Hold onto your seats…because we are going to 'QUAKE' you up!

Project 1 Presentation

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October 4th, 2021

Breakdown

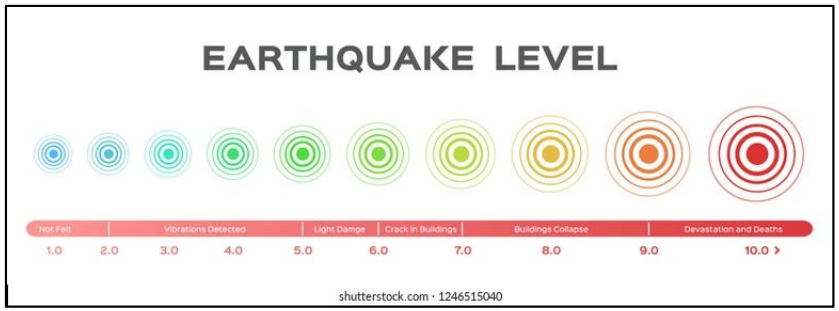
1. Project Scope
2. Definitions
3. Research Questions
4. Data Retrieval Methods & Cleaning data
5. Research Findings
6. Conclusions
7. Limitations and Future Considerations
8. Resources

Project Scope

- An investigation of earthquakes globally, during a 10 year time frame (2010-2020).
- Looking at various factors with earthquakes (when, where, and a possible trend of another disaster occuring from the earthquake).
- Motivation: Are you moving?… going on vacation somewhere?… are their ‘shaky-zones’ to stay away from?

Definitions

- ***Large Oceanic Event:*** Whether a large event in the Ocean occurred or not.
- ***Magnitude Richter Scale***



(2)

- ***Country Code Module standard:*** ISO 3166-1 alpha-2
- ***Alert Levels***

Alert Level and Color	Estimated Fatalities	Estimated Losses (USD)
Red	1,000+	$1 billion+
Orange	100-999	$100 million - $1 billion
Yellow	1-99	$1 million - $100 million
Green	0	<$1 million

(3)

Research Questions

(4)

1. Where do earthquakes happen by country?

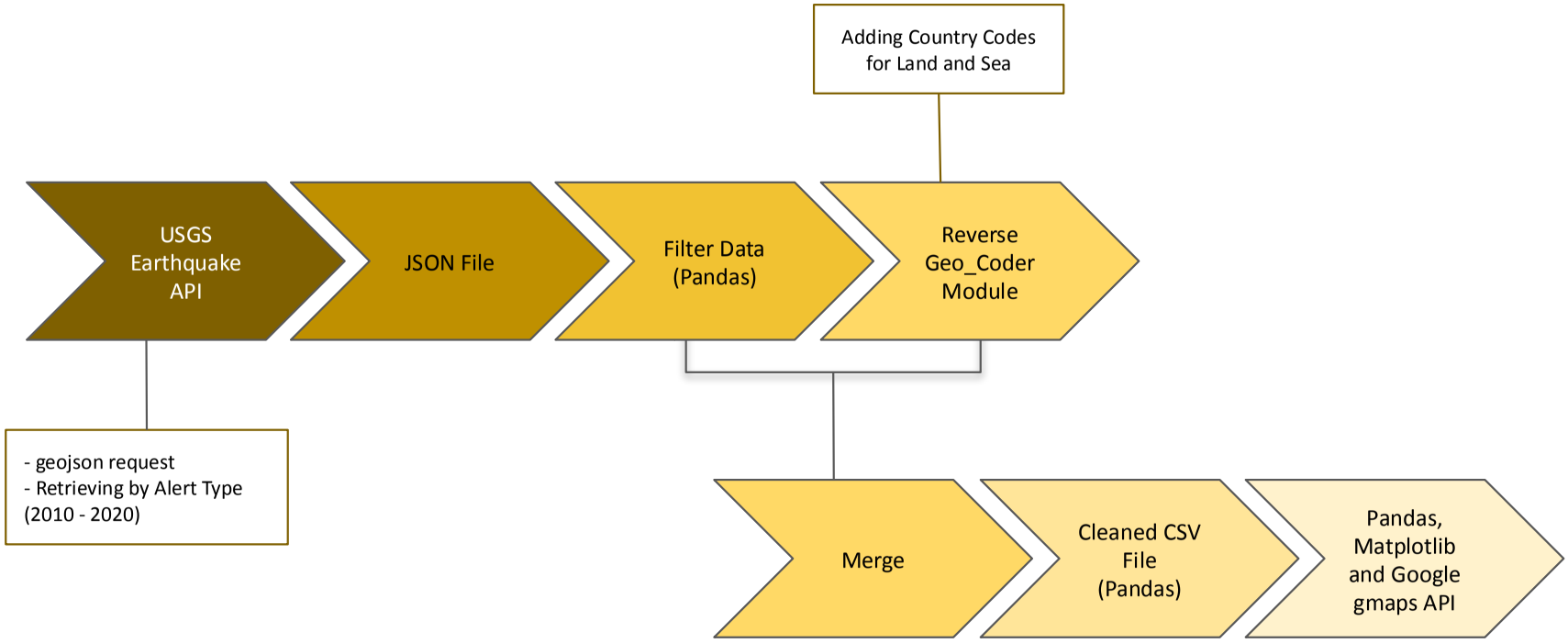
2. What is the density of magnitudes for earthquakes?

3. What month do earthquakes mostly occur?

4. What is the alert level density of earthquakes?

5. Is there a relationship between magnitude and % chance of large oceanic event?

Data Retrieval and Methods



Cleaning Data – Using Pandas (1)

```
# some data needs to be cleaned, get rows indexes with null values
rows_with_nan = [index for index, row in earthquake_data.iterrows() if row.isnull().any()]
rows_with_nan
```

```
#display the null value rows
null_rows = earthquake_data[earthquake_data.index.isin(rows_with_nan)== True]
null_rows
```

	id	Latitude	Longitude	Depth (km)	Lat_Lng	Alert	Place	Date	Magnitude	Tsunami	Type
64	us7000clnv	52.7551	-168.2401	23.00	(52.7551, -168.2401)	green	None	2020-12-01 11:22:39.923	6.4	1	earthquake
3798	us20004fw7	-4.0520	129.5097	10.00	(-4.052, 129.5097)	green	102 km SE of Amahai, Indonesia	2015-12-09 09:56:58.040	NaN	0	earthquake
3827	us100041nt	22.5019	94.8414	11.45	(22.5019, 94.8414)	green	53 km NW of Monywa, Myanmar	2015-11-27 03:33:57.810	NaN	0	earthquake

```
null_rows_todrop = rows_with_nan[1:3]
earthquake_clean= earthquake_data[earthquake_data.index.isin(null_rows_todrop)==False]
earthquake_clean.head()
```

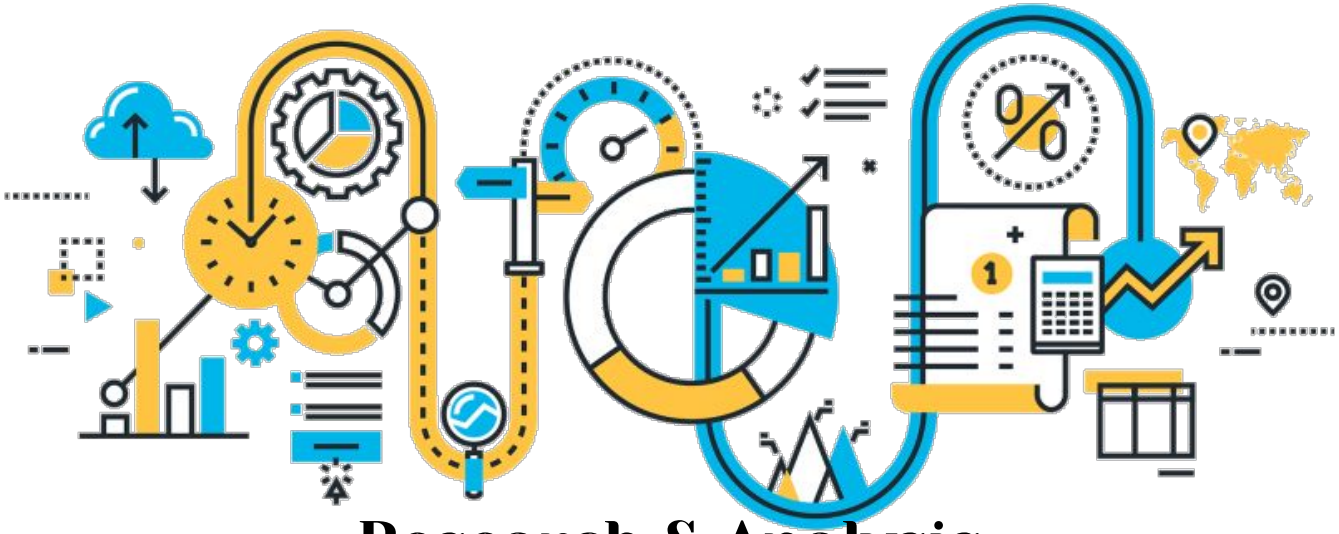
	id	Latitude	Longitude	Depth (km)	Lat_Lng	Alert	Place	Date	Magnitude	Tsunami	Type
0	us6000d454	-0.7603	-21.1005	10.00	(-0.7603, -21.1005)	green	central Mid-Atlantic Ridge	2020-12-29 18:34:57.647	5.7	0	earthquake
1	us6000d3xn	43.3890	-126.9951	10.00	(43.389, -126.9951)	green	212 km W of Bandon, Oregon	2020-12-29 02:10:29.079	5.7	1	earthquake

Cleaning Data - Using Pandas (2)

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6049 entries, 0 to 6048
Data columns (total 13 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   id             6049 non-null   object
 1   Latitude       6049 non-null   float64
 2   Longitude      6049 non-null   float64
 3   Depth (km)     6049 non-null   float64
 4   Lat_Lng        6049 non-null   object
 5   Alert          6049 non-null   object
 6   Place          6048 non-null   object
 7   Date           6049 non-null   object
 8   Magnitude      6049 non-null   float64
 9   Tsunami        6049 non-null   int64
 10  Type           6049 non-null   object
 11  Country        5794 non-null   object
 12  Country_Code   6048 non-null   object
dtypes: float64(4), int64(1), object(8)
memory usage: 614.5+ KB
```

```
# Country objects are fine as we use Country_Code in analysis
earthquake_data2_clean = earthquake_data2.dropna(subset=['Country_Code'])
```

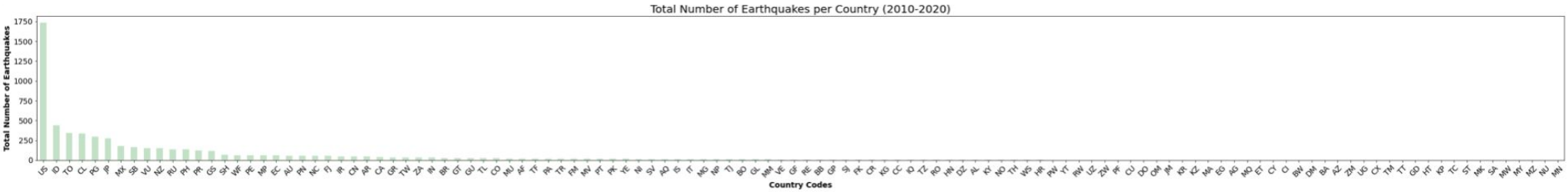
Our findings through...



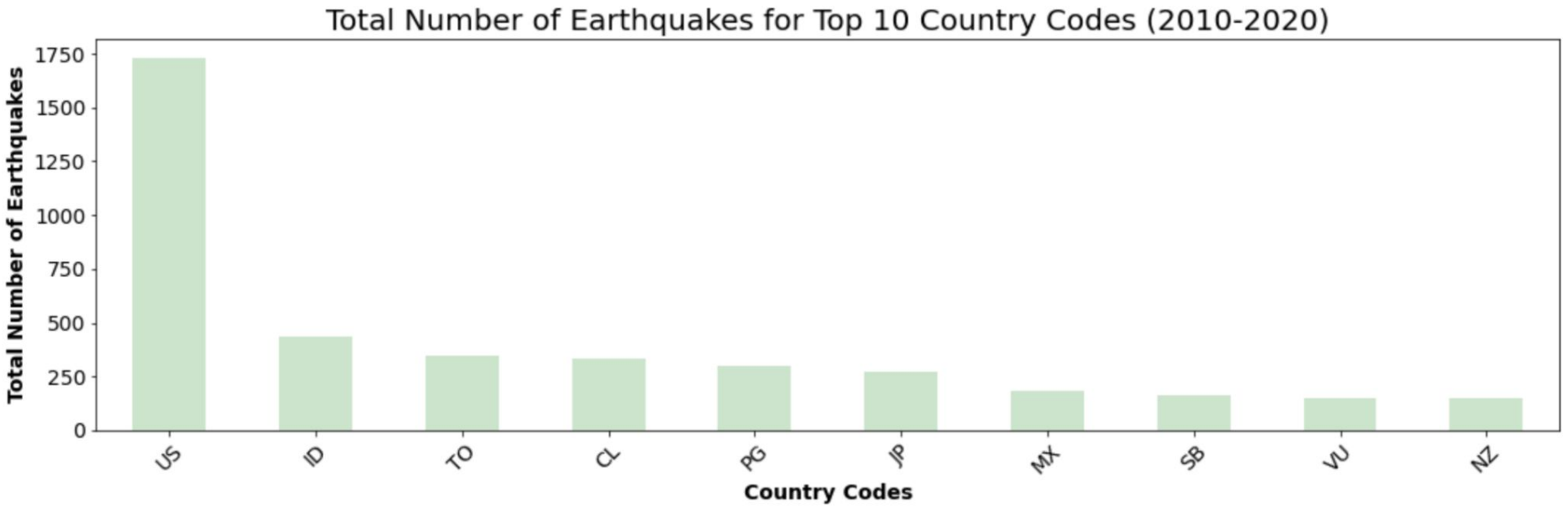
Research & Analysis

1. Where do earthquakes happen by Country?

Where do Earthquakes Happen by Country?



Where do Earthquakes Happen – Top 10?

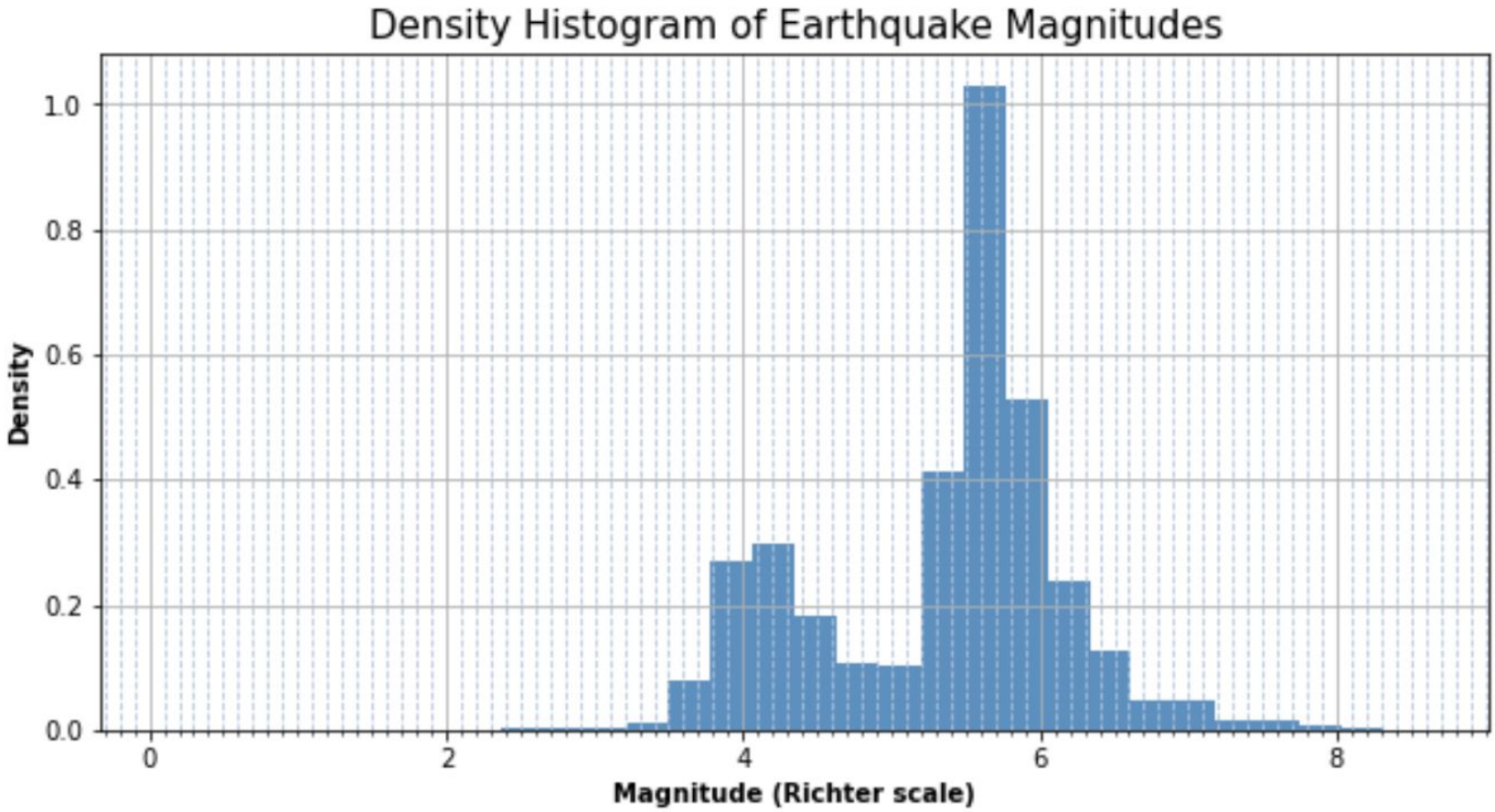


1. **US -** United States
2. **ID -** Indonesia
3. **TO -** Tonga
4. **CL -** Chile
5. **PG -** Papua New Guinea
6. **JP -** Japan
7. **MX -** Mexico
8. **SB -** Solomon Islands
9. **VU -** Vanuatu
10. **NZ -** New Zealand

2. What is the density of magnitudes for earthquakes?

1. Where do earthquakes happen by Country?

What is the Density of Magnitudes for Earthquakes?



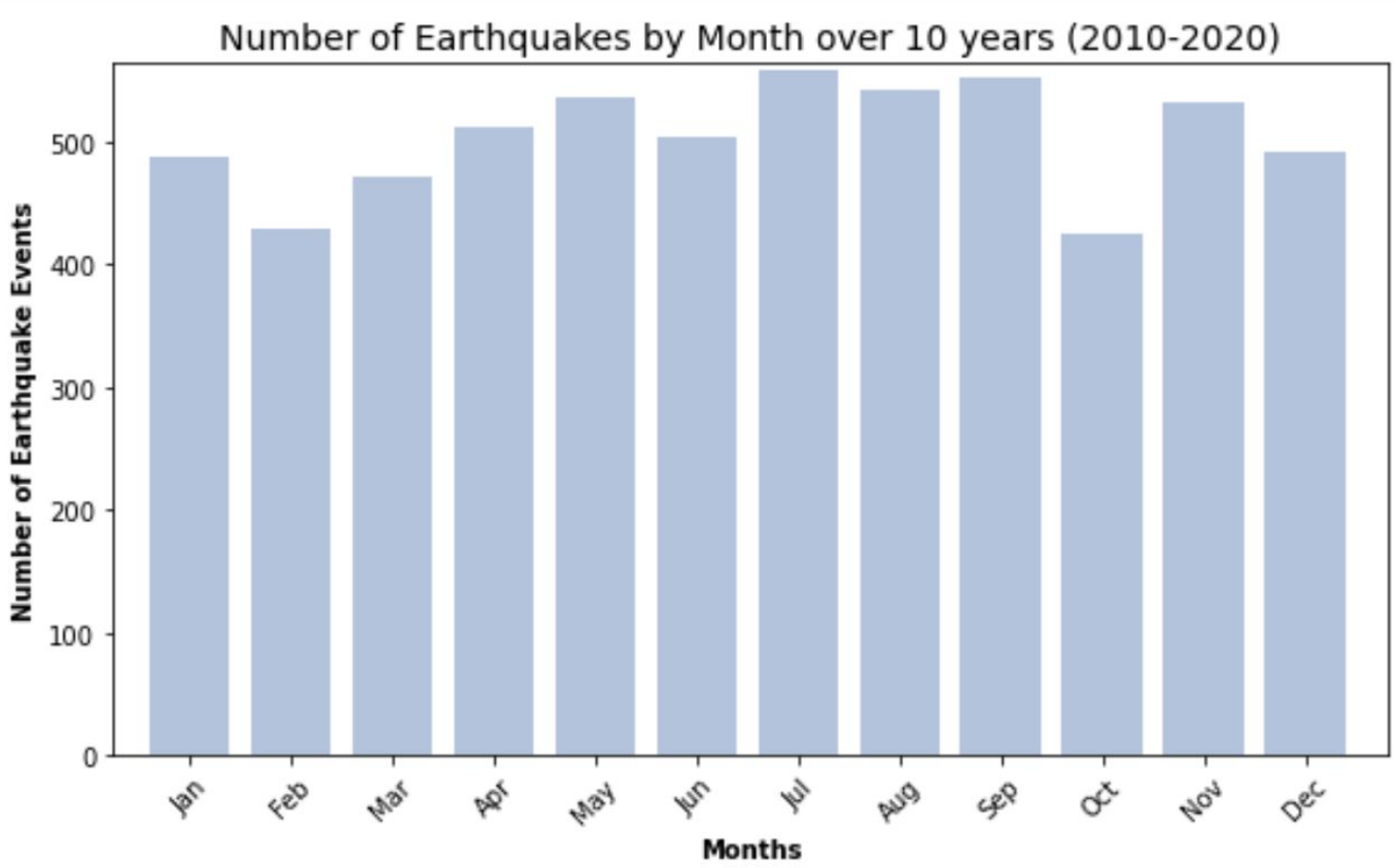
3. What month do earthquakes mostly occur?

2. What is the density of magnitudes for earthquakes?

1. Where do earthquakes happen by Country?

(5)

What Month do Earthquakes Mostly Occur?



3. What month do earthquakes mostly occur?

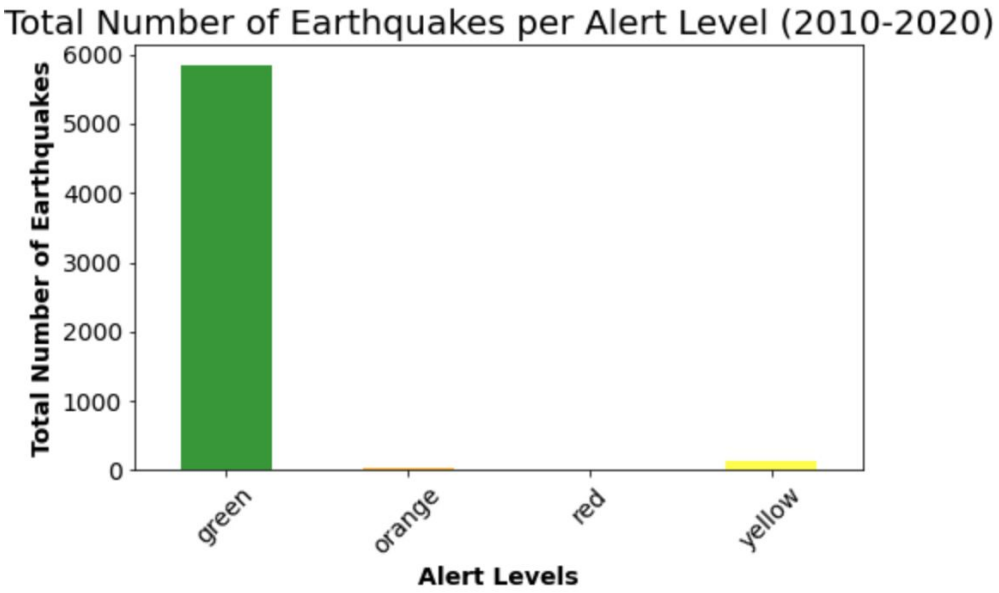
4. What is the alert level density for earthquakes?

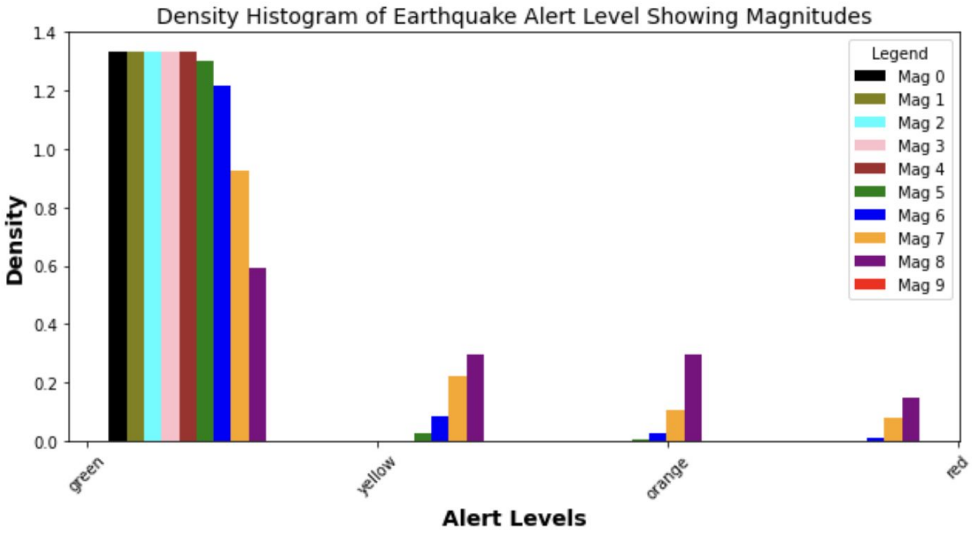
2. What is the density of magnitudes for earthquakes?

1. Where do earthquakes happen by Country?

(5)

What is the Alert Level Density for Earthquakes?



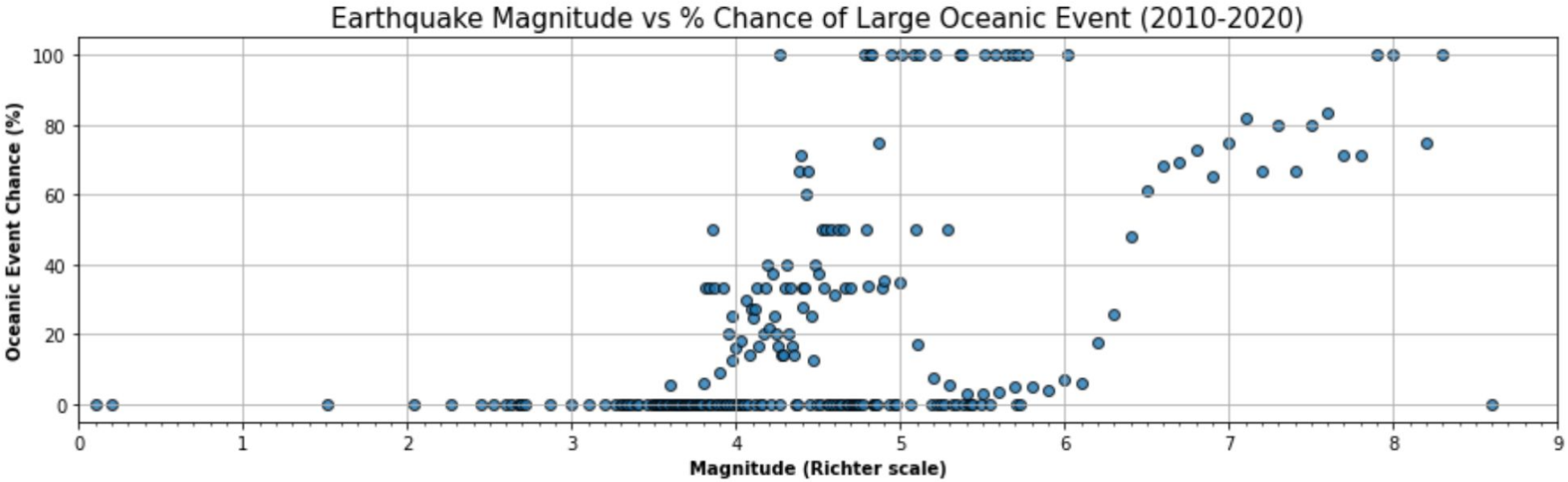


An interesting observation...

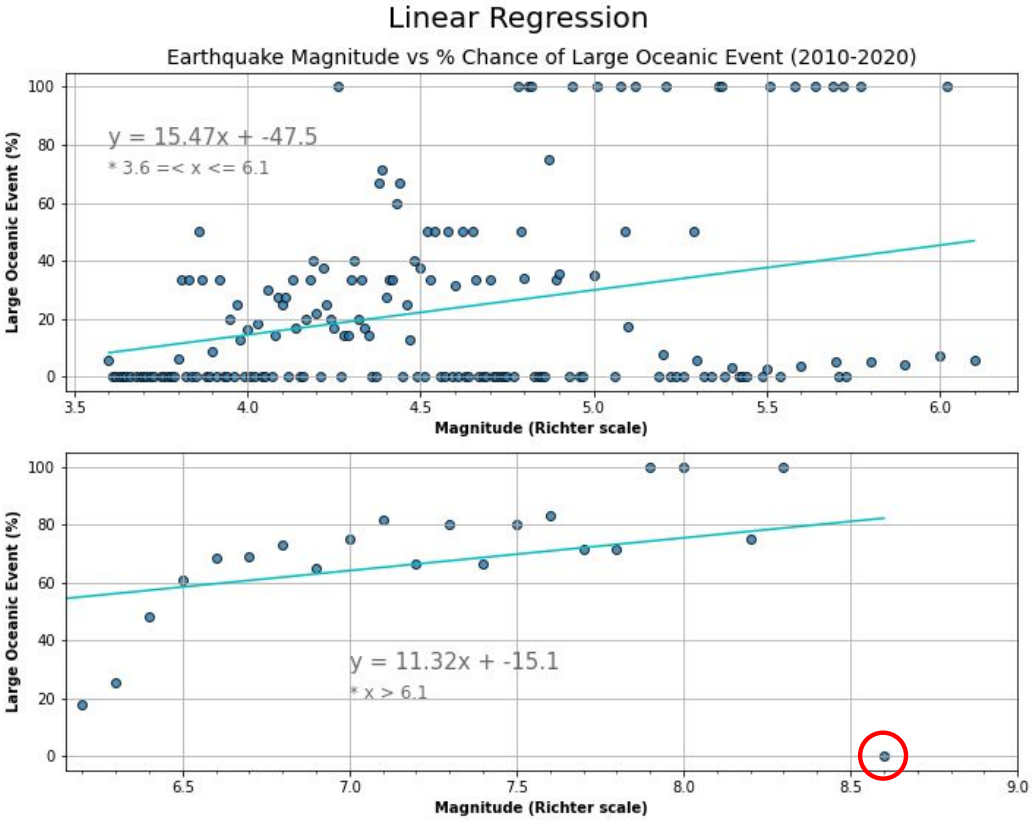
(7)

Is there a relationship between the magnitude of earthquakes and % chance that a large oceanic event will occur?

Is there a Relationship between Magnitude and % Chance of Large Oceanic Event?



Relational Analysis: Magnitude vs % Chance of Large Oceanic Event



$r^2 = 0.0921516495378 3814$

$r^2 = 0.0893320029132 0782$

Did this large earthquake cause an oceanic event?

- Indeed this earthquake happened in the Indian Ocean with a magnitude of 8.6.
- This was the highest in the 10 years of data.

(7)

	id	Latitude	Longitude	Depth (km)	Lat_Lng	Alert	Place	Date	Magnitude	Large Oceanic Event	Type	Country	Country_Code
5990	official20120411083836720_20	2.327	93.063	20.0	(2.327, 93.063)	yellow	off the west coast of northern Sumatra	2012-04-11 04:38:36.720	8.6	0	earthquake	Aceh	ID

Conclusions

3. What month do earthquakes mostly occur?

Earthquakes can happen at any time of the year.

4. What is the alert level density for earthquakes?

Green alerts (5852) have far more number of earthquakes than the other alerts.

All levels of magnitudes observed were present in the Green alert level. Magnitudes 6 - 8 were present at much lower densities in the remaining alert types.

2. What is the density of magnitudes for earthquakes?

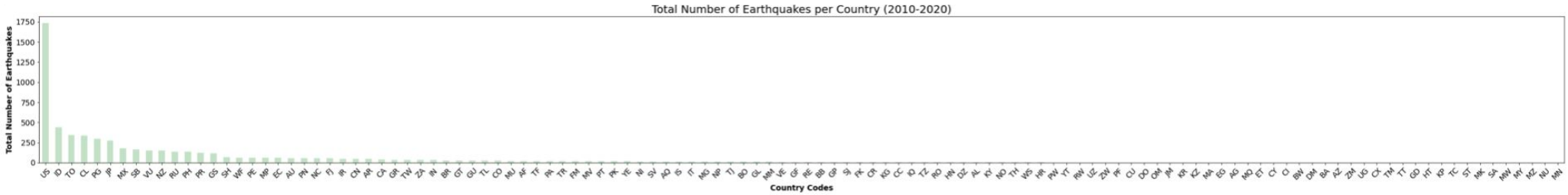
Magnitudes around 5.5 to <6.0 are the most dense.

Is there a Relationship between Magnitude and % Chance of Large Oceanic Event?

No correlation was observed between Magnitude and Large Oceanic Events.

1. Where do earthquakes happen by Country?

USA (count : 1733) has far more earthquakes than any other country over the ten years (2010-2020).



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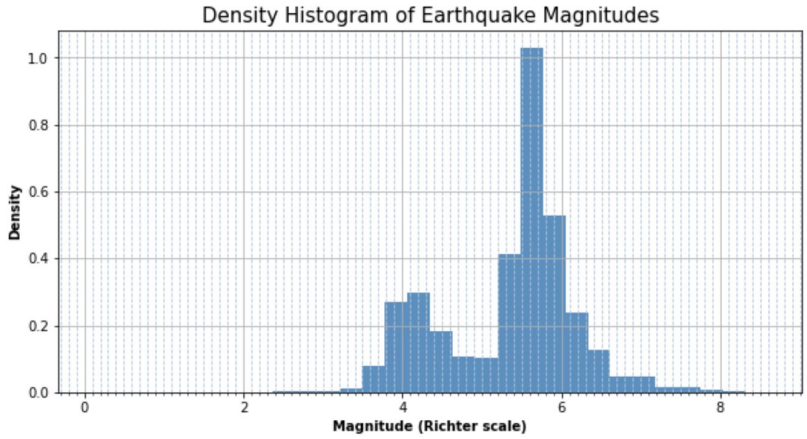
(5)



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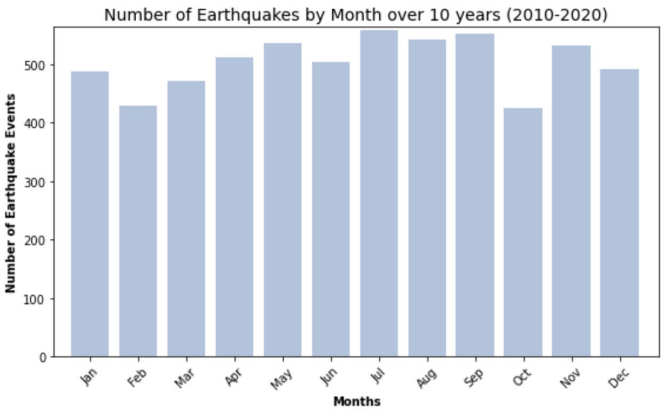

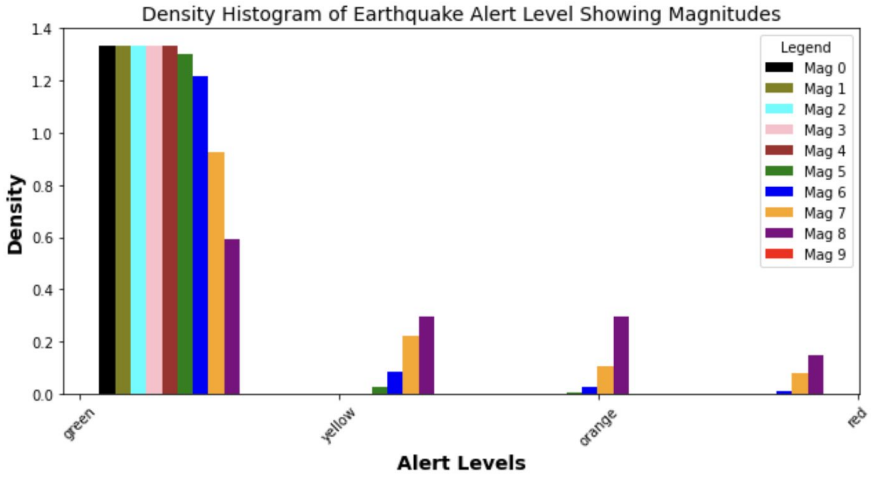

4. What is the alert level density for earthquakes?

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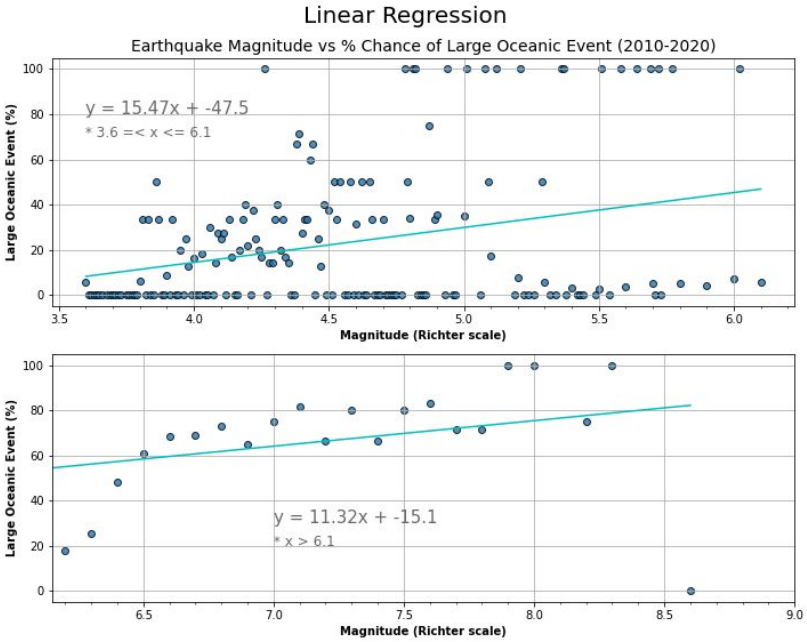
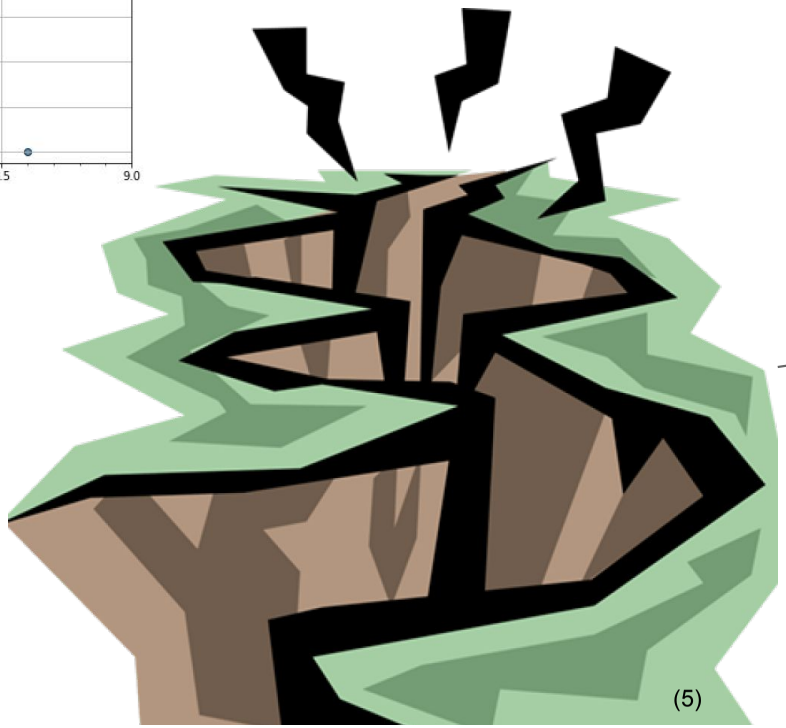
All levels of magnitudes observed were present in the Green alert level. Magnitudes 6 - 8 were present at much lower densities in the remaining alert types.

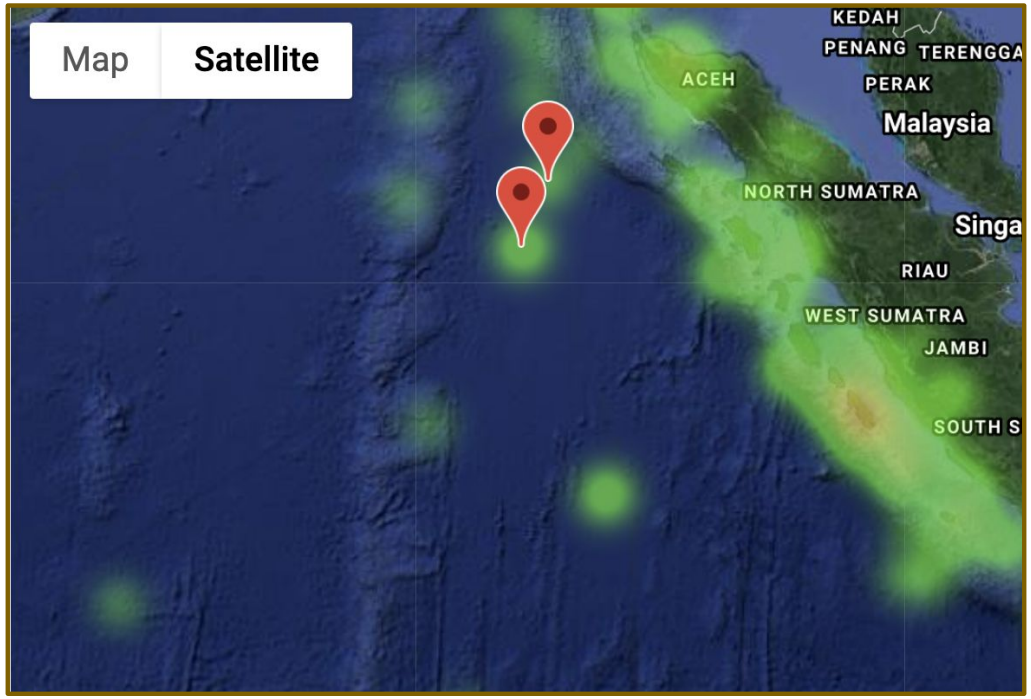




5. Is there a Relationship between Magnitude and % Chance of Large Oceanic Event?

No correlation was observed between Magnitude and Large Oceanic Events. The r-squared value is 0.09 for both linear regression plots.

Should we vacation here ?



Limitations

- One relationship:
  - Magnitude vs % Chance of Oceanic Event
- Questions in our scope (over ten years only):
  - Limiting question
  - Took only earthquakes in the 4 alert levels, there is more data...
  - Time constraints
- Using Linear Regression Analysis only:
  - Better model to suit data
- Using comparison of just two variables:
  - Potentially comparing with Depth?

Future Considerations

- Looking into **Depth** trends with Magnitudes
- Looking at Earthquake **Types** with Magnitudes
- Looking at **more variables** at a time:
    - ie) latitude/longitude in ocean only, with depth, and magnitude
- Looking at an **alternative Model** to fit the trends
- Density Analysis of **number of Earthquakes per day** over 10 years or more.

Written Analysis (1)

1 Where do earthquakes happen by Country?

- The ‘Total number of earthquakes by Counties’ plot, showed that USA (count: 1733) has far more earthquakes than any other country over the ten years (2010-2020).
- Indonesia being the second highest at 438.
- Most countries approximately one.

2. What is the density of magnitudes for earthquakes?

- The ‘Density Histogram of Earthquake Magnitudes’ plot shows that the Magnitudes around 5.5 to <6.0 are the most dense and thus, these magnitudes will occur more frequently than others around the world.

3. What month do earthquakes mostly occur?

- The 'Number of Earthquakes by Month over 10 years (2010-2020))' plot shows that earthquakes can happen during any month.
- The numbers reveal how 'almost evenly' spread the number of earthquake events are, in each month for 10 years..
- Varying between 400 and 550 each month.

4. What is the alert level density for earthquakes?

- The 'Total Number of Earthquakes per Alert Level (2010-2020)' plot, and the heat map shows that the Green alerts (5852) have a far more number of earthquakes than any other alert levels (orange:37,red:16,yellow:144).
- This is a good thing. As the alert levels tell us the number of fatalities and infrastructure damage value respectively.
- Additionally, the plot 'Density Histogram of Earthquake Alert Level Showing Magnitudes' shows that all levels of magnitudes that were noticed in this green alert level. Green level density: >1.3 and other alert levels were all lower than 0.3 .

Written Analysis (2)

5. Is there a Relationship between Magnitude and % Chance of Large Oceanic Event?

- The linear regression plots 'Earthquake Magnitude vs % Chance of Large Oceanic Event (2010-2020)' shows that no correlation between Magnitude and Large Oceanic Events were seen because the value of both charts r-squared = 0.09 rounded.
- This indicates that no correlation can be depicted.
- Note: Charts were separated by magnitude because the scatter plots showed two distinct seperations of clustering. One set of clusters for magnitudes between 3.6 and 6.1 and then another set of clusters > 6.1 . No events were noticed from 0 to <3.6

Notes: It was interesting to see that in the second regression analysis plot, where magnitudes were above 6.1, that there was one possible outlier at 8.6 However, this was indeed an earthquake at this great magnitude, that did not cause a large oceanic event. Therefore, we need to include other variables that cause large oceanic effects such as the depth of the earthquake to further analyse how earthquakes can cause a large oceanic event.

- Include latitudes and longitudes, only in the ocean
- Include magnitude
- Include depth of the earthquake
- Look at other possible Models that could fit better

Resources

1. USGS Earthquake API
2. USGS Documentation
3. Google Maps API (Google Cloud Platform)

Modules Added

1. **gmaps:** for heat map
2. **reverse_geocoder** : for the Country, City and country codes from latitude and longitude coordinates

Images Resources

(1) https://purvesinsurance.com/earthquake-insurance-davis-ca/
(2) https://www.shutterstock.com/search/richter+scale
(3) https://earthquake.usgs.gov/data/pager/background.php
(4) Satellite Image via google maps
(5) 205-2051050_earthquake-clipart-free-earthquake-clipart-at-getdrawings-png.png
(6) Satellite Image via google maps
(7) Satellite Image via google maps
(8) Research and Analysis Picture