

INTERNSHIP TYPE : MANDATORY

NAME AND SURNAME : BERKAY AHİ

STUDENT NUMBER : 19058042

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| --- | --- | --- | --- | --- |
| **Name of Company** | **Department** | **Intership Interval** | | **Work day** |
| **from Date** | **to Date** |
| SabancıDx | Advanced  Data Analytics  Department | 12/07/2023 | 24/08/2023 | 20 |

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| **EVALUATION**  **Adaptation to the workplace Diligence Ability** |
| The workplace supervisor who makes the evaluation evaluates the practical work result of the student according to the following criteria.   |  |  | | --- | --- | | Excellent  Good  Fair  Adequate  Unsuccessful | **A**  **B**  **C**  **D**  **TO** |   The contents of the internship book were examined and deemed appropriate.  …../…../….….  Authorized Supervisor  (Signature and Company Stamp) |

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| **SECTION** | **1.INTRODUCTION** | | | | **PAGE** | **3** |
| During the internship, the “Advanced Data Analytics” department of a large company was observed, the projects and products (applications) developed in the department were learned, ongoing software projects and all other projects in the company were examined and observed in detail by talking to the company employees and listening to what problems they faced with their projects and how they found solutions to these problems. First-hand information was obtained from experienced people about the company's relations with other companies to which it provides consultancy services. How the employees solve the problems arising in ongoing projects was learned by attending meetings with the employees. The subject matter of the different projects carried out in the department and the methods followed in the projects were obtained by talking to the employees, and it was learned how the projects were analyzed and maintained.  In order to fulfill the tasks assigned by the analytics project leader, machine learning, linear regression, python, jupyter notebook (data analysis) and many other data engineering topics were studied during the internship.  During the internship, worked on a global market price forecasting project in the tyre industry, the project is developed in the "Advanced Data Analytics" department for a client of the company.  The topics included in the internship notebook are listed in the "Table of Contents" section. | | | | | | |
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| **SECTION** | | **2. INTRODUCTION OF THE COMPANY** | | | | **PAGE** | **4** |
| SabancıDx provides their clients with innovative solutions in cyber security, advanced data analytics & marketing technologies, cloud & technology services and through the digital transformation products which they develop based on new generation technologies.  They aimed to spread their competencies to a wide range and geography through the investments they made in 2022. In this regard, they have acquired SEM, one of the leading data-oriented digital marketing companies in the sector, and Radiflow, one of the world's leading players in OT cyber security technologies. In addition, thanks to Sabancı Venture investment, they established a strategic partnership with Bulutistan, which provides its customers with hybrid cloud solutions such as data storage and cloud management.  As a result, SabancıDx, one of the leading technology companies in Turkey, is taking bold steps to expand into the global market. With the initiatives and acquisitions they have made, it is not difficult to foresee that they will be able to increase their customer portfolio and reach better places in the future.  Organizational chart is given below:  A screenshot of a computer  Description automatically generated | | | | | | | |
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| **SECTION** | **3. INTRODUCTION OF THE DEPARTMENT** | | | | **PAGE** | **5** |
| SabancıDx's Advanced Data Analytics Department serves as a dynamic nucleus of data-driven innovation, specializing in transformative fields like machine learning and pioneering sustainability projects. This team leverages its expertise to extract meaningful insights, develop predictive models, and cultivate innovative solutions that align with SabancıDx's vision for cutting-edge technology and sustainable practices. By harnessing the power of data to inform strategies, drive informed decision-making, and foster forward-looking initiatives, this department plays a pivotal role in propelling SabancıDx's growth and impact on a global scale.  The projects carried out in the department are usually shaped according to the requirements of the customers. The department develops machine learning models, designs dashboards according to the requests of companies, and mainly uses Python as the programming language.  **Workflow Diagrams should be included** in this section. If the company does not want to share this diagram, it is sufficient to take a signed and stamped petition stating that it cannot be shared with its excuse and it should be added it to the internship report.  An example Workflow Diagram is given below:  A diagram of a process flow  Description automatically generated | | | | | | |
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| **SECTION** | **3. INTRODUCTION OF THE DEPARTMENT** | | | | **PAGE** | **5** |
| The Advanced Data Analytics department has a flexible hierarchy. Employees report their work to their superiors in weekly meetings. Employees in the organization chart communicate effectively with each other through daily meetings.  Organizational chart of the department is given below:  A screenshot of a computer  Description automatically generated  ***Job Descriptions:***  ***Chief Analytics Officer:*** Leads analytics strategy, aligning it with business objectives. They oversee teams, ensure data quality, drive innovation, inform decisions, and foster a data-driven culture while staying updated on industry trends.  ***Advanced Analytics Manager:*** Oversees analysis, defines goals, ensures insights quality, leads innovation, mentors, manages projects, aligns with strategy for informed decision-making and business optimization.  ***Data Scientist:*** Analyzes large datasets, extracts insights, constructs predictive models with machine learning, and creates visuals to guide strategies. Collaborates across teams, learns new techniques, ensures ethical data use, and applies innovative data solutions to intricate problems.  ***Data Analyst:*** Extracts insights, creates visual reports, collaborates with teams for data-driven solutions, ensures quality, follows trends, and supports data strategy ethically.  ***Analytics Project Lead***: Takes charge of planning, executing, and overseeing data analytics projects. Collaborates with teams to define project goals, ensures data quality, and transforms complex insights into actionable recommendations. The lead also drives innovation, mentors team members, and aligns analytics initiatives with the company's strategic objectives.  ***Core-Hub Solution Lead***: The Core-Hub Solutions Lead spearheads the creation of digital and analytics products, services, and business models to enhance the entrepreneurship ecosystem. This involves team collaboration, project management, strategic alignment, innovation, performance tracking, and partnership building.  ***Sales Support Specialist:*** Aid sales team, manage documentation, assist customers, process orders, resolve inquiries, maintain CRM, generate reports. | | | | | | |
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| **SECTION** | **4. WEEKLY WORKING SCHEDULE** | | | | | **PAGE** | **6** |
| |  |  |  |  | | --- | --- | --- | --- | | **WORKING WEEK 1** | | Starting Date | 12/07/2023 | | Ending Date | 14/07/2023 | | **DAY** | **THE WORK DONE** | | **PAGE NO** | | Monday | -- | |  | | Tuesday | -- | |  | | Wednesday | The department was recognized, the tasks in general were tried to be learned. | |  | | Thursday | Visited the office and met with the employees. | |  | | Friday | People to work closely with in the project were contacted. | |  |  |  |  |  |  | | --- | --- | --- | --- | | **WORKING WEEK 2** | | Starting Date | 17/07/2023 | | Ending Date | 21/07/2023 | | **DAY** | **THE WORK DONE** | | **PAGE NO** | | Monday | Company and departmental organization chart was requested from Human Resources. | |  | | Tuesday | -- | |  | | Wednesday | The job descriptions of the people working in the department were questioned. | |  | | Thursday | -- | |  | | Friday | Tried to understand the pandas and numpy libraries of the Python programming language. | |  | | | | | | | | |
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| **SECTION** | **4. WEEKLY WORKING SCHEDULE** | | | | | | | | | | | **PAGE** | | **7** | |
| |  |  |  |  | | --- | --- | --- | --- | | **WORKING WEEK 3** | | Starting Date | 24/07/2023 | | Ending Date | 28/07/2023 | | **DAY** | **THE WORK DONE** | | **PAGE NO** | | Monday | Information about the “Global Market Price Forecast for Tyre Industry” project was received. | |  | | Tuesday | -- | |  | | Wednesday | Project’s details were examined and the subjects to be learned were listed. | |  | | Thursday | -- | |  | | Friday | Met with the “Global Market Price Forecast for Tyre Industry” project team and received information about their work. | |  |  |  |  |  |  | | --- | --- | --- | --- | | **WORKING WEEK 4** | | Starting Date | 31/07/2023 | | Finishing Date | 04/08/2023 | | **DAY** | **THE WORK DONE** | | **PAGE NO** | | Monday | A short training was given about the Exploratory Data Analysis (EDA) process. | |  | | Tuesday | -- | |  | | Wednesday | The concept of data manipulation and data cleaning is learned. | |  | | Thursday | -- | |  | | Friday | Tried to solve the problems that seen in the process of the data manipulation. | |  | | | | | | | | | | | | | | | | |
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| **SECTION** | **4. WEEKLY WORKING SCHEDULE** | | | | | | | | | | | **PAGE** | | **8** | |
| |  |  |  |  | | --- | --- | --- | --- | | **WORKING WEEK 5** | | Starting Date | 07/08/2023 | | Ending Date | 11/08/2023 | | **DAY** | **THE WORK DONE** | | **PAGE NO** | | Monday | Fill in missing values and bring the dataset into a usable format. | |  | | Tuesday | -- | |  | | Wednesday | Linear regression and machine learning concepts were explored. | |  | | Thursday | -- | |  | | Friday | Research was conducted on developing a machine learning model using linear regression. | |  |  |  |  |  |  | | --- | --- | --- | --- | | **WORKING WEEK 6** | | Starting Date | 14/08/2023 | | Finishing Date | 18/08/2023 | | **DAY** | **THE WORK DONE** | | **PAGE NO** | | Monday | A data mart containing the features that are expected to be input to the model was created. | |  | | Tuesday | -- | |  | | Wednesday | The relationship between the features and the target was analyzed. | |  | | Thursday | -- | |  | | Friday | The model was run with possible features and scenarios were obtained. | |  | | | | | | | | | | | | | | | | |
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| **SECTION** | **4. WEEKLY WORKING SCHEDULE** | | | | | | | | | | | **PAGE** | | **9** | |
| |  |  |  |  | | --- | --- | --- | --- | | **WORKING WEEK 7** | | Starting Date | 21/08/2023 | | Ending Date | 24/08/2023 | | **DAY** | **THE WORK DONE** | | **PAGE NO** | | Monday | The model was run with the features that are appropriate and the result was obtained. | |  | | Tuesday | -- | |  | | Wednesday | -- | |  | | Thursday | The resulting forecast was prepared for presentation to the client. | |  | | Friday | -- | |  | | | | | | | | | | | | | | | | |
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| **SECTION** | | | | **5. DAILY WORKING REPORTS** | | | | | | **PAGE** | | | **9** | |
| *12.07.2023*  *On the first day of the internship, we met the other interns and tried to understand the values of the company. A presentation about the company's goals and what they expect from the interns was explained in detail by the HR team. It was explained that different departments of the company have different products and what is the scope of use of some of these products. The work of the department where the internship will be done and the responsibilities that the intern can take in this department were briefly mentioned.*    *13.07.2023*  *An office visit was made to get information about the company and to see the working environment. The interior of the company and the sections where work can be done were visited and examined. The employees in the internship department were met and their tasks were learned. The responsibilities and working styles of the employees were examined. During these visits, the place and importance of the computer in the organization was examined and information about data analytics, and data engineering was obtained.*  *14.07.2023*  *A meeting was held with the people who will work together in the project during the internship. The responsibilities of other employees who will work in the project were tried to be understood. The items and work package definitions created during the design process of the project were examined.*  *17.07.2023*  *Research was started to create an organization chart, and the human resources team was contacted. The current organizational chart was requested and it was examined whether the current chart of the departments was the one sent by human resources. Afterwards, the authorized person in the department was contacted and asked for the department's schema, and it was compared whether the schema transmitted was the same as the schema created as a result of the examinations during the internship.*  *19.07.2023*  *One-to-one conversations were held with the employees about the work they do in the projects in order to write descriptions about the job descriptions of the employees by looking at the department diagram. As a result of the conversations with the employees, information about the functioning and workflow in the department was obtained.* | | | | | | | | | | | | | | |
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| **SECTION** | | | | **5. DAILY WORKING REPORTS** | | | | | | **PAGE** | | | **9** | |
| *21.07.2023*  *A short meeting was held with the project manager about the responsibilities in the project during the internship. After this meeting, pandas and numpy libraries of python programming language were started to be researched. It was learned that the Pandas library is frequently used in data cleaning and data manipulation processes.*    *24.07.2023*  *The project manager gave information about the responsibilities to be fulfilled in the main project to be worked during the internship.* *Research was conducted to understand the scope and purpose of the project. A detailed description of the project was made in the project section.*  *26.07.2023*  *In the project of building a machine learning model for global market price forecasting for tyre industry, which will be worked on during the internship, a list of topics that must be learned in order to be able to accomplish the tasks to be fulfilled were listed. Some of these topics are: pandas and numpy libraries of python, EDA process, linear regression, statistical models, macroeconomic indicators etc.*  *Research on these subjects were started, and employees were contacted to benefit from the knowledge of the employees in the department.*  *28.07.2023*  *Continued to research topics for further work and stayed in touch with people in the department to benefit from their experience. Afterwards, a meeting was held with colleagues in the "Global Market Price Forecast for Tyre Industry" project and information was received about ongoing developments.* | | | | | | | | | | | | | | |
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| **SECTION** | | **5. DAILY WORKING REPORTS** | | | | **PAGE** | **9** |
| *31.07.2023*  *A brief information was given about the teammate in the project about what the EDA process is. Subsequent investigations showed that, Exploratory Data Analysis (EDA) is the process of examining and visualizing data to uncover patterns, insights, and relationships, aiding in the understanding of its characteristics before in-depth analysis.*    *02.08.2023*  *Learned what is the process of data manipulation and data cleaning is. Data manipulation is the process of refining and reformatting raw data to prepare it for analysis, involving tasks such as cleaning, transforming, aggregating, and filtering. A few practical applications were made to bring the raw data to the desired format to be used in the project.*  *04.08.2023*  *After learning the concept of data manipulation, it became clear that while converting the data into the desired format to be able to use in the project, there were problems in some datasets such as missing values in some of them or not all values in the desired unit.* *Research has started to be done to eliminate these problems.*  *07.08.2023*  *Research was conducted on how to fill in missing values in the datasets. For example, in the Gross Domestic Product (GDP) macroeconomic data, some countries had missing values in some years and these values had to be filled. In order to fill these values, various missing value filling methods were followed, such as taking the average of the last three available quarters.* *In addition, various manipulations were made to ensure that all the data were in the same format, i.e. they all had to be at the same time frequency (quarterly or annual) in order to put them in the model. Manipulations were made with this criterion in mind.*  *09.08.2023*  *Linear regression and machine learning models are being explored to contribute in the later phases of the project.* *Linear regression is a supervised machine learning algorithm used for predicting a continuous target variable based on one or more input features by modeling the relationship between them as a linear equation.* *It was understood that each data we will use in the project is a feature for us and that we should use the features that are meaningful by looking at the correlation of these features with the target we want to predict.* | | | | | | | |
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| **SECTION** | | **5. DAILY WORKING REPORTS** | | | | **PAGE** | **9** |
| *11.08.2023*  *In the light of the information learned the other day, the features required to build a machine learning model using linear regression were investigated. Team members briefly explained why linear regression was used and not other forecasting algorithms.*    *14.08.2023*  *The process of cleaning the features that are expected to be input to the model, eliminating the problems that arise, creating a single excel file (data mart) and storing the finalised features (data) on this file was performed. By analysing the data in the created data mart, it was examined which features are logical to use in the model.*  *16.08.2023*  *Analysis graphs and correlation matrix of the correlation of features with the target were prepared and analysed in a meeting with the team. A model scenario was tested with the backward elimination method, paying attention to the need to use some features and concepts such as multicollinearity.* *As a result of multicollinearity tests, some features were found to have high correlation among themselves, an algorithm was created using python programming language to eliminate these features.*  *18.08.2023*  *After the features were put through various test phases, the model scenarios were run with different features. After running the model, the prediction results and metrics such as mean absolute error (mae), mean absolute percentage error, R squared, etc. were analysed and the models that would be efficient to be used were decided in a meeting.*  *21.08.2023*  *After analysing the statistical error metrics, the model that gave the best prediction was decided. A PowerBI dashboard was created to graph the prediction results of the decided model for each predicted region.* *Whether the model needs any improvement was analysed using various evaluation metrics. System design researches were initiated to enable the customer to enter new data and realise what-if scenarios on the interface created.*  *24.08.2023*  *The first version of the model to be shown to the customer was created, and it was realised that some developments in the industry had been missed in the forecasts. It was discussed that these forecasts could be improved in the following versions and new approaches could be introduced. It was already known that such problems may occur due to the slight volatility of the market and the data we use, and different solution techniques were started to be investigated to solve these problems.* | | | | | | | |
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| **SECTION** | | **6.PROJECT: “Global Market Price Forecasting for Tyre Industry”** | | | | **PAGE** | **9** |
| **SUB-SECTION** | | **6.1 Introduction of the Project** | | | | | |
| The name of the project to be carried out during the internship is "Global Market Price Forecasting for Tyre Industry" and hereinafter referred to as the project.  The aim of the project is to make global market price forecasting for a client company of the department working in the tyre industry. The data kept by the customer will be analysed by the department and a machine learning model will be built by adding additional data such as macroeconomic indicators etc. to the data provided by the customer and a price forecast will be made. While making this prediction, various machine learning models will be built and it will be decided which machine learning method should be used.  The main responsibilities to be carried out during the project:  - Cleaning and analysing the data planned to be used in the forecasting model.  - Researching additional external data sources that can be used (macroeconomic indicators, etc.)  - Bringing the found data sources into the desired format.  - Writing the code of the linear regression model.  The aim of the project, as stated above, is to make global market price forecasting for the wheel industry, and various libraries of the Python programming language will be used to achieve this goal. Some of these libraries are: pandas, numpy, sns, sklearn, etc. If necessary, a database can be designed and SQL query language can be used to facilitate file management. | | | | | | | |
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| **SECTION** | | **6. PROJECT: “Name of the Project”** | | | | **PAGE** | **10** |
| **SUB-SECTION** | | **6.2 Planning of the Project Process** | | | | | |
| Before the start of the project, the planned creation process of the project should be given in item by item. | | | | | | | |
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| **SECTION** | | **6. PROJECT: “Name of the Project”** | | | | **PAGE** | **11th** |
| **SUB-SECTION** | | **6.3 Detailing of the Project** | | | | | |
| The details of the project will be explained, taking into account the plan which is given the previous sub-section. | | | | | | | |
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| **SECTION** | | **6. PROJECT: “Name of the Project”** | | | | **PAGE** | **12** |
| **SUB-SECTION** | | **6.4 Screenshots of the Project** | | | | | |
| Screen outputs/images detailing the work that was obtained/done as a result of the project's work; should be included comprehensibly along with all necessary explanations. | | | | | | | |
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| **SECTION** | | **6. PROJECT: “Name of the Project”** | | | | **PAGE** | **13** |
| **SUB-SECTION** | | **6.4 Evaluation of the Project** | | | | | |
| In this section, the project will be evaluated in detail. The success rate, negative and positive aspects of the project should be presented according to the objectives determined at the beginning. The difficulties encountered in the project should be stated. It should be interpreted how the project can be developed in the future. | | | | | | | |
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| **SECTION** | **7. EVALUATION OF THE INTERNSHIP** | | | | **PAGE** | **14** |
| The knowledge and experience accomplished by the internship should be explained, and the results (problem, observation, comment, etc.) of the project or the contributed parts of the practice should be summarized. **Observations including the problems** encountered during the internship and/or observed in the company and the solutions produced to these problems or produced by the company should be reported.  A good evaluation section should be at least one page in size, as it covers the entire internship work. | | | | | | |
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| **SECTION** | **8. REFERENCES** | | | | **PAGE** | **15** |
| * <https://www.sabancidx.com/ileri-veri-analitigi/> * <https://pandas.pydata.org/docs//> * <https://numpy.org/> * <https://www.indeed.com/career-advice/career-development/data-manipulation> * <https://www.geeksforgeeks.org/what-is-exploratory-data-analysis/> * <https://www.analyticsvidhya.com/blog/2021/05/dealing-with-missing-values-in-python-a-complete-guide/> * <https://www.ibm.com/topics/linear-regression> | | | | | | |
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