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ARMAX ARIMA

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Archive of SID

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- Rainfall-runoff
 - Deterministic
 - Theoretical
 - Black box
 - Autoregressive Integrated Moving Average
 - Autoregressive Moving Average Model with Exogenous Input

Data base

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ARMAX

SAC-SMA

Bayesian regularization algorithm

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ANFIS

ANFIS

ANFIS

ARX

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()

(ANFIS)

Archive of SID

ARMAX

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ARMA

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ANFIS)

ARIMA

Hsu

Sacramento soil moisture accounting

Mendez

Xallas

Aquil

Cilallawi

ARMAX ()

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$$y(t) + a_1 y(t-1) + \dots + a_{na} y(t-na) =$$

$$\sum_{i=1}^p b_{1,i} u_i(t-nk) + \dots + b_{nb,i} u_i(t-nk-nb+1) + e + c_{nc} e(t-1) + \dots + c_{nc} e(t-nc)$$

(ANFIS)

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ANFIS

$\mu_i(t)$, y_t ,

$b, c, e(t), i$

nk, nc, nb, Na .

a

y, x

ARMAX(na, nb, nc, nk)

z

$f_1 = p_1 x + q_1 y + r_1$ then A_1 and y is B_1
IF x is

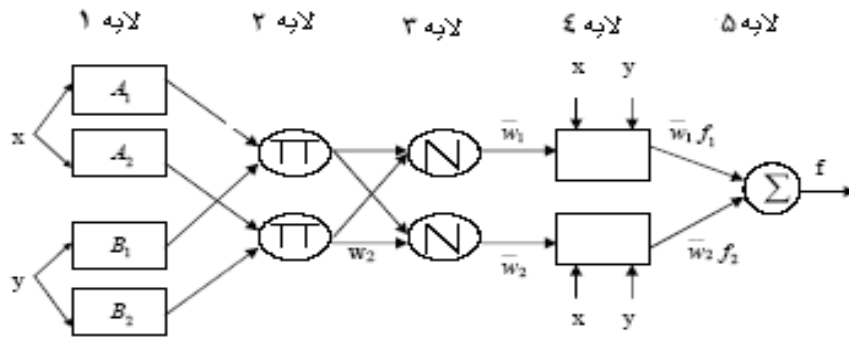
$f_2 = p_2 x + q_2 y + r_2$
IF x is A_2 and y is B_2 then

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ANFIS

ANFIS

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ANFIS

(...)

ANFIS

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$$y_{t+1} = \sum_{j=1}^k a_j f_{t,j} + \varepsilon_{t+1}$$

()

a_j, t i $f_{t,j}$ y_{t+1} ε_{t+1}
 ()

$$y = .8 * \frac{X_i - X_{\min}}{X_{\max} - X_{\min}} + .1 \quad ()$$

X_{\max}

X_{\min}

() () RMSE

()

ARMAX

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (Q_i^o - Q_i^c)^2} \quad ()$$

) MAE

$$MAE = \frac{1}{n} \sum_{i=1}^n [|Q_i^o - Q_i^c|] \quad ()$$

AARE

()

$$AARE = \frac{1}{N} \sum_{i=1}^n \left| \frac{(Q_i^o - Q_i^c)}{Q_i^o} * 100 \right| \quad ()$$

Q_i^c Q_i^o n

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Root mean square error

Mean absolute error

Average absolute relative error

MAE RMSE

AARE

ARMAX

()

() ()

() ()
() ()

ARMAX(7861)

AARE

() ()

MAE RMSE

	RMSE	MAE	AAR			
/	/	/	/	(,)		
/	/	/	/	(
/	/	/	/	(,)		ANFIS
/	/	/	/	(
/	/	/	/	(,)		ANFIS
/	/	/	/	(
/	/	/	/			ARX(721)
/	/	/	/			
/	/	/	/			
/	/	/	/			
/	/	/	/			

...

	RMSE	MAE	AAR			
/	/	/	/	()		
/	/	/	/			
/	/	/	/	,)		ANFIS
/	/	/	/			
/	/	/	/	()		ANFIS
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/	/	/	/	()		ARMAX7861
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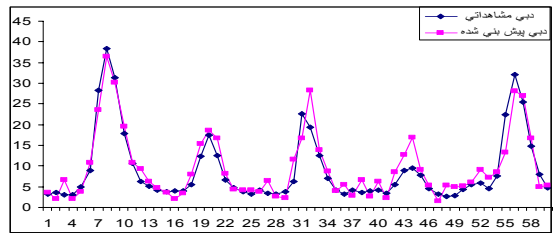
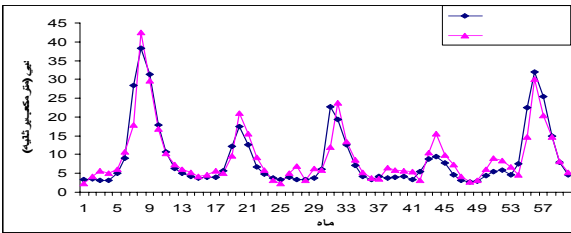
	RMSE	MAE	AARE			
/	/	/	/	,)		
/	/	/	/		(
/	/	/	/	,)		ANFIS
/	/	/	/		(
/	/	/	/)		ANFIS
/	/	/	/		(
/	/	/	/			ARMAX10851
/	/	/	/			
/	/	/	/			
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MAE	AARE	RMSE		
/	/	/	/	
/	/	/	/	ANFIS
/	/	/	/	ANFIS
/	/	/	/	ARX(721)
/	/	/	/	
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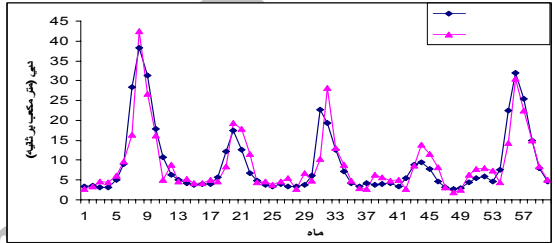
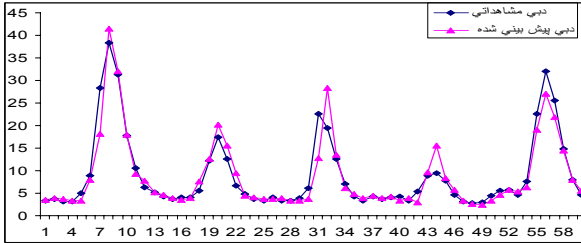
AARE	RMSE	MAE		
/	/	/	/	
/	/	/	/	ANFIS
/	/	/	/	ANFIS
/	/	/	/	ARMAX(7861)
/	/	/	/	
/	/	/	/	

AARE	RMSE	MAE		
/	/	/	/	
/	/	/	/	ANFIS
/	/	/	/	ANFIS
/	/	/	/	ARX(721)
/	/	/	/	
/	/	/	/	

AARE	RMSE	MAE		
/	/	/	/	
/	/	/	/	ANFIS
/	/	/	/	ANFIS
/	/	/	/	ARMAX(7861)
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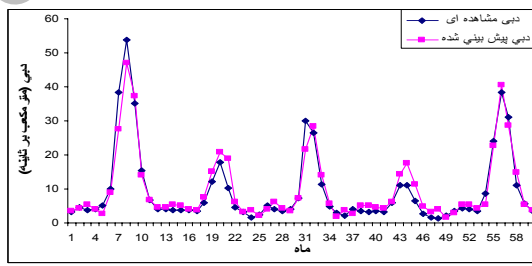
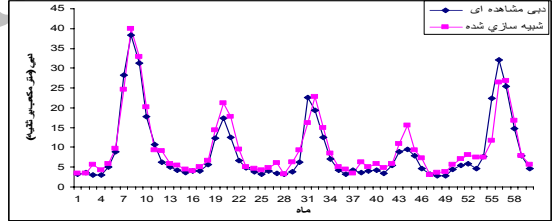
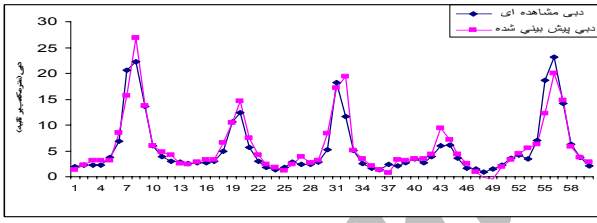


ARMAX7861



ANFIS

ANFIS



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SAC-SMA

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AARE RMSE ,MAE

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ARMAX ARX

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ARMAX

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Investigation on the efficiency of neuro-fuzzy method and statistical models in simulation of rainfall-runoff process

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Abstract

Rainfall-runoff is one of complex hydrological processes that is affected by a variety of physical and hydrological factors. In this study statistical method ARMAX model, neural network, neuro-fuzzy (ANFIS subtractive clustering and grid partition) and two hybrid models of this methods were used to simulate rainfall-runoff and prediction of streamflow. In each method optimum structure was determined then, streamflow forecasted using the best model. The results showed that hybrid methods have better application than single models and artificial intelligent has better application than linear ARMAX model due to nonlinearity of rainfall-runoff process. In this study all methods showed relatively suitable application but ANFIS method with subtractive clustering is suggested for modeling rainfall-runoff and streamflow prediction.

Keywords: Neural network, Rainfall-runoff processes, Neuro-Fuzzy, ANFIS, ARMAX method, Artificial Intelligent

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