Analysis of Tectonic Earthquake Characteristics in The Province of Nusa Tenggara Barat Indonesia and Its Surroundings

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Abstract. The type of earthquake that is most often felt in Indonesia is tectonic earthquakes. This type of earthquake is caused by the movement of the earth's crust due power generated by tectonic plate shifts. Province of Nusa Tenggara Barat is one of the earthquake prone areas in Indonesia. In this research, we will analysis of tectonic earthquakes characteristics in Province of Nusa Tenggara Barat by descriptive statistics concept approach and analysis type of data distribution earthquakes 2018. The Data used are tectonic earthquakes 2018 in Province of Nusa Tenggara Barat of Indonesia and sourced from the USGS earthquake catalog. The results of this study can be used as a reference for the Government of Indonesia and Province of Nusa Tenggara Barat in disaster mitigation planning in Province of Nusa Tenggara Barat.

1. Introduction
Earthquake tectonic activity in Indonesia is relatively high. Meteorological, Climatological, and Geophysical Agency noted that during 2018 there was an earthquake activity of 11,577 times in various magnitudes and depths. It is discovered that the type of earthquake that is most often happened in Indonesia is tectonic earthquakes. This type of earthquake is an earthquake caused by the movement of the earth's crust due to the power generated by tectonic plate shifts. According to plate tectonic theory that the outer portion of the earth's interior is formed of two layers. The first layer is the lithosphere which is rigid and dense. This layer consists of the crust and the top of the earth's mantle. Another layer is the asthenosphere, which is a layer that is dense but can change form into liquid and flow slowly on a very long geological time scale [1,2].

Indonesian territory has a high level of earthquake risk. This relates to the Indonesian archipelago which is a meeting of the world's large plates and several small plates or micro blocks, which are the Pacific and the Indo-Australian plates in the east, and the Eurasian and the Indian plates in the west, as showed in Fig. 1. The existence of large and smaller plates, namely the Caroline and the Philippine Sea plate take the tectonic structure in the Indonesian archipelago to be complicated. As a result of the tectonic process, earthquake often occur in most areas in Indonesia. One of the earthquakes’ sources that have been identified is the active subduction zone in the west to the eastern part of Indonesia. In addition, the energy from the collision process between the plates will cause faults on land or sea on several islands and seas of Indonesia. West Nusa Tenggara Province is one of the Indonesian regions in the active tectonic region [3,4].
Many geologists have examined the characteristics of the earthquake in Province of Nusa Tenggara Barat (NTB). Province of NTB, especially the Lombok Island, is in an active tectonic area [5]. The India-Australian Plate which stretches across the Nusa Tenggara region can be divided into three different zones, namely Roo Rise, Argo Abyssal Plain, and Scott Plateau. Lombok Island, NTB Province is surrounded by several earthquake sources, including the Back Arc Thrust Zone in the north, Megathrust in the south, and the sliding fault system in the west and east. Geographical location data from several earthquake spreads and earthquake focal mechanisms, it is known that the earthquake that occurred is related to the movement of the rising fault in the back arc of Lombok Island [5-8]. On July 29, 2018 an earthquake occurred in the NTB Province which had taken a significant toll with the epicenter located 47 km northeast of Mataram City, NTB Province with a depth of 24 km. Then, on August 5, 2018 the epicenter was 18 km northwest of East Lombok, NTB Province with a depth of 32 km. This earthquake is the main earthquake in the series of earthquakes on Lombok Island since the initial earthquake SR 6.4 [9,10].

In addition, there was also a fairly large earthquake on August 9, 2018 with a magnitude of 6.5 SR that struck the NTB Province. A total of 14,940 houses were damaged by the earthquake and 555 people died due to the earthquake in NTB Province during August 2018. Experts and institutions that interpreted in SAR data showed a fault deformation that caused the northern part of Lombok Island to rise by an average of about 25 cm [9]. The rear arc ascending fault line is usually referred to as the Flores fault because it is associated with the 1992 earthquake-tsunami event. This fault line stretches from Alor-Wetar Island, Flores, Sumbawa, Lombok, to Bali [7,9].

Earthquake research with a statistical science approach has been carried out by many researchers such as related to the classification and modeling of earthquakes with the stochastic process approach [11-13], the statistical method approach [14-17], and multivariate statistics [13, 18].

This study uses a descriptive statistical approach that aims to determine the characteristics of tectonic earthquakes in Province of NTB, analysis of earthquake distribution 2018 in Province of NTB, and determine the type of earthquake distribution based on earthquake data 2018 in Province of NTB using the Kolmogorov-Smirnov test. The results of this study are expected to be used as a reference for the Regional Government of the Province of NTB in compiling spatial planning and areas in Province of NTB and its surroundings.

2. Data and Methods
The province of NTB is one of the areas that is in earthquake prone areas in Indonesia. In the north side with: Java Sea and Flores Sea, south side with Indonesian Ocean, west side with Lombok Strait and Province of Bali, and east with the Sape Strait (Province of Nusa Tenggara Timur). Province of NTB is located at coordinates 8°.10' - 9°.5' Latitude and 115°.46' - 119°.5' Longitude. Province of NTB consists of two large islands namely Lombok and Sumbawa and hundreds of smaller islands

![Figure 1. The Map of Indonesian Tectonic Plates [3]
Out of 280 islands, only 32 are inhabited. The total area of the Province of NTB is 20,153.15 km². Sumbawa Island has the largest area in Province of NTB, which is 15,414.5 km² (76.49%) [19].

This study uses earthquake data of the United States Geological Survey (USGS) which is earthquake data 2018 in Province of NTB with criteria of magnitude > 3 and depth ≤ 50 km [20]. This data consists of 18 variables, namely: time/date, latitude, longitude, depth, magnitude, magtype, nst, gap, dmin, rms, net, id, upadet place, type, horizontal error, status, location source, mag source. This study only uses 6 variables namely longitude ($X_1$), latitude ($X_2$), depth ($X_3$), magnitude ($X_4$), date ($X_5$), and location source ($X_6$). Earthquake events 2018 in Province of NTB with these criteria are 165 events and in detail the number of events grouped by month during 2018 can be shown in Table 1 and Fig. 3.

| Months   | Number of Earthquake |
|----------|----------------------|
| January  | 0                    |
| February | 2                    |
| March    | 0                    |
| April    | 0                    |
| May      | 0                    |
| June     | 0                    |
| July     | 18                   |
| August   | 115                  |
| September| 17                   |
| October  | 4                    |
| November | 4                    |
| December | 5                    |
| Total    | 165                  |

Based on Table 1 and Fig. 3 shows that earthquake events are high in August 2018 and events are occurring in July and September 2018 while there are no earthquake events in January, March, April and May 2018. Then the earthquake events are relatively low occurred in February, October, November and December 2018.
In this research, observations will be made of the earthquake events distribution in 2018 to areas in Province of NTB based on visualization through mapping. The descriptive statistics are processed for earthquake event data related to several measure of central tendency and dispersion, then analyzed the results of the descriptive statistics [21]. On the other side, the data is presented in the form of scatterplots (2 and 3 dimensions) and boxplots which are then analyzed the results displayed through the boxplot and scatterplot [22,23]. The study continued with determining the type of data distribution of latitude, longitude, depth and magnitude of earthquake events using the Kolmogorov-Smirnov test. Then also shown a graph of the density function of the type of earthquake data distribution that has been tested with the Kolmogorov-Smirnov test approach including a histogram of the data.

3. RESULTS AND DISCUSSION

3.1 Analysis of earthquake characteristics 2018 in province of NTB

In this section, visualization of the earthquake distribution 2018 will be displayed based on regency areas in Province of NTB with criteria of magnitude > 3 and depth ≤ 50 km as shown in Fig. 4. Based on Fig. 4, it appears that the earthquake with these criteria gathered in the Lombok Island region, particularly in North Lombok Regency, Lombok Regency and Alas Strait and only a few earthquakes in Sumbawa Island, namely in Sumbawa and Sumbawa Besar Regencies.

Based on Table 1, it can be seen that in August 2018 earthquake frequency with magnitude > 3 and depth ≤ 50 km is high enough, 115 events. Then followed in July 2018 and September 2018, there were 18 and 17 events. The distribution of the earthquake July 2018 in the Province of NTB can be shown in Fig. 5. Based on Fig. 5, it can be seen that the earthquake is only spread in North Lombok and East Lombok Regencies of Lombok Island (July 2018). Whereas for August 2018, the distribution of the earthquake partly spread on Lombok Island (East Lombok and North Lombok Regencies) and
the Alas Strait. While a small portion spread in the Sumbawa Island Region, namely in the Sumbawa Regency (Fig. 6).

Figure 5. Distribution of earthquake July 2018 in Province of NTB

Figure 6. Distribution of earthquake August 2018 in Province of NTB

In September 2018, earthquakes spread rather infrequently in the Lombok Island, especially in North Lombok and East Lombok Regencies, also in the Alas Strait while only one incident occurred on Sumbawa Island (Fig. 7).
The initial stage in analyzing the characteristics of tectonic earthquakes in Province of NTB is to conduct a descriptive statistical analysis. Descriptive statistical results for earthquake data $X_1, X_2, X_3,$ and $X_4$ in 2018, July 2018, August 2018, and September 2018 can be shown in Table 2, Table 3, Table 4, and Table 5. Then the earthquake data $X_1$ in 2018, July 2018, August 2018 and September 2018 in Table 2, Table 3, Table 4, and Table 5 shows that the earthquake data $X_1$ in August 2018 has a high SD of 0.30063 when compared to the SD from the earthquake data $X_1$ of 2018, July 2018, and September 2018. This means a wider range of variations of the earthquake data $X_1$ in August 2018 when compared to the earthquake data $X_1$ in 2018, July 2018, and September 2018. The negative skewness value ($<0$) for the earthquake data $X_1$ in 2018, July 2018, August 2018, and September 2018 shows that the form of the distribution of earthquake data $X_1$ in 2018, July 2018, August 2018, and September 2018 was negatively neglected because the tail of the data distribution point referred to the left. Furthermore, based on kurtosis values it can be seen that the earthquake data $X_1$ in 2018, July 2018, August 2018, and September 2018 have a central part of the distribution which has a flatter peak because the value of kurtosis is $<3$ and is called platycurtic.

Based on the earthquake data $X_2$ in 2018, July 2018, August 2018 and September 2018 in Table 2, Table 3, Table 4, and Table 5 shows that the earthquake data $X_2$ September 2018 has a high Standard Deviation (SD) which is 0.12814 when compared with SD from earthquake of $X_2$ in 2018, July 2018, and August 2018. This shows that the wider range of variations of earthquake data $X_2$ of earthquake in September 2018 when compared with earthquake data $X_2$ of 2018, July 2018, and August 2018. Negative skewness value ($<0$) for earthquake data $X_2$ in 2018, July 2018, August 2018, and September 2018 show that the form of the distribution of earthquake data $X_2$ in 2018, July 2018, August 2018, and September 2018 was negatively neglected because the tail of the data distribution point referred to the left. Then based on the value of kurtosis, the middle part of the distribution of earthquake data $X_2$ in 2018 and September 2018 has a flatter peak because the value of kurtosis $<3$ and is called platykurtic. While the $X_2$ September 2018 earthquake data has a value of kurtosis $>3$ so that the center of the data distribution has a sharper peak and is called leptokurtic. On the other hand, the July 2, 2018 earthquake data, the central part of the data distribution has a peak between leptokurtic and platykurtic.

![Figure 7. Distribution of earthquake September 2018 in Province of NTB](image-url)
Table 2. Descriptive statistics of earthquake data 2018 in Province of NTB.

| Variable | N   | Min  | Max  | Mean  | SD   | Skewness | Kurtosis |
|----------|-----|------|------|-------|------|----------|----------|
| X₁       | 165 | -8.72| -8.17| -8.3278| 0.09472| -0.973   | 2.127    |
| X₂       | 165 | 115.84| 116.99| 116.5128| 0.28499| -0.227   | -0.962   |
| X₃       | 165 | 3.30 | 34.56| 12.6288| 6.27589| 2.050    | 3.607    |
| X₄       | 165 | 3.70 | 6.90 | 4.5976 | 0.51796| 0.973    | 4.848    |

Table 3. Descriptive statistics of earthquake data July 2018 in Province of NTB.

| Variable | N | Min | Max  | Mean  | SD   | Skewness | Kurtosis |
|----------|---|-----|------|-------|------|----------|----------|
| X₁       | 18 | -8.41| -8.17| -8.2607| 0.06569| -0.713   | 0.000    |
| X₂       | 18 | 116.36| 116.59| 116.5018| 0.06164| -0.515   | 0.084    |
| X₃       | 18 | 10.00| 12.00| 11.1111| 0.47140| 4.243    | 18.000   |
| X₄       | 18 | 4.00 | 6.40 | 4.6944 | 0.57238| 1.600    | 3.668    |

Table 4. Descriptive statistics of earthquake data August 2018 in Province of NTB.

| Variable | N | Min | Max  | Mean  | SD   | Skewness | Kurtosis |
|----------|---|-----|------|-------|------|----------|----------|
| X₁       | 115| -8.72| -8.19| -8.3370| 0.08774| -0.796   | 1.839    |
| X₂       | 115| 115.97| 116.99| 116.5003| 0.30063| -0.109   | -1.299   |
| X₃       | 115| 3.30 | 33.31| 12.4069| 5.95548| 1.936    | 3.366    |
| X₄       | 115| 3.80 | 6.90 | 4.6191 | 0.53638| 1.955    | 5.096    |

Table 5. Descriptive statistics of earthquake data September 2018 in Province of NTB.

| Variable | N | Min | Max  | Mean  | SD   | Skewness | Kurtosis |
|----------|---|-----|------|-------|------|----------|----------|
| X₁       | 17 | -8.71| -8.17| -8.3159| 0.12814| -1.859   | 5.037    |
| X₂       | 17 | 116.04| 116.99| 116.6198| 0.25384| -0.583   | 0.179    |
| X₃       | 17 | 6.75 | 34.56| 17.2547| 9.97771| 0.918    | -0.783   |
| X₄       | 17 | 4.10 | 5.00 | 4.4706 | 0.30977| 0.669    | -0.633   |

Furthermore, based on Table 2, Table 3, Table 4, and Table 5 it can be seen that the $X_3$ earthquake data for September 2018 has a high SD 9.97771 when compared with the SD data depth of 2018, July 2018, and August 2018. This shows that $X_3$ earthquake data for September 2018 is wider in variation range compared to the earthquake data $X_3$ for 2018, July 2018, and September 2018. Positive skewness values (> 0) for the earthquake data $X_3$ for 2018, July 2018, and August 2018 indicate that the shape of the distribution of earthquake data $X_3$ in 2018, July 2018, and August 2018 is positively right (Fig. 8). On the other hand, it can be seen that the value of kurtosis of earthquake data $X_3$ in 2018, July 2018, and August 2018 is greater than 3 so it can be said that the central part of the distribution of earthquake data $X_3$ in 2018, July 2018, and August 2018 has a sharper peak and is called leptokurtic.
Figure 8. Scatterplot of earthquakes data $X_1$, $X_3$, and $X_5$ in Province of NTB a).2018, b). July 2018, c). August 2018, and d). September 2018.

While the $X_3$ earthquake data for September 2018 has a kurtosis value $< 3$ so that the central part of the data distribution is more pointed (leptokurtic). On the other hand, the $X_4$ earthquake data for July 2018 has an SD value of 0.57238 which is greater than the $X_4$ earthquake data for 2018, August 2018 and September 2018 (Table 2, Table 3, Table 4, and Table 5). This means that variations in magnitude data for July 2018 are wider in range when compared to earthquake data $X_4$ in 2018, August 2018, and September 2018. So, positive of skewness values ($> 0$) for earthquake data $X_4$ in 2018, July 2018, August 2018, and September 2018 shows that the form of the distribution of earthquake data $X_4$ in 2018, July 2018, August 2018, and September 2018 was positively skewed because the tail of the data distribution point was intended to the right. Earthquake data $X_4$ in 2018, July 2018, and August 2018 have a value of kurtosis $> 3$ (leptokurtic) so that the peak is more pointed in the middle of the distribution of earthquake data $X_4$ in 2018, July 2018, and August 2018. The earthquake data $X_4$ in September 2018 has a value of kurtosis $< 3$ (platykurtic) so that the middle part of the distribution of the $X_4$ earthquake data for September 2018 has a flatter peak in the middle of the intended data distribution.
Figure 9. Scatterplot of earthquakes data $X_3$ and $X_4$ in Province of NTB. a. 2018, b. July 2018, c. August 2018, and d. September 2018.

Fig. 8 shows scatterplots based on earthquake data $X_1$, $X_2$, and $X_3$ in 2018, July 2018, August 2018, and September 2018. Based on Fig. 9a, it can be seen that the frequency of earthquakes occurring with depth in 2018 is at intervals of $20 \leq X_3 \leq 35$ km less frequently occur when compared with the frequency of earthquake events with a depth interval $X_3 \leq 20$ km. Furthermore, it was seen that the earthquake depth of July 2018 at an interval of $10 \leq X_3 \leq 12$ km and the frequency of earthquake events was rare (Fig. 8b). On the other side, it appears that the frequency of earthquakes in August 2018 is quite high and spreads at depths at intervals $5 \leq X_3 \leq 35$ km. At depths with intervals of $15 \leq X_3 \leq 35$ km and $0 \leq X_3 \leq 10$ km, earthquake frequency rarely occurs compared to the frequency of earthquake occurrence in depth with intervals of $10 \leq X_3 \leq 15$ km (Fig 8c). Then based on Fig. 8d seen for September 2018 that at depths with intervals of $0 \leq X_3 \leq 5$ km and $25 \leq X_3 \leq 31$ km there was no earthquake while the earthquake occurred at depth with intervals of $5 \leq X_3 \leq 24$ km and $32 \leq X_3 \leq 35$ km occur quake with rare frequency. Fig. 9 shows scatterplots based on earthquake data $X_3$ and $X_4$ of 2018, July 2018, August 2018, and September 2018. Based on the Fig. 9, it appears that the $X_3$ and $X_4$ data points do not form a particular pattern. This means there is no trend to the data.

3.2 Determination of the type of earthquake distribution of 2018 in province of NTB
Before determining the type of distribution, the boxplots will be shown based on earthquake data $X_1$, $X_2$, $X_3$, and $X_4$ in Province of NTB for 2018, July 2018, August 2018, and September 2018. Fig. 2 shows the $X_1$ earthquake data boxplot in Province of NTB for 2018, July 2018, August 2018, and September 2018.
Figure 10. Boxplot based on earthquakes data 2018, July 2018, August 2018, and September 2018 in Province of NTB. a. $X_1$, b. $X_2$, c. $X_3$, and d. $X_4$.

Based on Fig. 10a shows that the median value of earthquake data $X_1$ in 2018, July 2018, August 2018, and September 2018 are at intervals of $116 \leq X_1 \leq 117$ with the highest median value in earthquake events in 2018 while the lowest median values in earthquake events in August 2018. Then the distribution in Fig. 10a also shows that there are outliers in the 14th data from the September 2018 earthquake because it has the lowest value below the normal diversity. The diversity or variation of the $X_1$ earthquake data, looks very high at the September 2018 earthquake. This can be seen in the wide boxplot. The minimum value is recorded above 116.2 and the maximum is 117.

Based on Fig. 10b shows that earthquake data $X_2$ for 2018, July 2018, August 2018, and September 2018 are at intervals of $-8.5 \leq X_2 \leq -8.3$ with the highest median value in the earthquake events data for July 2018 while the lowest in the earthquake events data for August 2018. On the other side, based on the distribution, it can be seen that the earthquake in September 2018 has outliers, namely the third data which is very low under normal diversity. Variance of $X_2$ data looks very high on the data of earthquake events in August 2018. This can be seen from the wide boxplot. Furthermore, the boxplot for depth data can be shown in Fig. 10c.

| Variable | P-Value | Jenis Distribusi | Parameter |
|----------|---------|-----------------|-----------|
| $X_1$    | 0.69162 | GEV             | $k= -0.39019; \sigma = 0.30393; \mu = 116.43$ |
| $X_2$    | 0.99642 | GEV             | $k= -0.50927; \sigma = 0.10011; \mu = -8.3499$ |
| $X_3$    | -       | -               | -         |
| $X_4$    | 0.16257 | GEV             | $k= 0.16976; \sigma = 0.31387; \mu = 4.3537$ |
Table 7. KS test results of earthquakes data July 2018 in Province of NTB.

| Variable | P-Value | Jenis Distribusi | Parameter |
|----------|---------|------------------|-----------|
| $X_1$    | 0.92048 | Lognormal        | $\sigma = 5.1427E-4; \mu = 4.7579$ |
| $X_2$    | 0.99184 | GEV              | $k = -0.6014; \sigma = 0.07435; \mu = -8.2738$ |
| $X_3$    | -       | -                | -         |
| $X_4$    | 0.87054 | GEV              | $k = 0.17075; \sigma = 0.36104; \mu = 4.4134$ |

Table 8. KS test results of earthquakes data August 2018 in Province of NTB.

| Variable | P-Value | Jenis Distribusi | Parameter |
|----------|---------|------------------|-----------|
| $X_1$    | 0.30228 | GEV              | $k = -0.34527; \sigma = 0.31621; \mu = 116.40$ |
| $X_2$    | 0.97546 | GEV              | $k = -0.44148; \sigma = 0.09218; \mu = 8.3609$ |
| $X_3$    | -       | -                | -         |
| $X_4$    | 0.37559 | Burr             | $k = 0.22717; \alpha = 44.899; \beta = 4.1929$ |

Table 9. KS test results of earthquakes data September 2018 in Province of NTB.

| Variable | P-Value | Jenis Distribusi | Parameter |
|----------|---------|------------------|-----------|
| $X_1$    | 0.99908 | GEV              | $k = -0.50343; \sigma = 0.28246; \mu = 116.56$ |
| $X_2$    | 0.64781 | Logistik         | $\sigma = 0.07065; \mu = 8.31590$ |
| $X_3$    | 0.26585 | GEV              | $k = -0.26004; \sigma = 5.7226; \mu = 11.995$ |
| $X_4$    | 0.97599 | GEV              | $k = -0.01562; \sigma = 0.25089; \mu = 413218$ |

Based on Fig. 10c shows that the median values for earthquake data $X_3$ in 2018, July 2018, and August 2018 are almost the same location and is a low median value when compared to the median value of earthquake events in September 2018. Earthquake data $X_3$ in 2018 and August 2018 have many outliers above normal diversity besides there are some that are below the normal limit. Then the variance of earthquake data $X_3$, it can be seen that the earthquake data $X_3$ of September 2018 has a high distribution with a minimum number below 10 km and a maximum number approaching 35 km. On the other side, a boxplot for earthquake data $X_4$ has also been made for the events of 2018, July 2018, August 2018, and September 2018. The results can be shown in Fig. 10d. Based on Fig. 10d shows that the median for earthquake data $X_4$ in 2018, July 2018, and August 2018 are at intervals of $4.0 \leq X_4 \leq 5.5$ with the highest median value is on the earthquake data $X_4$ in July 2018 while the lowest median values in the earthquake data $X_4$ are August 2018 and September 2018. Very high variance is in the earthquake data $X_4$ for July 2018 as shown by the wider boxplot in Fig. 10d. The minimum magnitude figure is recorded at 4.0 and the maximum is close to 5.5, besides that there is still an outliers of earthquake data $X_4$ in July 2018 which reached magnitude at 6.4 (Fig. 10d). Furthermore, the type of earthquake distribution will be determined in Province of NTB for 2018, including earthquake distribution in July 2018, August 2018 and September 2018 using the Kolmogorov-Smirnov (KS) Test with a significance level of $\alpha = 0.05$. 

Then the type of distribution is determined based on earthquake data variables $X_1$, $X_2$, $X_3$ and $X_4$ in NTB Province 2018, July 2018, August 2018, and September 2018. Test the type of data distribution using the Kolmogorov-Smirnov Test with a significance level of $\alpha = 0.05$. Based on the test results generally show that each earthquake data variables $X_1$, $X_2$, $X_3$ and $X_4$ in 2018, July 2018, August 2018, and September 2018 followed several types of distribution but only one type of distribution was chosen based on the selection of the largest $P$-value. The detailed test results for 2018, July 2018, August 2018, and September 2018 can be shown in Table 4, Table 5, Table 6, and Table 7.

Based on Table 4, Table 5, Table 6, and Table 7, it can be seen that earthquake data variables $X_1$, $X_2$, $X_3$ and $X_4$ in Province of NTB of 2018, July 2018, August 2018, and September 2018 tended to be dominant following the GEV distribution and followed by the Burr, lognormal and logistic distribution. Then it was also seen that the $X_3$ earthquake data for 2018, July 2018, and August 2018 did not follow any type of distribution other than the $X_3$ earthquake data for September 2018.

Figure 11. Histogram and Probability Density Function based on earthquakes data $X_1$ in Province of NTB a) 2018, b) July 2018, c) August 2018, and d) September 2018.
Figure 12. Histogram and Probability Density Function based on earthquakes data $X_2$ in Province of NTB a. 2018, b. July 2018, c. August 2018, and d. September 2018.

Figure 13. Histogram and Probability Density Function based on earthquakes data $X_3$ September 2018 in Province of NTB
Furthermore, graph of histogram and density functions from earthquake data $X_1$, $X_2$, $X_3$ and $X_4$ in Province of NTB in 2018, July 2018, August 2018, and September 2018 can be shown with Fig. 11, Fig. 12, Fig.13, And Fig. 14.

![Graphs of histogram and density functions](image)

**Figure 14.** Histogram and Probability Density Function based on earthquakes data $X_4$ in Province of NTB a). 2018, b). July 2018, c). August 2018, and d). September 2018.

Based on Fig. 11., Fig. 12., Fig. 13., And Fig. 14 show that graph of histogram and density function of each earthquake data $X_1$, $X_2$, $X_3$ and $X_4$ in Province of NTB for 2018, July 2018, August 2018, and September 2018 indicates that the tail is on the left or right side of the distribution. This means that the distribution is not symmetrical so it can be concluded that earthquake data $X_1$, $X_2$, $X_3$ and $X_4$ in Province of NTB for 2018, July 2018, August 2018, and September 2018 are not normally distributed.

4. Conclusions
Based on the results and discussion, it can be seen that; earthquake events in Province of NTB for 2018 with the criteria of magnitude $> 3$ and a depth $\leq 50$ km if observed per month, the earthquake events are more frequent in August 2018 and followed by July and September 2018 when it compared to other months in 2018. Earthquakes with these criteria gathered in the Lombok Island region, namely in North Lombok Regency and only a few incidents in Sumbawa Island, namely in Sumbawa and Sumbawa Besar Regencies. In addition, earthquake frequency is quite high at a depth interval of $10 \leq X_3 \leq 15$ km for 2018, August 2018, and September 2018 while July 2018 is at a depth interval of $10 \leq X_3 \leq 12$ km.
Based on the results of the boxplot shows that the distribution of earthquake data $X_1$, $X_2$, $X_3$ and $X_4$ in Province of NTB for 2018, July 2018, August 2018, and September 2018 are not symmetrical so it can be concluded that earthquake data $X_1$, $X_2$, $X_3$ and $X_4$ in Province of NTB for 2018, July 2018, August 2018, and September 2018 are not normally distributed.

Based on the results of distribution test using KS test for earthquake data in 2018, July 2018, August 2018, and September 2018 with the criteria of magnitude $> 3$ and depth $\leq 50$ km obtained, among others: distribution types based on earthquake longitude data in 2018, August 2018, and September 2018 followed the GEV distribution while the longitude data for July 2018 followed the Lognormal distribution; the type of distribution based on earthquake latitude data in 2018, July 2018, August 2018 follows the GEV distribution while the earthquake latitude data in September 2018 follows the Logistics distribution; the type of distribution based on earthquake depth data for 2018, July 2018, and August 2018 does not follow one of the distributions while the earthquake depth data for September 2018 follows the GEV distribution; and distribution types based on earthquake magnitude data for 2018, July 2018, and September 2018 follow the GEV distribution while magnitude data for August 2018 follows the Burr distribution. This research can be continued by grouping earthquake events in regency areas in Province of NTB using the K-Mean cluster concept. Then proceed with determining the distribution type of each earthquake data of cluster as a result of grouping.

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