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|  | Exploratory Data Analysis | |  |
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|  | Ministry of Social Development | |  |
| Mihir Bachkaniwala  Submitted on: 28/02/2023 |  |  |
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# Exploratory Data Analysis (EDA)

* Understanding the data: This involves getting to know the data you are working with by reviewing the data's source, structure, and contents. It is essential to understand the data's features, such as its type, range, and distribution, to make informed decisions about which EDA techniques to use.
* Cleaning the data: This step involves detecting and correcting errors and inconsistencies in the data to ensure that the results of the EDA are accurate and reliable. Data cleaning may involve imputing missing values, identifying and removing outliers, and standardizing the data.
* Exploring the data: This step involves visualizing the data to identify patterns, trends, and relationships between variables. The goal is to identify interesting features of the data that may provide insights into the underlying phenomenon being studied.
* Summarizing the data: This step involves summarizing the data using descriptive statistics such as measures of central tendency, dispersion, and correlation. These statistics can provide a quick overview of the data and help identify potential issues or interesting patterns.
* Drawing conclusions: Based on the results of the EDA, you can draw conclusions about the data and the phenomenon being studied. This step involves synthesizing the insights gained from the data analysis and identifying potential follow-up analyses that could provide more information or answer specific research questions.

In summary, a good EDA involves thorough understanding and cleaning of the data, effective exploration and visualization techniques, and careful summarization and conclusion drawing.

The objective of this report is to conduct an exploratory data analysis on an incident reporting dataset from the MSD (Ministry of Social Development). This dataset contains row-level information for incident events, including details about injuries sustained, hazards involved, demographic information of employees, and details about the incident events such as the location, severity, and actions taken after the incident.

The purpose of this analysis is to gain insights into the data and uncover patterns and trends that may inform the MSD's decision-making process regarding incident prevention and management. This report will focus on analyzing the data using various data visualization techniques and statistical methods to answer questions such as which regions have the highest incident and lowest incident rates, the summary of the top 5 types of incidents, and the top 5 common body parts injured.

The report will start with a data cleaning process to ensure that the data is accurate and complete. Then, we will conduct exploratory data analysis, which involves the use of visualizations and descriptive statistics to understand the data better. Finally, we will summarize our findings and provide recommendations to the MSD based on the insights obtained from the data analysis.

## Understanding the data

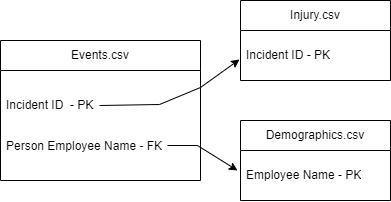
Based on the initial analysis done with Excel and Jupyter Notebook, the dataset consists of three tables: Demographic.csv, Event.csv, and Injury.csv. The Demographic table has 1621 rows and 7 columns, with data types of Int64 and varchar. There are no missing values or duplicates in this table.

The Event table has 3076 rows and 11 columns, with data types of Int64, varchar, and datetime64. There are missing values in the Site 3 Name and Site 2 Name columns, which indicates that some events occurred outside of the site. Additionally, there are duplicates in this table, with 460 duplicate records found.

The Injury table has 3224 rows and 8 columns, with data types of Int64 and varchar. There are missing values in the Injury and Body Part columns, with 19.6% and 4.74% of the data missing, respectively.

The earliest record in the dataset is dated 10 February 2018 and the latest record is on 19th January 2021.

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|  | Demographic.csv | Event.csv | Injury.csv |
| Number of records and columns | Rows: 1621  Columns:7 | Rows:3076  Columns:11 | Rows:3224  Columns:8 |
| Data types | Int64, varchar | Int64, varchar, datetime64  Note: Data type for date changed to datetime64. | Int64, varchar |
| Missing values | No missing values | Site 3 Name: 21.39%  Site 2 Name: 2.40% | Injury: 19.6 %  Body Part: 4.74% |
| Duplicates | No Duplicates | No Duplicates | 460 Duplicates found |



## Cleaning the data

Based on the initial analysis, the data cleaning process involved the removal of duplicate records and rows with missing or unassigned values. The 'Injury.csv' file had 460 duplicate rows, which were removed to decrease the total number of rows to 2764. Additionally, rows with 'N/A' or 'Unassigned' values were eliminated as they did not require any intervention or medical care.

The 'Incident Date' column was modified to have a more precise data type of datetime64. This modification will facilitate the analysis of the incident data over time.

To find relationships between columns across the data frames, we merged the data frames. This process will allow us to investigate relationships between injury types, demographics, and incident events.

The data visualization phase will involve the use of graphs, charts, and other visual aids to explore the relationships between different variables in the dataset. The goal of this phase is to identify any patterns, trends, or anomalies in the data that may be useful for understanding the incident reporting system and improving workplace safety.

## Exploring the data

During the Exploratory Data Analysis (EDA) phase, we analyzed the files to gain insights into the demographic distribution of incidents, the regions with the highest and lowest incident rates, the types of incidents, and the nature of injuries. We categorized incidents based on age group, gender, ethnicity, and salary range to examine the demographic distribution. We created several bar graphs to visualize the distribution of incidents based on each of these attributes. The bar graph representing the number of incidents by gender showed that female employees had a higher number of incidents compared to male employees. The bar graph representing the number of incidents by ethnicity showed that incidents were reported across various ethnicities, with the highest number of incidents reported by group 'B' employees. The bar graph representing the number of incidents by age group showed that employees in the age band 1 reported the highest number of incidents.

We also examined the regions with the highest and lowest incident rates by combining data from multiple sources into a single dataframe. We plotted a bar graph showing the total number of incidents per region and a bar graph showing the highest and lowest incident rates. The bar graph representing the highest and lowest incident rates showed that Region K had the highest incident rate while Region M had the lowest incident rate. The bar graph representing the total number of incidents per region showed that Region G had the highest number of incidents while Region J had the lowest number of incidents.

Furthermore, we analyzed the types of incidents and nature of injuries by creating several bar graphs. A bar graph representing the top 5 types of incidents showed that "Sprain/ Strain" was the most common type of incident reported, followed by "Bruising/Crushing." The bar graph representing the top 5 common body parts injured showed that the "Back" was the most commonly injured body part. The bar graph representing the nature of injuries showed that "Ergonomic" were the most common type of injury reported. Overall, the visualizations created during the EDA phase provide valuable insights into the distribution of incidents and the nature of injuries reported.

## Summarizing the data

The Injury dataset analysis reveals that mental health concerns in the workplace should not be overlooked, as a significant percentage of cases associated with psychological distress did not specify any particular body part. This finding underlines the importance of prioritizing mental health support for employees. Additionally, the most common body parts injured were identified as the back, multiple locations, wrist, shoulders, and neck, providing a clear focus for safety measures to prevent injuries in these areas. Targeted safety measures should also be considered for employees in the Case Manager role, as this group had the highest number of injuries.

The analysis also highlighted the need for site-specific safety measures, as the Customer service delivery site had the highest number of injuries compared to other sites. The M1 salary band was associated with the highest number of injuries, indicating the need for targeted safety measures for employees in this salary range. It is noteworthy that the National office and offsite injuries were relatively low in number, which suggests that the current safety measures may be effective in preventing injuries at these locations.

The potential consequences of incidents were classified, and it was observed that a significant number of cases had moderate consequences, indicating the need for appropriate measures to prevent incidents from escalating to more severe outcomes. Interestingly, a majority of incidents required no treatment, suggesting that many incidents were minor in nature. This highlights the importance of implementing effective safety measures to prevent even minor incidents from occurring.

Furthermore, a deeper analysis of Ergonomic injuries showed a high number of incidents related to workstation setup. This indicates that ergonomic training and equipment may be necessary to improve workstation ergonomics, thereby reducing ergonomic injuries. In conclusion, this exploratory data analysis provides valuable insights into the nature of incidents, and the findings should be used to inform targeted safety measures to prevent injuries in the workplace.

## References for Visualizations

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| Fig 1.1 | Distribution of demographics by gender |
| Fig 1.2 | Distribution of demographics by ethnicity |

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| Fig 1.3 | Distribution of demographics by Age Band |
| Fig 1.4 | Distribution of demographics by Salary Range |

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| Fig 1.5 | Regions with the highest incident and lowest incident rates |
| Fig 1.6 | Total incidents by region |

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| Fig 1.7 | Summary on the top 5 type of incidents |
| Fig 1.8 | Top 5 common body parts injured |

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| Fig 1.9 | Top 5 Position Titles with most injuries |
| Fig 2.0 | Plot of injury count by salary range |

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| Fig 2.1 | Weekly frequency of incidents |
| Fig 2.2 | Monthly frequency of incidents |

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| Fig 2.3 | Plotting the locations of injuries |
| Fig 2.4 | Events captured at Client Service Delivery |

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| Fig 2.5 | Incident status breakdown for this dataset |
| Fig 2.6 | Potential consequences of the incidents |

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| Fig 2.7 | Treatments of Injuries |
| Fig 2.8 | Nature of Injuries |

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| Fig 2.9 | Distribution of Nature of Injury for Ergonomic Type |

## Drawing conclusions

Firstly, the data analysis provides insights into the demographic distribution of incidents, the regions with the highest and lowest incident rates, the types of incidents, and the nature of injuries. The analysis helps to identify the common body parts injured, position titles with the most injuries, and the injury count by salary range.

Secondly, the data shows that there is a high incidence of psychological distress associated with incidents that did not specify any particular body part. Additionally, the closed status was the most common incident status, and Case Managers had the highest number of injuries.

Finally, the data analysis also reveals that future enhancements can be made for advanced tracking of unassigned cases by adding another timestamp with updated information on event captured. This could help in doing a more in-depth analysis of the data using the concept of slow changing dimensions.

Overall, the EDA provides valuable insights into the incidents and injuries, which can help organizations take steps to prevent them from occurring in the future.

This report has been created for the exploratory data analysis conducted, which summarizes the findings and insights gained from the analysis. The report has been documented in a Word file and is also available in PDF format. Additionally, the code used to perform the analysis has been implemented in Jupyter Notebook, which is also accessible on my Github repository.

Link for Github Repository - https://github.com/MihirB-Byte/MSD-Assessment

The exploratory data analysis involved various tasks such as data cleaning, data merging, data visualization, and data interpretation. Quick insights were generated in both Jupyter Notebook to identify patterns and trends in the data. The findings were summarized and presented in the report, which also includes visual representations of the analyzed data. Overall, the exploratory data analysis aimed to provide a better understanding of the data and generate insights that can be used to inform decision-making processes.