Exploring Earthquakes Dynamics

IE6600 – Computation and Visualization for Analytics

Final Report

Group - 1

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Introduction:

Everyone does not consider Natural Disasters as a crucial factor for performing actions like, there are places so called hotspots for natural calamities around the world. The magnitude is a numerical representation of the total energy released during an earthquake, calculated based on the amplitude of ground oscillations caused by the passage of seismic waves, recorded by seismometers (seismograms). Earthquakes are natural phenomena that result from the sudden release of energy within the Earth's crust, leading to seismic waves that can cause various levels of destruction and impact human populations. Understanding the correlation between earthquake characteristics, such as magnitude, depth, and earthquake types (e.g., mb, mw, mwr, mj, mwb), and the subsequent impact on human casualties and property damage is crucial for developing effective disaster mitigation response strategies

Problem Statement:

Inspired by Project – 1 which is story telling on Natural disasters: causes, effects, and mitigation plans. Earthquakes are one of the major calamities that account for human loss and economic damage, focusing on the following hypothesis/ questions -

Earthquakes:

- **How did earthquake occurrence vary over different time periods?**
- **Is there a correlation between earthquake magnitude wrt geographical location and its impact in terms of dynamics like Number of deaths, injuries, houses destroyed?**
- **What is the distribution of earthquake depths worldwide?**

Data Description:

Two datasets are being used for the analysis

One dataset contains all the earthquakes that have a magnitude of 6+.

time – time stamp representing date and time ISO8601 format of Earthquake occurrence

Date – generated field which has Date of Occurrence in the MM:DD: YYYY format

Time - generated field which has Time of Occurrence in the HH:MM: SS format

latitude, longitude - geographical coordinates of the earthquake's location

depth - The depth of the earthquake hypocenter below the Earth's surface, measured in kilometers

mag - The magnitude of the earthquake, representing the energy released. There are different magnitude scales such as Richter scale, Moment Magnitude Scale (Mw)

magType – The type of magnitude scale used to measure the earthquake. For example, "mb" refers to body-wave magnitude, "mw" refers to moment magnitude, and others

nst - The number of seismic stations reporting earthquake data

gap - The angular separation between the azimuthally closest station and the furthest station from the earthquake epicenter

dmin - The closest distance to seismic stations that reported the earthquake

rms - A measure of the goodness of fit of the seismograph data to the model of the earthquake. It indicates the variability of the recorded seismic waveforms.

net - The seismic network reporting the earthquake data

id - a unique ID identifier

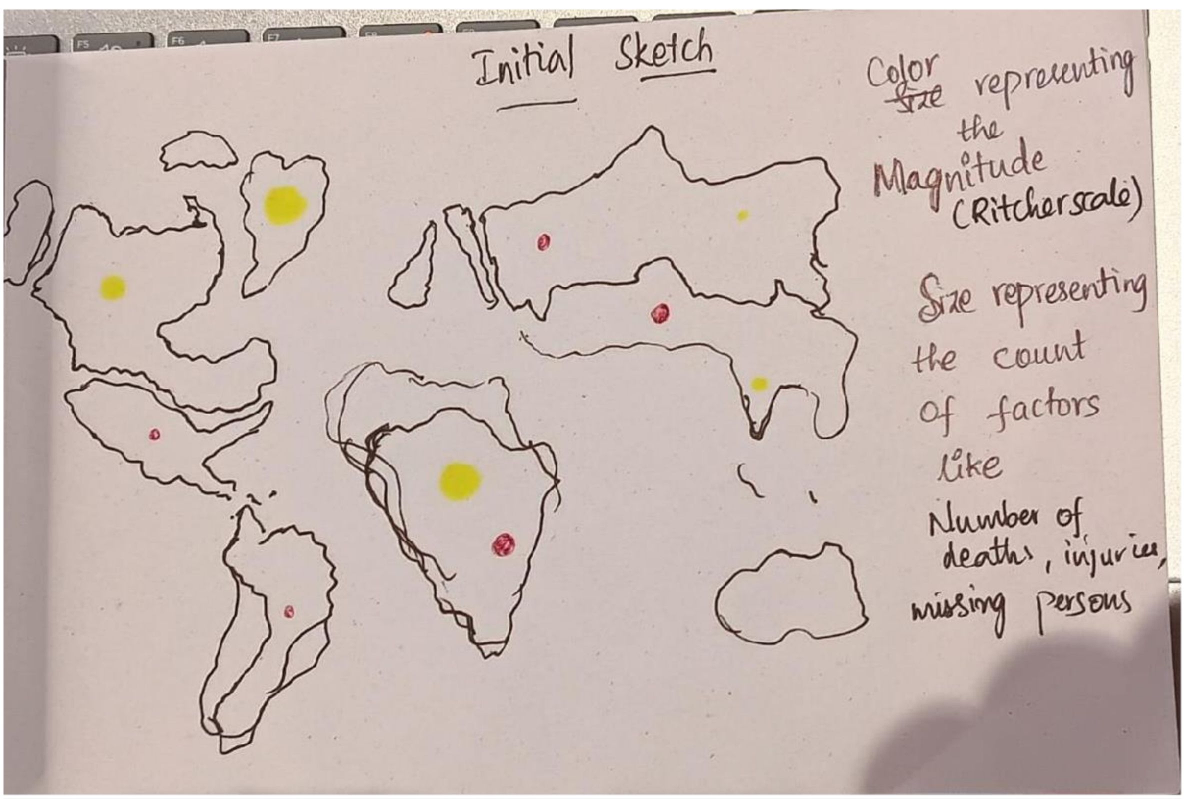
updated - the time when the data was updated due to misentries (or) fallacies

place - location of earthquake

The second dataset also contains similar fields like country, Day, id, location name, month, region code, Regions, state, year, Damage ($ Millions), damage_descriptiondeaths_description, eq_mag_mb, eq_mag_mfa, eq_mag_ml, eq_mag_ms, eq_mag_mw, eq_mag_unk,F1focal_depth, hour, houses_damaged, houses_damaged_description, total_houses_damaged, houses_destroyed_description, latitude, injuries_description, longitude, Magnitude, minute, Magnitude, missing_description, Number of deaths, Number of Houses Destroyed, Number of Injuries, Number of Missing Persons, second for over 100 years of data from 1921 – 2022, and the fields look to be self explanatory

Filters are being applied at a dataset level, to hide the unnecessary columns and to select data from a particular range of time of our interest

Initial Sketch of the Dashboard:



Methodology:

Dashboard for Earthquake Analytics

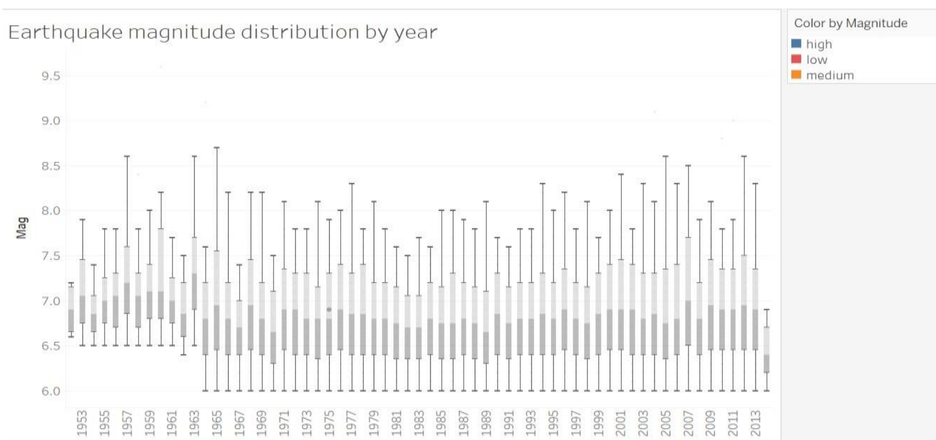
The data in the Excel format was imported into Tableau and the visualizations were created starting from **Key Performance Indicators**(KPIs) like Total Number of Earthquakes, Average Gap, Average Dmin, Average Depth, Average Gap, Average Nst, Average Rms, Max Gap.

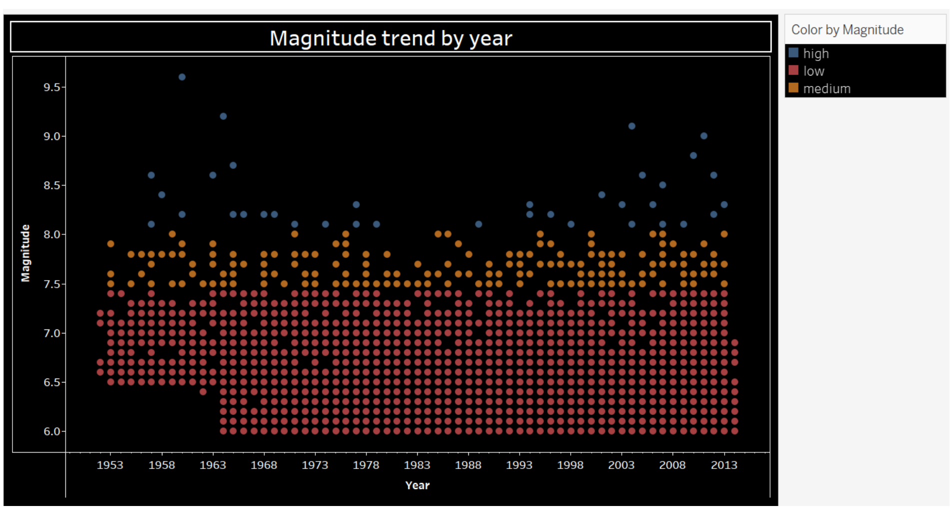
Interactive filters and controls were added for Magnitude and depth distribution over time.

Design Process:

The dashboard includes several interactive filters and controls, allowing users to explore the data in different ways. For example, users can use the date filter to select a specific time period to view, and they can use the magnitude filter to filter the data to only show earthquakes of a certain magnitude or higher. The dashboard uses actions to allow users to interact with the different charts and views. For example, users can click on a data point in the magnitude distribution chart to filter the other charts on the dashboard to only show earthquakes of that magnitude

Iteration 1:

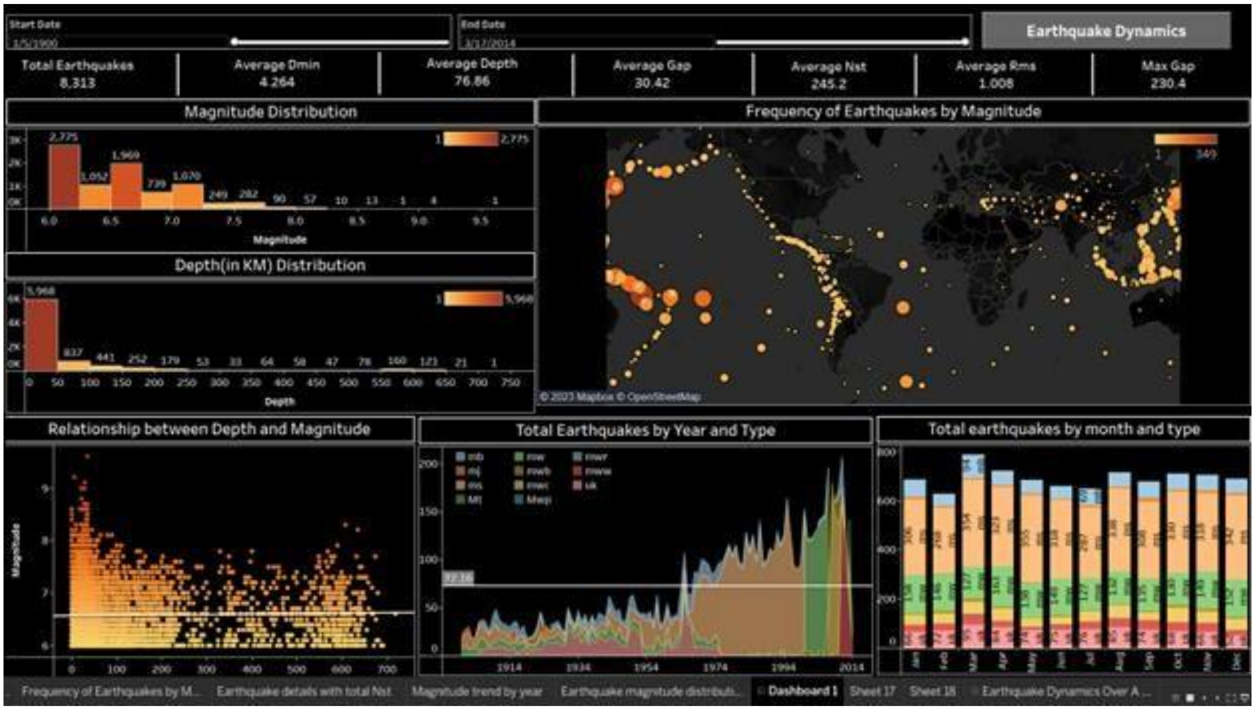




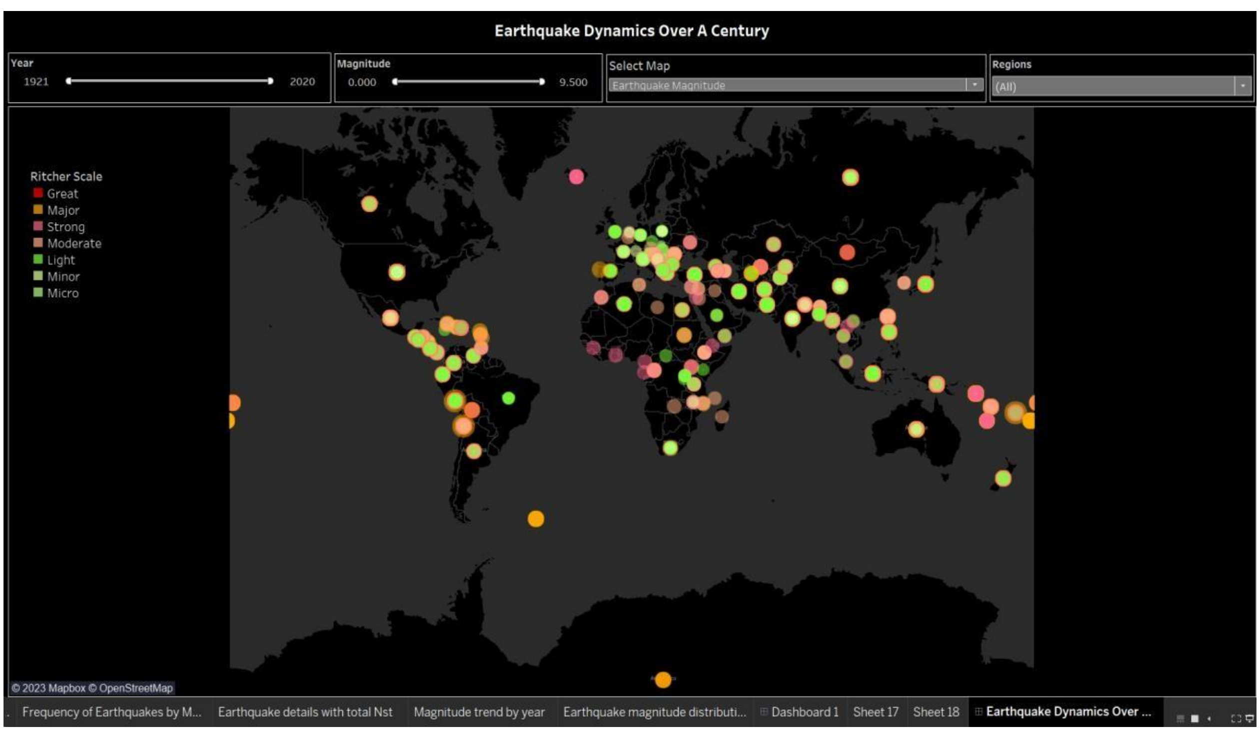
Playing with the themes to decide on which suit the best for the depiction of Earthquake analysis

Iteration 2:

Dashboard 1



Dashboard 2



Key Insights from Data:

Most values of the earthquake magnitude range from 6 to 6.25 and with more number of

As the magnitude of the earthquake decreases there is an observed increase in the depth of earthquakes

March month has seen a rise in several earthquakes in most of the years. The most active regions for earthquakes are East of Asia(Japan), West of the United States, the Gulf of California, Argentina, Bolivia

Magnitude and Severity:

The prevalence of earthquakes in the 6 to 6.25 magnitude range suggests the importance of preparedness measures for moderate to strong seismic events. Building structures and infrastructure resilient to such magnitudes becomes crucial in earthquake-prone regions

Depth Considerations:

Understanding the relationship between earthquake magnitude and depth can inform seismic hazard assessments. Deeper earthquakes might have different effects on the Earth's surface, and this knowledge can contribute to risk mitigation strategies

Seasonal Preparedness:

Recognizing a seasonal pattern, such as increased earthquake activity in March, allows for targeted preparedness efforts during specific times of the year. Emergency response planning and public awareness campaigns can be intensified during these periods

Regional Risk Assessment:

The identified hotspots, including East Asia, the western United States, and certain regions in South America, should be prioritized for comprehensive risk assessments. This involves evaluating the vulnerability of structures, population density, and emergency response capabilities

These key insights contribute to a better understanding of earthquake patterns, enabling stakeholders to make informed decisions in earthquake-prone regions and fostering more resilient communities