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LAMPIRAN

Lampiran 1. *Syntax* ARL Bagan Kendali MEWMA

```
Title ‘Bagan Kendali\MEWMA2000’;
proc iml;
create control var {count};
do i= 1 to 10000;
Flag = 0; /*Flag to stop iterations*/
count=0; /*Count variable to measure ARL*/
D=0; /*Value holder for calculated values*/
var=2; /*number of variables in simulation*/
do while (Flag=0);
m={0, 3};
l={1 1.44,1.44 2};
s={1 .9, .9 1};
lamda=.8;
/*Begin observation generation*/
seed = 0;
n = 1;
sigma =l#s;
p = nrow(sigma);
b = repeat(m`,n,1);
q = root(sigma);
z =normal(repeat(seed,n,p));
y =z*q + b;
out=y;
j=count+1;
k=2*j;
/*Calculation of test statistic*/
beta= 1-lamda;
gam= (1-lamda)**k;
del = ((lamda * (1-gam))/(2-lamda));
sig = del * sigma;
siginv = inv(sig);
```

```
h = 10.17; /*MEWMA critical value*/
B=lamda * y;
C = beta * Z;
Z= C + B;
Ti2 = Z * siginv * Z`;
count = count + 1;
flag = (Ti2 > h);
if count > 9999 then flag = 1;
end;
append var {count};
end;
quit;
proc means data = control MEAN; /*Calculation of ARL*/
var count; output out = stats;
run;
```

Lampiran 2. *Syntax* ARL Bagan Kendali MCUSUM

```
Title ‘Bagan Kendali MCUSUM2000’;
proc iml;
create control var {count};
do i= 1 to 10000;
Flag = 0; /*Flag to stop iterations*/
count=0; /*Count variable to measure ARL*/
D=0; /*Value holder for calculated values*/
var=2; /*number of variables in simulation*/
do while (Flag=0);
m={0, 3}; /*Mean or observation vector*/
l={1 1.44, 1.44 2}; /*Covariance matrix*/
s={1 .9, .9 1}; /*Correlation values*/
/*Begin observation generation*/
seed = 0;
n = 1;
sigma =l#s;
p = nrow(sigma);
b = repeat(m`,n,1);
q = root(sigma);
z =normal(repeat(seed,n,p));
y =z*q + b;
out=y;
j=count+1;
k=2*j;
fir={0, 0}; /*Fast initial response values (not used in simulation)*/
R=D+(y)-fir`;
if R > 0 then D=R;
else D=0;
MCt = R;
h = 12.20; /*Critical value for test*/
count = count + 1;
```

```
flag = (MCt > h);
if count > 9999 then flag = 1;
end;
append var {count};
end;
quit;
proc means data = control MEAN; /*Calculation of ARL*/
var count; output out = stats;
run;
```

Lampiran 3. Perbandingan jarak mahalanobis dengan nilai chi-kuadrat

No.	d_i^2	$\chi^2_{\alpha,2}$	No.	d_i^2	$\chi^2_{\alpha,2}$	No.	d_i^2	$\chi^2_{\alpha,2}$
1	0,00882	0,00355	38	0,34888	0,28538	75	0,74805	0,61355
2	0,00983	0,01067	39	0,35428	0,29358	76	0,75494	0,62321
3	0,00983	0,01781	40	0,37326	0,30181	77	0,75955	0,63292
4	0,02601	0,02498	41	0,38862	0,31008	78	0,76524	0,64268
5	0,04558	0,03217	42	0,39635	0,31837	79	0,76857	0,65248
6	0,05292	0,03939	43	0,39635	0,32671	80	0,77684	0,66233
7	0,05714	0,04664	44	0,40079	0,33508	81	0,78942	0,67224
8	0,07646	0,05391	45	0,40553	0,34348	82	0,79138	0,68219
9	0,07646	0,06121	46	0,40553	0,35192	83	0,80223	0,69219
10	0,07772	0,06854	47	0,44396	0,36039	84	0,82372	0,70224
11	0,08215	0,07589	48	0,45659	0,36890	85	0,83067	0,71234
12	0,08585	0,08327	49	0,46925	0,37745	86	0,83563	0,72249
13	0,14648	0,09068	50	0,47600	0,38603	87	0,85098	0,73269
14	0,14995	0,09811	51	0,48107	0,39465	88	0,85722	0,74295
15	0,15184	0,10558	52	0,48622	0,40331	89	0,86165	0,75326
16	0,16062	0,11307	53	0,49830	0,41201	90	0,86286	0,76362
17	0,16391	0,12058	54	0,52771	0,42074	91	0,86711	0,77404
18	0,16507	0,12813	55	0,53952	0,42951	92	0,90915	0,78451
19	0,16692	0,13571	56	0,54191	0,43832	93	0,92268	0,79504
20	0,17809	0,14331	57	0,55019	0,44717	94	0,92561	0,80562
21	0,17809	0,15095	58	0,55154	0,45606	95	0,92990	0,81626
22	0,18419	0,15861	59	0,57083	0,46499	96	0,93077	0,82695
23	0,18615	0,16630	60	0,57758	0,47396	97	0,93222	0,83770
24	0,20329	0,17402	61	0,57790	0,48297	98	0,93491	0,84852
25	0,21343	0,18177	62	0,58344	0,49202	99	0,94955	0,85938
26	0,21403	0,18956	63	0,58857	0,50111	100	0,95251	0,87031
27	0,21801	0,19737	64	0,59607	0,51024	101	0,95755	0,88130
28	0,24960	0,20521	65	0,59859	0,51942	102	0,97395	0,89235
29	0,26673	0,21309	66	0,62422	0,52863	103	0,99384	0,90346
30	0,27086	0,22099	67	0,64999	0,53789	104	0,99404	0,91464
31	0,27587	0,22893	68	0,67471	0,54719	105	1,01006	0,92587
32	0,29464	0,23690	69	0,67471	0,55654	106	1,01795	0,93717
33	0,30020	0,24490	70	0,67797	0,56593	107	1,01998	0,94854
34	0,30020	0,25293	71	0,69870	0,57536	108	1,02256	0,95996
35	0,30890	0,26099	72	0,70293	0,58484	109	1,02256	0,97146
36	0,31760	0,26909	73	0,71691	0,59437	110	1,03171	0,98302
37	0,32366	0,27722	74	0,71901	0,60394	111	1,03171	0,99465

Lanjutan Lampiran 3.

No.	d_i^2	$\chi^2_{\alpha,2}$	No.	d_i^2	$\chi^2_{\alpha,2}$	No.	d_i^2	$\chi^2_{\alpha,2}$
112	1,04545	1,00634	149	0,74805	0,61355	186	1,04545	1,00634
113	1,06086	1,01811	150	0,75494	0,62321	187	1,06086	1,01811
114	1,06086	1,02994	151	0,75955	0,63292	188	1,06086	1,02994
115	1,06734	1,04185	152	0,76524	0,64268	189	1,06734	1,04185
116	1,06734	1,05382	153	0,76857	0,65248	190	1,06734	1,05382
117	1,06834	1,06587	154	0,77684	0,66233	191	1,06834	1,06587
118	1,07967	1,07799	155	0,78942	0,67224	192	1,07967	1,07799
119	1,08100	1,09019	156	0,79138	0,68219	193	1,08100	1,09019
120	1,09610	1,10246	157	0,80223	0,69219	194	1,09610	1,10246
121	1,10235	1,11480	158	0,82372	0,70224	195	1,10235	1,11480
122	1,10319	1,12723	159	0,83067	0,71234	196	1,10319	1,12723
123	1,11317	1,13973	160	0,83563	0,72249	197	1,11317	1,13973
124	1,13359	1,15230	161	0,85098	0,73269	198	1,13359	1,15230
125	1,13807	1,16496	162	0,85722	0,74295	199	1,13807	1,16496
126	1,14480	1,17770	163	0,86165	0,75326	200	1,14480	1,17770
127	1,14665	1,19052	164	0,86286	0,76362	201	1,14665	1,19052
128	1,15100	1,20343	165	0,86711	0,77404	202	1,15100	1,20343
129	1,17662	1,21641	166	0,90915	0,78451	203	1,17662	1,21641
130	1,19668	1,22948	167	0,92268	0,79504	204	1,19668	1,22948
131	1,24356	1,24264	168	0,92561	0,80562	205	1,24356	1,24264
132	1,24905	1,25589	169	0,92990	0,81626	206	1,24905	1,25589
133	1,26171	1,26922	170	0,93077	0,82695	207	1,26171	1,26922
134	1,26218	1,28264	171	0,93222	0,83770	208	1,26218	1,28264
135	1,26345	1,29616	172	0,93491	0,84852	209	1,26345	1,29616
136	1,26747	1,30976	173	0,94955	0,85938	210	1,26747	1,30976
137	1,27710	1,32346	174	0,95251	0,87031	211	1,27710	1,32346
138	1,28055	1,33726	175	0,95755	0,88130	212	1,28055	1,33726
139	1,28455	1,35114	176	0,97395	0,89235	213	1,28455	1,35114
140	1,28924	1,36513	177	0,99384	0,90346	214	1,28924	1,36513
141	1,28924	1,37921	178	0,99404	0,91464	215	1,28924	1,37921
142	1,30842	1,39340	179	1,01006	0,92587	216	1,30842	1,39340
143	1,31413	1,40768	180	1,01795	0,93717	217	1,31413	1,40768
144	1,32425	1,42207	181	1,01998	0,94854	218	1,32425	1,42207
145	1,33402	1,43657	182	1,02256	0,95996	219	1,33402	1,43657
146	1,33976	1,45116	183	1,02256	0,97146	220	1,33976	1,45116
147	1,36830	1,46587	184	1,03171	0,98302	221	1,36830	1,46587
148	1,37541	1,48069	185	1,03171	0,99465	222	1,37541	1,48069

Lanjutan Lampiran 3.

No.	d_i^2	$\chi^2_{\alpha,2}$	No.	d_i^2	$\chi^2_{\alpha,2}$
223	2,76545	3,11186	253	3,52044	4,51503
224	2,79679	3,14576	254	3,54670	4,58401
225	2,80754	3,18024	255	3,60733	4,65544
226	2,81483	3,21533	256	3,79996	4,72952
227	2,81579	3,25105	257	3,96533	4,80646
228	2,83220	3,28741	258	4,05175	4,88647
229	2,84706	3,32445	259	4,25577	4,96981
230	2,84941	3,36219	260	4,52979	5,05678
231	2,85229	3,40065	261	4,65048	5,14771
232	2,85700	3,43987	262	4,65668	5,24296
233	2,85722	3,47987	263	4,76884	5,34299
234	2,88123	3,52069	264	4,79643	5,44827
235	2,89289	3,56235	265	4,82453	5,55941
236	2,89845	3,60491	266	5,50305	5,67709
237	2,91011	3,64839	267	5,62989	5,80213
238	2,96454	3,69284	268	5,69322	5,93552
239	3,03058	3,73829	269	6,22542	6,07843
240	3,04491	3,78481	270	6,33453	6,23236
241	3,05325	3,83243	271	6,68987	6,39912
242	3,07269	3,88121	272	7,39105	6,58106
243	3,07910	3,93121	273	7,46669	6,78123
244	3,14357	3,98250	274	7,73393	7,00368
245	3,14969	4,03513	275	8,26361	7,25401
246	3,16585	4,08919	276	9,43389	7,54021
247	3,19794	4,14475	277	10,23150	7,87432
248	3,20926	4,20190	278	11,03456	8,27566
249	3,22114	4,26072	279	13,54276	8,77829
250	3,34263	4,32133	280	16,59996	9,45123
251	3,42964	4,38384	281	17,90211	10,47288
252	3,49086	4,44836	282	20,99174	12,67011

Lampiran 4. Data PDAM Tirta Je'ne'berang Kabupaten Gowa Tahun 2020 Fase I

Hari Ke-	Kekeruhan	Klor Bebas
1	3,37	0,48
2	4,20	0,56
3	4,10	0,75
4	5,25	0,19
5	4,10	1,33
6	3,52	1,26
7	4,20	0,75
8	3,91	1,00
9	4,59	0,27
10	4,87	0,84
11	3,60	1,12
12	4,80	0,22
13	3,07	0,23
14	3,78	0,90
15	4,98	0,40
16	3,99	1,07
17	4,11	0,43
18	5,59	0,52
19	4,11	0,46
20	4,09	0,45
21	6,15	0,50
22	4,63	0,24
23	4,93	0,59
24	6,88	1,69
25	6,96	0,94
26	2,50	0,11
27	3,71	0,11
28	3,45	0,11
29	4,79	2,30
30	4,68	0,55
31	4,46	0,49
32	2,14	0,71
33	3,71	1,39
34	5,14	0,30
35	3,17	0,14
36	4,55	1,54
37	4,16	1,58

Hari Ke-	Kekeruhan	Klor Bebas
38	4,44	0,44
39	4,81	0,41
40	4,52	1,50
41	3,95	0,20
42	3,21	1,97
43	4,13	0,46
44	3,33	0,22
45	5,95	0,32
46	4,76	1,07
47	4,12	1,79
48	4,27	1,35
49	3,50	0,70
50	3,05	0,10
51	5,42	1,19
52	4,70	0,82
53	5,16	1,19
54	4,94	0,10
55	3,06	0,25
56	4,16	0,30
57	5,06	0,54
58	5,94	2,79
59	5,50	1,45
60	8,12	2,60
61	7,23	0,42
62	5,13	0,86
63	4,69	0,66
64	4,54	0,54
65	4,26	0,18
66	3,48	0,12
67	4,48	0,53
68	3,33	0,86
69	4,23	0,66
70	2,97	0,21
71	5,08	0,27
72	4,24	0,40
72	4,24	0,40
73	2,39	0,95

Hari Ke-	Kekeruhan	Klor Bebas
74	4,20	1,88
75	3,99	1,12
76	4,52	0,41
77	4,95	1,51
78	3,90	1,17
79	4,08	0,40
80	4,96	0,14
81	4,18	0,85
82	3,62	0,91
83	3,43	0,11
84	2,01	0,11
85	3,34	1,14
86	3,51	0,97
87	3,10	2,42
88	4,15	0,38
89	4,06	0,17
90	4,11	0,68
91	1,27	0,18
92	2,95	0,40
93	3,80	0,46
94	1,41	0,34
95	5,15	0,54
96	3,96	0,71
97	6,41	0,11
98	4,33	0,38
99	3,51	0,24
100	4,19	1,70
101	6,19	0,98
102	6,62	1,68
103	4,89	1,15
104	4,06	0,52
105	5,53	0,68
106	4,23	1,22
107	3,81	1,32
108	4,68	0,97
109	3,79	0,22
110	5,15	1,91

Hari Ke-	Kekeruhan	Klor Bebas
111	4,91	0,96
112	4,29	1,10
113	4,38	1,51
114	3,87	0,81
115	4,08	0,39
116	4,97	1,17
117	5,76	1,02
118	6,41	0,47
119	5,51	0,57
120	5,50	0,46
121	5,85	0,47
122	5,90	0,31
123	5,26	1,91
124	4,50	0,43
125	3,10	0,62
126	4,28	0,52
127	4,64	1,47
128	5,15	1,00
129	5,78	0,95
130	3,82	0,78
131	3,79	0,67
132	3,85	0,46
133	4,25	0,88
134	3,50	0,48
135	4,00	0,35
136	3,52	1,82
137	3,03	0,43
138	2,62	0,91
139	3,64	1,14
140	2,84	0,37
141	2,74	0,41
142	3,69	1,48
143	2,44	1,51
144	2,39	1,37
145	2,67	0,69
146	2,29	0,50
147	3,13	0,52

Lampiran 5. *Syntax* MATLAB untuk Bagan Kendali MEWMA

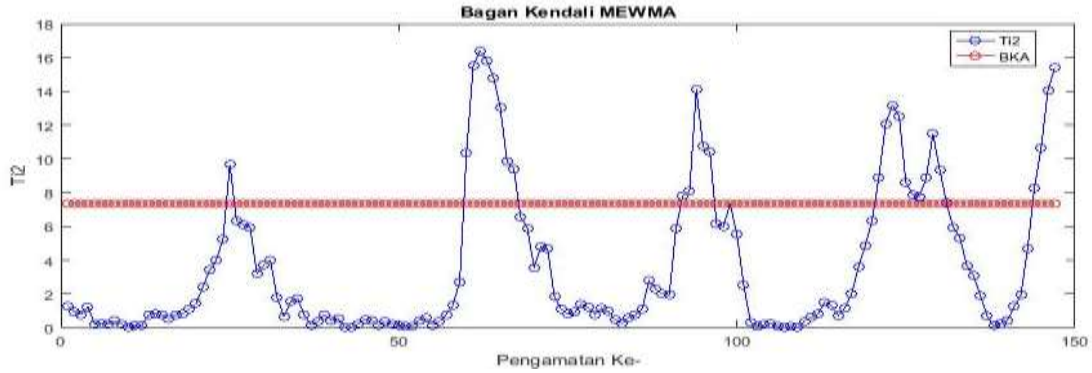
```
clc;
clear;
X =xlread('AnalisisData1.xlsx');
lamda=0.8;
H =10.58;
S=cov(X);
[brsX,klmX]=size(X);
t=brsX;
w=klmX;
rata=mean(X);
for i=1:t
   for j=1:2
      X(i,j)=X(i,j)-rata(j);
   end
end
v=zeros((t-1),w);
for i=1:t
   xt=X(i,:)-rata;
end
xi=X;
v=zeros((t-1),w);
for i=1:(t-1)
   v(i,:)=xi(i+1,:)-X(i,:);
end
S=(1/2)*(v'*v)/(t-1)
for p=1:3
   Z(1,p)=r*X(1,p);
end
for i=2:t
   for p=1:3
      Z(i,p)=r*X(i,p)+(1-r)*Z(i-1,p);
   end
end
for i=1:t
   Szi=(r*(1-(1-r)^(2*i))/(2-r))*S;
   iS=inv(Szi);
   Z1=Z(i,:);
T2(i)=Z1*iS*Z1';
End
keluar=0;
d=0;

for i=1:t
   if T2(i)>H
      keluar=keluar+1;
      d=d+1;
      ygkeluar(d)=i;
```

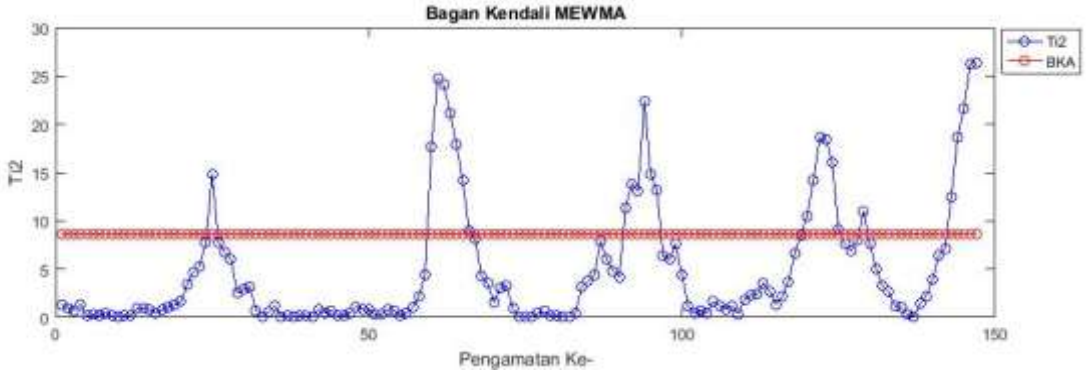
```
   end
end
for i=1:t
    batas(i)=H;
    x(i)=I;
end
jumlah_keluar=keluar;
A=max(T2);
plot(X);
title('Bagan Kendali MEWMA');
xlabel('Pengamatan Ke-');
ylabel('Ti2');
```

Lampiran 6. Output Bagan Kendali MEWMA untuk Masing -masing Pembobot

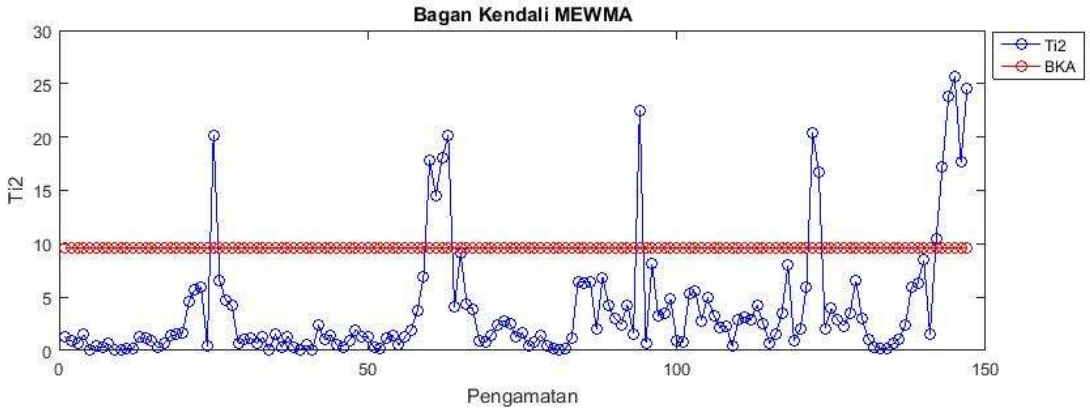
Pembobot λ=0,05



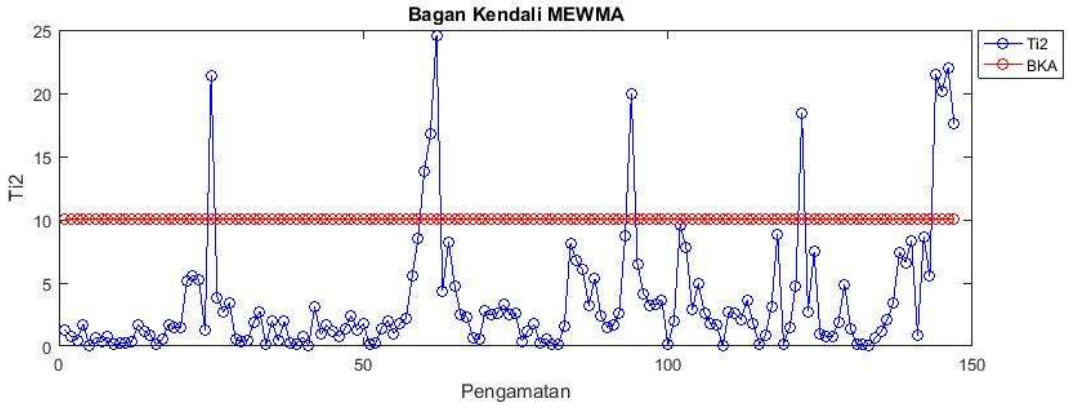
Pembobot λ=0,1



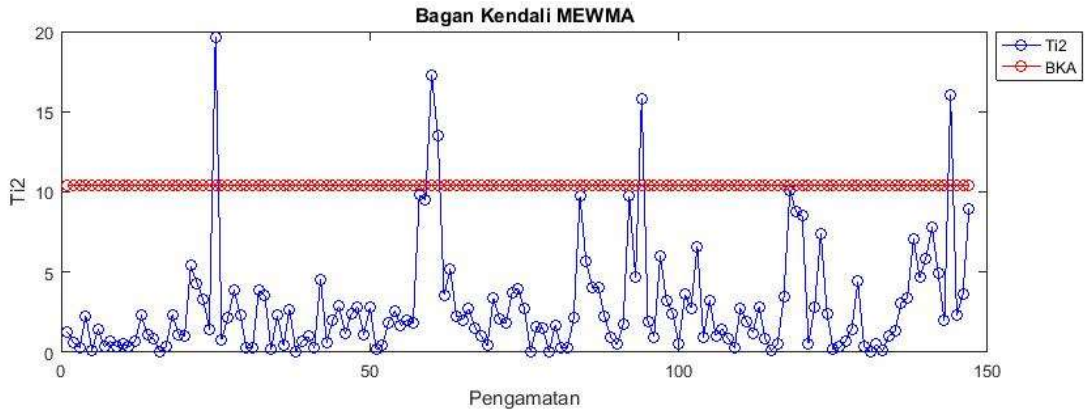
Pembobot λ=0,2



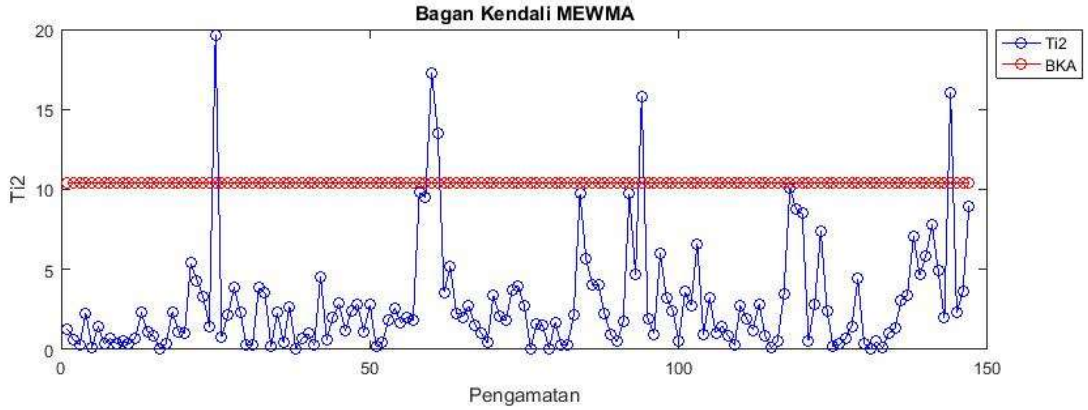
Pembobot λ=0,3



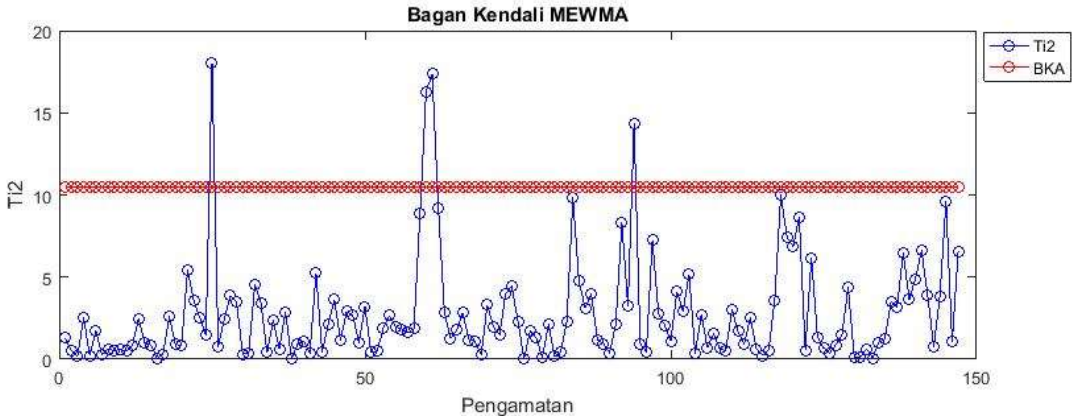
Pembobot λ=0,4



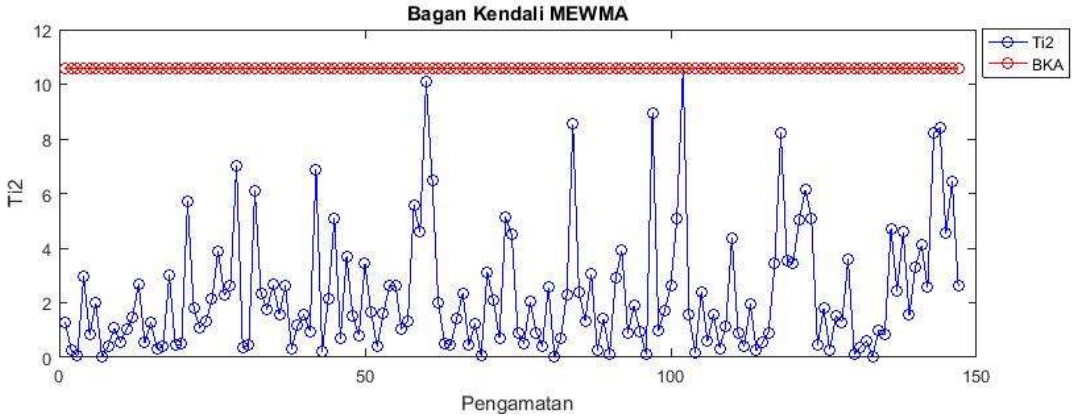
Pembobot λ=0,5



Pembobot λ=0,6



Pembobot λ=0,8



Lampiran 7. Data PDAM Tirta Je'ne'berang Kabupaten Gowa Tahun 2020 Fase II

Hari Ke-	Kekeruhan	Klor Bebas
1	3,60	0,99
2	2,26	0,92
3	2,65	0,40
4	3,75	0,82
5	2,93	0,52
6	2,29	0,49
7	2,40	0,18
8	3,19	0,16
9	3,15	0,17
10	3,17	1,17
11	3,72	0,71
12	3,93	0,88
13	3,38	0,36
14	3,60	0,99
15	2,26	0,92
16	2,65	0,40
17	3,75	0,82
18	2,93	0,52
19	2,29	0,49
20	2,40	0,18
21	3,19	0,16
22	3,15	0,17
23	3,17	1,17
24	3,72	0,71
25	3,93	0,88
26	3,38	0,36
27	3,31	0,81
28	2,78	0,39
29	2,81	0,14
30	3,51	0,40
31	3,25	1,10
32	3,89	1,38
33	1,96	2,41
34	2,58	1,10
35	3,22	0,31
36	3,51	0,30
37	1,92	0,14

Hari Ke-	Kekeruhan	Klor Bebas
38	2,80	0,24
39	2,17	0,40
40	1,85	0,15
41	2,13	0,38
42	1,54	0,22
43	1,76	0,21
44	1,61	0,20
45	1,57	1,23
46	1,58	0,44
47	2,16	0,18
48	1,39	0,18
49	1,50	0,20
50	1,36	0,15
51	1,39	0,24
52	1,32	0,11
53	1,61	0,18
54	1,58	0,17
55	1,47	0,26
56	1,62	0,23
57	1,46	0,13
58	1,44	0,34
59	1,63	0,24
60	1,66	0,20
61	1,43	0,72
62	1,52	0,64
63	1,84	0,70
64	1,47	0,68
65	1,47	0,13
66	1,40	0,43
67	1,59	0,14
68	4,38	0,23
69	4,70	0,57
70	5,65	0,57
71	5,16	0,19
72	4,68	0,19
73	2,99	0,37
74	2,32	0,15

Hari Ke-	Kekeruhan	Klor Bebas
75	1,90	0,19
76	2,01	0,11
77	2,81	1,21
78	1,96	0,18
79	2,15	0,49
80	2,18	0,68
81	2,30	0,91
82	1,83	0,72
83	1,81	0,69
84	2,31	0,68
85	2,20	0,18
86	2,50	0,93
87	3,02	0,97
88	1,88	0,85
89	2,20	0,75
90	1,97	0,33
91	1,53	0,69
92	2,45	0,70
93	2,31	0,84
94	2,85	0,33
95	2,86	0,83
96	3,41	0,91
97	3,02	1,10
98	2,40	0,96
99	2,55	0,96
100	3,50	0,77
101	4,29	1,41
102	4,45	1,09
103	1,99	1,00
104	3,84	0,78
105	2,55	0,91
106	3,85	1,15
107	5,20	0,92
108	2,83	1,10
109	2,60	0,22
110	3,50	0,37
111	2,36	0,32

Hari Ke-	Kekeruhan	Klor Bebas
112	3,12	0,55
113	4,49	0,21
114	2,75	0,43
115	3,69	0,32
116	4,22	1,16
117	4,38	0,61
118	3,97	0,73
119	3,72	0,91
120	2,61	0,93
121	1,58	0,80
122	3,72	0,22
123	3,71	0,10
124	2,82	2,20
125	3,68	0,18
126	4,52	0,41
127	4,67	0,41
128	5,67	0,25
129	4,55	0,15
130	4,04	0,25
131	4,92	0,24
132	4,79	0,42
133	4,44	0,37
134	5,07	0,18
135	4,46	1,18

Lampiran 8. Daftar Riwayat Hidup

CURRICULUM VITAE

A. Data Pribadi

1. Nama : Ardiansyah Abubakar
2. Tempat, tanggal lahir : Tassilli, 06 Agustus 1995
3. Alamat : Dusun Tassilli Desa Pattallassang Kec. Pattallassang Kab. Gowa Sulawesi Selatan
4. Kewarganegaraan : Indonesia
5. Nomor HP : +6281336822560
6. Email : ardiansyahabubakar946@gmail.com
7. Bidang/Ketertarikan : Data Scientist

B. Riwayat Pendidikan

1. Tamat SMA tahun 2012 di Madrasah Aliyah Guppi Samata;
2. Sarjana (S1) tahun 2016 di Universitas Islam Negeri Alauddin Makassar Jurusan Pendidikan Matematika;
3. Magister (S2) tahun 2022 di Universitas Hasanuddin Departemen Statistika Program Studi Magister Statistika.

C. Riwayat Pekerjaan

1. 2016, Guru di Madrasah Aliyah Guppi Samata;
2. 2018, Staff Kaur Keuangan di Desa Pattallassang Kec. Pattallassang Kab. Gowa;
3. 2019, Kepala Urusan Keuangan di Desa Pattallassang Kec. Pattallassang Kab. Gowa;
4. 2021, Administrator Database Sistem Keuangan Desa Wilayah Kecamatan Pattallassang di Dinas Pemberdayaan Masyarakat dan Desa Kab. Gowa

D. Karya Ilmiah

Abubakar, A., Nursalam., dan Mardhiah., 2016. *Pengaruh Model Pembelajaran Aptitude Treatment Interaction (ATI) Terhadap Hasil Belajar Matematika Siswa ditinjau dari Waktu Belajar dan Ukuran Kelas IX Sekolah Menengah Pertama (SMP) Negeri di Kec. Pattallassang Kab. Gowa.* Jurnal Matematika dan Pembelajaran (MaPan), Vol. 4 (1), June 2016.

Abubakar, A., Tinungki, G. M., dan Herdiani, E.T., 2022. *Monitoring Variability Process of Water Quality PDAM Tirta Je'ne'berang using MEWMV Control Chart*, Vol. 110 (1), page 362-372, October 2022.