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Analysis of Annual Peak Flood Discharge Data by Log Pearson Type III Distribution of the River Krishnai of Assam

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Abstract

The Krishnai river originated from Garo Hills of Meghalaya at an elevation of about 280 meter above mean sea level. The catchment area of this river lying between 25° 35′ to 26° 2′ north latitude and 90° 20′ to 90° 45′ east longitude is in Garo hills of Meghalaya in the north slope of the state adjoining Assam. This paper basically offers an attempt to study the annual peak flood discharge data of the Krishnai river at Velterghat gauging station by Log Pearson Type III distribution model. 46 years annual peak discharge data are collected right from 1972 to 2018 from Goalpara Investigation Division (Irrigation), Goalpara .The row data are collected in m^3/sec and the data are arranged in descending order and ranked. The return period of the peak discharge of the Krishnai river at Velterghat gauging station are calculated using Weibull method and exceedance probability is calculated from the return periods. Finally the likely annual peak discharge values are estimated using Log Pearson Type III distribution at Velterghat gauging station of the Krishnai river. The analysis and results are helpful when the policy maker wants to design flood in or near the Krishnai river.

Keywords: Flood, Log Pearson Type III distribution, discharge

1. Introduction

Krishnai River is a South bank tributary of the river Brahmaputra. It is originated from Garo Hills of Meghalaya at an elevation of about 280 meter above mean sea level and connected to Dudhnoi River at Tomuni about 12 km north from Dudhnoi town at an elevation about 150 meter above mean sea and finally follows towards the River Brahmaputra. The catchment area lying between 25° 35′ to 26° 2′ north latitude and 90° 20′ to 90° 45′ east longitude is in Garo hills of Meghalaya in the north slope of the state adjoining Assam.

1.2Data collection

The annual peak discharge flow data in m^3/s is collected from 1972 to 2018 from Goalpara Investigation Division (Irrigation), Goalpara. Here the annual peak flood flow data are assumed to be independent of each other.

2. Methodology

2.1Log Pearson Type III Distribution

In hydrology, the probability of exceedence, is the probability that a flow is greater than, or equal to a particular value. The relative frequency is the probability of the flow being less t han a particular value. The return period is termed for the average recurrence interval as giver below.

If P(X),F(X) and T(X) are the exceedence probability(Ep), relative frequency and average recurrence interval then P(X)= 1-F(X) and $T(X)=\frac{1}{P(X)}$=1/{1-F(X)}

Here Weibull's method is used to calculate the return period. In this method, the annual peak discharge series is ranked in order of magnitude and the return period is calculated as T(x) =Tr= (n+1)/m;

Where m is the rank of an individual flood event X

within the data series and n is the size of the series. To calculate the above mentioned parameters and peak discharge the following methods are used.
The general equation to calculate the Log-Pearson TypeIII distribution is given by
LogX= $\overline{logX}$ +kσlog_X ; implies the peak discharge can be calculated as
Peak Discharge = Antilog ($\overline{logX}$ +kσlog_X);

Where x is discharge values at the gauging station with some specified probability.
$\overline{logX}$ and σ are the arithmetic mean and standard deviation of logX series respectively.
K is the frequency factors are the functions of skew coefficient and return period and its corresponding values can be found in the frequency factor table.[1-5]

3. Results and Discussion

Table1.The following table shows the calculation for Mean, Variance, SD, Return period and Exceedence Probability.

LogX	Return Period Tr =(n+1)/m	Ep.(1/Tr)
2.9686556	47	0.021276596
2.92116084	23.5	0.042553191
2.9209577	15.666	0.063829787
2.8598585	11.75	0.085106383
2.8435504	9.4	0.106382979
2.8103602	7.8333	0.127659574
2.8074064	6.7142	0.14893617
2.7941672	5.875	0.170212766
2.7857568	5.2222	0.191489362
2.7755594	4.7	0.212765957
2.7543330	4.2727	0.234042553
2.7480484	3.9166	0.255319149
2.7433529	3.6153	0.276595745
2.7152510	3.3571	0.29787234
2.6668267	3.1333	0.319148936
2.6609318	2.9375	0.340425532
2.6227630	2.76470	0.361702128
2.5951654	2.61111	0.382978723
2.5759149	2.47368	0.404255319
2.5755111	2.35	0.425531915
2.5384983	2.23809	0.446808511
2.5382720	2.13636	0.468085106
2.5304686	2.04347	0.489361702
2.524525	1.95833	0.510638298
2.481342	1.88	0.531914894
2.472419	1.80769	0.553191489
2.4552408	1.74074	0.574468085
2.454738	1.67857	0.595744681
2.422245	1.62068	0.617021277
2.3931363	1.56666	0.638297872
2.3600250	1.51612	0.659574468
2.3464703	1.46875	0.680851064
2.3463920	1.42424	0.70212766
2.3192518	1.38235	0.723404255
2.3099493	1.34285	0.744680851
2.3050932	1.30555	0.765957447
2.2988094	1.27027	0.787234043
2.2964677	1.23684	0.808510638
2.2814197	1.20512	0.829787234
2.2716325	1.175	0.85106383
2.2219877	1.14634	0.872340426
2.19926138	1.11904	0.893617021
2.17785380	1.09302	0.914893617
2.17666993	1.06818	0.936170213
2.11106078	1.04444	0.957446809
2.05491932	1.02173	0.978723404
Average ($\overline{logX}$)=2. 522471		

Variance=[∑(LogX-Ave(logX))^2]/(n-1)
=2.66245105/(46-1)=.05916558and SD=0.24323976
Skew coefficient(C)= {n* ∑ (LogX-Ave(LogX))^3}/{(n-1)*(n-2)* (LogX-Ave(LogX))^3}
=0.1 (approximately)

Table2.Estimation of Peak Discharge by Log- Pearson Type III Distribution

T	Ep	C	K	$Q=10^\wedge X_T$
2	0.5		-0.017	329.87
5	0.2		0.836	531.89
10	0.1		1.292	686.65
25	0.04	.1	1.785	905.01
50	0.02		2.107	1083.87
100	0.01		2.4	1277.16
200	0.005		2.67	1485.67

Projecting the annual peak discharge of variable return period by Log-Pearson flood frequency analysis method:
The annual peak discharge of a river is very uncertain and random process with respect to monsoon flood, monsoon rainfall and not an easy task to predict the exact peak discharge of a certain return period for forecasting

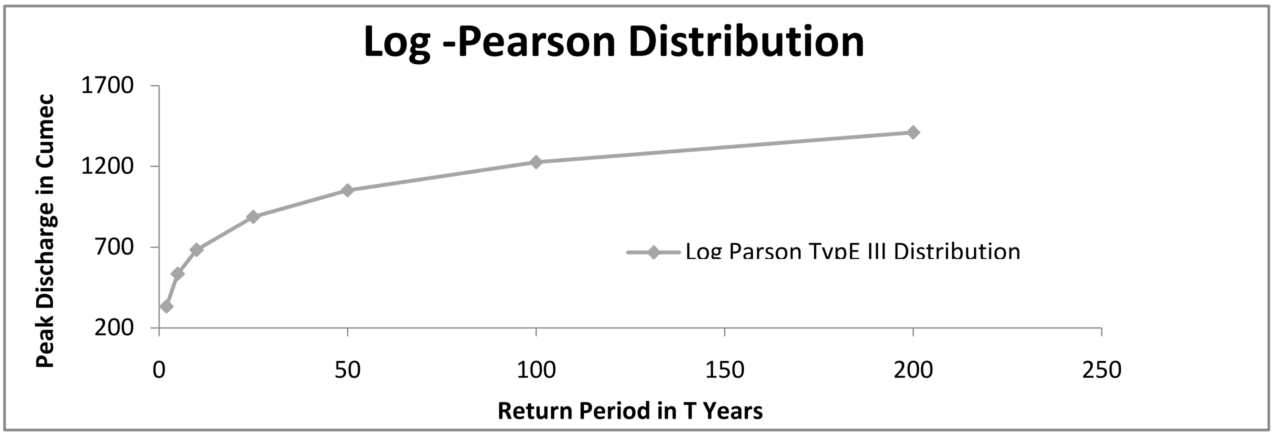

Fig.2 The graph of Return period and estimated peak discharge in c^3/sec is shown in the graph paper

Conclusions

The Log-Pearson Type- III distribution model gives the likely values of annual peak flood discharge corresponding to the return period at Velterghat gauging station of the Krishnai river. It is helpful when the policy maker wants to design flood in the river or the near the river of the flood affected area.

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