Lab 02

Jyosna Philip

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# Dataset Description

This dataset includes a record of the date, time, location, depth, magnitude, and source of every earthquake with a reported magnitude 5.5 or higher from 1965-2016.

earthquakes <- read.csv("C:/Users/jyosn/Downloads/database.csv/database.csv")  
head(earthquakes)

## Date Time Latitude Longitude Type Depth Depth.Error  
## 1 01/02/1965 13:44:18 19.246 145.616 Earthquake 131.6 NA  
## 2 01/04/1965 11:29:49 1.863 127.352 Earthquake 80.0 NA  
## 3 01/05/1965 18:05:58 -20.579 -173.972 Earthquake 20.0 NA  
## 4 01/08/1965 18:49:43 -59.076 -23.557 Earthquake 15.0 NA  
## 5 01/09/1965 13:32:50 11.938 126.427 Earthquake 15.0 NA  
## 6 01/10/1965 13:36:32 -13.405 166.629 Earthquake 35.0 NA  
## Depth.Seismic.Stations Magnitude Magnitude.Type Magnitude.Error  
## 1 NA 6.0 MW NA  
## 2 NA 5.8 MW NA  
## 3 NA 6.2 MW NA  
## 4 NA 5.8 MW NA  
## 5 NA 5.8 MW NA  
## 6 NA 6.7 MW NA  
## Magnitude.Seismic.Stations Azimuthal.Gap Horizontal.Distance Horizontal.Error  
## 1 NA NA NA NA  
## 2 NA NA NA NA  
## 3 NA NA NA NA  
## 4 NA NA NA NA  
## 5 NA NA NA NA  
## 6 NA NA NA NA  
## Root.Mean.Square ID Source Location.Source Magnitude.Source  
## 1 NA ISCGEM860706 ISCGEM ISCGEM ISCGEM  
## 2 NA ISCGEM860737 ISCGEM ISCGEM ISCGEM  
## 3 NA ISCGEM860762 ISCGEM ISCGEM ISCGEM  
## 4 NA ISCGEM860856 ISCGEM ISCGEM ISCGEM  
## 5 NA ISCGEM860890 ISCGEM ISCGEM ISCGEM  
## 6 NA ISCGEM860922 ISCGEM ISCGEM ISCGEM  
## Status  
## 1 Automatic  
## 2 Automatic  
## 3 Automatic  
## 4 Automatic  
## 5 Automatic  
## 6 Automatic

tail(earthquakes)

## Date Time Latitude Longitude Type Depth Depth.Error  
## 23407 12/28/2016 08:18:01 38.3754 -118.8977 Earthquake 10.80 1.3  
## 23408 12/28/2016 08:22:12 38.3917 -118.8941 Earthquake 12.30 1.2  
## 23409 12/28/2016 09:13:47 38.3777 -118.8957 Earthquake 8.80 2.0  
## 23410 12/28/2016 12:38:51 36.9179 140.4262 Earthquake 10.00 1.8  
## 23411 12/29/2016 22:30:19 -9.0283 118.6639 Earthquake 79.00 1.8  
## 23412 12/30/2016 20:08:28 37.3973 141.4103 Earthquake 11.94 2.2  
## Depth.Seismic.Stations Magnitude Magnitude.Type Magnitude.Error  
## 23407 34 5.6 ML 0.350  
## 23408 40 5.6 ML 0.320  
## 23409 33 5.5 ML 0.260  
## 23410 NA 5.9 MWW NA  
## 23411 NA 6.3 MWW NA  
## 23412 NA 5.5 MB 0.029  
## Magnitude.Seismic.Stations Azimuthal.Gap Horizontal.Distance  
## 23407 20 35.86 0.132  
## 23408 18 42.47 0.120  
## 23409 18 48.58 0.129  
## 23410 NA 91.00 0.992  
## 23411 NA 26.00 3.553  
## 23412 428 97.00 0.681  
## Horizontal.Error Root.Mean.Square ID Source Location.Source  
## 23407 NA 0.1988 NN00570709 NN NN  
## 23408 NA 0.1898 NN00570710 NN NN  
## 23409 NA 0.2187 NN00570744 NN NN  
## 23410 4.8 1.5200 US10007NAF US US  
## 23411 6.0 1.4300 US10007NL0 US US  
## 23412 4.5 0.9100 US10007NTD US US  
## Magnitude.Source Status  
## 23407 NN Reviewed  
## 23408 NN Reviewed  
## 23409 NN Reviewed  
## 23410 US Reviewed  
## 23411 US Reviewed  
## 23412 US Reviewed

Our target variable is Magnitude i.e, the magnitude of the Earthquake.

dim(earthquakes)

## [1] 23412 21

Thus there are 23412 observations(rows) and 21 attributes(columns).

mean(earthquakes$Magnitude)

## [1] 5.882531

sd(earthquakes$Magnitude)

## [1] 0.4230656

Thus the population mean is 5.88 and population sd is 0.42.

# Sample

s=sample(earthquakes$Magnitude,100,replace=FALSE)  
mean(s)

## [1] 5.872

sd\_s=sd(s)  
sd\_s

## [1] 0.4621163

Thus the sample population mean is 5.81 and sample sd is 0.35.

## TWO SIDED HYPOTHESIS TEST

To test whether the avg earthquake magnitude is 5.81 or not.

H0: mean=5.86

H1: mean!=5.86

library(BSDA)

## Loading required package: lattice

##   
## Attaching package: 'BSDA'

## The following object is masked from 'package:datasets':  
##   
## Orange

z.test(x=s,alternative="two.sided",mu=5.86,sigma.x=sd\_s,conf.level=0.95)

##   
## One-sample z-Test  
##   
## data: s  
## z = 0.25967, p-value = 0.7951  
## alternative hypothesis: true mean is not equal to 5.86  
## 95 percent confidence interval:  
## 5.781427 5.962573  
## sample estimates:  
## mean of x   
## 5.872

The z-value is -1.43 which is greater than the critical value at 0.95 confidence level. Also p-value is 0.1528 which is greater than than 0.05, hence we fail to reject H0. Conclusion: The mean magnitude of Earthquakes from 1965-2016(if they were above 5.5) is 5.86 .

# LEFT-TAILED HYPOTHESIS TEST

To test whether the average magnitude of earthquakes is 5.86 or less than it. H0: mean=5.86 H1: mean<5.86

z.test(x=s,alternative="less",mu=5.86,sigma.x=sd\_s,conf.level=0.95)

##   
## One-sample z-Test  
##   
## data: s  
## z = 0.25967, p-value = 0.6024  
## alternative hypothesis: true mean is less than 5.86  
## 95 percent confidence interval:  
## NA 5.948011  
## sample estimates:  
## mean of x   
## 5.872

The z-value is -1.43 which is greater than -1.46. -1.46 is the critical value at 5% significance level for left-tailed test. Also p-value is 0.076 which is greater than than 0.05. Hence we fail to reject H0. Conclusion: The mean magnitude of Earthquakes from 1965-2016(if they were above 5.5) is 5.86 .

# RIGHT-TAILED HYPOTHESIS TEST

To test whether the average magnitude of earthquakes is 5.86 or greater than it. H0: mean=5.86 H1: mean>5.86

z.test(x=s,alternative="greater",mu=5.86,sigma.x=sd\_s,conf.level=0.95)

##   
## One-sample z-Test  
##   
## data: s  
## z = 0.25967, p-value = 0.3976  
## alternative hypothesis: true mean is greater than 5.86  
## 95 percent confidence interval:  
## 5.795989 NA  
## sample estimates:  
## mean of x   
## 5.872

The z-value is -1.43 which is less than 1.46. 1.46 is the critical value at 5% significance level for right-tailed test. Also p-value is 0.924 which is much greater than than 0.05. Hence we fail to reject H0. Conclusion: The mean magnitude of Earthquakes from 1965-2016(if they were above 5.5) is 5.86 .