VaxCare 2022

USER

~~~~**MANUAL**

LAPR2 | LANGUAGE SKILLS MODULE

Content

User Manual Structure Guidelines (from cover to annexes) \_ structure to develop the VaxCare application User Manual.

User Documentation offers information for the users to use the product successfully.

User Manual Structure Guidelines Cover

* Document title, authors, institution ID, date (copyright info)

VaxCare

Backloggers

João Castro, Gustavo Jorge, João Leitão, Guilherme Sousa, Pedro Monteiro

1210816, 1211061, 1211063, 1211073, 1211076

ISEP LEI

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* Glossary Relevant terms and abbreviations used in the document

|  |  |  |
| --- | --- | --- |
| Terms or Expression (EN) | Termo ou Expressão (PT) | Description(EN) |
| Administrator | Administrador | A person responsible for carrying out the administration of a business or organization |
| Adverse Reactions | Reações Adversas | An adverse effect is an undesired harmful effect resulting from a medication or other intervention, such as surgery. |
| Algorithm | Algoritmo | A step-by-step procedure for solving a problem or accomplishing some end. |
| Application User | Utilizador da Aplicação | A person that is going to use the application as a client. |
| Application | Aplicação | A program that performs a particular task or set of tasks. |
| Asymptotic Behavior | Comportamento Assintótico | The asymptotic behavior of sequences of random variables, that is the behavior of infinitely long sequences of random variables, is an involved mathematical concept but it has important implications for the statistical analysis of data from large samples. |
| Benchmark Algorithm | Algoritmo de Referência | In statistical learning benchmarking is the methodology of comparing learners or algorithms with respect to a certain performance measure. |
| Brute-Force Algorithm | Algoritmo de Força Bruta | In computer science, brute-force search or exhaustive search, also known as generate and test, is a very general problem-solving technique and algorithmic paradigm that consists of systematically enumerating all possible candidates for the solution and checking whether each candidate satisfies the problem’s statement. |
| CamelCase | CamelCase | CamelCase is a naming convention in which a name is formed of multiple words that are joined together as a single word with the first letter of each of the multiple words capitalized so that each word that makes up the name can easily be read. |
| Centers | Centros | The point from which an activity or process is directed, or on which it is focused. |
| Client | Cliente | A person served by or utilizing the services of a social agency. |
| Computation Complexity | Complexidade Computacional | In computer science, the computational complexity of an algorithm is the number of resources required to run it. Focus is given to time and memory requirements. |
| Contiguous | Contíguo | Being in actual contact: touching along a boundary or at a point. |
| Coordinator | Coordenador | A person whose job is to organize events or activities and to negotiate with others to ensure they work together effectively. |
| Default | Predefinição | A preselected option adopted by a computer program or other mechanism when no alternative is specified by the user or programmer. |
| Digital Certificate | Certificado Digital | An official document that states that the information on it is true, however it’s in a digital format. |
| Dosage Scheme | Esquema de Dosagem | The size, frequency, and number of doses of a given vaccine. |
| Employee | Funcionário | A person employed for wages or salary, especially at non-executive level. |
| Entries and Exists List | Lista de Entradas e Saídas | List of people that have entered and exited the vaccination center. |
| FIFO Queue | Fila FIFO | A FIFO Queue is a queue that operates on a first-in, first-out (FIFO) principle. This means that the request (like a customer in a store or a print job sent to a printer) is processed in the order in which it arrives. |
| GHD | DGS | Acronym for General Health Directorate. |
| GRHC | AGES | Acronym for Groupings of Health Centers. |
| Given Vaccine | Vacina Administrada | The Vaccine that was administered to the patient. |
| Healthcare Center | Centro dos Cuidados de Saúde | A healthcare center is one of the network of clinics staffed by a group of general practitioners and nurses providing healthcare services to people in a certain area. |
| JUnit5 | JUnit5 | JUnit 5 is the updated version of the highly popular testing library for Java applications, JUnit. |
| JaCoCo | JaCoCo | JaCoCo runs as a Java agente. It’s responsible for instrumenting the byte code while running the tests. JaCoCo drills into each instruction, and shows which lines are exercised during each test. |
| JavaFX11 | JavaFX11 | JavaFX is a modern, efficient, and fully featured toolkit for developing rich client applications. |
| JavaDoc | JavaDoc | JavaDoc is a documentation tool for the Java programming language. The document it creates from the Java sources is in HTML format and describes the application programming interface. |
| Mass Vaccination Center | Centro de Vacinação em Massa | Mass vaccination centers are like healthcare centers but usually only administer one type of vaccine during pandemic events. |
| NHS | SNS | Acronym for National Health Service. |
| Nurse | Enfermeira | A person skilled or trained in caring for sick or injured people. |
| Outbreak | Surto | A sudden rise in the incidence of a disease. |
| Performance | Desempenho | The execution of an action. |
| RHA | ARS | Acronym for Regional Health Administration. |
| Receptionist | Rececionista | A receptionist is an employee taking an office or administrative support position. |
| SMS | SMS | Acronym for Short Message Service. |
| SMS User | Utilizador SNS | SNS User is a person that is registered in the SNS system. |
| SVG | SVG | Scalable Vector Graphics (SVG) is a web-friendly vector file format. As opposed to pixel-based raster files like JPEGs, vector files store images via mathematical formulas based on points and lines on a grid. |
| Slot | Intervalo | A time when something can happen or is planned to happen, especially when it is one of several possible times. |
| System | Sistema | A group of devices or artificial objects or an organization forming a network especially for distributing something or serving a common purpose. |
| Time Complexity | Complexidade Temporal | Time complexity is the amount of time taken by an algorithm to run, as a function of the length of the input. It measures the time taken to execute each statement of code in an algorithm. |
| Type of Vaccine | Tipo de Vacina | Related to the kind of virus that the vaccine cures. |
| User Info | Informação do Utilizador | Health related information about a user. |
| User Waiting List | Lista de Espera de Utilizadores | List of users who are waiting in the vaccination center to be vaccinated. |
| User | Utilizador | A person who uses or operates the application. |
| Vaccination Center | Centro de Vacinação | In our case, it includes mass vaccination centers and healthcare centers, linking both because they share the vaccination process. |
| Vaccination Process | Processo de Vacinação | The entire process from start to finish that a user must endure to complete their vaccination. |
| Vaccine Appointment | Agendamento de Vacinas | An arrangement for a meeting with the vaccination center to be administered a vaccine. |
| Vaccine | Vacina | A vaccine is a biological preparation that provides active acquired immunity to a particular infectious disease. A vaccine typically contains an agent that resembles a disease-causing microorganism and is often made from weakened or killed forms of the microbe, its toxins, or one of its surface proteins. |
| SLR | RLS | Stands for simple linear regression. |
| MLR | RLM | Stands for multiple linear regression. |

* Table of contents \_ List of sections, numbered, including the start page (index)

1. **Introduction** 
   1. Purpose and Scope (of the manual: what kind of information it contains, and who it is addressed to)
   2. This user manual contains all the useful information regarding the developed application, in the simplest way, so that the users which are the main target of this document, can easily learn and understand how to use the VaxCenter.
   3. System Overview (overall description of the application: objectives and scope, structure and main features, highlighting the core modules, using a diagram)
   4. System Requirements (e.g., which OS, version and service packs are needed for the application to work; how much disk space, RAM, and/or processor speed are required)
   5. The app can be run in every operating system.
   6. Software Installation (procedure and relevant specifications to install the application)
2. **System Features**

Non-Graphical Interface Features:

* 1. Login:

1. In the main menu, select the option that says “Login” by typing its index number on the screen.
2. Now you’ll have to start by typing either your email address or your user ID.
3. After the email address, you’ll have to type your password.
   * 1. Login Successful:

A menu for the User’s role is shown.

* + 1. Invalid Email Address:

If the user enters an invalid email address or user ID, the following message will show: “Invalid UserId and/or Password. You have 2 more attempt(s).”

* + 1. Invalid Password:

If the user enters an invalid password, the following message will show: “Invalid UserId and/or Password. You have 2 more attempt(s).”

* + 1. Login Tries Limit:

If the user fails the login 3 times, the system will show the same message (with 0 attempt(s) left) and will redirect you back to the main menu.

If you are an Administrator:

* 1. Register a Mass Vaccination Center:

*Prerequisite: Login by following feature 2.1*

Follow the steps bellow, paying special attention to the format instructions inside the brackets.

Uma imagem com texto

Descrição gerada automaticamente

Figure 1 - Example of the creation of a Mass Vaccination Center.

* + 1. Register Mass Vaccination Center Success:

If all the information is well filled, just like in the step 2.2, this message will show:

Uma imagem com texto

Descrição gerada automaticamente

Figure 2 - Data Confirmation Message.

And you’ll be asked to confirm the data, which if you do, the vaccination center gets registered in the system.

* + 1. Register Mass Vaccination Center Invalid Information:

If at least one of the filled parameters being validated (the ones that have instructions inside brackets) is wrong, a message specifying the problem for the user will show.

* 1. Register Healthcare Center

Just like in topic 2.2, follow the steps bellow, paying special attention to the format instructions inside the brackets:

Uma imagem com texto

Descrição gerada automaticamente

Figure 3 - Example of the creation of a Healthcare Center.

* + 1. Register Healthcare Center Success:

If all the information is well filled, just like in the step 2.3, this message will show:

Uma imagem com texto

Descrição gerada automaticamente

Figure 4 - Data Confirmation Message

* + 1. Register Healthcare Center Invalid Information:

If at least one of the filled parameters being validated (the ones that have instructions inside brackets) is wrong, a message specifying the problem for the user will show.

* 1. Register an Employee.

*Prerequisite: Login by following step 2.1*

1. Select option “2” In Administrator Menu.

Uma imagem com texto

Descrição gerada automaticamente

Figure 5 - Administrator Menu

1. Select a role for the new employee.

Uma imagem com texto

Descrição gerada automaticamente

Figure 6 - Role Selection.

1. Here is the ‘Register New Employee’ form:
   1. Some of the requested information have a specific format or validation, *follow steps X in Troubleshooting.*

Uma imagem com texto

Descrição gerada automaticamente

1. There are five fields and all of them are required. Please type and click on ‘Enter’ in keyboard.
   * 1. Valid Information

Both ID and Password for the employee are generated automatically and the new employee is added.

Uma imagem com texto

Descrição gerada automaticamente

* + 1. Invalid Information.

If any of the employee´s given information is invalid the following error message will display: “Invalid Employee Data”.

Uma imagem com texto

Descrição gerada automaticamente

* 1. Get List of Employees:

*Prerequisite: Login by following step 2.1*

1. Select option “3” In Administrator Menu.

Uma imagem com texto

Descrição gerada automaticamente

1. The user must select the role he wants to get a list of.
   * 1. Get List of Employees Success:

If the list of employees with the role the user selected is registered in the system, a message containing the list will show:



* + 1. Get List of Employees Invalid:

If the list of employees with the role the user selected is not registered in the system, this message will show:

Uma imagem com texto

Descrição gerada automaticamente

* 1. Specify a New Vaccine Type:

*Prerequisite: Login by following step 2.1*

1. Select option “4” In Administrator Menu.

Uma imagem com texto

Descrição gerada automaticamente

1. Follow the steps bellow to create a vaccine type. (The Vaccine Type Code must have 5 letters maximum):

Uma imagem com texto

Descrição gerada automaticamente

* + 1. Specify a New Vaccine Type Success:

If all the information is well filled, a message of data confirmation and success will show:

Uma imagem com texto

Descrição gerada automaticamente

* + 1. Specify a New Vaccine Type Invalid:

If the information is not well filled, a message of invalid data will appear, and what the user wrote will be presented so that they can find out what gone wrong, and the user will be redirected to the Administrator’s Menu.

Uma imagem com texto

Descrição gerada automaticamente

* 1. Specify a new vaccine and its administration process.

*Prerequisite: Login by following step 2.1*

1. Select option ‘5.’ In Administrator Menu.

Uma imagem com texto

Descrição gerada automaticamente

1. Select available vaccine type.

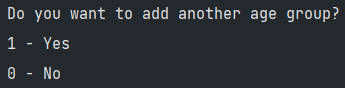
Uma imagem com texto

Descrição gerada automaticamente

1. Here is the ‘Specify a new vaccine and its administration process’ form:
2. Some of the requested information have a specific format or validation, *follow steps X in Troubleshooting.*

Uma imagem com texto

Descrição gerada automaticamente Uma imagem com texto

Descrição gerada automaticamente

1. There are eight fields and all of them are required. Please type and click on ‘Enter’ in keyboard.
   * 1. Valid Information.

New Vaccine is added.

* + 1. Invalid Information.

If any of the vaccine´s given information is invalid the following error message will display: “Invalid Vaccine Data”.

Uma imagem com texto

Descrição gerada automaticamente

* 1. Load a CSV file or get a list of SNS Users

Select option “6” In Administrator Menu.

Uma imagem com texto

Descrição gerada automaticamente

To load a file with the SNS User Info, select “0”:

Uma imagem com texto

Descrição gerada automaticamente

The user must type the path of the file containing the SNS User Info.

Uma imagem com texto

Descrição gerada automaticamente

To get a list of all SNS Users registered in the system, select “1”:

Uma imagem com texto

Descrição gerada automaticamente

* + 1. Load a CSV file or get a list of SNS Users Success

If the users that are supposed to be loaded to the system, aren’t registered yet, a message of success will show, giving the user the option of loading another file:

Uma imagem com texto

Descrição gerada automaticamente

* + 1. Load a CSV file or get a list of SNS Users Invalid – Duplicates:

If the users that are supposed to be loaded to the system, are already registered, an error message will show, giving the user the option of loading another file:

Uma imagem com texto

Descrição gerada automaticamente

* + 1. Load a CSV file or get a list of SNS Users Invalid – File Doesn’t Exist:

If the file the user is trying to load doesn’t exist, an error message will show, giving the user the option of loading another file:

Uma imagem com texto

Descrição gerada automaticamente

If you are a Nurse

* 1. Consult the users in the waiting room of a Vaccination Center.

*Prerequisite: Login by following step 2.1*

1. Select option ‘1.’ In Nurse Menu.

Uma imagem com texto

Descrição gerada automaticamente

Select one of the available centers.

1. If there are users in center waiting room, a list with all those people will be presented.

Uma imagem com texto

Descrição gerada automaticamente

If you are a User

* 1. Schedule Vaccine

*Prerequisite: Login by following step 2.1*

1. Select option ‘1.’ In User Menu.

Uma imagem com texto

Descrição gerada automaticamente

1. Select an available vaccination center.
2. Select an available vaccine type.

Uma imagem com texto

Descrição gerada automaticamente

* 1. The only vaccine types presented are those that fit within the user age.

1. Choose a date and time for the vaccination
2. The only dates and times presented are those that are not already filled and in a 2 months max span.
3. The selected vaccine type is checked in order to ensure that the user is not scheduling a vaccination in-between the interval between doses.

Uma imagem com mesa

Descrição gerada automaticamente Uma imagem com mesa

Descrição gerada automaticamente

1. Save the new appointment.

Uma imagem com texto

Descrição gerada automaticamente

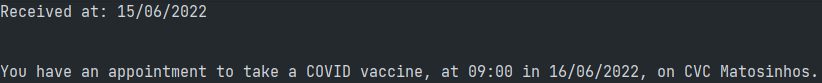
1. Confirm SMS with the appointment information.

Uma imagem com texto

Descrição gerada automaticamente

* + 1. Confirm Appointment SMS.

If user´s authorizes the SMS message, it will be sent to their mobile phone.



Graphical Interface Features:

If you are a Nurse:

* 1. Record Vaccine Administration.

*Prerequisite: Login by following step 2.1*

1. Select option ‘Record Vaccine Administration.’ In Nurse Menu.

Uma imagem com texto

Descrição gerada automaticamente

1. Choose one of the available centers from the ‘Facility’ combo box.



1. Choose one user in the Waiting Room List from ‘User List’ the combo box.



1. Choose a vaccine.
   * 1. If a user has already taken a vaccine with a vaccine type correspondent to the one, he selected on the new appointment, ‘Vaccine’ combo box is disabled.
     2. If it´s user first dose, choose one of the available vaccines from ‘Vaccine’ combo box.



1. Check User name in ‘Name’ text field and age in ‘Age’ text field.



1. Check user´s vaccine dosage for current dose in ‘Dosage’ text field.



1. Insert administrated vaccine lot number.



1. Click ‘Record’ button to add new administered vaccine to user bulletin.

Uma imagem com texto

Descrição gerada automaticamente

1. Troubleshooting

If you experience trouble with VaxCare, try the following solutions. Check the items on pages X to Y. Consult local authorized **DGS** service facility.

3.1 Registering an Employee

3.1.1 Invalid Email Address

* As you insert the email, make sure to use ‘@’ and ‘.’ (Valid Domains 🡪 Table X in ‘Email Domains’).

3.1.2 Invalid Citizen Card Number

* Citizen Card Number follows **Portuguese** format (Check it in here 🡪 [PT Portugal Flag Icon | Public Domain World Flags Iconset | Wikipedia  Authors](https://www.autenticacao.gov.pt/o-cartao-de-cidadao)).

3.1.3 Invalid Address

* While filling your address you must introduce ‘Street / Zip-Code / Location’ (Valid Zip Code 🡪 Table X in ‘Zip Code Format’).
  + 1. Invalid Phone Number
* Phone Number follows **Portuguese** format, it´s mandatory that it contains nine digits.
* Phone Number must start with ‘9’ and the second digit must be valid (🡪 Table X in ‘Phone Number Confirmation Digits’).

3.1.5 Unable to Register Employee

* If you are still not able to register an employee even after following the previous steps (Steps 3.1.1 🡪 3.1.4), that means that there is already some employee with the same Citizen Card Number.
  1. Specifying new Vaccine

3.2.1 Missing Vaccine Types

* If the displayed error is “Vaccine Types Missing”, it means that you should follow steps 2.7 🡪 2.7.2 (‘Specify a new vaccine and its administration process’) so you have at least one vaccine type to proceed ‘Specifying new Vaccine’.

3.2.2 Invalid Age Group

* If the ‘minimum age of the group’ is bigger than the ‘maximum age of the group’ (or vice-versa), you will need to restart the creation process and making sure to introduce a valid age group.

3.2.3 Invalid Time Interval and/or Dosage

* Both ‘dosage’ and ‘time interval’ between vaccines should be positive integers.
* It´s mandatory that the ‘dosage’ integer contains not more than three digits.

3.2.4 More Age Groups

* If the vaccine you pretend to add has more than one age group, just make sure to select the option ‘Add another age group’ after introducing the ‘time interval between vaccines’ (This option is visible in Step 2.7 – 3) – ‘System features’).

3.2.5 Invalid ID

* The vaccine ‘ID’ is nothing more than a (at max.) five digits integer.

3.2.6 Unable to Specify Vaccine

* If you are still not able to specify a vaccine even after following the previous steps (Steps 3.2.1 🡪 3.2.5), that means that there is already some vaccine with the same **name** and/or **ID**.
  1. Scheduling Vaccination

3.3.1 Missing Vaccination Centers

• If the displayed error is “Vaccination Centers Missing”, it means that you should follow steps 2.X  2.X.Y (‘Register Vaccination Center’) so you have at least one vaccination center to proceed ‘Scheduling Vaccination’.

3.3.2 Only one Vaccine Type

• If you selected a center and the application only presents one vaccine type, that means that you´ve chosen a Mass Vaccination Center (In case you wish to change your selected center, just cancel, and restart filling information).

• In order to be able to select from more than one vaccine type, you need to have at least one Healthcare Center (Step 3.1.1  ‘Missing Vaccination Centers’).

3.3.3 Unavailable Dates

• If you are in ‘Choose the Date for the appointment’ and no date is appearing, that means that you will have to schedule vaccination for another day or even in other vaccination center (Due to the fact of the appointments being full for that specific day).

3.3.4 Invalid Appointment

• If the user doesn´t meet any of the existing vaccines age group´s for the selected vaccine type, scheduling is interrupted.

• If the time passed since the last taken vaccine is inferior to the ‘time interval between doses’, the appointment will also be invalidated.

* 1. Unable to Register a Vaccination Center.

3.4.1 Invalid Email Address

* Phone Number follows **Portuguese** format, it´s mandatory that it contains nine digits.
* Phone Number must start with ‘9’ and the second digit must be valid (🡪 Table X in ‘Phone Number Confirmation Digits’).

3.4.2 Invalid Email Address

* As you insert the email, make sure to use ‘@’ and ‘.’ (Valid Domains 🡪 Table X in ‘Email Domains’).

3.4.3 Invalid Website

* As you insert the website, make sure to use a valid prefix and domain (Valid Domains 🡪 Table X in ‘Website Domains’).

3.4.4 Invalid Opening/Closing hour

* As you insert both opening and closing hour for the vaccination center, make sure you choose a value between 0 and 24 which are the hour limits in a day, and make sure that the opening hour is before the closing hour, and obviously, the closing hour is after the opening hour.

3.4.5 Invalid Slot Duration

* As you insert the slot duration for the vaccination center, make sure that it doesn’t have more than 3 digits.

3.4.6 Invalid Maximum of Vaccines Per Slot

* As you insert the maximum number of vaccines per slot for the vaccination center, make sure that it doesn’t have more than 3 digits.

3.4.7 Invalid Address Zip-Code

* While filling the location information, make sure the zip-code is valid according to the Portuguese Zip-Code Format (Valid Zip Code 🡪 Table X in ‘Zip Code Format’).

3.4.8 Missing a Center Coordinator or a Vaccine Type

* To create a vaccination center, there must be at least one center coordinator and one vaccine type registered in the system, so if you can’t register a vaccination center, because there aren’t center coordinators or vaccine types, create them first, following the steps 2.4 and 2.6.
  1. Record Vaccine Administration

3.5.1 Missing Vaccination Centers

• If you came across the ‘Missing Vaccination Center’ error, just follow step  3.3.1 (Above).

3.5.2 Empty Waiting Room

• If ‘User List’ (step 2.10 – 3) combo box) is empty it means that no arrival was registered, and no one is currently waiting to be vaccinated.

3.5.3 Missing Vaccine

• If ‘Vaccine’ (step 2.10 – 4) combo box) is empty it means that, the chosen user age doesn´t fit into any of the available vaccine.

3.5.5 Missing User’s Name and Age

• If ‘Name’ and ‘Age’ (step 2.10 – 5) text fields) are empty it means that no user was selected, related to topic  3.5.2 (Above).

3.5.6 Missing Vaccine Type and Dosage

• If ‘Vaccine Type’ and ‘Dosage’ (step 2.10 – 6) text fields) are empty it means that no vaccine was selected, related to topic  3.5.3

3.5.7 Invalid Lot Number

• If ‘lot number is not valid’ error pops up, you inserted an invalid lot number (lot number must have five alphanumerical chars, one hyphen and followed by two numbers).

* 1. Unable to create a vaccine type

3.6.1 Invalid Vaccine Code

* As you insert the vaccine code to create a vaccine type, make sure that it doesn’t have more than 5 digits.

1. FAQs \_ Q # customer’s possible question A # short, direct, accurate answer … (a short reference guide – a list –, along with answers to the most common questions customers might ask about the application) \_ as many as needed \_

Annexes \_

# Annex A. \_ MATCP \_ MATCP related content (detailed on the next slides)

# Annex B. \_ MDISC \_ MDISC related content (detailed on the next slides)

Linear Regression

1 Simple Linear Regression

1.1 Overview of Simple Linear Regression (Brief theorical description).

Simple Linear Regression is a **linear regression** model with a single explanatory variable with the goal to describe and estimate the relationship between two quantitative variables (one dependent of the other). From this relationship we can obtain a graph that, as accurately as possible, predicts the values of the dependent variable with the independent variable values.

To produce this graph, it is often used a method called **ordinary least squares**, which, the goal, is to minizine, as much as possible, the sum of these squared deviations.

Once this graph is obtained, we can calculate the **determination/correlation coefficient**. This coefficient tells us how precise the data is. Generally, we look for a correlation coefficient bigger than 0.9.

Furthermore, we can also calculate the paraments that define the regression line of the graph. In order to better explore the relationship, the SLR also uses **hypothesis tests** and **confidence intervals** to estimate these paraments.

The regression line looks like this:

Lastly, there is the analysis of variables, also known as **Anova table**. This shows how the sum of square are distributed according to source of variation.

1.2 Simple Linear Regression Model

1.2.1 Model significance (Brief explanation of the results obtained by the Anova table, including the information of coefficient correlation.)

1.2.2. Hypothesis tests for model coefficients (Brief explanation of the regressor meaning/significance. The test decision must be obtained for significant levels of 1% and 5%.)

1.2.3 Confidence intervals for prediction values (Construction of confidence intervals for prediction values with confidence levels of 90% and 95% with a brief explanation of the results.)

Linear Regression

2 Multiple Linear Regression

2.1 Overview of Multiple Linear Regression (brief theoretical description)

Multiple Linear Regression is also a linear regression model, although, like the name indicates, it uses **multiple explanatory variables**, in opposition of the Simple Linear Regression. The goal of this type of regression is also to study the relationship between these variables (one dependent and many independents).

Taking in account that MLR works with more than two variables, there is no regression line like the SLR. So, instead, we calculate **correlation coefficients** for each variable. Consequently, the regression model looks like this:

To calculate these coefficients, we first need to calculate some **matrixes**.

* The X matrix – where the first column is formed by 1’s and the others columns are composed by the values of the independent variables.
* The X matrix transposed
* X matrix transposed times the X matrix
* The inverse of the matrix above.
* Finally, the X matrix transposed times the dependent variable values.

Then, by determining these matrixes, we just have to multiple the inverse matrix with the last one mentioned. By calculating these, we will have the different correlation coefficients.

Once the coefficients are calculated, it is possible to estimate the dependent variable values with given independent variable values.

Like the SLR, on the MLR, to better explore the relationship between these variables, we also estimate these coefficients with **hypotheses tests** and **confident intervals**.

Lastly, the **Anova table** is also used to make decisions regarding the results.

2.2 Multiple Linear Regression Model

2.2.1 Model significance (Brief explanation of the results obtained by the Anova table, including the information of the coefficient determination.)

2.2.2. Hypothesis tests for model coefficients (The test decision must be obtained for significant levels of 1% and 5%. Brief explanation of each regressor meaning/significance.)

2.2.3 Confidence intervals for prediction values (Construction of confidence intervals for prediction values with confidence levels of 90% and 95% with a brief explanation of the results.)

1 Sorting clients by arrival time, or by leaving time

1.1 Introduction (Short introduction to the problem at hands and presentation of the implemented algorithms pseudocode.)

1.2 Runtime tests for inputs of varying sizes (For varied-length time intervals, observe the algorithms execution time, complementing it with a graph presenting the asymptotic growth of the execution time, according to the input size.)

1.3 Worst-case time complexity analysis (Analysis of the time complexity in the worst case of each algorithm, accurately explained.)

2 Evaluation of the effectiveness of the vaccination center’s response

1.1 Introduction (Short introduction to the problem at hands and presentation of the pseudocode of the implemented brute-force algorithm.)

1.2 Runtime tests for inputs of varying sizes (For varied-length time intervals, observe the algorithms execution time, both the implemented and the reference one, complementing it with a graph presenting the asymptotic growth of the execution time, according to the input size.)

1.3 Worst-case time complexity analysis (Analysis of the time complexity in the worst case of the developed brute-force algorithm, accurately explained.)