- link to data repository:

https://github.com/mikigit97/FinalProject

Please contact Dr. Yuval Bitan to get the dataset.

Project Report -
Submitted by : Nitzan Ofer, Mickael Zeitoun, Yael Berkovich

- Introduction

In this study, 748 recruits with the intent of volunteering in Magen David Adom (MDA) from all over Israel attended a training camp that took place in the summer of 2022, and in this specific training camp the volunteers were given VR glasses as part of their training. The training camp's purpose was to give the volunteers the tools, knowledge and confidence to volunteer in ambulances that will answer emergency medical calls. During the training camp, the volunteers answered a survey consisting of subjective questions on various scenarios related to emergency medicine. Our general data science question is “is there a correlation between the volunteers performance in the simulation of various medical scenarios in VR glasses and their confidence level”, and more specifically, "is there a correlation between the volunteers performance in the trauma exercise simulation and their confidence level".

The general problem area that this analysis contributes to is the readiness and professionalism of the emergency medicine forces.

We find this matter important because with higher readiness and professionalism resulting from additional practice using the VR simulators, more lives can be saved when answering emergency medical calls.

This matter poses difficulties such as scarcity of such data that can hinder conducting extensive studies on this specific correlation. Another difficulty is subjectivity of confidence feelings, volunteers’ confidence feelings are inherently subjective. Each individual may interpret and express their confidence differently, making it difficult to establish a standardized and objective measure.

While there may be prior work on the relationship between simulation performance and confidence in different contexts, extending this understanding to the specific domain of MDA and utilizing VR training sets this study apart. The use of VR technology for training simulations in emergency medical services is relatively new, and the correlation between performance and confidence has not been extensively explored within this specific context.

Our approach involves analyzing the grades given to volunteers that used the VR sets, and checking the correlation and relationship between the grades given and the confidence of the volunteers using statistical methods such as r squared and using models such as linear regression and logistic regression as well as model evaluation tools (precision, recall and f1 score)

- Data Overview

The data we used contains 748 rows, each row represents a MDA volunteer that has participated In a VR simulation. The columns in the data are divided into multiple sections.

The first section is the Routine section, these columns contain questions regarding simulations that are considered day to day practice executed by the MDA volunteers , these

columns include questions about a vein opening scenario ,questions about monitor scenario ,questions about plasma scenario. The columns contain categorical values.

The second section in the data is the trauma section, these columns contain questions regarding a trauma scenario, in the scenario a MDA team is treating a motorcyclist that has gone through an accident, the questions these columns represent regard actions that are needed to be performed by the MDA team. The columns contain categorical values.

The third section of the data contains columns that represent the volunteer's personal confidence and opinions regarding the different scenarios in the simulations.
The columns include questions that ask volunteers their level of confidence after undergoing the routine simulation scenarios and trauma simulation scenarios.
In addition to these questions there are questions that ask about what the volunteers think about the vr sets themselves.
In this project we will focus on the columns in the second section, the trauma section (columns G-K) and column R which is in the third section and will be our dependent variable.
the columns we will consider as our independent variables are:

What did the trauma victim suffer from?
What are the symptoms that helped you diagnose the injured?
What is the needed treatment immediately after placing a tourniquet?
What signs and symptoms helped you determine if the treatment was successful?
Where is the equipment used to treat an amputation in the ambulance?

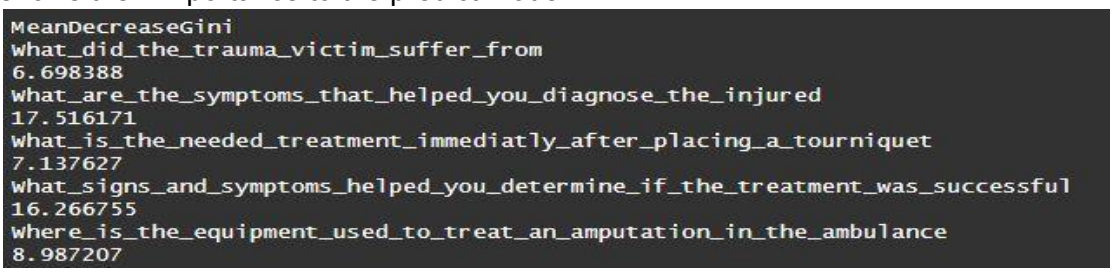
the column we will consider as out dependent variable:
Can the simulator improve your ability to treat similar cases?

- Methods and results

First of all, we wanted to see if there's any correlation between the respondents' scores on the theoretical questions about the scenarios they practiced on the VR and their level of confidence, to answer the question whether
We decided to do so using a Multivariate Linear Regression Model. We took 5 independent variables, columns G - K, that represent the respondents' scores on the theoretical questions about the Trauma scenario practice, and a dependent variable, column R that represented the respondents' confidence level.
After initializing and running the model, we got the following results:
r-adjusted score of about 0.01.
We infer, from the linear regression we created and the metrics we got, that there is very little correlation if any between the variables we checked. Meaning that the variables we checked don't necessarily correlate and the VR practice doesn't influence the respondents' confidence. Therefore, we can only assume there are more variables the research didn't take into account, such as the respondents' young age (e.g. they are teenagers aged 16 - 17 years old) or their educational background.

After getting the results of the Multivariate Linear Regression, we decided to try non linear models for classification - Random Forest and Logistic Regression - to see if their metrics are any better than the linear regression metrics.
Starting with Random Forest, we used the same variables - columns G - K the grades for the theoretical questions regarding the Trauma VR scenario practice and column R. After running the model and getting the metrics we need to evaluate the model's performance, we saw that the f1_score is ~ 0.7 and so is the precision - standing at about 0.8. This non linear multiclass classification model was successful at predicting accurately the level of confidence and so we infer that there could be relation between the variables we checked.
We also checked for the mean decrease gini coefficients and got the following results:

We can see there are two variables that influence the predicted value more than the others: “What are the symptoms that helped you diagnose the injured” and “What signs and symptoms helped you determine if the treatment was successful”. We can’t infer from the model that there is correlation between these variables and the predicted variable but it shows their importance to the predict model.



Lastly, we decided to try to run another non linear model - Logistic Regression - on the same variables we used in the other models that we tried. We translated the discrete predict values to 0/1 so it would be a binary variable. Before the change, the values ranged between 1 and 3, with 1 indicating that the volunteer is confident, 2 indicating part confident and 3 indicating that the volunteer is not confident. We changed the values 2 and 3 to be 0 (the volunteer is not confident) and kept the value 1 as 1 (the volunteer is confident). We ran the model and got the following evaluation metrics: f1_score of about 0.88, precision of about 0.994 and recall of 0.8.
After getting the high f1_score on the logistic regression, which is another non linear model, we got the coefficients of the model and their p values. Considering the p values are much greater than 0.05 thus we can’t conclude that there is any relation between the variables.

We also calculated the distance correlation coefficient, which is supposed to find linear and non linear correlation, and got a correlation of 0.001. As of now, we conclude there is no correlation between the volunteers performance in the trauma exercise simulation and their confidence level.

● Limitations and Future Work
Some of the limitations we encountered include Sample Size and Representativeness, our sample of volunteers may not adequately represent the entire population of Magen David Adom volunteers using VR training. A small or biased sample may limit the generalizability of our findings.
Another limitation is self reported Data, the volunteers' confidence levels are self-reported. Self-report data can be subjective and prone to biases or inaccuracies. It's important to acknowledge and consider the limitations of relying solely on self-reported measures.
Future directions we would follow include using additional models in order to get a better sense of how the relationship between the dependent variable and the independent variables looks like and try to search for another non linear correlation score. We would also want to investigate how teenagers of the ages 16-18 evaluate their self confidence, in order to lower the uncertainty of the subjective aspect of this study.