

Earthquake Magnitude Interval Analysis

Ridhwan Choudahri

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1. Analysis Overview

This report documents the process of fitting a linear regression model to earthquake data and using it to generate interval estimates for earthquake magnitude at a specific location. The analysis focuses on: * A **95% Confidence Interval** for the average magnitude. * A **95% Prediction Interval** for a single earthquake's magnitude.

The target location for these predictions is defined by: `depth = 12`, `latitude = 28.7`, and `longitude = 77.1`.

2. R Code and Model Setup

A linear model (`lm`) was created to predict `magnitude` using `depth`, `latitude`, and `longitude` as predictor variables. The code below details the entire process from loading the data to generating the intervals.

```
library(readxl)

earthquake_data <- read_excel("C:/Users/Lenovo/Downloads/earthquake.xlsx")

model <- lm(magnitude ~ depth + latitude + longitude, data = earthquake_data)

new_point <- data.frame(depth = 12, latitude = 28.7, longitude = 77.1)

confidence_interval <- predict(model, newdata = new_point, interval = "confidence", level = 0.95)

prediction_interval <- predict(model, newdata = new_point, interval = "prediction", level = 0.95)

print("Confidence Interval:")
print(confidence_interval)

print("Prediction Interval:")
print(prediction_interval)
```

3. Results and Interpretation

The R script produced the following results for the specified location.

3(a) 95% Confidence Interval

The **confidence interval** provides a range for the **average** magnitude of all earthquakes that might occur at the location.

Output:

```
      fit      lwr      upr
1 5.982154 5.909327 6.054981
```

Interpretation: The predicted average magnitude is **5.98**. We can be 95% confident that the true average magnitude for all earthquakes at this specific depth, latitude, and longitude is between **5.91** and **6.05**.

3(b) 95% Prediction Interval

The **prediction interval** provides a range for the magnitude of a **single future** earthquake. It is wider because it accounts for both the model's uncertainty and the random variability of an individual event.

Output:

```
      fit      lwr      upr
1 5.982154 5.555356 6.408952
```

Interpretation: The predicted magnitude for a single event is also **5.98**. We are 95% confident that the magnitude of the next single earthquake at this location will fall between **5.56** and **6.41**. As expected, this range is wider than the confidence interval.