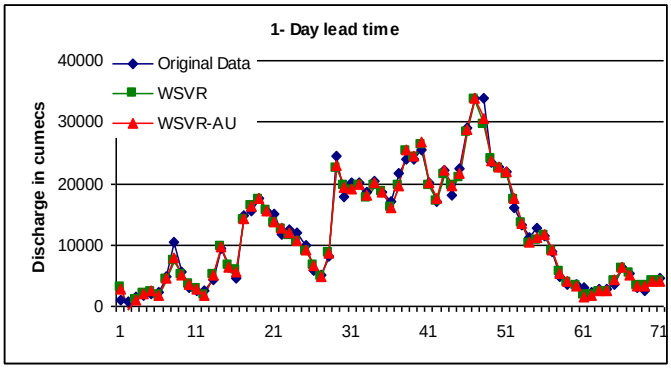
Support Vector Regression

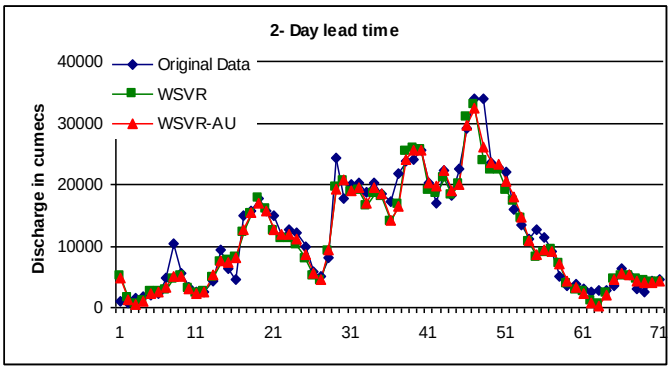
Performance indices for 1–5-day lead time forecasts for the **WSVR-AU and WSVR** models

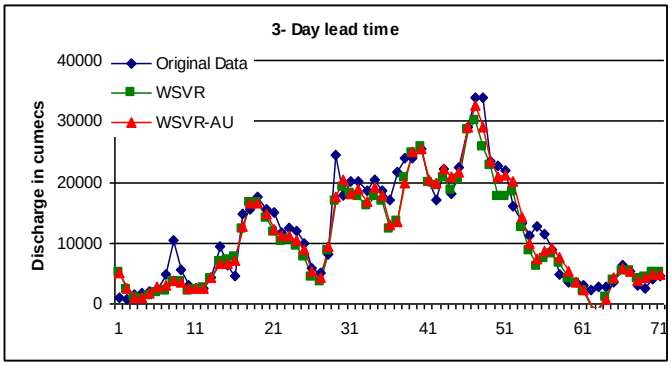
Naraj	RMSE (cumecs)			E		
Lead Time	WBANN	WSVR	WSVR-AU	WBANN	WSVR	WSVR-AU
1	**2247.9**	1081.9	952.3	**.93**	0.98	0.98
2	**2921.6**	2285.1	2028.4	**.89**	0.93	0.95
3	**3367.2**	2871.7	2426.9	**.85**	0.89	0.92
4	**4850.9**	3967.8	3105.6	**.69**	0.79	0.87
5	**4981.3**	5161.9	3671.4	**.68**	0.65	0.82

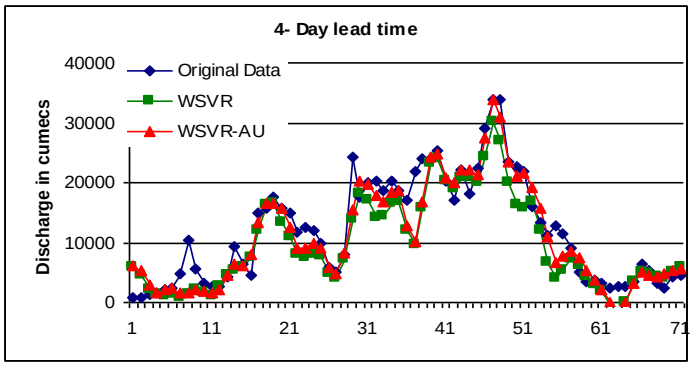
*WSVR= Wavelet based Support Vector Regression; WSVR-AU= Wavelet based Support Vector Regression with auto update

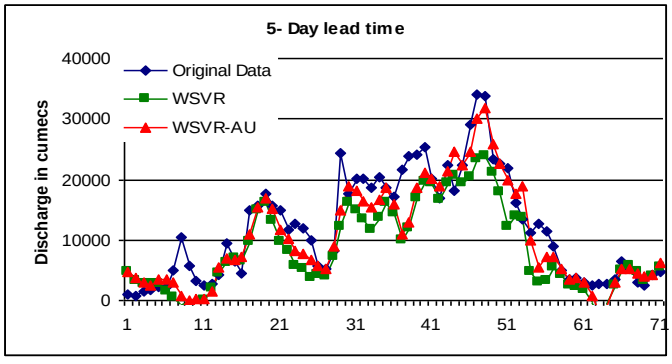
Hydrographs of observed and predicted discharge of testing dataset for Naraj using the **WSVR-AU and WSVR** models.



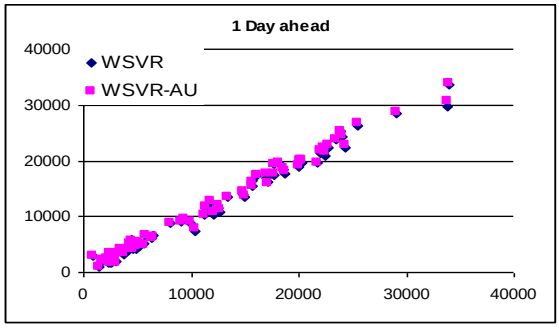


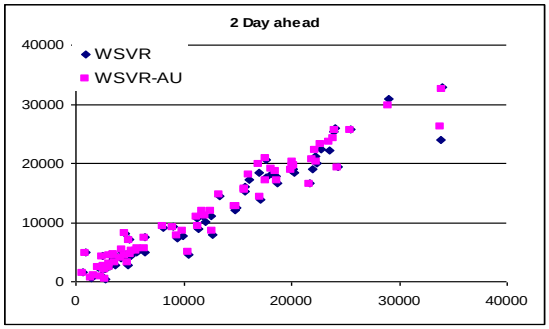


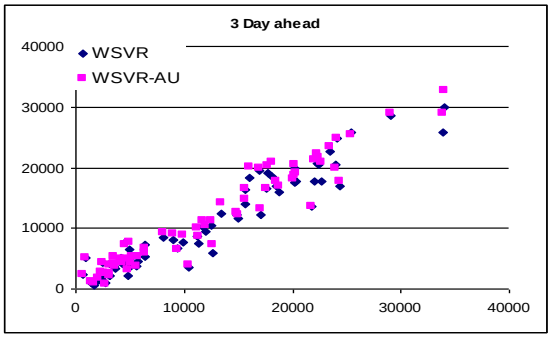


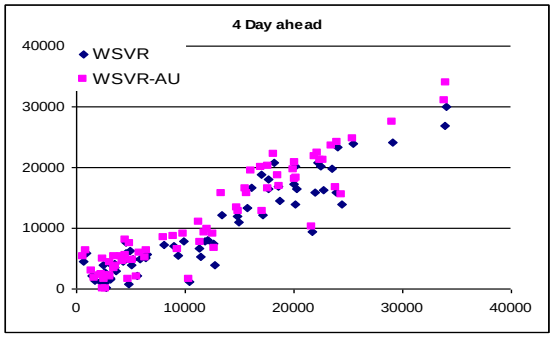


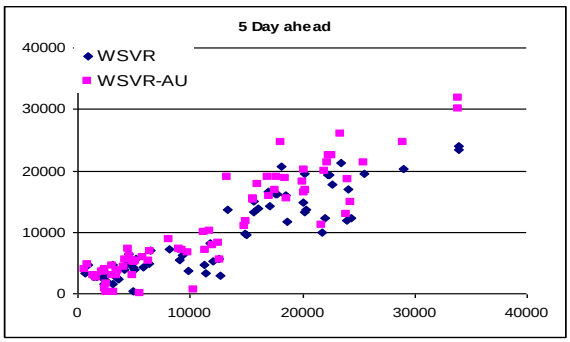
Scatter plots of observed and predicted discharge of testing dataset for Naraj using the **WSVR-AU and WSVR** models.







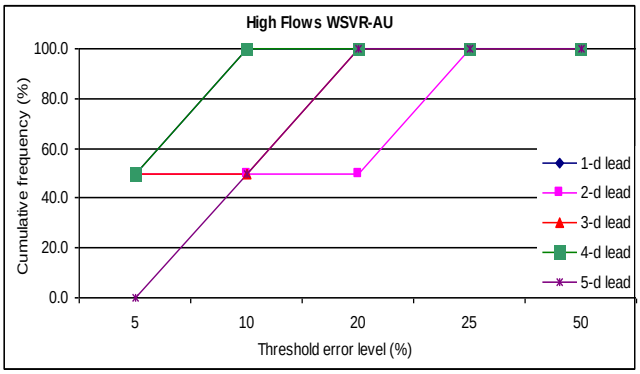


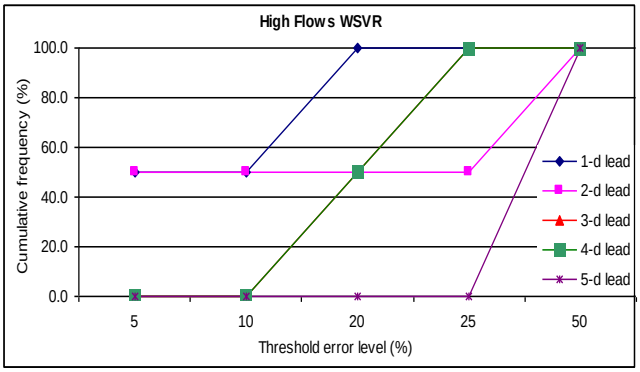


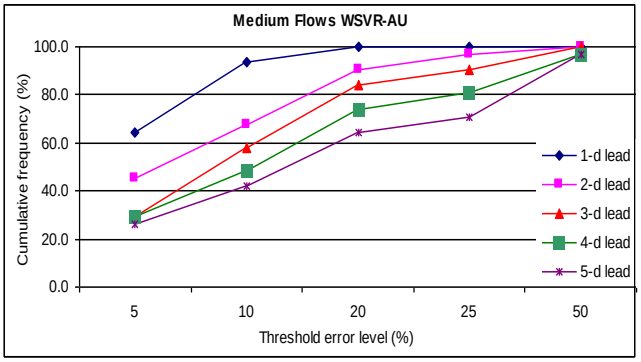
Threshold statistics for **WSVR-AU and WSVR** models for testing period

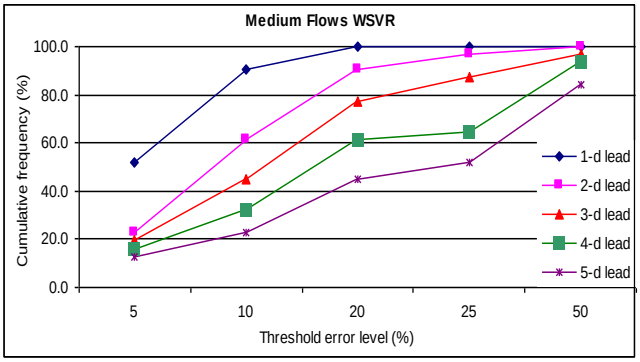
TS%	1-d lead	2-d lead	3-d lead	4-d lead	5-d lead	1-d lead	2-d lead	3-d lead	4-d lead	5-d lead	1-d lead	2-d lead	3-d lead	4-d lead	5-d lead
WSVR-AU	**High Flows**					**Med. Flows**					**Low Flows**				
5	50.0	50.0	50.0	50.0	0.0	64.5	45.2	29.0	29.0	25.8	21.1	21.1	18.4	23.7	18.4
10	100.0	50.0	50.0	100.0	50.0	93.5	67.7	58.1	48.4	41.9	47.4	28.9	28.9	34.2	26.3
20	100.0	50.0	100.0	100.0	100.0	100.0	90.3	83.9	74.2	64.5	65.8	55.3	47.4	36.8	39.5
25	100.0	100.0	100.0	100.0	100.0	100.0	96.8	90.3	80.6	71.0	76.3	57.9	57.9	47.4	42.1
50	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.8	96.8	94.7	78.9	73.7	65.8	63.2
WSVR															
5	50.0	50.0	0.0	0.0	0.0	51.6	22.6	19.4	16.1	12.9	15.8	10.5	7.9	7.9	0.0
10	50.0	50.0	0.0	0.0	0.0	90.3	61.3	45.2	32.3	22.6	34.2	21.1	15.8	13.2	10.5
20	100.0	50.0	50.0	50.0	0.0	100.0	90.3	77.4	61.3	45.2	73.7	52.6	31.6	18.4	18.4
25	100.0	50.0	100.0	100.0	0.0	100.0	96.8	87.1	64.5	51.6	73.7	65.8	47.4	39.5	28.9
50	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.8	93.5	83.9	94.7	78.9	73.7	65.8	57.9

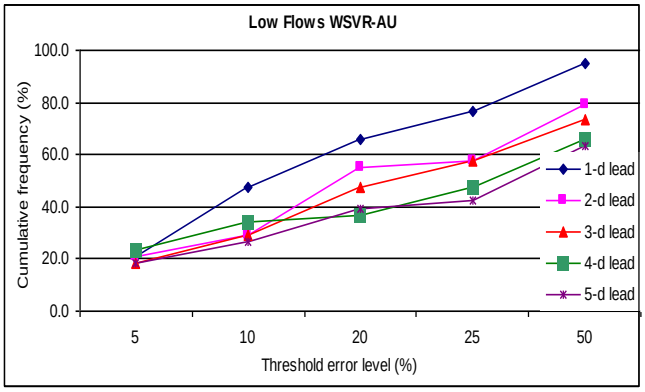
Distribution of forecast by **WSVR-AU and SVR** model errors across different error thresholds for 1–5 day lead time forecasts for low, medium and high flow profiles.

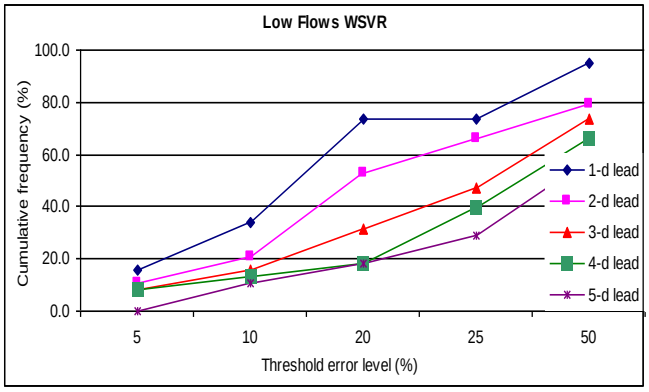












MATLAB IMPEMENTATION

1. Support Vector Regression

% example of a 2D Support Vector Regression

%----------Data creation---------------------------

x=trn;

y=tr_tr;

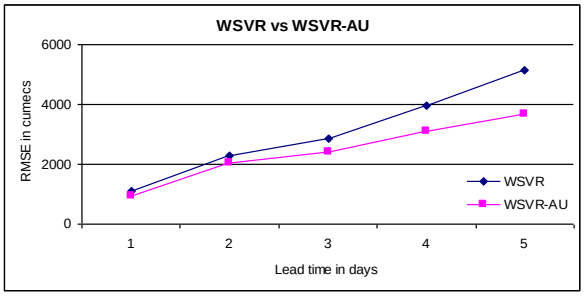
```
%----------------Parameter specifications-------------------------------------
C = 60;
lambda = 1.0;
epsilon = .001;
kerneloption = 01;
kernel='poly';
verbose=1;
[xsup,ysup,w,w0] = svmreg(x,y,C,epsilon,kernel,kerneloption,lambda,verbose);
%-----------------------------------------------------------
xtest=tin;
ypred = svmval(xtest,xsup,w,w0,kernel,kerneloption);
```

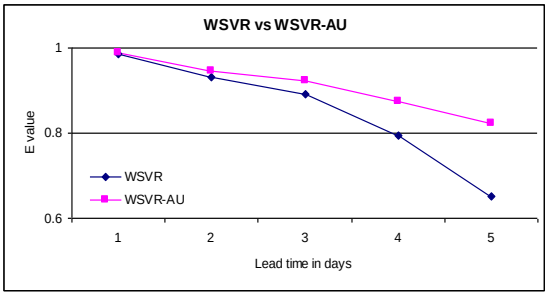
2. Support Vector Regression with Auto Update

```
%  example of a 2D Support Vector Regression with Auto Update
%-----------Data creation------------------------------
 output=zeros(1)
for i=0:70
     q=423+i;
     z=424+i;
      k=tr_tr(1:q,1);
      l=trn(1:q,1);
      tin=trn(z:z,1);
      for a=2:28
      ab=trn(1:q,a);
  l=cat(2,l,ab);
 cd=trn(z:z,a);
 tin=cat(2,tin,cd);
        end
%-----------------------------------------------------
```

```
C = 60;

lambda = .010;

epsilon = .01;

kerneloption = 01;

kernel='poly';

verbose=1;

 [xsup,ysup,w,w0] = svmreg(trn,tr_tr,C,epsilon,kernel,kerneloption,lambda,verbose);

%-----------------------------------------------------------

output1 = svmval(tin,xsup,w,w0,kernel,kerneloption);

output=cat(1,output,output1)

% ypredmat=reshape(ypred,na,nb);

% %-----------------------------------------------------------

 end
```

Comparison of RMSE and E value of WSVR-AU and WSVR models





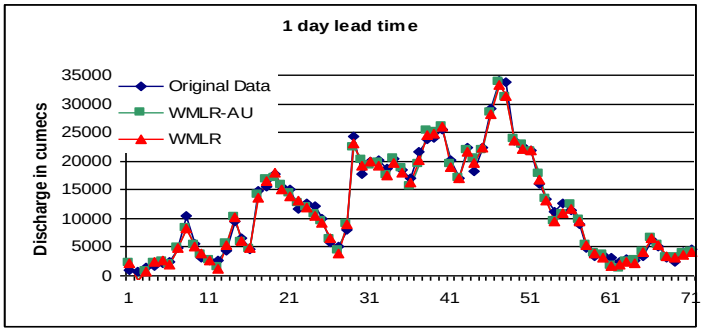
Multiple Linear Regression

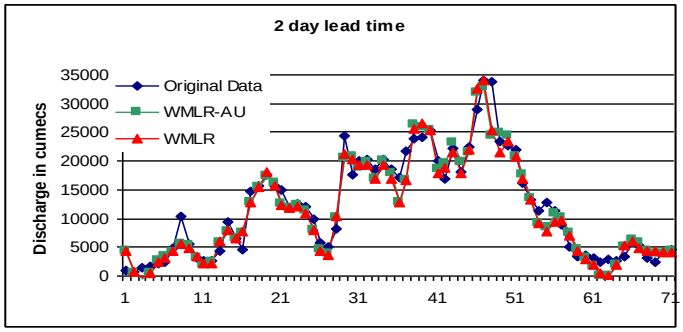
Performance indices for 1–5-day lead time forecasts for the **WMLR-AU and WMLR** models

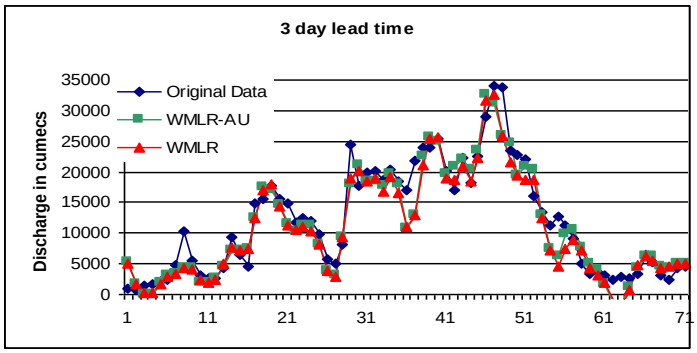
Naraj	RMSE (cumecs)			E		
Lead Time	WBANN	WMLR	WMLR-AU	WBANN	WMLR	WMLR-AU
1	**2247.9**	941.5	1033.4	**.93**	0.99	0.99
2	**2921.6**	2141.9	2198.8	**.89**	0.94	0.94
3	**3367.2**	2830.8	2798.3	**.85**	0.90	0.90
4	**4850.9**	3803.3	3413.1	**.69**	0.81	0.85
5	**4981.3**	4700.4	4065.9	**.68**	0.71	0.78

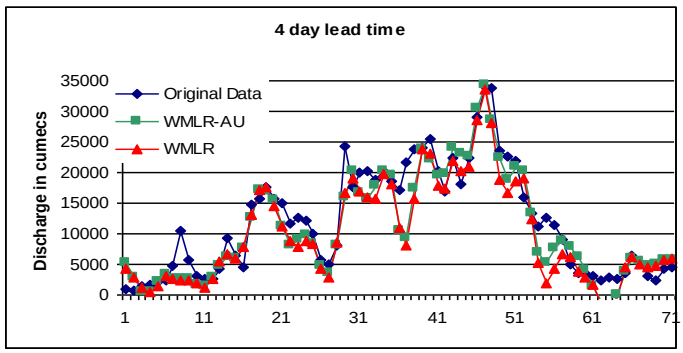
*WMLR= Wavelet based MLR ; WMLR-AU =Wavelet based MLR with auto update

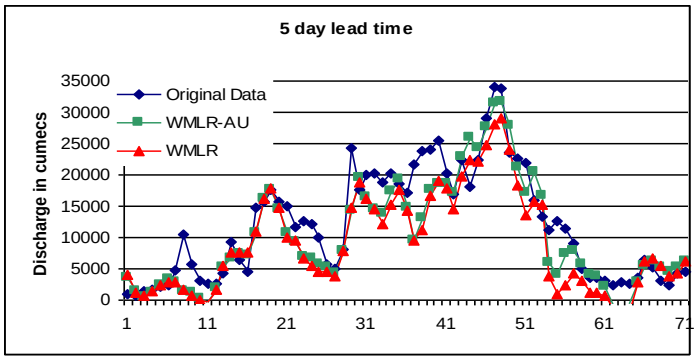
Hydrographs of observed and predicted discharge of testing dataset for Naraj using the **WMLR-AU and WMLR** models.



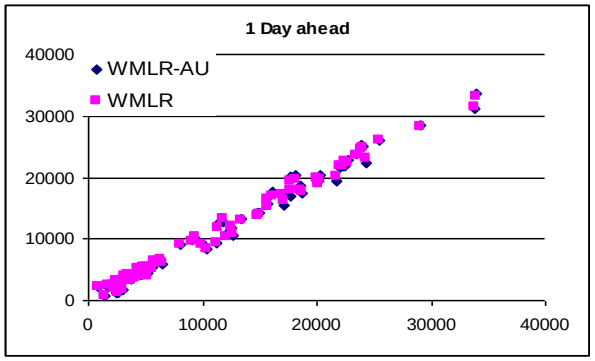


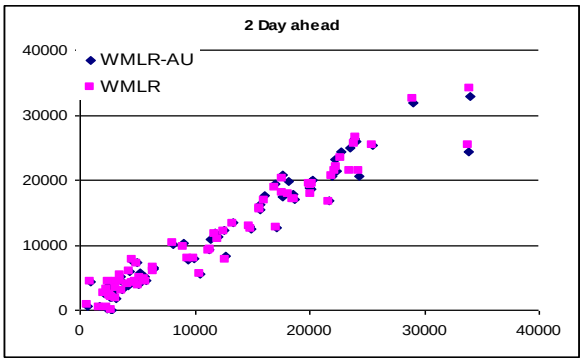


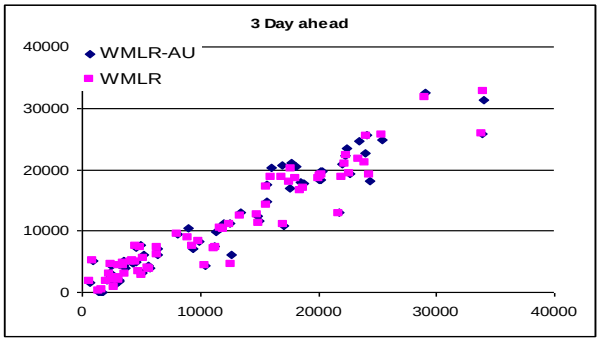


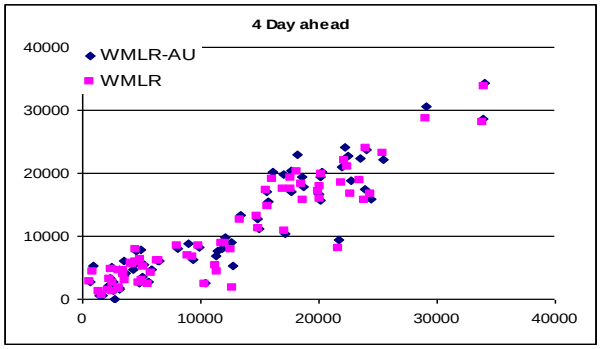


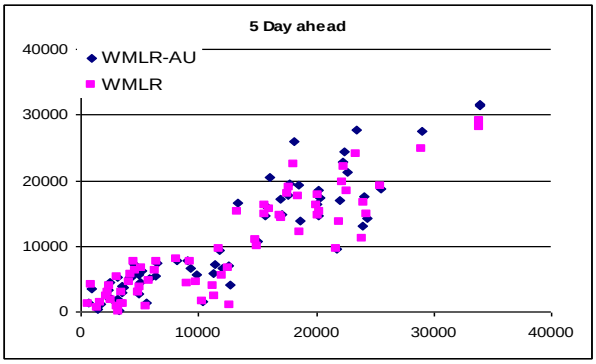
Scatter plots of observed and predicted discharge of testing dataset for Naraj using the **WMLR-AU and WMLR** models.







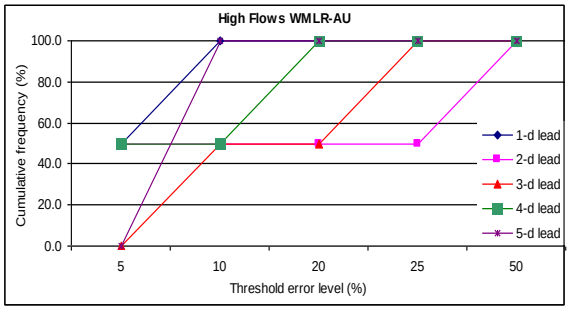


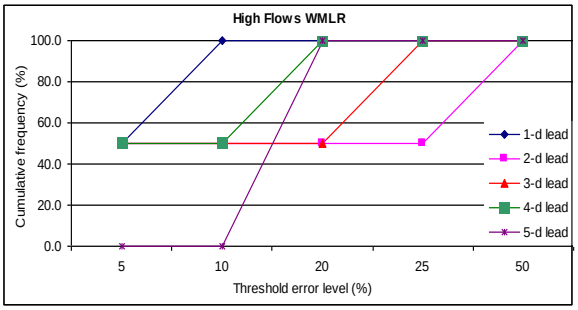


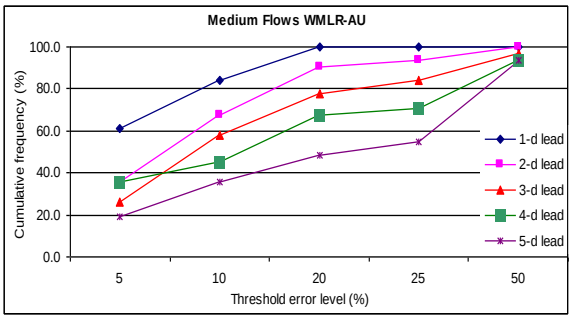
Threshold statistics for **WMLR-AU and WMLR** models for testing period

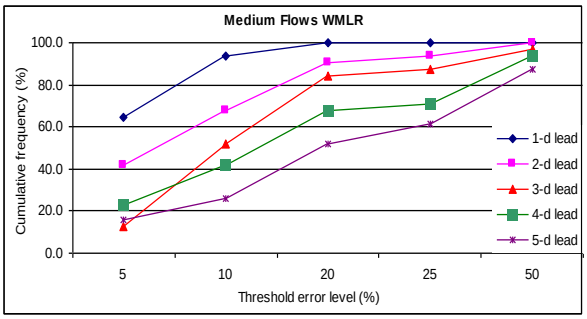
TS%	1-d lead	2-d lead	3-d lead	4-d lead	5-d lead	1-d lead	2-d lead	3-d lead	4-d lead	5-d lead	1-d lead	2-d lead	3-d lead	4-d lead	5-d lead
WMLR-AU	**High Flows**					**Med. Flows**					**Low Flows**				
5	50.0	50.0	0.0	50.0	0.0	61.3	35.5	25.8	35.5	19.4	26.3	13.2	5.3	7.9	5.3
10	100.0	50.0	50.0	50.0	100.0	83.9	67.7	58.1	45.2	35.5	50.0	23.7	15.8	26.3	5.3
20	100.0	50.0	50.0	100.0	100.0	100.0	90.3	77.4	67.7	48.4	71.1	44.7	36.8	31.6	31.6
25	100.0	50.0	100.0	100.0	100.0	100.0	93.5	83.9	71.0	54.8	78.9	55.3	44.7	34.2	36.8
50	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.8	93.5	93.5	94.7	81.6	71.1	60.5	65.8
WMLR															
5	50.0	50.0	50.0	50.0	0.0	64.5	41.9	12.9	22.6	16.1	13.2	7.9	5.3	10.5	7.9
10	100.0	50.0	50.0	50.0	0.0	93.5	67.7	51.6	41.9	25.8	31.6	21.1	10.5	13.2	10.5
20	100.0	50.0	50.0	100.0	100.0	100.0	90.3	83.9	67.7	51.6	63.2	44.7	34.2	21.1	21.1
25	100.0	50.0	100.0	100.0	100.0	100.0	93.5	87.1	71.0	61.3	78.9	55.3	42.1	23.7	28.9
50	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.8	93.5	87.1	89.5	78.9	73.7	65.8	47.4

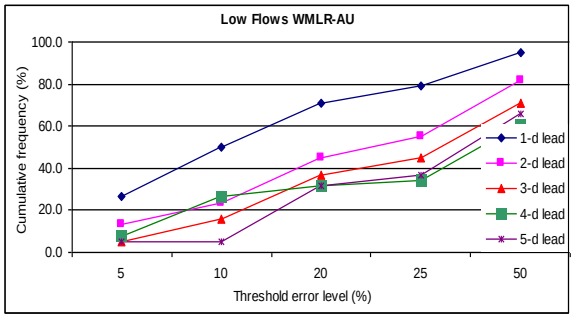
Distribution of forecast by **WMLR-AU and WLR** model errors across different error thresholds for 1–5 day lead time forecasts for low, medium and high flow profiles.

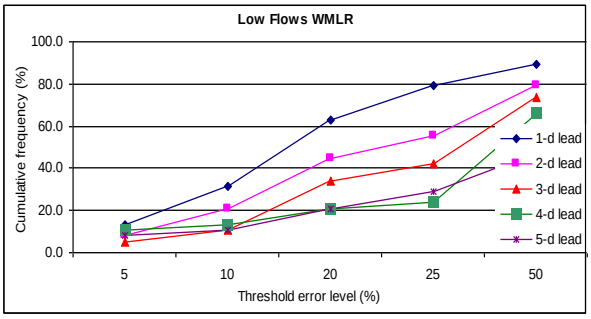












MATLAB IMPLEMENTATION

1. Multiple Linear Regression

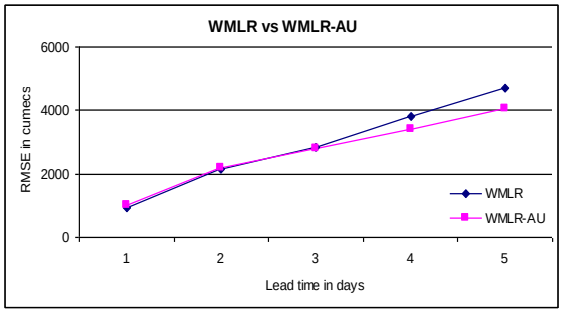
```
v=mregress(target,trn_input,1)

m=size(v,1)

v1=v(2:m,1)

n=tst_input*v1

output=n+v(1,1)
```

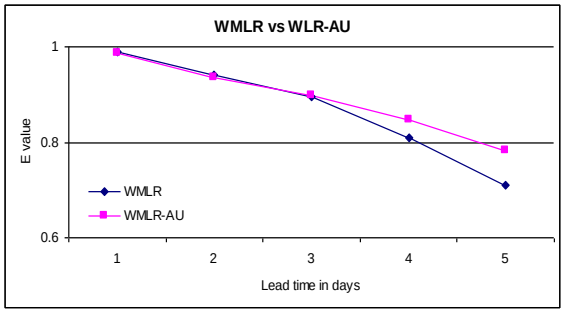
2. Multiple Linear Regression with Auto Update

```
output=zeros(1)

for i=0:122
```

```
 q=346+i;
 z=347+i;
k=target(1:q,1);
    l=trn_input(1:q,1);
tst_input=trn_input(z:z,1);
     for a=2:16
    ab=trn_input(1:q,a);
 l=cat(2,l,ab);
 cd=trn_input(z:z,a);
 tst_input=cat(2,tst_input,cd);
 end
v=mregress(k,l,1);
m=size(v,1);
v1=v(2:m,1);
z=q+1;
n=tst_input*v1;
output1=n+v(1,1);
output=cat(1,output,output1)
  end
```

Comparison of RMSE and E value of WMLR-AU and WSVR models





Example from other river system

Comparison of RMSE and E value of WSVR-AU, WSVR, WMLR-AU and WSVR models for **Kamla River** of North Bihar.