ANALYSIS OF MAXIMUM DAILY RAINFALL DISTRIBUTIONS AT SELECTED RAIN GAUGING STATIONS IN KARANGANYAR REGION

Presented in accordance with the requirements
For the degree of Bachelor of Civil Engineering

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ANALYSIS OF MAXIMUM DAILY RAINFALL DISTRIBUTION AT SELECTED RAIN STATIONS IN KARANGANYAR REGION

Abstrak

Peningkatan dan perubahan pola hujan menyebabkan studi tentang curah hujan maksimum pada basis harian. Tujuannya adalah untuk menemukan distribusi pas dan untuk memeriksa kebaikan, waktu yang ideal untuk menghitung informasi dari stasiun adalah pukul 9 pagi, masa studi 1990-2016 studi ini termasuk lima lokasi di wilayah Karanganyar stasiun (1) Jumantono 125c (2) Polokarto 110c (3) Mojolaban 128d (4) kerjo 41 (5) Matesih 125. Hasilnya telah dihitung dengan menggunakan program Aprob_4.1 dari http://istiarto.staff.ugm.ac. id / # itu dibuat oleh Departemen Teknik Sipil dan Lingkungan Fakultas Teknik UGM dan histogram data curah hujan telah dibuat oleh MATLAP. Hasil studi jumantono station (data log rata-rata: 1,9957, standar deviasi: 0,0931, log kurtosis: 3,6, skewne: -0,37, kepercayaan 90%, hasil uji chi-square adalah log normal & log pearson III, hasil tes samirnov-kolmogrov adalah log person III) stasiun Bendosari (data log rata-rata: 2,0281, deviasi standar: 0,0874, log kurtosis: 3,53, skewne: -0,17, kepercayaan 90%, hasil tes chi-square adalah Gumbel, hasil tes samirnov-kolmogrov adalah log orang III) Mojolaban station (data log rata-rata: 1,898, deviasi standar: 0,1567, log kurtosis: 4,13, skewne: -0,13, kepercayaan adalah 90%, hasil tes chi-square adalah Gumbel, hasil tes samirnov-kolmogrov normal) Stasiun Jumantono (data log rata-rata: 1.9618, deviasi standar: 0.1244, log kurtosis: 3.73, skewne: -0.82, kepercayaan adalah 90%, hasil tes chi-square adalah log normal

Kata kunci: friksi samping, mean, standar deviasi, distribusi pas

Abstract

The increase and the change of rain pattern led to the study of the maximum rainfall on a daily bases. The objective is to find the fitting distribution and to check the goodness, the ideal time to calculate the information from the stations is at 9:00 am, the study period 1990-2016 the study include five location in the region of Karanganyar the stations (1) Jumantono 125c (2) Polokarto 110c(3) Mojolaban 128d (4) kerjo 41 (5) Matesih 125. The results has been calculated by using Aprob_4.1 the program from http://istiarto.staff.ugm.ac.id/# it is created by Department of Civil Engineering and Environment Faculty of Engineering UGM and the histogram of the rainfall data has been created by MATLAP. The result of the study jumantono station (the mean log data: 1.9957, the standard deviation: 0.0931, the log of kurtosis: 3.6, the skewnees: -0.37, the confidence is 90%, the chi-square test results are log normal & log pearson III, samirnov-kolmogrov test result is log person III) Bendosari station (the mean log data: 2.0281, the standard deviation: 0.0874, the log of kurtosis: 3.53, the skewnees: -0.17, the confidence is 90%, the chi-square test results is Gumbel, samirnov-kolmogrov test result is log person III) Mojolaban station (the mean log data: 1.898, the standard deviation: 0.1567, the log of kurtosis: 4.13, the skewnees: -0.13, the confidence is 90%, the chi-square test results is Gumbel, samirnov-kolmogrov test result is normal) Jumantono station (the mean log data: 1.9618, the standard deviation: 0.1244, the log of kurtosis: 3.73, the skewnees: -0.82, the confidence is 90%, the chi-square test results are log normal & log pearson III, samirnov-kolmogrov test result is log

Keywords: side friction, mean, standard deviation, fitting distributi

1. INTRODUCTION

Analysis of rain fall data strongly depends on its distribution pattern. It has long been a topic of interest in the fields of meteorology in establishing a probability distribution that provides a good fit to daily rainfall. Several of the studies has been conducted in Indonesia and all around the world on this topic and finding the fitting distribution function such as normal, log normal, log person type III and gumbel distribution were identified. The purpose if this study is not so much to investigate the properties of rainfall, but instead to be able produce artificially generated rainfall sequence that can be used as input in other models to explore the behaviour of hydraulic system. The study of rainfall distribution is very important for civil engineering for design and construction of certain project, such as dams and urban drainage systems, prevention of flood damage and the management of water resources, because they require knowledge of extreme events of high return periods of available records and could not be directly from the recorded data.

2. METHOD

The main purpose of this research is to find the fitting Distribution at selected rain station in Karanganyar region by using secondary data from 27 years continuous survey in karangnyar region, the data was analyzed by using Aprob_41E it's an application developed by the University of UGM it have multiple uses in the field of hydrology by inserting the data from the stations in the app, the will find the distribution and the goodness of the data it will only take few scanned, and by using matlab the normal distribution curve was found(bell curve)

2.1 Location

Karanganyar region is located in the South East of Central Java, Indonesia. Matagrtan to the east, Sragen region in the north, Wonogiri region Sukoharjo region in the South and Surakata and boyolali in the west. The average height 551 meters above sea level, karanganyar regency covers 77, 378, 6374 ha

Figure 1. Location of Research

2.2 Data collection

The data used in this research is primarily obtained from secondary data from five different stations from the region of Kranganyer, the study cover the time period from five 1990-2016, it's include the daily rainfall amount anything less than 5mm will consider as tress ideally the register at 9:00 am WIP.

A. Jumantonostation: owned by Cab Din Karanganyar the tool used in the stations is manual, the number is 125c.
B. Polokartostation: owned by Cab Din Sukoharjothe tool used in the stations are manual station numbers of the station 110c.
C. Mojolabanstation: owned by Cab Din Sukoharjo the tool used in the stations is manual station number is 128d.
D. Kerjo; owned by Cab Din Karanganyar the tool used in the stations are manual, the number is 41.
E. Matesihowned by Cab Din Karanganyar the tool used in the stations are manual, the number is 125.

3. ANALYSIS AND DISCUSSION

3.1 The Curve Bell Of The Stations

The bell curve is another name for the normal distribution curve that has certain characteristics, including the fact it's shaped like bell.

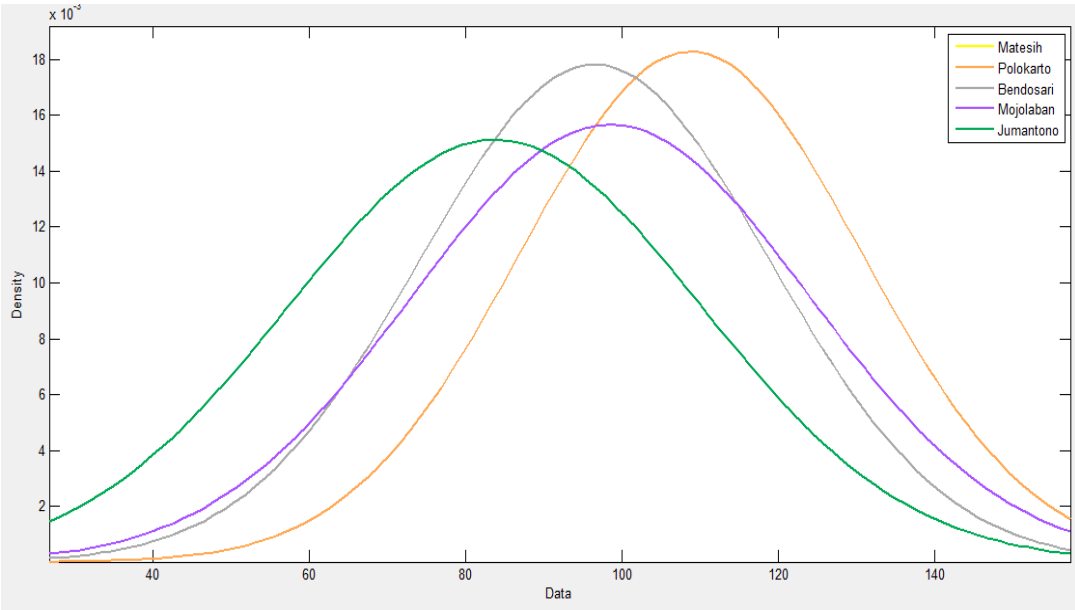

Figure 2. The bell curve

3.2 Fitting the probability distribution

All the data has been extract using Analysis Frequency Data Hydrology (AProb_4.1) the English version, by inserting the maximum daily rainfall from each year.

- Daily rainfall is normally measured each day at 9 am local time
- Very few stations have a complete unbroken record of the climate information
- If the data recorded is less than 5 mm it is consider as a trace.

It's rare to find continues data for long period of time, and this problem has been solved in this study, by using Distance Power Method (Reciprocal method). Some data has been restored to make sure all data pass the tests and the best distributions have been fined. To solve this problem we can use

- Normal Ratio Method
- The Method of Data Interpolation

3.3 Testing the goodness of fit and identifying the best fitted probability distribution

The goodness of fit of a statistical model describes how well it fits a set of observations. Measures of goodness of fit typically summarize the discrepancy between observed values and the values expected under the model in question.

A. Alpha

Is the significant level which mean that likely hood of getting more is extreme Data is less or equal to α.

B. Smirnov-Kolmogorov

In statistics, the Kolmogorov–Smirnov test (K–S test or KS test) is a nonparametric test of the equality of continuous, one-dimensional probability distributions that can be used to compare a sample with a reference probability distribution (one-sample K–S test).

Table.1. Smirnov-Kolmogorov

stations	G umbel	log normal	Log Pearson iii	Normal
Polokarto	7.481-ok	6.963-ok	6.963-ok	5.926-fail
Bendosari	5.407-ok	6.444-ok	6.444-ok	9.556-ok
Mojolaban	4.370-ok	5.407-ok	5.407-ok	5.926-ok
Jumantono	12.148-fail	5.407-ok	5.407-ok	5.926-fail
Matesih	7.481-ok	5.926-ok	5.926-ok	13.185-fail

C. Chi-square

A chi-squared test, also written as $\chi 2$ test, is any statistical hypothesis test where the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. The chi-squared test is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories.

Table.2 Chi-square

stations	G umbel	log normal	Log Pearson iii	Normal
Polokarto	0.126-ok	0.116-ok	0.112-ok	0.125-ok
Bendosari	0.133-ok	0.122-ok	0.114-ok	0.128-ok
Mojolaban	0.112-ok	0.132-ok	0.084-ok	0.067-ok
Jumantono	0.144-ok	0.112-ok	0.075-ok	0.085-ok
Matesih	0.134-ok	0.153-ok	0.099-ok	0.200-ok

3.4 Return period (expected frequency)

A return period, also known as a recurrence interval (sometimes repeat interval) is an estimate of the likelihood of an event, such as an earthquake, flood, landslide, or a river discharge flow to occur.

It is a statistical measurement typically based on historic data denoting the average recurrence interval over an extended period of time, and is usually used for risk analysis (e.g. to decide whether a project should be allowed to go forward in a zone of a certain risk, or to design structures to withstand an event with a certain return period). The following analysis assumes that the probability of the event occurring does not vary over time and is independent of past events.

Table.3 Rainfall return period

Return period	Jumantono station				Matesih station			
	Gumbel	log normal	Pearson iii	Normal	Gumbel	log normal	Pearson iii	Normal
2	91	92	95	95	104	104	97	112
5	113	117	117	116	113	117	117	116
10	127	147	136	136	127	132	128	127
20	141	165	145	146	141	147	136	136
50	159	165	145	146	159	165	145	146
100	173	178	150	153	173	178	150	153

Table.4 Rainfall return period

Return period	Polokarto station				Bendosari station			
	Gumbel	log normal	Pearson iii	Normal	Gumbel	log normal	Pearson iii	Normal
2	98	99	100	101	105	107	107	109
5	116	119	119	119	124	126	127	127
10	129	130	129	128	137	138	138	137
20	141	141	138	136	149	149	147	145
50	156	154	147	145	165	161	158	154
100	168	163	154	151	177	170	166	160

Table.5 Rainfall return period

Return period	Mojolaban station			
	Gumbel	log normal	Pearson iii	Normal
2	79	79	84	84
5	103	117	117	116
10	127	132	128	127
20	141	147	136	136
50	159	165	145	146
100	173	178	150	153

4. CONCLUSION

- It's rare to find continues data for long period of time, and this problem has been solved in this study, by using Distance Power Method (Reciprocal method). Some data has been restored to make sure all data pass the tests and the best distributions have been fined.
- The standard deviations in stations were less than the means in each station which conclude that most data are clustered closely around the mean (more reliable).
- The skewness of data were Negative in most cases which mean that more data was on the right side of the bill curve due to the fact that some years were very dry, except the last station (Matesih) this station had positive skewness due to the fact that many years were highly outstanding numbers.
- The fitting distribution past on Smirnov-Kolmogorov is log pearson III for Polokarto station, Mojolaban Station, had a normal distribution as the most fitting which is very rare to happen, Bendosari station , Matesih Station and Jumantono station fitting distributions are log pearson III.
- The fitting distributions based on Chi-square test, the best fit distribution probability for the stations Polokarto station, Jumantono station and Matesih Station is log peaeson tybe III. But for the fitting distribution for the fitting distribution Mojolaban station and bendosari station is Gumbel

RECOMMENDATION

- The tools need to be improved for more technologically advance, because many days no one went to check the amount of rain because the new machinery clean and send the data to the base automatically

- For survey location, it will be improved if the location has more stations.

- For survey location another study need to be conducted with longer data and more continues data.

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