II-39 Development of Relationship Between Runoff Parameters and Catchment Characteristics in Northern Part of Pakistan

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1.Introduction

Regression analysis provides a powerful tool for analysing hydrological data for modeling purposes. The present study deals with maximum mean daily discharge ,Qp, and lag time ,Lt, which is defined as the time difference between centre mass of rainfall and centre mass of hydrograph, interms of catchment characteristics such as total rainfall ,R, area ,A, length of main river ,L, and average slope ,S. Fifteen catchments (see Table.1) were selected with nearly the same climatological and hydrological conditions in northern part of Pakistan. An approch called "index" (index=total rainfall*area) was used to classify the observations in three parts(index>1000, 1000<index<4200 and index>4200) to achieve better results. However, it was observed that each catchment was situated with one climatological station and in some cases the stations were not located properly inside the catchment. Besides, during rainy season (June to September) catchments were effected with high amount of snow melt simultaneously. And even by separating the base flow the effect of snow melt was not neglected properly. Therefore, it was quite difficult to fit a model specially in case of lag time. Generally, the best models were selected on the bases of highest coefficient of determination r^2, and least residual ,ei.

2.Basic Equations and Models Descriptions

The fundamental multiple regression equation is express as: $\hat{Y}$ =B0+B1X1+B2X2+B3X3+.........
where $\hat{Y}$ is dependent or estimated variable, X1,X2,X3, are independent variables, B0 is constant or intercept, B1,B2,B3, are regression coefficients. The coefficient of determination r^2, and residual ,ei, can be express as

$$r^2=(Yi-\bar{Y})/(Yi-\bar{Y}) \quad \text{and} \quad ei=Yi-\hat{Y}i$$

where Yi is observed value, $\bar{Y}$ is mean of observed values and ei is residual. The range of r^2, is between zero to one. Therefore, the best fitted model shows r^2, near to one and Σ ei near to zero.

3.Data Analysis

Through the data analysis of observations following results were achieved.

for index upto 1000 (inch-sq.miles):

Ln(Qp)=0.204*R+1.22*Ln(A) r^2= 0.98

Lt=-0.044*Ln(R)+0.48*Ln(A)-0.48*Ln(L) r^2= 0.59

for index 1000 upto 4200 (inch-sq.miles):

Ln(Qp)=0.50*Ln(R)+1.20*Ln(A) r^2= 0.99

Lt=0.104*R+0.0001*A+16.08*S r^2= 0.82

for index above 4200 (inch-sq.miles):

Ln(Qp)=0.292*R+1.70*Ln(L) r^2= 0.99

Lt=-0.002*R+0.731*Ln(A)-0.975*Ln(L)-0.21*Ln(S) r^2= 0.73

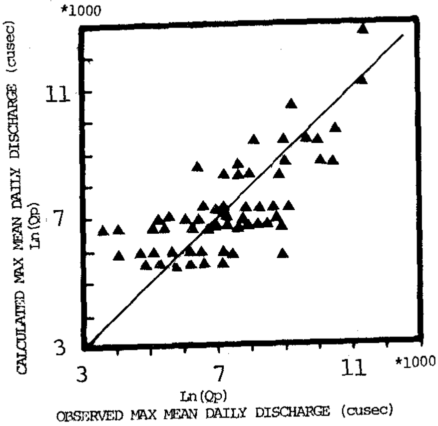
4.Conclusion

Max mean daily discharge models shows higher coefficient of determination as compare to lag time. Therefore,

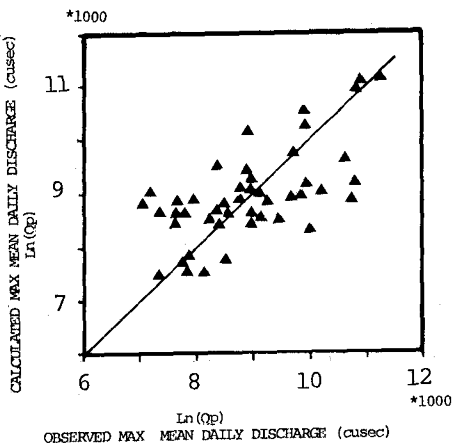
TABLE 1.

List of Catchments and Rivers For the Present Study Based on Hydrological Homegeneous Catchments.

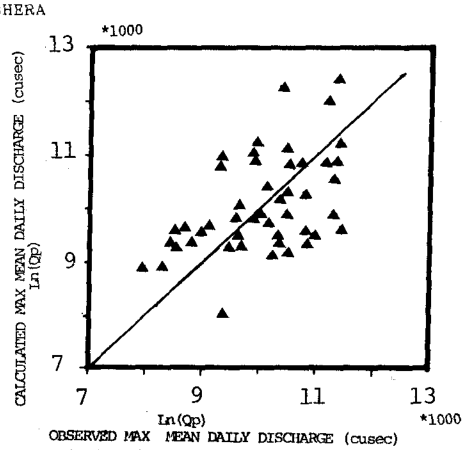
Serial No.	Name of Cathchments:	Elevation (Meters)	River	Area (Sq.Km)	Length of River(Km)	Average Slope
(1)	KUNHAR RIVER AT GAHRI HABIBULAH	2573.0	KUNHAR	2382.80	77.23	0.05624
(2)	KUNHAR RIVER AT NARAN	3693.0	KUNHAR	1036.0	60.0	0.04425
(3)	JHELUM RIVER AT KOHALA	-	JHELUM	24889.90	402.2	0.04018
(4)	JHELUM RIVER AT CHINARI	2499.0	JHELUM	13597.50	342.76	0.02607
(5)	KISHANGANGA RIVER AT MUZAFFAR ABAD	3170.0	KISHAN GANGA	7277.90	304.10	0.05191
(6)	HARO RIVER AT GARIALA	649.0	HARO	3056.20	188.66	0.03307
(7)	HARO RIVER NEAR KHANPUR	576.0	HARO	777.0	84.71	0.03375
(8)	SWAT RIVER AT CHAKDARA	2032.0	SWAT	5775.70	231.3	0.05541
(9)	GORBAND RIVER NEAR SHAHPUR	2241.0	GORBAND	652.68	34.75	0.03938
(10)	WADALA KASS AT PAPIN	-	SOAN	634.55	68.56	0.00448
(11)	POONCH RIVER AT KOTLI	1995.0	POONCH	3237.50	195.50	0.02097
(12)	SIL RIVER AT CHAHAN	476.0	SIL	240.87	43.44	0.00321
(13)	SOAN RIVER AT CHIHRAH	1231.0	SOAN	326.34	52.13	0.04545
(14)	BRANDU RIVER NEAR DAGGAR	1177.0	BRANDU	598.29	60.82	0.04051
(15)	KABUL RIVER AT NOWSHERA	-	KABUL	88578.0	1013.67	0.02481



Relationship Between OBS & CAL Max Mean Daily Discharge for Index upto 1000



Relationship Between OBS & CAL Max Mean Discharge for Index 1000 upto 4200



Relationship Between OBS & CAL Max Mean Discharge for Index Above 4200

max mean daily discharge is much more reliable parameter for modeling purpose as compare to lag time. However, in case of maximum mean daily discharge, index upto 1000 was found the most suitable range for modeling purpose. And in case of lag time, index 1000 upto 4200 was the most suitable range.

***Comment:** Due to small space of paper, I was not able to show the lag time graphs.

5.References

1.Haan,c.T: Statistical Method in Hydrology.,pp.180-221,1973
2.Acreman,M.C:Predicting the Mean Annual Flood from Basin Characteristics in Scotland., J.Hyd, Vol.30, No.1,pp.37-49,1985
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