

DAFTAR PUSTAKA

- Bersimis, S., S. Psarakis dan J. Panaretos. 2007. Multivariate Statistical Process Control Chart: An Overview. *Quality & Reliability Engineering International*, 23, hal. 517-543.
- Delsen, M.L.S.V. dan Talaku, M.W.(2016). Kinerja Bagan kendali W dan Bagan kendali G. *Jurnal Ilmu Matematika dan Terapan*, Vol 10 No 2. 137-147
- Huwang, L., Yeh, A., & Wu, Chen. (2007). *Monitoring Multivariate Process Variability for Individual Observations. Journal of Quality Technology*, vol 39,3, pp. 258- 278.
- Johnson, Richard. Dean Wichern. (2007). *Applied Multivariate Statistical Analysis*, 5th ed. New Jersey: Prentice.
- Lowry, C.A et al. 1992. *A Multivariate Exponentially Weighted Moving Average Control Chart*. *Technometrics* Vol. 34, No. 1: Hal. 46 – 53
- Mason, R. L., & Young, J. C. 2002. *Multivariate Statistical Process Control with Industrial Applications*. American Statistical Association and Society for Industrial and Applied Mathematics: Philadelphia.
- Montgomery, D. C. (2009). *Introduction to Statistical Quality Control, sixth Edition*. New York: John Wiley & Sons, Inc.
- Morison, D. (1990). *Multivariate Statistical Methods (Third Edition)*. New York: Mc Graw Hill Publishing Company.
- Wadityowati, Y. (2018). Analisis Kapabilitas Proses Produksi Minyak Goreng Filma di PT. Smart Tbk Surabaya (Sinar Mas Agro Resources And Technology Tbk). Skripsi. Program Studi Matematika Fakultas MIPA. Surabaya: Institut Teknologi Sepuluh Nopember.
- Wen Lu, C. dan Reynolds, M. R. 2001. *Cusum Charts for Monitoring an Autocorrelated Process*. *Journal of Quality Technology*, pp. 316-334.
- Yulianti, F., (2017). Perbandingan Kinerja Bagan kendali Ewma (*Exponentially Weighted Moving Average*) dan DOB (*Decision On Belief*) pada Pengendalian Kualitas Produk Etiket Rokok Studi Kasus Pt. Gudang Garam Direktorat Grafika. Skripsi. Program Studi S1 Statistika Fakultas MIPA. Surabaya: Institut Teknologi Sepuluh Nopember.

LAMPIRAN

Lampiran 1 . Data Proses Produksi Minyak Goreng Filma Bulan Desember Tahun 2017 sebagai Fase I

No	X1	X2	X3
1	0.039	0.208	1.8
2	0.041	0.221	1.8
3	0.041	0.248	1.6
4	0.039	0.254	1.6
5	0.042	0.283	1.7
6	0.04	0.253	1.7
7	0.04	0.288	1.7
8	0.039	0.215	1.5
9	0.039	0.31	1.5
10	0.041	0.32	1.7
11	0.04	0.241	1.6
12	0.04	0.182	1.7
13	0.041	0.291	1.8
14	0.043	0.144	1.7
15	0.04	0.195	1.8
16	0.041	0.184	2.1
17	0.043	0.195	1.8
18	0.043	0.28	1.8
19	0.043	0.148	1.6
20	0.041	0.224	1.7
21	0.04	0.252	1.8
22	0.04	0.181	1.6
23	0.04	0.17	1.5
24	0.042	0.184	1.5
25	0.037	0.353	1.7
26	0.041	0.23	1.4
27	0.041	0.256	1.3
28	0.041	0.159	1.4
29	0.04	0.219	1.4
30	0.046	0.186	1.4
31	0.045	0.197	1.5
32	0.044	0.191	1.6
33	0.044	0.214	1.6
34	0.044	0.225	1.6
35	0.042	0.221	1.5
36	0.044	0.225	1.6
37	0.044	0.208	1.7
38	0.043	0.181	1.7
39	0.044	0.217	1.7

40	0.044	0.189	1.7
41	0.045	0.203	1.8
42	0.045	0.225	1.8
43	0.043	0.219	2.1
44	0.045	0.165	2.1
45	0.042	0.234	1.5
46	0.043	0.233	1.5
47	0.044	0.156	1.6
48	0.044	0.203	1.7
49	0.045	0.24	1.6
50	0.042	0.205	1.7
51	0.043	0.217	1.7
52	0.044	0.152	1.6
53	0.042	0.18	1.6
54	0.043	0.188	1.6
55	0.045	0.222	1.5
56	0.044	0.19	1.6
57	0.042	0.203	1.5
58	0.045	0.229	1.7
59	0.042	0.172	2.1
60	0.044	0.21	1.7
61	0.045	0.187	1.8
62	0.044	0.175	1.8
63	0.041	0.245	1.7
64	0.044	0.284	1.6
65	0.043	0.194	1.6
66	0.043	0.194	1.7
67	0.044	0.189	1.6
68	0.044	0.202	1.7
69	0.044	0.211	1.7

Lampiran 2. Data Proses Produksi Minyak Goreng Filma Bulan Januari Tahun 2018 sebagai Fase II

No	X1	X2	X3
1	0.044	0.227	1.7
2	0.044	0.197	1.5
3	0.042	0.172	1.6
4	0.042	0.174	1.7
5	0.043	0.18	1.6
6	0.045	0.21	1.8
7	0.041	0.221	1.6
8	0.044	0.205	1.8
9	0.044	0.202	1.8
10	0.044	0.224	1.7
11	0.042	0.203	1.7
12	0.045	0.25	1.7
13	0.044	0.211	1.8
14	0.047	0.223	1.8
15	0.043	0.186	1.8
16	0.045	0.177	1.7
17	0.04	0.194	1.5
18	0.043	0.206	1.8
19	0.038	0.173	1.5
20	0.044	0.154	1.8
21	0.042	0.19	1.5
22	0.044	0.21	1.2
23	0.044	0.219	1.5
24	0.044	0.228	1.5
25	0.042	0.195	1.5
26	0.041	0.17	1.5
27	0.043	0.193	1.5
28	0.045	0.206	1.5
29	0.044	0.215	1.4
30	0.043	0.218	1.4
31	0.043	0.22	1.8
32	0.042	0.232	1.5
33	0.047	0.207	1.8
34	0.045	0.221	1.7
35	0.045	0.177	1.7
36	0.043	0.217	1.7
37	0.045	0.246	1.7
38	0.044	0.143	1.7
39	0.044	0.215	1.7

40	0.043	0.207	1.6
41	0.044	0.215	1.7
42	0.044	0.235	1.6
43	0.041	0.266	1.6
44	0.042	0.205	1.6
45	0.04	0.207	1.5
46	0.04	0.222	1.4
47	0.043	0.218	1.6
48	0.041	0.212	1.5
49	0.041	0.213	1.4
50	0.042	0.24	1.5
51	0.042	0.202	1.4
52	0.042	0.222	1.5
53	0.041	0.207	1.4
54	0.043	0.208	1.5
55	0.042	0.264	1.8
56	0.044	0.224	1.8
57	0.044	0.42	1.9
58	0.04	0.251	1.4
59	0.041	0.188	1.5
60	0.042	0.199	1.4
61	0.042	0.217	1.5
62	0.042	0.213	1.5
63	0.041	0.204	1.5
64	0.041	0.226	1.5
65	0.041	0.164	1.4
66	0.044	0.178	1.4
67	0.043	0.189	1.6
68	0.042	0.2	1.5
69	0.041	0.147	1.4
70	0.044	0.364	1.9
71	0.043	0.181	1.4
72	0.041	0.179	1.4
73	0.041	0.194	1.4
74	0.042	0.175	1.5
75	0.041	0.175	1.5
76	0.044	0.185	1.8
77	0.044	0.229	1.8
78	0.044	0.22	1.8
79	0.043	0.174	1.8
80	0.045	0.237	1.8
81	0.045	0.237	1.8

82	0.043	0.177	1.7
83	0.043	0.203	1.8
84	0.041	0.196	1.8

Lampiran 3. *Syntax* SAS untuk ARL Bagan Kendali MEWMV

```

proc iml;
create control var {count};
do i= 1 to 10000;
Flag = 0;
count=0;
D=0;
var=2;
do while (Flag=0);
m={0, 0};
l={1 1, 1 1};
s={1 .0,.0 1};
omega=.9; h =6.475; /*MEWMV critical value*/
/*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;
c= y*y`;
j=count+1;
k=2*j;
/*Control chart- limit development*/
V=omega*c + (1-omega)*D;
D=V;
U=det(V);
q=log(U);
T=trace(V);
r=T-q-var;
count = count + 1;
flag = (r > 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 4. *Syntax* SAS untuk ARL Bagan Kendali MEWMS

```

proc iml;
create control var {count};
do i= 1 to 10000;
Flag = 0;
count=0;
D=0;
var=2;
do while (Flag=0);
m={0, 0};
l={1 1, 1 1};
s={1 .0,.0 1};
omega=.1; crit=2.8725; /*MEWMS critical value*/
/*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;
c= y*y`;
j=count+1;
k=2*j;
V=omega*c + (1-omega)*D;
D=V;
T=trace(V);
/*Control chart- limit development*/
w=(omega/(2-omega))+(2-2*omega)/(2-omega) * (1-omega)**(2*(count-1));
hi=var+ (crit)*sqrt(2*var*w);
low = var - (crit)*sqrt(2*var*w);
count = count + 1;
flag = (T > hi | T<low);
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 5. Uji *Bartlett* Fase I**KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.511
Bartlett's Test of Sphericity	Approx. Chi-Square	12.689
	df	3
	Sig.	.005

Lampiran 6. Perbandingan jarak mahalanobis dengan nilai chisquare fase I

No	dj2urut	chisquare	No	dj2urut	chisquare
1	0.173711	0.0092	40	2.98515	2.7756
2	0.242281	0.1958	41	2.99897	2.8642
3	0.321056	0.2799	42	2.99978	2.9554
4	0.45324	0.3555	43	3.01297	3.0495
5	0.610579	0.4262	44	3.08598	3.1466
6	0.619401	0.4936	45	3.11541	3.2471
7	0.690846	0.5588	46	3.19206	3.3512
8	0.692297	0.6226	47	3.48519	3.4592
9	0.720516	0.6846	48	3.50908	3.5716
10	0.731384	0.7461	49	3.51618	3.6887
11	0.741587	0.8069	50	3.56726	3.8110
12	0.754219	0.8672	51	3.64967	3.9391
13	0.799169	0.9273	52	3.74569	4.0736
14	0.821103	0.9872	53	4.11582	4.2153
15	0.859362	1.0471	54	4.27194	4.3652
16	0.894818	1.1071	55	4.29732	4.5242
17	0.944226	1.1672	56	4.43286	4.6937
18	0.953445	1.2277	57	4.91923	4.8753
19	0.954101	1.2844	58	5.50276	5.0711
20	0.960568	1.3496	59	5.53346	5.2835
21	0.978308	1.4113	60	5.82996	5.5161
22	1.02554	1.4735	61	6.47408	5.7731
23	1.15877	1.5363	62	6.51055	6.0607
24	1.22018	1.5999	63	6.60446	6.3876
25	1.22018	1.6642	64	6.61933	6.7669
26	1.231	1.7293	65	7.62258	7.2196
27	1.26256	1.7954	66	9.03748	7.7826
28	1.39524	1.8624	67	9.17504	8.5304
29	1.47729	1.9305	68	9.53319	9.6549
30	1.59222	1.9997	69	13.5916	12.0403
31	1.77187	2.0702			
32	1.81894	2.1419			
33	1.93916	2.2151			
34	2.3478	2.2897			
35	2.34824	2.3660			
36	2.41288	2.4439			
37	2.61722	2.5237			
38	2.63374	2.6055			
39	2.67583	2.5273			

Lampiran 7. Syntax MATLAB Bagan Kendali MEWMV

```

clear;
clc;
X=xlsread('C:\Users\acer\Documents\MATLAB\Data1.xlsx');
omega=0.9;
lamda=0.9;
p=3;
L=4.4984;
A=X*X';
[brsA,klmA]=size(A);
t=brsA;
I=eye(t);
for i=1:t
    elemen(i)=lamda*(1-lamda)^(i-1)
end
for i=1:t;
    for j=1:t;
        if i<j;
            M(i,j)=0;
        else
            for l=i:t;
                M(l,j)=elemen(l-j+1);
            end
        end
    end
end
for u=1:brsA
    Apartu=A(1:u,1:u);
    Ipartu=I(1:u,1:u);
    Mpartu=M(1:u,1:u);
    elemenC=[];
    for i=1:u
        if i>1
            elemenC(i)=omega*(1-omega)^(u-i);
        else
            elemenC(i)=(1-omega)^(u-i);
        end
    end
    C=diag(elemenC);
    Q=(Ipartu-Mpartu)'*C*(Ipartu-Mpartu);
    trv(u)=trace(Q*Apartu);
    ekspektasi(u)=p*trace(Q);
    Q2=Q.^2;
    sumQ2=sum(sum(Q2));
    var(u)=2*p*sumQ2;
    ba=ekspektasi+(L*sqrt(var));
    bb=ekspektasi-(L*sqrt(var));
end
trvpartial=trv(:,1:t);

```

```

ekspekpartial=ekspektasi(:,1:t);
varpartial=var(:,1:t);
bapartial=ba(:,1:t);
bbpartial=bb(:,1:t);
keluar=0;
d=0;
for i=1:t-1;
    if trvpartial(i)<bbpartial(i)
        keluar=keluar+1;
        d=d+1;
        yangkeluar(d)=i;
    end
    if trvpartial(i)>bapartial(i)
        keluar=keluar+1;
        d=d+1;
        yangkeluar(d)=i;
    end
end
x=1:t;
plot(x,trvpartial,'b.-',x,bapartial,'k-',x,bbpartial,'k-');
title('Bagan Kendali MEWMV');
xlabel('Pengamatan ke-');
ylabel('Trace Vt');

```

Lampiran 8. Uji *Bartlett* Fase II**KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.564
Bartlett's Test of Sphericity	Approx. Chi-Square	35.885
	df	3
	Sig.	.000

Lampiran 9. Perbandingan jarak mahalanobis dengan nilai chisquare fase II

No	dj2urut	chisquare	No	dj2urut	chisquare
1	0.02724	0.0807	40	1.8238	2.2111
2	0.0799098	0.1709	41	1.8865	2.2723
3	0.34011	0.2437	42	1.91026	2.3345
4	0.340343	0.3090	43	1.95919	2.3978
5	0.429298	0.3697	44	1.96888	2.4623
6	0.469045	0.4274	45	2.03751	2.5281
7	0.501448	0.4830	46	2.08471	2.5952
8	0.56379	0.5369	47	2.10374	2.6637
9	0.572097	0.5896	48	2.1784	2.7337
10	0.581937	0.6413	49	2.18343	2.8054
11	0.581937	0.6924	50	2.25139	2.8787
12	0.6163	0.7428	51	2.2521	2.9538
13	0.644957	0.7928	52	2.26231	3.0308
14	0.655292	0.8425	53	2.29841	3.1098
15	0.682772	0.8919	54	2.37723	3.1911
16	0.767633	0.9412	55	2.52621	3.2746
17	0.780837	0.9904	56	2.56123	3.3607
18	0.817292	1.0396	57	2.60338	3.4494
19	1.01352	1.0889	58	2.61913	3.5411
20	1.16734	1.1382	59	2.6722	3.6358
21	1.22712	1.1877	60	2.76852	3.7339
22	1.24096	1.2374	61	2.96902	3.8357
23	1.32898	1.2873	62	2.99787	3.9414
24	1.34689	1.3375	63	3.05621	4.0515
25	1.35865	1.3881	64	3.05621	4.1664
26	1.35865	1.4390	65	3.07158	4.2865
27	1.43686	1.4902	66	3.0839	4.4124
28	1.52603	1.5420	67	3.60731	4.5447
29	1.53649	1.5942	68	3.7706	4.6843
30	1.54737	1.6469	69	3.78327	4.8320
31	1.58669	1.7001	70	4.30117	4.9888
32	1.59665	1.7540	71	4.44237	5.1561
33	1.64954	1.8085	72	4.76024	5.3356
34	1.71861	1.8636	73	4.76807	5.5292
35	1.74265	1.9195	74	4.78207	5.7394
36	1.7431	1.9761	75	4.80419	5.9697
37	1.76821	2.0335	76	5.24314	4.6224
38	1.78182	2.0918	77	5.69278	6.5096
39	1.79375	2.1510	78	6.44885	6.8340

No	dj2 urut	chisquare
79	6.49754	7.2107
80	6.77888	7.6606
81	10.2847	8.2206
82	13.3108	8.9646
83	17.2514	10.0850
84	31.0945	12.4637

Lampiran 10. Tabel Nilai L bagan kendali MEWMV dan MEWMS untuk $p=3$

- MEWMV

ω	λ	L	ω	λ	L	ω	λ	L
0.1	0.1	2.7900	0.4	0.1	3.8984	0.7	0.1	4.3777
	0.2	2.7939		0.2	3.9063		0.2	4.3797
	0.3	2.7949		0.3	3.9121		0.3	4.3816
	0.4	2.7988		0.4	3.9219		0.4	4.3836
	0.5	2.7979		0.5	3.9277		0.5	4.3855
	0.6	2.8027		0.6	3.9395		0.6	4.3875
	0.7	2.8066		0.7	3.9492		0.7	4.3836
	0.8	2.8105		0.8	3.9511		0.8	4.3836
	0.9	2.8164		0.9	3.9492		0.9	4.3758
0.2	0.1	3.3105	0.5	0.1	4.1016	0.8	0.1	4.4707
	0.2	3.3086		0.2	4.1016		0.2	4.4668
	0.3	3.3164		0.3	4.1094		0.3	4.4629
	0.4	3.3213		0.4	4.1152		0.4	4.4688
	0.5	3.3340		0.5	4.1191		0.5	4.4688
	0.6	3.3438		0.6	4.1270		0.6	4.4688
	0.7	3.3535		0.7	4.1367		0.7	4.4629
	0.8	3.3594		0.8	4.1387		0.8	4.4590
	0.9	3.3691		0.9	4.1328		0.9	4.4551
0.3	0.1	3.6484	0.6	0.1	4.2578	0.9	0.1	4.5234
	0.2	3.6523		0.2	4.2578		0.2	4.5195
	0.3	3.6602		0.3	4.2617		0.3	4.5117
	0.4	3.6699		0.4	4.2695		0.4	4.5195
	0.5	3.6797		0.5	4.2715		0.5	4.5176
	0.6	3.6895		0.6	4.2715		0.6	4.5137
	0.7	3.6943		0.7	4.2734		0.7	4.5098
	0.8	3.7011		0.8	4.2813		0.8	4.5078
	0.9	3.7070		0.9	4.2715		0.9	4.4984

- MEWMS

ω	L
0.1	2.8212
0.2	3.3281
0.3	3.6621
0.4	3.915
0.5	4.1133
0.6	4.2715
0.7	4.3902
0.8	4.4766
0.9	4.5315