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Prediction of Daily Discharge with Statistica Software

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Abstract. In spite of the increasing process of water problems and its increasing demand, water supplies successful management needs systematic and comprehensive approaches to provide consumers' needs. In this regard, using new methods of water supplies modeling enjoys a special significance. In this study, statistica software was used to predict the daily discharge of Gharasoo River in Golestan province in Iran. In order to predict the daily discharge, statistical data of four hydrometric and udometry stations of basin was given to the software. Results indicated that statistica software predicted the daily discharge well.

Keywords: water supplies management, discharge prediction, statistica software, Gharasoo River.

1. Introduction

One of the important issues in water supplies management is the correct distinction of discharge instantly, in a long and short time as well as the prediction of discharge in the future in order to manage the consumption based on such a prediction. Due to the complexity of the methods like artificial intelligence (ANN), simpler methods with much more efficiency can be used in some initial studies. In this study, statistica software was used for the first time in order to predict the daily discharge.

2. Method

Area and data

The basin of Gharasoo River is located in Golestan province in the north of Iran. The limitation of this basin is (54) to (54.45) Eastern longitude and (36.36) to (36.59) northern width. The area of this basin Gharasoo River is 1678.1 km. the maximum height of the basin and river length is 3200 m and 108.005 km respectively. Figure 1 shows the natural map and basin condition of Gharasoo River.

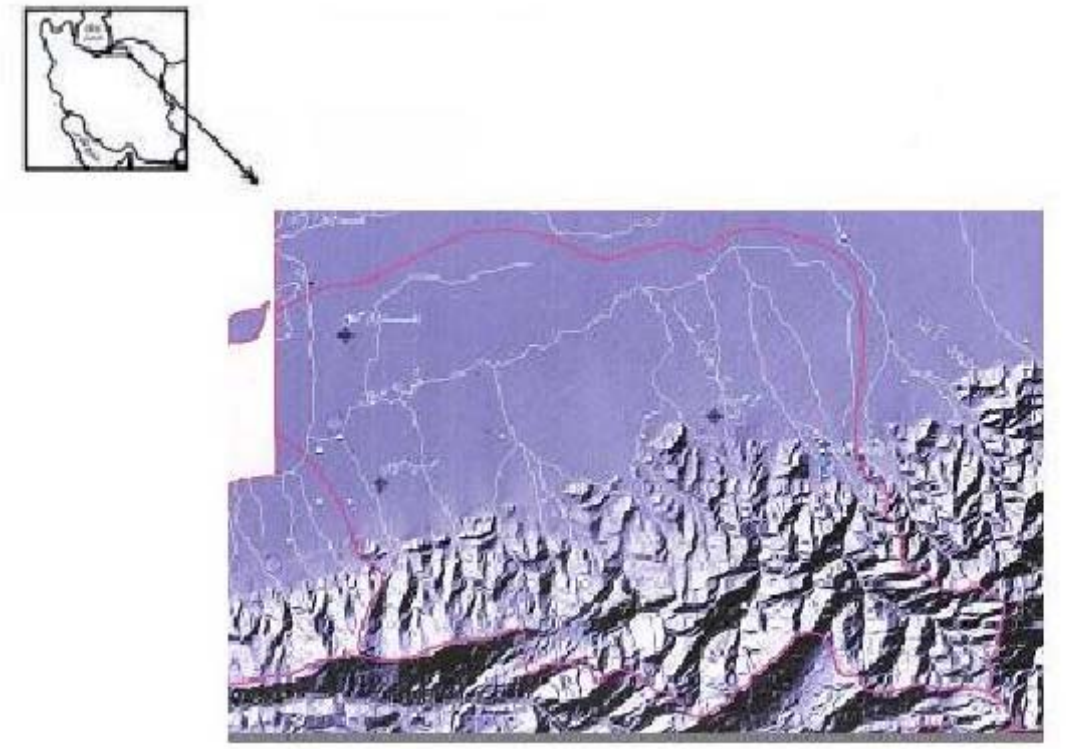

Figure 1: Natural map and basin condition of Gharasoo River

Gharesou station is located in the outlet of the basin. In addition to Gharasoo station, Ziarat, Shastkalateh and Kordkooy hydrometric stations were used in this study.

Table1: Properties of Qaresoo basin stations

	Code	ɔcation	River	gitudinal	atitude
estan-26	2-050	ıaresou	ıaresou	4 03 00	5 50 00
estan-26	2-043	arkhoran	Ziarat	4 28 00	5 46 00
estan-26	2-045	stkalateh	stkalateh	4 20 00	5 45 00
estan-26	2-049	ɭlejadeh	ɔrdkooy	4 05 00	5 47 00

Effective parameters in Gharasoo River discharge
The following parameters were effective in Gharasoo River discharge.
The mean of daily discharge in Gharasoo station
The mean of daily discharge in Naharkhoran station
The mean of daily discharge in Polejadeh station
The mean of daily rainfall in Naharkhoran station
The mean of daily rainfall in Shastkalateh station
The mean of daily rainfall in Polejadeh station
The mean of daily rainfall in Gharasoo station

In statistica software, the following five internal patterns were used:

$$Q(t) = f\{P_g(t), P_n(t), P_{sh}(t), P_p(t), P_g(t-1), P_n(t-1), P_{sh}(t-1), P_p(t-1), Q_n(t), Q_n(t-1), Q_p(t), Q(t-1), Q(t-1), Q(t-2)\} \quad (1)$$

$$Q(t) = f\{Q_n(t), Q_n(t-1), Q_p(t), Q(t-1), Q(t-1), Q(t-2)\} \quad (2)$$

$$Q(t) = f\{P_g(t), P_n(t), P_{sh}(t), P_p(t), P_g(t-1), P_n(t-1), P_{sh}(t-1), P_p(t-1), Q(t-1), Q(t-2)\} \quad (3)$$

$$Q(t) = f\{Q(t-1), Q(t-2)\} \quad (4)$$

$$Q(t) = f\{P_g(t), P_n(t), P_{sh}(t), P_p(t), P_g(t-1), P_n(t-1), P_{sh}(t-1), P_p(t-1)\} \quad (5)$$

In the above equations:

Q: The mean of daily discharge in Gharasoo station

Q_n: The mean of daily discharge in Naharkhoran station

Q_{p1} The mean of daily discharge in Polejaddeh station

P_{n1} The mean of daily rainfall in Naharkhoran station

P_{sh1} The mean of daily rainfall in Shastkalateh station

P_{p1} The mean of daily rainfall in Polejaddeh station

P_{g1} The mean of daily rainfall in Gharasoo stationinternall

In the next part, sensitivity analysis of each internal parameter was studied. The important aims of sensitivity analysis are as follows:

1Observation and analysis of model output changes in comparison with input parameters changes

2 Evaluation of input data proportion in comparison with output results

Table 2: Sensitivity analysis results

	Input	pattern	Second pattern	Third attern	pattern	attern
Input Parameters Sensitivity	Rainfall of Gharaso	0.223	--	0.456	--	0.493
	One-day later Rainfall of Gharaso	0.021	--	0.028	--	0.1
	Rainfall of Naharkhora	0.009	--	0.021	--	0.035
	e-day later Rainfall of Naharkhora	0.012	--	0.027	--	0.08
	Rainfall of Shastkalate	0.007	--	0.007	--	0.056
	ıe-day later Rainfall of Shastkalate	0.038	--	0.074	--	0.04
	Rainfall of Polejadde	0.032	--	0.012	--	0.041
	)ne-day later Rainfall of Polejadde	0.041	--	0.024	--	0.07
	Discharge of Naharkhora	0.074	0.122	--	--	--
	day later Discharge of Naharkhora	0.120	0.058	--	--	--
	Discharge of Polejaddeh	0451	0.1091	---	---	
	y later Discharge of Polejaddeh	0741	0.1959	---	---	
	ay later Discharge of Gharasoo	.155	0.3266	.2049	5407	
	ay later Discharge of Gharasoo	1427	0.1872	.1379	4593	

Prediction of river discharge with statistica software

In this study, the outlet discharge was predicted with statistica software and the results of every pattern were compared with each other.

As it is shown in Table 3, the first pattern has the highest correlation coefficient.

Table 3: Results of statistica function with different patterns

Patterns	R2
First	0.8490
Second	0.8025
Third	0.8106
Forth	0.7925
Fifth	0.5425

Figure 2 and 3 shows the observed discharge and predicted discharge with statistica software. Figure 4 shows the results of both observed and predicted discharge. It shows that predicted maximum discharge is lower than observed discharge.

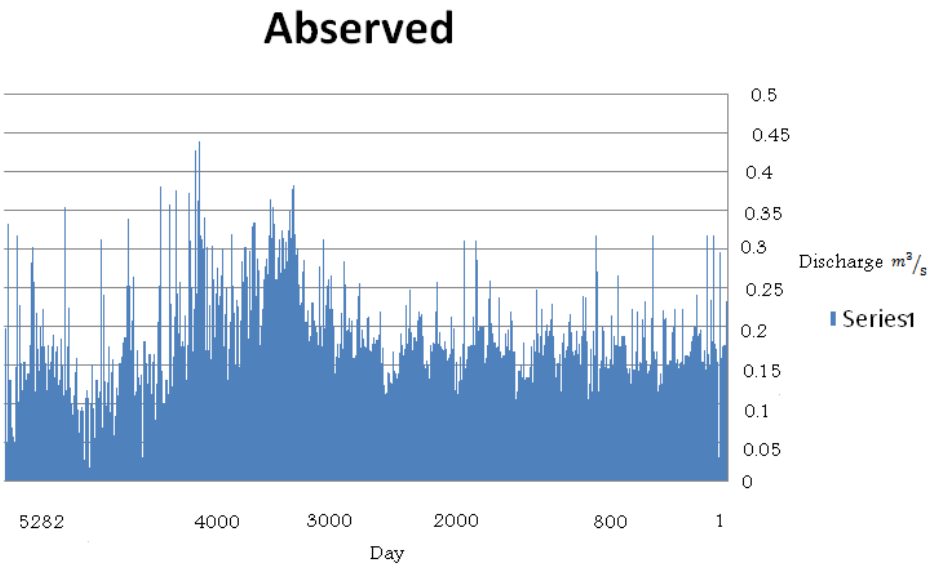

Figure 2: Daily discharge hydrograph of Gharasoo Station (Observed)

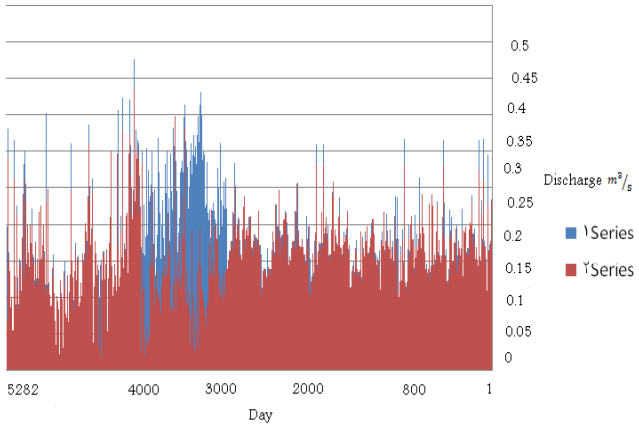

Figure 3: Daily discharge hydrograph of Gharasoo Station (Predicted)

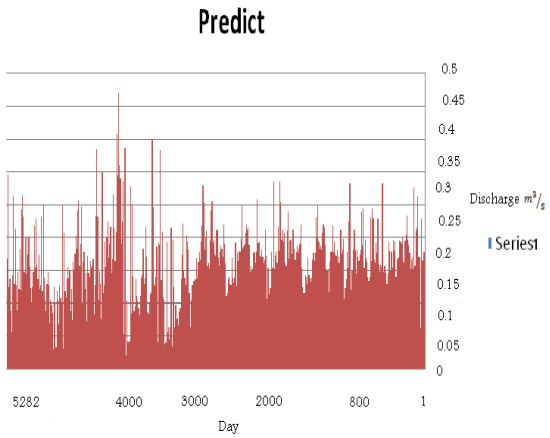

Figure 4: Daily discharge hydrograph of Gharasoo Station (Observed and Predicted)

3. Summary

In this study, five internal patterns were used in which two of them indicated useful results. The first pattern showed the minimum error in comparison with the other patterns.

1 In the prediction of river flow on, one-day later discharge, two-day later discharge and rainfall in the same day were played significant roles in model.

2 Since statistica software is not so complicated and it has suitable accuracy, it is recommended to be used in predicting daily discharge.

4. References

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