Geologic computing Hw 4

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Problem 1:

Determining the frequency-magnitude relationship for a given earthquake catalog. This will count and output the number of earthquakes greater than or equal to each magnitude from M2 to M9 and the log of each frequency.

Command:

perl magnitude.pl earthquake_catalog_example.dat > magnitude.out

or

perl magnitude_hash.pl earthquake_catalog_example.dat > magnitude_hash.out

Output:

Number of events by Richter Magnitude

M2 = 21500

M3 = 15720

M4 = 2432

M5 = 377

M6 = 35

M7 = 6

M8 = 0

M9 = 0

Log number of events by Richter Magnitude

M2 = 4.3324384599156

M3 = 4.19645254170339

M4 = 3.3859635706007

M5 = 2.57634135020579

M6 = 1.54406804435028

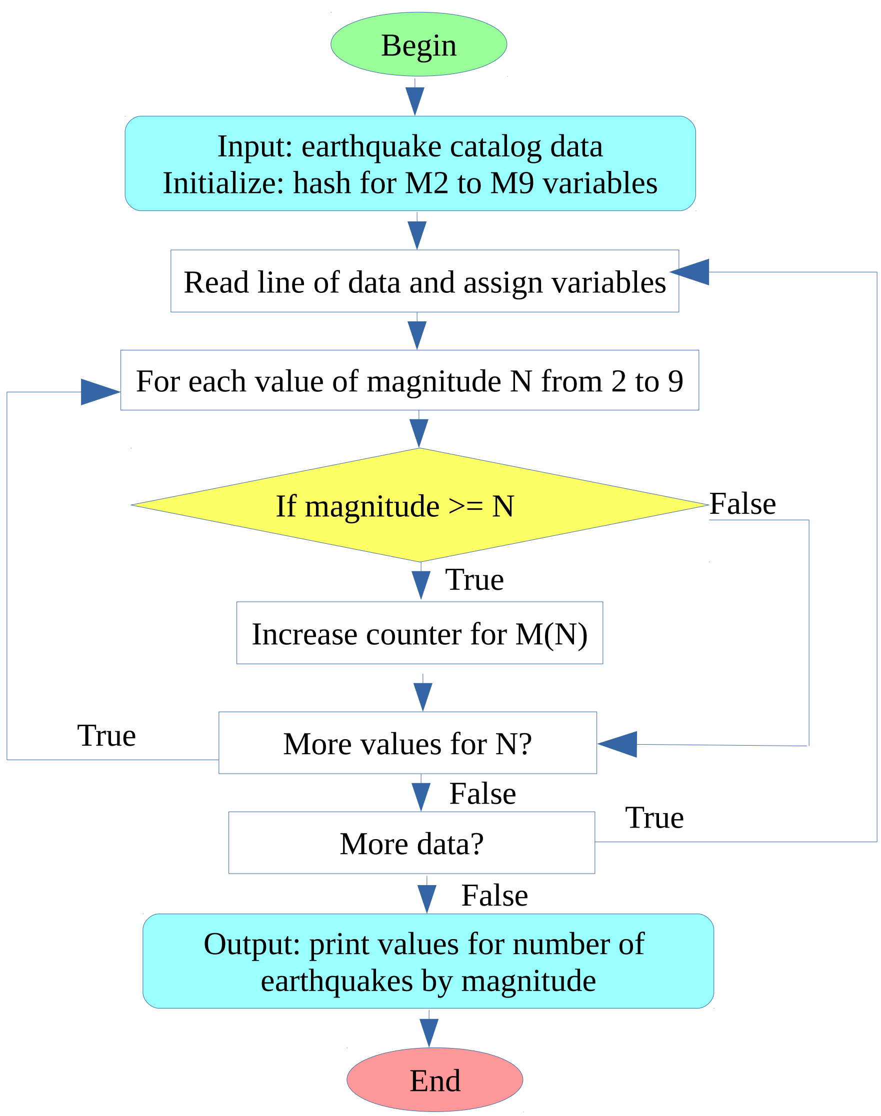
M7 = 0.778151250383644

M8 = -inf

M9 = -inf

Discussion:

Considering the Gutenburg-Richter Law states that there is supposed to be a linear correlation between the magnitude and the log of the frequency, this data seems to support the law. It can be seen with a nearly 1 to 1 change between magnitude and log-frequency from M3 to M7. The problem with this is that the change from M2 to M3 does not fit the law. An explanation for this could be that there are smaller events within the M2 category that were not included or recorded in this dataset, so that the value is lower than what would actually be seen. The values for M8 and M9 are only because there were no events of this magnitude, so this doesn't contradict the  Gutenburg-Richter Law.Problem 1 Flowchart:



Problem 2:

This problem uses the script developed in problem 1 and applies it to a selected area of USGS data. I initially looked at data just in the Lassen region, but there was limited data. I then included more of Northern California and a bit of data off of the coast near the triple junction. I will also be using data from Japan to see values for some of the larger magnitude earthquakes. Both data sets include events magnitude 2 and above from January 1, 2000 to present.

Commands:

perl magnitude_csv.pl north_cal.csv > magnitude_cal.out

and

perl magnitude_csv.pl japan.csv > magnitude_japan.out

Outputs:

Northern California

Number of events by Richter Magnitude

M2 = 17108

M3 = 1491

M4 = 226

M5 = 29

M6 = 3

M7 = 0

M8 = 0

M9 = 0

Log number of events by Richter Magnitude

M2 = 4.23319924158477

M3 = 3.17347764345299

M4 = 2.35410843914744

M5 = 1.46239799789896

M6 = 0.477121254719662

M7 = -inf

M8 = -inf

M9 = -inf

Japan

Number of events by Richter Magnitude

M2 = 16841

M3 = 16840

M4 = 15408

M5 = 1966

M6 = 207

M7 = 21

M8 = 2

M9 = 1

Log number of events by Richter Magnitude

M2 = 4.22636787585649

M3 = 4.22634208716363

M4 = 4.18774626978046

M5 = 3.29358351349612

M6 = 2.31597034545692

M7 = 1.32221929473392

M8 = 0.301029995663981

M9 = 0

Discussion:

While lacking in larger magnitude earthquakes, the data from Northern California has a very consistent 1 log-frequency to 1 magnitude ratio. This shows a very clear example of the Gutenburg-Richter Law with a linear relationship between the log of the number of events and the magnitude. In contrast, the data from Japan seems to be heavily weighted towards higher magnitude events. The fact that the values for M2, M3 and M4 are all within 1000 events shows a main reason, as this indicates that there is little data for earthquakes below M4 from this database. This explains the plateau in log-frequency for M2 to M4. However, starting from M4 up to M8 displays a fairly consistent  Gutenburg-Richter relationship with linear relation as seen before. The small change from M8 to M9 is likely due to the rarity of these data values, and results from the specific beginning and end time for the dataset. Overall, the Gutenburg-Richter relationship can be seen throughout the data sets from different regions.