

DATA PENULIS

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Nilai Tugas Akhir : A
Tanggal USTA : 31 Januari 2005

KOMENTAR DOSEN PENGUJI

Nama Mahasiswa : Andi Indrawan
NRP : 0023161
Judul Tugas Akhir : Usulan Peningkatan Kapasitas Dalam Upaya Memenuhi
Permintaan Pada PT. Kerta Laksana Bandung.

Komentar-komentar Dosen Penguji :

1. Seharusnya dicantumkan alasan pemilihan metode "*Line Balancing*" (dibandingkan metode lain).
2. Pengertian "optimal" tidak benar, lebih tepat "terbaik".
3. Penelitian sudah cukup baik, tetapi bab V tidak perlu rinci (pengolahannya), hasilnya dapat diletakkan di lampiran.
4. Penelitian dilakukan dengan sangat baik.

Contoh perhitungan :

Untuk tabel inflow :

$$\begin{aligned}\text{dari SK I ke SK III} &= \frac{\text{Frekuensi perpindahan I ke III}}{\text{Jumlah frekuensi kolom stasiun ker ja yang dituju}} \\ &= \frac{320}{320} \\ &= 1\end{aligned}$$

Untuk tabel outflow :

$$\begin{aligned}\text{dari SK I ke SK III} &= \frac{\text{Frekuensi perpindahan I ke III}}{\text{Jumlah frekuensi baris stasiun ker ja asal}} \\ &= \frac{320}{856} \\ &= 0.374\end{aligned}$$

Untuk tabel rata – rata inflow – outflow

$$\begin{aligned}\text{dari SK I ke SK III} &= \frac{\text{nilai inf low} + \text{nilai outflow}}{2} \\ &= \frac{1 + 0.374}{2} \\ &= 0.687\end{aligned}$$

Contoh Perhitungan : (untuk interval kelas 251.385 – 255.485)

$$Z_1 = \frac{\text{Batas kelas bawah} - \bar{X}}{S}$$

$$Z_1 = \frac{251.385 - 259.08}{4.85}$$

$$Z_1 = -1.587$$

$$Z_2 = \frac{\text{Batas kelas atas} - \bar{X}}{S}$$

$$Z_2 = \frac{255.485 - 259.08}{4.85}$$

$$Z_2 = -0.741$$

$$\begin{aligned} \text{Luas} &= P(Z_1 < Z < Z_2) \\ &= P(Z_2) - P(Z_1) \\ &= P(-0.741) - P(-1.587) \\ &= 0.229 - 0.056 \\ &= 0.173 \end{aligned}$$

$$E_i = \text{luas} \times n = 0.173 \times 36 = 6.228$$

Perhitungan χ^2

$$\begin{aligned} \chi^2_{hitung} &= \sum \frac{(o_i - e_i)^2}{e_i} \\ &= 2.898 \end{aligned}$$

$$V = k - r - 1 = 4 - 2 - 1 = 1$$

$$\alpha = 0.05$$

$$\chi^2_{(\alpha;v)} = 3.841$$

$$\chi^2_{hitung} < \chi^2_{(\alpha;v)} = 2.898 < 3.841$$

Maka data mengikuti distribusi normal, karena $\chi^2_{hitung} < \chi^2_{(\alpha;v)}$

Uji Keseragaman

Operasi Potong Pipa Pipa Screw 1

Tabel Uji Keseragaman

Sub Group Ke-	Data Pengamatan Ke-						Rata- rata
	1	2	3	4	5	6	
1	256.82	253.67	251.39	263.41	255.02	260.46	256.80
2	258.02	269.24	259.22	260.43	261.05	265.29	262.21
3	256.28	259.84	259.27	262.85	259.22	253.83	258.55
4	256.88	252.62	263.46	255.05	259.22	251.45	256.45
5	259.29	260.47	257.42	259.23	262.21	254.46	258.85
6	257.47	261.01	258.62	256.83	276.58	259.26	261.63

Rata-rata untuk masing-masing subgroup :

Contoh Sub group 1

$$\begin{aligned}\bar{X}_1 &= \frac{\sum X}{n} \\ &= \frac{256.82 + 253.67 + 251.39 + 263.41 + 255.02 + 260.46}{6} \\ &= 256.8\end{aligned}$$

Rata-rata :

$$\begin{aligned}\bar{\bar{X}} &= \frac{\sum \bar{X}}{k} \\ &= \frac{256.8 + 262.21 + 258.55 + 256.45 + 258.85 + 261.63}{6} \\ &= 259.08\end{aligned}$$

Standar Deviasi :

$$\begin{aligned}\sigma &= \sqrt{\frac{\sum (X_i - \bar{X})^2}{N - 1}} \\ &= \sqrt{\frac{(256.82 - 259.08)^2 + (253.67 - 259.08)^2 + \dots + (259.26 - 259.08)^2}{36 - 1}} \\ &= 4.85\end{aligned}$$

Standar Deviasi dari sub group :

$$\begin{aligned}\sigma_{\bar{x}} &= \frac{\sigma}{\sqrt{n}} \\ &= \frac{4.85}{\sqrt{6}} \\ &= 1.98\end{aligned}$$

k = jumlah subgroup = 6

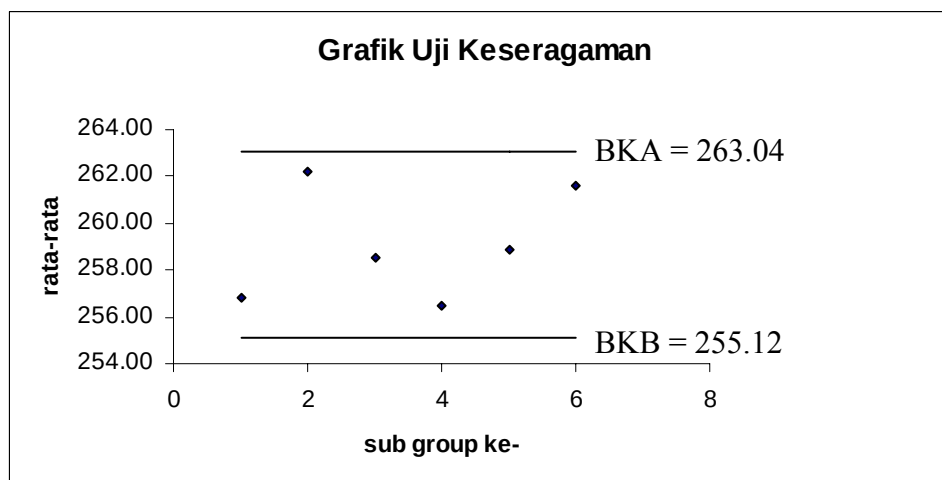
n = jumlah data tiap subgroup = 6

N = jumlah data = 36

Tingkat kepercayaan : 95% (C = 2)

$$BKA = \bar{X} + c * \sigma_{\bar{x}} = 259.08 + 2 * 1.98 = 263.04$$

$$BKB = \bar{X} - c * \sigma_{\bar{x}} = 259.08 - 2 * 1.98 = 255.12$$



Berdasarkan hasil perhitungan dan grafik uji keseragaman diatas, dapat disimpulkan bahwa data seragam, karena rata-rata dari sub grup masih berada di daerah BKA dan BKB.

Uji Kecukupan

Operasi Potong Pipa Pipa Screw 1

Tingkat Kepercayaan : 95% (c = 2)

Tingkat Ketelitian = 5%

$$\sum X_i = 9326.84$$

$$\sum (X_i)^2 = 86989944.39$$

$$\sum X_i^2 = 2417211.88$$

$$\begin{aligned} N' &= \left(\frac{\frac{c}{\alpha} \sqrt{N \sum X_i^2 - (\sum X_i)^2}}{\sum X_i} \right)^2 \\ &= \left(\frac{\frac{2}{0.05} \sqrt{36 * 2417211.88 - 86989944.39}}{9326.84} \right)^2 \\ &= 0.545 \end{aligned}$$

Karena $N' < N$ ($0.136 < 36$), maka data cukup.

Uji Kenormalan

Operasi Potong Pipa Badan (Produk E)

No (i)	Waktu operasi	Sx	Z	Fx	$ Sx - Fx $
1	294.12	0.063	-1.455	0.073	0.010
2	294.79	0.125	-1.394	0.082	0.043
3	296.45	0.188	-1.244	0.107	0.081
4	301.28	0.250	-0.808	0.210	0.040
5	305.49	0.313	-0.427	0.335	0.022
6	307.33	0.375	-0.261	0.397	0.022
7	307.37	0.438	-0.257	0.398	0.039
8	309.94	0.500	-0.025	0.490	0.010
9	311.55	0.563	0.120	0.548	0.015
10	311.74	0.625	0.137	0.555	0.070
11	312.51	0.688	0.207	0.582	0.106
12	315.82	0.750	0.506	0.694	0.056
13	316.51	0.813	0.568	0.715	0.097
14	317.07	0.875	0.619	0.732	0.143
15	325.3	0.938	1.363	0.913	0.024
16	336.24	1.000	2.351	0.991	0.009

H_0 : data berdistribusi normal

H_1 : data tidak berdistribusi normal

$$\begin{aligned}\mu &= \frac{\sum \text{waktu operasi}}{n} \\ &= \frac{294.12 + 294.79 + \dots + 336.24}{16} \\ &= 310.22\end{aligned}$$

$$\begin{aligned}\sigma &= \sqrt{\frac{\sum (x - \mu)^2}{n - 1}} \\ &= \sqrt{\frac{(294.12 - 310.22) + (294.79 - 310.22) + \dots + (336.24 - 310.22)}{16 - 1}} \\ &= 11.067\end{aligned}$$

Contoh perhitungan untuk data no 1 (i = 1)

$$\begin{aligned}Sx &= \frac{i}{n} \\ &= \frac{1}{16} \\ &= 0.063\end{aligned}$$

$$\begin{aligned}
 Z &= \frac{x - \mu}{\sigma} \\
 &= \frac{294.12 - 310.22}{0.063} \\
 &= -1.455
 \end{aligned}$$

$$F_x = P(z) = 0.073$$

$$\begin{aligned}
 d &= \max |S_x - F_x| \\
 &= 0.143
 \end{aligned}$$

$$d_{(n,\alpha)} = 0.33$$

$$\text{wilayah kritis } d > d_{(n,\alpha)} \rightarrow 0.143 < 0.33$$

keputusan : terima H_0

Kesimpulan : data berdistribusi normal

Tabel Data Permintaan Produk Selama 2 Tahun

Bulan	Data Permintaan (Unit)					Total (Unit)
	Screw Conveyor U 5 Meter	Screw Conveyor U 7.5 Meter	Screw Conveyor U 10 Meter	Screw 5 Meter	Screw Extruder	
Aug-02	8	20	13	7	6	54
Sep-02	7	22	11	9	7	56
Oct-02	13	23	12	6	7	61
Nov-02	15	19	9	13	8	64
Dec-02	11	23	13	9	5	61
Jan-03	14	15	16	8	6	59
Feb-03	12	25	20	7	1	65
Mar-03	13	24	16	11	3	67
Apr-03	15	19	17	7	8	66
May-03	10	24	12	9	4	59
Jun-03	10	13	16	7	8	54
Jul-03	12	19	17	11	9	68
Aug-03	15	25	14	10	8	72
Sep-03	10	24	15	8	11	68
Oct-03	11	21	13	9	9	63
Nov-03	14	25	18	12	10	79
Dec-03	13	20	11	10	8	62
Jan-04	16	23	15	9	0	63
Feb-04	14	25	20	10	4	73
Mar-04	17	21	17	12	9	76
Apr-04	15	28	18	8	10	79
May-04	17	19	13	12	0	61
Jun-04	16	24	17	14	6	77
Jul-04	19	27	15	11	10	82
Total	303	529	365	223	188	1589

Tabel Data Total Permintaan Semua Produk Screw Conveyor Selama 2 Tahun

Bulan	Permintaan (Unit)
Aug-02	54
Sep-02	56
Oct-02	61
Nov-02	64
Dec-02	61
Jan-03	59
Feb-03	65
Mar-03	67
Apr-03	66
May-03	59
Jun-03	54
Jul-03	68

Bulan	Permintaan (Unit)
Aug-03	72
Sep-03	68
Oct-03	63
Nov-03	79
Dec-03	62
Jan-04	63
Feb-04	73
Mar-04	76
Apr-04	79
May-04	61
Jun-04	77
Jul-04	82

$$\begin{aligned}
 \text{Rata - rata}(\bar{X}) &= \frac{\sum X}{n} \\
 &= \frac{1589}{24} \\
 &= 66.208
 \end{aligned}$$

$$\begin{aligned}
 \text{S tan dar deviasi}(S) &= \sqrt{\frac{(X_i - \bar{X})^2}{n - 1}} \\
 &= \sqrt{\frac{((54 - 66.208)^2 + (56 - 66.208)^2 + \dots + (82 - 66.208)^2)}{24 - 1}} \\
 &= 8.097
 \end{aligned}$$

$$\begin{aligned}
 \text{Coefficien Variancy} &= \frac{S}{\bar{X}} \\
 &= \frac{8.097}{66.208} \\
 &= 0.122
 \end{aligned}$$

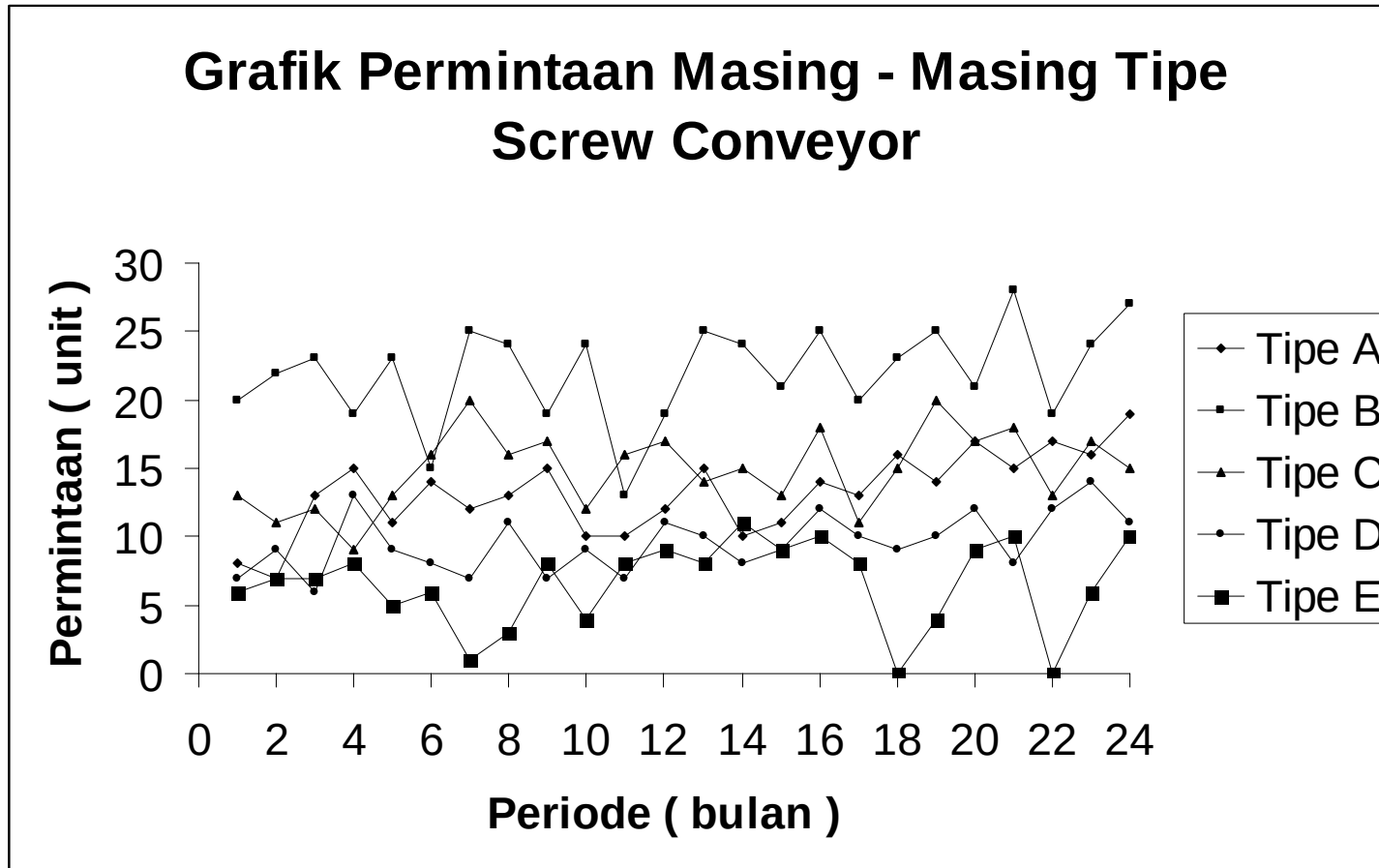
Karena Coefficien Variansi ≤ 0.2 maka data mengikuti pola stasioner.

Metode peramalan yang dipakai :

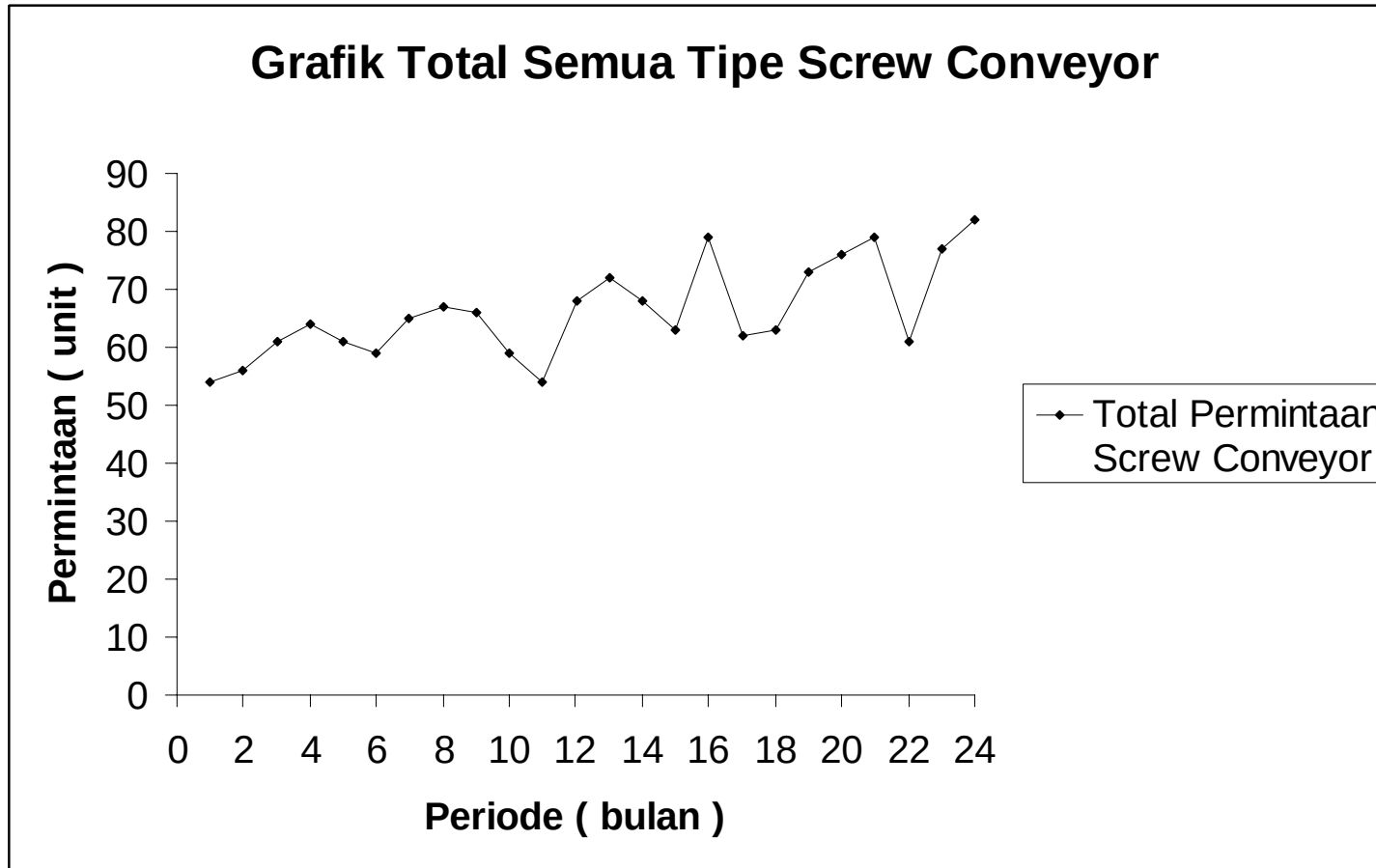
1. Simple Average
2. Single Moving Average
3. Weighted Moving Average
4. Single Exponential Smoothing
5. Regresi Konstan

Ukuran kesalahan yang dipakai adalah MAD

Berikut ini adalah grafik permintaan masing-masing jenis screw selama 2 tahun terakhir :



Berikut ini adalah grafik total permintaan semua tipe screw selama 2 tahun terakhir :



Tabel Nilai MAD Berdasarkan Masing-Masing Metode Peramalan

No	Metode Peramalan	Keterangan	MAD
1	Simple Average	-	6.837
2	Single Moving Average	M = 1	6.608
		M = 2	7.431
		M = 3	6.952
		M = 4	6.412
		M = 5	6.431
		M = 6	7.064
		M = 7	6.983
		M = 8	6.984
		M = 9	7.229
		M = 10	7.721
		M = 11	7.776
		M = 12	7.868
		M = 13	7.804
		M = 14	8.221
		M = 15	9.14
		M = 16	8.109
		M = 17	9.134
		M = 18	10.916
		M = 19	11.421
		M = 20	11.362
		M = 21	10.38
		M = 22	13.977
		M = 23	16.487

No	Metode Peramalan	Keterangan	MAD
3	Weight Moving Average	M = 2 (1, 2)	7.196
		M = 3 (1, 2, 3)	6.936
		M = 4 (1, 2, 3, 4)	6.72
		M = 5 (1, 2, 3, 4, 5)	6.842
		M = 6 (1, 2, 3, 4, 5, 6)	7.111
		M = 7 (1, 2, 3, 4, 5, 6, 7)	7.18
		M = 8 (1, 2, 3, 4, 5, 6, 7, 8)	7.213
		M = 9 (1, 2, 3, 4, 5, 6, 7, 8, 9)	7.422
		M = 10 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)	7.658
		M = 11 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11)	7.622
		M = 12 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)	7.711
		M = 13 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13)	7.559
		M = 14 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14)	7.903
		M = 15 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15)	8.713
		M = 16 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16)	7.951
		M = 17 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17)	8.612
		M = 18 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18)	9.787
		M = 19 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19)	10.292
		M = 20 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20)	10.438
		M = 21 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21)	9.917
		M = 22 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22)	11.618
		M = 23 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23)	13.836
4	Single Exponential Smoothing	alpha = 0.5	6.409
5	Regresi Konstan		6.576

Peramalan dengan metoda Simple Average

[illegible]

Month	Actual Data	Forecast by SA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
Aug-04		66.208							
Sep-04		66.208							
Oct-04		66.208							
Nov-04		66.208							
Dec-04		66.208							
Jan-04		66.208							
Feb-04		66.208							
Mar-04		66.208							
Apr-04		66.208							
May-04		66.208							
Jun-04		66.208							
Jul-04		66.208							
CFE		125.349							
MAD		6.837							
MSE		70.804							
MAPE		9.686							
Trk.Signal		18.335							
R-square		0.660							

Peramalan dengan metoda Single Moving Average ($M = 4$)

Month	Actual Data	Forecast by 4-MA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
Aug-02	54								
Sep-02	56								
Oct-02	61								
Nov-02	64								
Dec-02	61	58.75	2.25	2.25	2.250	5.063	3.689	1.000	
Jan-03	59	60.5	-1.5	0.75	1.875	3.656	3.115	0.400	0.906
Feb-03	65	61.25	3.75	4.5	2.500	7.125	4.000	1.800	0.538
Mar-03	67	62.25	4.75	9.25	3.063	10.984	4.772	3.020	0.698
Apr-03	66	63	3	12.25	3.050	10.588	4.727	4.016	0.865
May-03	59	64.25	-5.25	7	3.417	13.417	5.422	2.049	0.416
Jun-03	54	64.25	-10.25	-3.25	4.393	26.509	7.359	-0.740	0.198
Jul-03	68	61.5	6.5	3.25	4.656	28.477	7.634	0.698	0.156
Aug-03	72	61.75	10.25	13.5	5.278	36.986	8.368	2.558	0.180
Sep-03	68	63.25	4.75	18.25	5.225	35.544	8.230	3.493	0.222
Oct-03	63	65.5	-2.5	15.75	4.977	32.881	7.842	3.164	0.221
Nov-03	79	67.75	11.25	27	5.500	40.688	8.375	4.909	0.258
Dec-03	62	70.5	-8.5	18.5	5.731	43.115	8.786	3.228	0.294
Jan-04	63	68	-5	13.5	5.679	41.821	8.725	2.377	0.305
Feb-04	73	66.75	6.25	19.75	5.717	41.638	8.714	3.455	0.308
Mar-04	76	69.25	6.75	26.5	5.781	41.883	8.725	4.584	0.324
Apr-04	79	68.5	10.5	37	6.059	45.904	8.993	6.107	0.326
May-04	61	72.75	-11.75	25.25	6.375	51.024	9.564	3.961	0.336
Jun-04	77	72.25	4.75	30	6.289	49.526	9.385	4.770	0.363
Jul-04	82	73.25	8.75	38.75	6.413	50.878	9.449	6.043	0.370

Month	Actual Data	Forecast by 4-MA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
Aug-04		74.75							
Sep-04		74.75							
Oct-04		74.75							
Nov-04		74.75							
Dec-04		74.75							
Jan-04		74.75							
Feb-04		74.75							
Mar-04		74.75							
Apr-04		74.75							
May-04		74.75							
Jun-04		74.75							
Jul-04		74.75							
CFE		38.750							
MAD		6.413							
MSE		50.878							
MAPE		9.449							
Trk.Signal		6.043							
R-square		0.370							

Permalan dengan metode Weight Moving Average (M = 4 ; 1, 2, 3, 4)

Month	Actual Data	Forecast by 4-WMA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
Aug-02	54								
Sep-02	56								
Oct-02	61								
Nov-02	64								
Dec-02	61	60.5	0.5	0.500	0.500	0.250	0.820	1.000	
Jan-03	59	61.4	-2.4	-1.900	1.450	3.005	2.444	-1.310	
Feb-03	65	60.8	4.2	2.300	2.367	7.883	3.783	0.972	0.117
Mar-03	67	62.3	4.7	7.000	2.950	11.435	4.591	2.373	0.353
Apr-03	66	64.2	1.8	8.800	2.720	9.796	4.218	3.235	0.516
May-03	59	65.4	-6.4	2.400	3.333	14.990	5.323	0.720	0.314
Jun-03	54	63.3	-9.3	-6.900	4.186	25.204	7.023	-1.648	0.204
Jul-03	68	59.2	8.8	1.900	4.763	31.734	7.763	0.399	0.181
Aug-03	72	61.8	10.2	12.100	5.367	39.768	8.474	2.255	0.185
Sep-03	68	65.9	2.1	14.200	5.040	36.232	7.936	2.817	0.235
Oct-03	63	67.8	-4.8	9.400	5.018	35.033	7.907	1.873	0.285
Nov-03	79	66.8	12.2	21.600	5.617	44.517	8.535	3.846	0.252
Dec-03	62	71.3	-9.3	12.300	5.900	47.745	9.032	2.085	0.313
Jan-04	63	67.9	-4.9	7.400	5.829	46.050	8.943	1.270	0.325
Feb-04	73	65.9	7.1	14.500	5.913	46.341	8.995	2.452	0.311
Mar-04	76	68.4	7.6	22.100	6.019	47.054	9.058	3.672	0.309
Apr-04	79	71.1	7.9	30.000	6.129	47.958	9.113	4.894	0.325
May-04	61	75.3	-14.3	15.700	6.583	56.654	9.909	2.385	0.386
Jun-04	77	70.6	6.4	22.100	6.574	55.828	9.825	3.362	0.381
Jul-04	82	72.5	9.5	31.600	6.720	57.549	9.913	4.702	0.368

Month	Actual Data	Forecast by 4-WMA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
Aug-04		76							
Sep-04		76							
Oct-04		76							
Nov-04		76							
Dec-04		76							
Jan-04		76							
Feb-04		76							
Mar-04		76							
Apr-04		76							
May-04		76							
Jun-04		76							
Jul-04		76							
CFE		31.59999							
MAD		6.720001							
MSE		57.54901							
MAPE		9.913128							
Trk.Signal		4.702378							
R-square		0.3682057							
		m=4							
		W(1)=1							
		W(2)=2							
		W(3)=3							
		W(4)=4							

Peramalan dengan metode Single Exponential Smoothing ($\alpha = 0.5$)

Month	Actual Data	Forecast by SES	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
Aug-02	54								
Sep-02	56	54	2.000	2.000	2.000	4.000	3.571	1.000	
Oct-02	61	55	6.000	8.000	4.000	20.000	6.704	2.000	
Nov-02	64	58	6.000	14.000	4.667	25.334	7.594	3.000	
Dec-02	61	61	0.000	14.001	3.500	19.001	5.696	4.000	
Jan-03	59	61	-2.000	12.001	3.200	16.001	5.235	3.750	
Feb-03	65	60	5.000	17.001	3.500	17.500	5.644	4.857	
Mar-03	67	62.5	4.500	21.501	3.643	17.893	5.797	5.902	
Apr-03	66	64.750	1.250	22.751	3.344	15.852	5.310	6.804	
May-03	59	65.375	-6.375	16.376	3.681	18.606	5.920	4.449	
Jun-03	54	62.188	-8.188	8.189	4.131	23.449	6.844	1.982	0.804
Jul-03	68	58.094	9.906	18.095	4.656	30.238	7.546	3.886	0.775
Aug-03	72	63.047	8.953	27.048	5.014	34.398	7.954	5.394	0.661
Sep-03	68	67.523	0.477	27.525	4.665	31.770	7.396	5.900	0.741
Oct-03	63	67.762	-4.762	22.763	4.672	31.120	7.408	4.872	0.807
Nov-03	79	65.381	13.619	36.382	5.269	41.411	8.063	6.905	0.586
Dec-03	62	72.190	-10.190	26.192	5.576	45.312	8.586	4.697	0.682
Jan-04	63	67.095	-4.095	22.097	5.489	43.634	8.464	4.026	0.693
Feb-04	73	65.048	7.952	30.049	5.626	44.723	8.599	5.341	0.652
Mar-04	76	69.024	6.976	37.025	5.697	44.930	8.629	6.499	0.622
Apr-04	79	72.512	6.488	43.514	5.737	44.789	8.608	7.585	0.613
May-04	61	75.756	-14.756	28.758	6.166	53.024	9.350	4.664	0.687
Jun-04	77	68.378	8.622	37.380	6.278	53.993	9.434	5.954	0.646
Jul-04	82	72.689	9.311	46.691	6.410	55.415	9.518	7.285	0.602

Month	Actual Data	Forecast by SES	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
Aug-04		77.344							
Sep-04		77.344							
Oct-04		77.344							
Nov-04		77.344							
Dec-04		77.344							
Jan-04		77.344							
Feb-04		77.344							
Mar-04		77.344							
Apr-04		77.344							
May-04		77.344							
Jun-04		77.344							
Jul-04		77.344							
CFE		46.691							
MAD		6.409							
MSE		55.414							
MAPE		9.517							
Trk.Signal		7.284							
R-square		0.602							
		Alpha=0.500							
		F(0)=54							

Periode	Permintaan (Yt) (Unit)	Peramalan (Yt') (Unit)	$Y_t - Y_t'$	$ Y_t - Y_t' $
Aug-02	54	66.208	-12.208	12.208
Sep-02	56	66.208	-10.208	10.208
Oct-02	61	66.208	-5.208	5.208
Nov-02	64	66.208	-2.208	2.208
Dec-02	61	66.208	-5.208	5.208
Jan-03	59	66.208	-7.208	7.208
Feb-03	65	66.208	-1.208	1.208
Mar-03	67	66.208	0.792	0.792
Apr-03	66	66.208	-0.208	0.208
May-03	59	66.208	-7.208	7.208
Jun-03	54	66.208	-12.208	12.208
Jul-03	68	66.208	1.792	1.792
Aug-03	72	66.208	5.792	5.792
Sep-03	68	66.208	1.792	1.792
Oct-03	63	66.208	-3.208	3.208
Nov-03	79	66.208	12.792	12.792
Dec-03	62	66.208	-4.208	4.208
Jan-04	63	66.208	-3.208	3.208
Feb-04	73	66.208	6.792	6.792
Mar-04	76	66.208	9.792	9.792
Apr-04	79	66.208	12.792	12.792
May-04	61	66.208	-5.208	5.208
Jun-04	77	66.208	10.792	10.792
Jul-04	82	66.208	15.792	15.792
Aug-04		66.208		
Sep-04		66.208		
Oct-04		66.208		
Nov-04		66.208		
Dec-04		66.208		
Jan-04		66.208		
Feb-04		66.208		
Mar-04		66.208		
Apr-04		66.208		
May-04		66.208		
Jun-04		66.208		
Jul-04		66.208		
				157.832

$$\begin{aligned}
 MAD &= \frac{|Y_t - Y_t'|}{N} \\
 &= \frac{157.832}{24} \\
 &= 6.576
 \end{aligned}$$

Persentase jumlah permintaan produk pada divisi *Screw Conveyor*

No	Produk	Permintaan (unit/1 tahun)	Persentase Permintaan (%)	Kumulatif persentase Permintaan (%)
1	Screw Conveyor 7.5 meter	282	29.75	29.75
2	Screw Conveyor 10 meter	186	19.62	49.37
3	Screw Conveyor 5 meter	177	18.67	68.04
4	Screw 5 meter	125	13.19	81.22
5	Screw Extruder	85	8.97	90.19
6	Belt Conveyor	23	2.43	92.62
7	Rumah Screw 5 meter	20	2.11	94.73
8	Screw Dia	18	1.90	96.62
9	Rumah Screw 2.5 meter	15	1.58	98.21
10	Hopper	9	0.95	99.16
11	Bucket Elevator	8	0.84	100.00
Total		948		

Contoh perhitungan : .

Screw Conveyor 7.5 meter

$$\begin{aligned}
 \text{persentase permintaan} &= \frac{\text{jumlah permintaan produk i}}{\text{total permintaan semua produk}} \times 100\% \\
 &= \frac{282}{948} \times 100\% \\
 &= 29.75\%
 \end{aligned}$$

Operasi	Operasi Yang Mengikuti	Bobot
A1	A2, A3, A4, A8, A9, A18, A30, A38, A42, A56, A70, A74	1890.4
A2	A3, A4, A8, A9, A18, A30, A38, A42, A56, A70, A74	1766.24
A3	A4, A8, A9, A18, A30, A38, A42, A56, A70, A74	1557.6
A4	A8, A9, A18, A30, A38, A42, A56, A70, A74	1183.84
A5	A8, A9, A18, A30, A38, A42, A56, A70, A74	1963.04
A6	A8, A9, A18, A30, A38, A42, A56, A70, A74	1731.68
A7	A8, A9, A18, A30, A38, A42, A56, A70, A74	1559.52
A8	A9, A18, A30, A38, A42, A56, A70, A74	1072.48
A9	A18, A30, A38, A42, A56, A70, A74	940.32
A10	A11, A12, A17, A18, A30, A38, A42, A56, A70, A74	1213.76
A11	A12, A17, A18, A30, A38, A42, A56, A70, A74	1118.08
A12	A17, A18, A30, A38, A42, A56, A70, A74	1091.84
A13	A14, A15, A16, A17, A18, A30, A38, A42, A56, A70, A74	1074.53
A14	A15, A16, A17, A18, A30, A38, A42, A56, A70, A74	1052.77
A15	A16, A17, A18, A30, A38, A42, A56, A70, A74	1019.84
A16	A16, A17, A18, A30, A38, A42, A56, A70, A74	993.92
A17	A18, A30, A38, A42, A56, A70, A74	957.76
A18	A30, A38, A42, A56, A70, A74	887.84
A19	A20, A23, A24, A29, A30, A38, A42, A56, A70, A74	4573.92
A20	A23, A24, A29, A30, A38, A42, A56, A70, A74	4484.48
A21	A22, A23, A24, A29, A30, A38, A42, A56, A70, A74	5067.04
A22	A23, A24, A29, A30, A38, A42, A56, A70, A74	4892.64
A23	A24, A29, A30, A38, A42, A56, A70, A74	4191.2
A24	A29, A30, A38, A42, A56, A70, A74	3412.32
A25	A26, A27, A28, A29, A30, A38, A42, A56, A70, A74	6893.6
A26	A27, A28, A29, A30, A38, A42, A56, A70, A74	5839.52
A27	A28, A29, A30, A38, A42, A56, A70, A74	2858.24
A28	A29, A30, A38, A42, A56, A70, A74	2449.28
A29	A30, A38, A42, A56, A70, A74	2123.68
A30	A38, A42, A56, A70, A74	859.2
A31	A32, A33, A37, A38, A42, A56, A70, A74	2039.08
A32	A33, A37, A38, A42, A56, A70, A74	1744.48
A33	A37, A38, A42, A56, A70, A74	1637.92
A34	A35, A36, A37, A38, A42, A56, A70, A74	1161.76
A35	A36, A37, A38, A42, A56, A70, A74	1138.4
A36	A37, A38, A42, A56, A70, A74	1117.6
A37	A38, A42, A56, A70, A74	1023.84
A38	A42, A56, A70, A74	884.64
A39	A40, A41, A42, A56, A70, A74	605.6
A40	A41, A42, A56, A70, A74	497.12
A41	A42, A56, A70, A74	403.36
A42	A56, A70, A74	263.52
A43	A44, A56, A70, A74	361.92
A44	A56, A70, A74	295.36
A45	A46, A47, A55, A56, A70, A74	461.6
A46	A47, A55, A56, A70, A74	395.04
A47	A55, A56, A70, A74	272.48
A48	A49, A50, A54, A55, A56, A70, A74	973.76

Operasi	Operasi Yang Mengikuti	Bobot
A49	A50, A54, A55, A56, A70, A74	876.48
A50	A54, A55, A56, A70, A74	419.52
A51	A52, A53, A54, A55, A56, A70, A74	390.24
A52	A53, A54, A55, A56, A70, A74	361.92
A53	A54, A55, A56, A70, A74	291.2
A54	A55, A56, A70, A74	263.68
A55	A56, A70, A74	219.68
A56	A70, A74	172.8
A57	A58, A59, A60, A69, A70, A74	800
A58	A59, A60, A69, A70, A74	768
A59	A60, A69, A70, A74	673.28
A60	A69, A70, A74	426.24
A61	A62, A63, A64, A68, A69, A70, A74	1314.46
A62	A63, A64, A68, A69, A70, A74	1181.34
A63	A64, A68, A69, A70, A74	1059.74
A64	A68, A69, A70, A74	760.22
A65	A66, A67, A68, A69, A70, A74	943.26
A66	A67, A68, A69, A70, A74	902.3
A67	A68, A69, A70, A74	811.42
A68	A69, A70, A74	661.66
A69	A70, A74	317.44
A70	A74	158.72
A71	A72, A73, A74	677.12
A72	A73, A74	583.68
A73	A74	346.88
A74	-	90.88

Operasi	Operasi Yang Mengikuti	Bobot
B1	B2, B3, B4, B8, B9, B18, B27, B54, B62, B66, B70, B87, B101, B105	3960.1
B2	B3, B4, B8, B9, B18, B27, B54, B62, B66, B70, B87, B101, B105	3793.7
B3	B4, B8, B9, B18, B27, B54, B62, B66, B70, B87, B101, B105	3454.6
B4	B8, B9, B18, B27, B54, B62, B66, B70, B87, B101, B105	2847.3
B5	B6, B7, B8, B9, B18, B27, B54, B62, B66, B70, B87, B101, B105	4113.5
B6	B7, B8, B9, B18, B27, B54, B62, B66, B70, B87, B101, B105	3737.5
B7	B8, B9, B18, B27, B54, B62, B66, B70, B87, B101, B105	3457.7
B8	B9, B18, B27, B54, B62, B66, B70, B87, B101, B105	2666.3
B9	B9, B18, B27, B54, B62, B66, B70, B87, B101, B105	2451.5
B10	B11, B12, B17, B18, B27, B54, B62, B66, B70, B87, B101, B105	2895.9
B11	B12, B17, B18, B27, B54, B62, B66, B70, B87, B101, B105	2740.4
B12	B17, B18, B27, B54, B62, B66, B70, B87, B101, B105	2697.8
B13	B14, B15, B16, B17, B18, B27, B54, B62, B66, B70, B87, B101, B105	2669.7
B14	B15, B16, B17, B18, B27, B54, B62, B66, B70, B87, B101, B105	2634.3
B15	B16, B17, B18, B27, B54, B62, B66, B70, B87, B101, B105	2580.8
B16	B17, B18, B27, B54, B62, B66, B70, B87, B101, B105	2538.6
B17	B18, B27, B54, B62, B66, B70, B87, B101, B105	2479.9
B18	B27, B54, B62, B66, B70, B87, B101, B105	2366.3
B19	B20, B21, B22, B26, B27, B54, B62, B66, B70, B87, B101, B105	3828.2
B20	B21, B22, B26, B27, B54, B62, B66, B70, B87, B101, B105	3661.8
B21	B22, B26, B27, B54, B62, B66, B70, B87, B101, B105	3322.8
B22	B26, B27, B54, B62, B66, B70, B87, B101, B105	2715.4
B23	B24, B25, B26, B27, B54, B62, B66, B70, B87, B101, B105	3981.6
B24	B25, B26, B27, B54, B62, B66, B70, B87, B101, B105	3605.7
B25	B26, B27, B54, B62, B66, B70, B87, B101, B105	3325.9
B26	B27, B54, B62, B66, B70, B87, B101, B105	2534.5
B27	B54, B62, B66, B70, B87, B101, B105	2319.7
B28	B29, B32, B33, B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	7052
B29	B32, B33, B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	6906.6
B30	B31, B32, B33, B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	7853.3
B31	B32, B33, B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	7569.9
B32	B33, B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	6430.1
B33	B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	5519.5
B34	B35, B36, B37, B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	8729.2
B35	B36, B37, B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	7444.6
B36	B37, B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	4308.7
B37	B38, B50, B53, B54, B62, B66, B70, B87, B101, B105	3810.3
B38	B50, B53, B54, B62, B66, B70, B87, B101, B105	3425.5
B39	B40, B43, B44, B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	7052
B40	B43, B44, B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	6906.6
B41	B42, B43, B44, B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	7141.7
B42	B43, B44, B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	7000
B43	B44, B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	6430.1
B44	B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	5519.5
B45	B46, B47, B48, B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	8729.2
B46	B47, B48, B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	7444.6
B47	B48, B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	4308.7
B48	B49, B50, B53, B54, B62, B66, B70, B87, B101, B105	3810.3
B49	B50, B53, B54, B62, B66, B70, B87, B101, B105	3425.5
B50	B53, B54, B62, B66, B70, B87, B101, B105	1994.7
B51	B52, B53, B54, B62, B66, B70, B87, B101, B105	2529.3
B52	B53, B54, B62, B66, B70, B87, B101, B105	2385.5
B53	B54, B62, B66, B70, B87, B101, B105	1822.3

Operasi	Operasi Yang Mengikuti	Bobot
B54	B62, B66, B70, B87, B101, B105	1764.9
B55	B56, B57, B61, B62, B66, B70, B87, B101, B105	3616.1
B56	B57, B61, B62, B66, B70, B87, B101, B105	3132.5
B57	B61, B62, B66, B70, B87, B101, B105	2959.3
B58	B59, B60, B61, B62, B66, B70, B87, B101, B105	2185.6
B59	B60, B61, B62, B66, B70, B87, B101, B105	2147.6
B60	B61, B62, B66, B70, B87, B101, B105	2113.8
B61	B62, B66, B70, B87, B101, B105	1961.4
B62	B66, B70, B87, B101, B105	1559
B63	B64, B65, B66, B70, B87, B101, B105	845.52
B64	B65, B66, B70, B87, B101, B105	815.62
B65	B66, B70, B87, B101, B105	798.72
B66	B70, B87, B101, B105	725.92
B67	B68, B69, B70, B87, B101, B105	1264.9
B68	B69, B70, B87, B101, B105	1088.6
B69	B70, B87, B101, B105	936.26
B70	B87, B101, B105	709.02
B71	B72, B87, B101, B105	853.32
B72	B87, B101, B105	760.76
B73	B74, B75, B87, B101, B105	726.18
B74	B75, B87, B101, B105	679.9
B75	B87, B101, B105	580.32
B76	B77, B78, B86, B87, B101, B105	869.44
B77	B78, B86, B87, B101, B105	823.16
B78	B86, B87, B101, B105	723.58
B79	B80, B81, B85, B86, B87, B101, B105	1863.2
B80	B81, B85, B86, B87, B101, B105	1705.1
B81	B85, B86, B87, B101, B105	962.52
B82	B83, B84, B85, B86, B87, B101, B105	914.94
B83	B84, B85, B86, B87, B101, B105	868.92
B84	B85, B86, B87, B101, B105	754
B85	B86, B87, B101, B105	709.28
B86	B87, B101, B105	637.78
B87	B101, B105	561.6
B88	B89, B90, B91, B100, B101, B105	2600
B89	B90, B91, B100, B101, B105	2496
B90	B91, B100, B101, B105	2188.2
B91	B100, B101, B105	1385.3
B92	B93, B94, B95, B99, B100, B101, B105	4272.3
B93	B94, B95, B99, B100, B101, B105	3839.7
B94	B95, B99, B100, B101, B105	3444.5
B95	B99, B100, B101, B105	2471
B96	B97, B98, B99, B100, B101, B105	3065.9
B97	B98, B99, B100, B101, B105	2932.8
B98	B99, B100, B101, B105	2637.4
B99	B100, B101, B105	2150.7
B100	B101, B105	1031.7
B101	B105	515.84
B102	B103, B104, B105	2200.6
B103	B104, B105	1897
B104	B105	1127.4
B105	-	295.36

Operasi	Operasi Yang Mengikuti	Bobot
C1	C2, C3, C4, C8, C9, C18, C27, C54, C62, C66, C70, C87, C101, C105	2766.1
C2	C3, C4, C8, C9, C18, C27, C54, C62, C66, C70, C87, C101, C105	2626.4
C3	C4, C8, C9, C18, C27, C54, C62, C66, C70, C87, C101, C105	2391.7
C4	C8, C9, C18, C27, C54, C62, C66, C70, C87, C101, C105	1971.2
C5	C6, C7, C8, C9, C18, C27, C54, C62, C66, C70, C87, C101, C105	2847.8
C6	C7, C8, C9, C18, C27, C54, C62, C66, C70, C87, C101, C105	2587.5
C7	C8, C9, C18, C27, C54, C62, C66, C70, C87, C101, C105	2393.8
C8	C9, C18, C27, C54, C62, C66, C70, C87, C101, C105	1845.9
C9	C9, C18, C27, C54, C62, C66, C70, C87, C101, C105	1697.2
C10	C11, C12, C17, C18, C27, C54, C62, C66, C70, C87, C101, C105	2004.8
C11	C12, C17, C18, C27, C54, C62, C66, C70, C87, C101, C105	1897.2
C12	C17, C18, C27, C54, C62, C66, C70, C87, C101, C105	1867.7
C13	C14, C15, C16, C17, C18, C27, C54, C62, C66, C70, C87, C101, C105	1848.2
C14	C15, C16, C17, C18, C27, C54, C62, C66, C70, C87, C101, C105	1823.8
C15	C16, C17, C18, C27, C54, C62, C66, C70, C87, C101, C105	1786.7
C16	C17, C18, C27, C54, C62, C66, C70, C87, C101, C105	1757.5
C17	C18, C27, C54, C62, C66, C70, C87, C101, C105	1716.8
C18	C27, C54, C62, C66, C70, C87, C101, C105	1638.2
C19	C20, C21, C22, C26, C27, C54, C62, C66, C70, C87, C101, C105	2674.8
C20	C21, C22, C26, C27, C54, C62, C66, C70, C87, C101, C105	2535.1
C21	C22, C26, C27, C54, C62, C66, C70, C87, C101, C105	2300.4
C22	C26, C27, C54, C62, C66, C70, C87, C101, C105	1879.9
C23	C24, C25, C26, C27, C54, C62, C66, C70, C87, C101, C105	2756.5
C24	C25, C26, C27, C54, C62, C66, C70, C87, C101, C105	2496.2
C25	C26, C27, C54, C62, C66, C70, C87, C101, C105	2302.6
C26	C27, C54, C62, C66, C70, C87, C101, C105	1754.6
C27	C54, C62, C66, C70, C87, C101, C105	1606
C28	C29, C32, C33, C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	5560
C29	C32, C33, C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	5459.4
C30	C31, C32, C33, C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	6114.8
C31	C32, C33, C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	5918.6
C32	C33, C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	5129.5
C33	C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	4253.2
C34	C35, C36, C37, C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	7939.6
C35	C36, C37, C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	6753.8
C36	C37, C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	3399.8
C37	C38, C50, C53, C54, C62, C66, C70, C87, C101, C105	3169.8
C38	C50, C53, C54, C62, C66, C70, C87, C101, C105	2803.5
C39	C40, C43, C44, C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	5560
C40	C43, C44, C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	5459.4
C41	C42, C43, C44, C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	5622.1
C42	C43, C44, C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	5524
C43	C44, C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	5129.5
C44	C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	4253.2
C45	C46, C47, C48, C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	7939.6
C46	C47, C48, C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	6753.8
C47	C48, C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	3399.8
C48	C49, C50, C53, C54, C62, C66, C70, C87, C101, C105	3169.8
C49	C50, C53, C54, C62, C66, C70, C87, C101, C105	2803.5
C50	C53, C54, C62, C66, C70, C87, C101, C105	1381
C51	C52, C53, C54, C62, C66, C70, C87, C101, C105	1751
C52	C53, C54, C62, C66, C70, C87, C101, C105	1651.5
C53	C53, C54, C62, C66, C70, C87, C101, C105	1261.6

Operasi	Operasi Yang Mengikuti	Bobot
C54	C62, C66, C70, C87, C101, C105	1221.8
C55	C56, C57, C61, C62, C66, C70, C87, C101, C105	2503.4
C56	C57, C61, C62, C66, C70, C87, C101, C105	2168.6
C57	C61, C62, C66, C70, C87, C101, C105	2048.8
C58	C59, C60, C61, C62, C66, C70, C87, C101, C105	1513.1
C59	C60, C61, C62, C66, C70, C87, C101, C105	1486.8
C60	C61, C62, C66, C70, C87, C101, C105	1463.4
C61	C62, C66, C70, C87, C101, C105	1357.9
C62	C66, C70, C87, C101, C105	1079.3
C63	C64, C65, C66, C70, C87, C101, C105	585.36
C64	C65, C66, C70, C87, C101, C105	564.66
C65	C66, C70, C87, C101, C105	552.96
C66	C66, C70, C87, C101, C105	502.56
C67	C68, C69, C70, C87, C101, C105	875.7
C68	C69, C70, C87, C101, C105	753.66
C69	C70, C87, C101, C105	648.18
C70	C87, C101, C105	490.86
C71	C72, C87, C101, C105	601.56
C72	C87, C101, C105	526.68
C73	C74, C75, C87, C101, C105	508.14
C74	C75, C87, C101, C105	470.7
C75	C87, C101, C105	401.76
C76	C77, C78, C86, C87, C101, C105	607.32
C77	C78, C86, C87, C101, C105	569.88
C78	C86, C87, C101, C105	500.94
C79	C80, C81, C85, C86, C87, C101, C105	1289.9
C80	C81, C85, C86, C87, C101, C105	1180.4
C81	C85, C86, C87, C101, C105	666.36
C82	C83, C84, C85, C86, C87, C101, C105	633.42
C83	C84, C85, C86, C87, C101, C105	601.56
C84	C85, C86, C87, C101, C105	522
C85	C86, C87, C101, C105	491.04
C86	C87, C101, C105	441.54
C87	C101, C105	388.8
C88	C89, C90, C91, C100, C101, C105	1800
C89	C90, C91, C100, C101, C105	1728
C90	C91, C100, C101, C105	1514.9
C91	C100, C101, C105	959.04
C92	C93, C94, C95, C99, C100, C101, C105	2957.8
C93	C94, C95, C99, C100, C101, C105	2658.2
C94	C95, C99, C100, C101, C105	2384.6
C95	C99, C100, C101, C105	1710.7
C96	C97, C98, C99, C100, C101, C105	2122.6
C97	C98, C99, C100, C101, C105	2030.4
C98	C99, C100, C101, C105	1825.9
C99	C100, C101, C105	1489
C100	C101, C105	714.24
C101	C105	357.12
C102	C103, C104, C105	1523.5
C103	C104, C105	1313.3
C104	C105	780.48
C105	-	204.48

Operasi	Operasi Yang Mengikuti	Bobot
D1	D2, D5, D6, D11	2786.04
D2	D5, D6, D11	2718.96
D3	D4, D5, D6, D11	3155.88
D4	D5, D6, D11	3025.08
D5	D6, D11	2499
D6	D11	1914.84
D7	D8, D9, D10, D11	4525.8
D8	D9, D10, D11	3735.24
D9	D10, D11	1499.28
D10	D11	1192.56
D11	-	948.36

Operasi	Operasi Yang Mengikuti	Bobot
E1	E2, E3, E7, E15, E24, E28, E40, E48	720.64
E2	E3, E7, E15, E24, E28, E40, E48	667.12
E3	E7, E15, E24, E28, E40, E48	501.44
E4	E5, E6, E7, E15, E24, E28, E40, E48	1169.52
E5	E6, E7, E15, E24, E28, E40, E48	1073.52
E6	E7, E15, E24, E28, E40, E48	638.96
E7	E15, E24, E28, E40, E48	480.72
E8	E9, E10, E14, E15, E24, E28, E40, E48	485.04
E9	E10, E14, E15, E24, E28, E40, E48	471.12
E10	E14, E15, E24, E28, E40, E48	435.76
E11	E12, E13, E14, E15, E24, E28, E40, E48	552.64
E12	E13, E14, E15, E24, E28, E40, E48	506.64
E13	E14, E15, E24, E28, E40, E48	437.44
E14	E15, E24, E28, E40, E48	422
E15	E24, E28, E40, E48	410.96
E16	E17, E19, E23, E24, E28, E40, E48	447.68
E17	E19, E23, E24, E28, E40, E48	434.16
E18	E19, E23, E24, E28, E40, E48	423.76
E19	E23, E24, E28, E40, E48	410.24
E20	E21, E22, E23, E24, E28, E40, E48	517.04
E21	E22, E23, E24, E28, E40, E48	468.48
E22	E23, E24, E28, E40, E48	457.04
E23	E24, E28, E40, E48	390
E24	E28, E40, E48	351.28
E25	E26, E27, E28, E40, E48	500.24
E26	E27, E28, E40, E48	446
E27	E28, E40, E48	399.12
E28	E40, E48	329.2
E29	E30, E33, E34, E39, E40, E48	1643.04
E30	E33, E34, E39, E40, E48	1598.32
E31	E32, E33, E34, E39, E40, E48	1889.6
E32	E33, E34, E39, E40, E48	1802.4
E33	E34, E39, E40, E48	1451.68
E34	E39, E40, E48	1234.88
E35	E36, E37, E38, E39, E40, E48	1950.16
E36	E37, E38, E39, E40, E48	1510.96
E37	E38, E39, E40, E48	830.64
E38	E39, E40, E48	705.04
E39	E40, E48	590.56
E40	E48	283.84
E41	E42, E43, E47, E48	1379.68
E42	E43, E47, E48	1256.96
E43	E47, E48	633.6
E44	E45, E46, E47, E48	439.2
E45	E46, E47, E48	427.52
E46	E47, E48	417.12
E47	E48	370.24
E48	-	246.4

Tabel Perhitungan Proporsi Jam Kerja Tersedia

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
I	Potong Pipa Screw 1	A	Gergaji Potong *	1 orang	5.59	16	89.44	2101.80	0.0425	492.15
	Potong As Pipa 1,2				10.90		174.40		0.0829	959.98
	Potong Pipa Screw 2	B			5.59	26	145.34		0.0691	800.17
	Potong As Pipa 1,2				10.90		283.40		0.1348	1560.98
	Potong Pipa Screw 2				5.59		145.34		0.0691	800.17
	Potong As Pipa 3				5.45		141.70		0.0674	780.49
	Potong As Drat	5.53			143.78	0.0684	792.07			
	Potong Pipa Screw 1	C			5.59	18	100.62		0.0478	553.52
	Potong As Pipa 1,2				10.90		196.20		0.0933	1080.41
	Potong Pipa Screw 2				5.59		100.62		0.0478	553.52
	Potong As Pipa 3				5.45		98.10		0.0466	539.62
	Potong As Drat	5.53			99.54	0.0473	547.73			
	Potong Pipa Screw 1	D			5.59	12	67.08		0.0319	369.40
	Potong As Pipa 1,2				10.90		130.80		0.0622	720.27
	Potong Pipa Badan	E			6.69	8	53.52		0.0254	294.13
	Potong Pipa Screw 1				5.59		44.72		0.0212	245.49
Potong As Pipa 1,2	10.90		87.20	0.0414	479.41					
II	Potong Badan	A	Las Plasma	1orang	3.28	16	52.48	7442.36	0.0070	81.06
	Potong Screw 1				65.88		1054.08		0.1416	1639.72
	Potong Badan	B			3.28	26	85.28		0.0114	132.01
	Potong Screw 1				49.41		1284.66		0.1726	1998.70
	Potong Screw 2				49.41		1284.66		0.1726	1998.70
	Potong Badan	C			3.28	18	59.04		0.0079	91.48
	Potong Screw 1				65.88		1185.84		0.1593	1844.69
	Potong Screw 2				65.88		1185.84		0.1593	1844.69

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)		
					(menit)							
II	Potong Screw 1	D	Las Plasma	1 orang	65.88	12	790.56	7442.36	0.1062	1229.79		
	Potong Badan	E			2.59	8	20.72		0.0027	31.26		
	Potong Screw 1				54.90		439.20		0.0590	683.22		
III	Potong Flens Rumah 1, 2	A	Las Plasma	1 orang	14.46	16	231.36	4487.64	0.0515	596.37		
	Potong Flens Keluar				5.98		95.68		0.0213	246.65		
	Potong Corong Keluar				2.26		36.16		0.0080	92.64		
	Potong Tutup Samping				18.60		297.60		0.0663	767.75		
	Potong Duduk Motor				6.78		108.48		0.0241	279.07		
	Potong Tutup 1 (buat lbg in)				3.30		52.80		0.0117	135.48		
	Potong Flens Masuk				6.08		97.28		0.0216	250.12		
	Potong Flens Rumah 3, 4	B			14.46	26	375.96		0.0837	969.24		
	Potong Flens Rumah 1, 2				14.46		375.96		0.0837	969.24		
	Potong Flens Keluar				5.98		155.48		0.0346	400.66		
	Potong Corong Keluar				2.26		58.76		0.0130	150.54		
	Potong Duduk As Drat				1.15		29.90		0.0066	76.42		
	Potong Tutup Samping				18.60		483.60		0.1077	1247.16		
	Potong Duduk Motor				6.78		176.28		0.0392	453.93		
	Potong Tutup 3 (as drat)				0.72		18.72		0.0041	47.47		
	Potong Tutup 1 (buat lbg in)				3.30		85.80		0.0191	221.17		
	Potong Flens Masuk				6.08		158.08		0.0352	407.61		
	Potong Flens Rumah 3, 4				C		14.46		18	260.28	0.0579	670.48
	Potong Flens Rumah 1, 2						14.46			260.28	0.0579	670.48
	Potong Flens Keluar						5.98			107.64	0.0239	276.76
	Potong Corong Keluar	2.26				40.68	0.0090			104.22		
	Potong Tutup Samping	18.60				334.80	0.0746			863.86		
	Potong Duduk As Drat	1.15				20.70	0.0046			53.26		
	Potong Duduk Motor	6.78				122.04	0.0271			313.81		
	Potong Tutup 3 (as drat)	0.72				12.96	0.0028			32.42		

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
III	Potong Tutup 1 (buat lbg in)	C	Las Plasma	1 orang	3.30	18	59.40	4656.92	0.0132	152.85
	Potong Flens Masuk				6.08		109.44		0.0243	281.39
	Potong Flens Rumah 1, 2	E			12.00	8	96.00		0.0213	246.65
	Potong Flens Keluar				6.07		48.56		0.0108	125.06
	Potong Duduk Motor				6.78		54.24		0.0120	138.96
	Potong Tutup Samping				15.34		122.72		0.0273	316.13
IV	Potong Badan 1,2	A	Potong Plat	1 orang	7.76	16	124.16	3458.68	0.0358	414.56
	Potong Corong Keluar				1.36		21.76		0.0062	71.79
	Potong Duduk P.Block				1.46		23.36		0.0067	77.58
	Potong Tutup 1,3				4.16		66.56		0.0192	222.33
	Potong Corong Masuk				1.77		28.32		0.0081	93.79
	Potong Plat Depan Kunci				2.00		32.00		0.0092	106.53
	Potong Plat Atas Kunci				8.32		133.12		0.0384	444.67
	Potong Cincin				2.56		40.96		0.0118	136.64
	Potong Plat Keping 1,2,3	5.84			93.44	0.0270	312.66			
	Potong Badan 3,4	B			6.40	26	166.40		0.0481	556.99
	Potong Badan 1,2				6.40		166.40		0.0481	556.99
	Potong Corong Keluar				1.36		35.36		0.0102	118.11
	Potong Duduk P.Block				1.46		37.96		0.0109	126.22
	Potong tutup 2,4				3.56		92.56		0.0267	309.18
	Potong Tutup 1,3				3.56		92.56		0.0267	309.18
	Potong Corong Masuk				1.77		46.02		0.0133	154.01
	Potong Plat Depan Kunci				4.00		104.00		0.0300	347.40
	Potong Plat Atas Kunci				16.64		432.64		0.1250	1447.50
	Potong Cincin				5.12		133.12		0.0384	444.67
	Potong Plat Keping 1,2,3				11.68		303.68		0.0878	1016.72

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
IV	Potong Badan 3,4	C	Potong Plat	1 orang	7.76	18	139.68	3458.68	0.0403	466.67
	Potong Badan 1,2				7.76		139.68		0.0403	466.67
	Potong Corong Keluar				1.36		24.48		0.0070	81.06
	Potong Duduk P.Block				1.46		26.28		0.0075	86.85
	Potong tutup 2,4				4.16		74.88		0.0216	250.12
	Potong Tutup 1,3				4.16		74.88		0.0216	250.12
	Potong Corong Masuk				1.77		31.86		0.0092	106.53
	Potong Plat Depan Kunci				4.00		72.00		0.0208	240.86
	Potong Plat Atas Kunci				16.64		299.52		0.0865	1001.67
	Potong Cincin				5.12		92.16		0.0266	308.02
	Potong Plat Keping 1,2,3				11.68		210.24		0.0607	702.90
	Potong Corong Masuk	1.74		13.92	0.0040	46.32				
	Potong Hopper	5.75		46.00	0.0132	152.85				
	Potong Corong Keluar	3.38		27.04	0.0078	90.32				
	Potong Duduk P.Block	1.46		11.68	0.0033	38.21				
V	Cetak Plat Depan Kunci	A	Manual cetakan	1 orang	5.92	16	94.72	3536.00	0.0267	309.18
	Cetak Plat Atas Kunci				7.60		121.60		0.0343	397.19
	Cetak Cincin				5.68		90.88		0.0257	297.60
	Cetak Plat Keping 1,2,3				14.80		236.80		0.0669	774.70
	Cetak Plat Atas Kunci	B			15.20	26	395.20		0.1117	1293.48
	Cetak Plat Depan Kunci				11.84		307.84		0.0870	1007.46
	Cetak Cincin				11.36		295.36		0.0835	966.93
	Cetak Plat Keping 1,2,3				29.60		769.60		0.2176	2519.80
	Cetak Plat Depan Kunci	C			11.84	18	213.12		0.0602	697.11
	Cetak Plat Atas Kunci				15.20		273.60		0.0773	895.13
	Cetak Cincin				11.36		204.48		0.0578	669.32
	Cetak Plat Keping 1,2,3				29.60		532.80		0.1506	1743.94

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
VI	Kerja Bangku Plat Depan Kunci	A	Manual gerinda	1 orang	15.44	16	247.04	6190.08 (65.43%)	0.0261	302.23
	Kerja Bangku Plat Atas Kunci				18.72		299.52		0.0316	365.92
	Kerja Bangku Cincin				9.36		149.76		0.0158	182.96
	Kerja Bangku Plat Keping 1,2,3				16.00		256.00		0.0270	312.66
	Kerja Bangku Plat Depan Kunci	B			30.88	802.88	0.0848		981.98	
	Kerja Bangku Plat Atas Kunci				37.44	973.44	0.1028		1190.42	
	Kerja Bangku Cincin				18.72	486.72	0.0514		595.21	
	Kerja Bangku Plat Keping 1,2,3				32.00	832.00	0.0879		1017.88	
	Kerja Bangku Plat Depan Kunci	C			30.88	555.84	0.0587		679.74	
	Kerja Bangku Plat Atas Kunci				37.44	673.92	0.0712		824.49	
	Kerja Bangku Cincin				18.72	336.96	0.0356		412.24	
	Kerja Bangku Plat Keping 1,2,3				32.00	576.00	0.0608		704.06	
	Pasang Cincin	A	Las		21.52	16	344.32	3269.76 (34.57%)	0.0364	421.51
	Pasang Plat atas Depan + Cincin				9.92		158.72		0.0167	193.38
	Pasang Cincin	B			43.04	26	1119.04		0.1183	1369.91
	Pasang Plat atas Depan + Cincin				19.84		515.84		0.0545	631.11
	Pasang Cincin	C			43.04	18	774.72		0.0819	948.40
	Pasang Plat atas Depan + Cincin				19.84		357.12		0.0377	436.56
VII	Bubut Screw	A	Bubut	1 orang	186.33	16	2981.28	17674.48	0.1686	1952.38
	Bubut Flens Masuk				28.56		456.96		0.0258	298.76
	Bubut Screw	B			241.22	26	6271.72		0.3548	4108.58
	Bubut Flens Masuk				28.56		742.56		0.0420	486.36
	Bubut Screw	C			372.66	18	6707.88		0.3795	4394.61
	Bubut Flens Masuk				28.56		514.08		0.0290	335.82
VIII	Bubut Screw	D	Bubut	1 orang	186.33	12	2235.96	3974.20	0.5626	6514.90
	Bubut Flens Rumah	E			54.32	8	434.56		0.1093	1265.69
	Bubut Screw				85.04		680.32		0.1711	1981.33
	Bubut Tutup Samping				77.92		623.36		0.1568	1815.74

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
IX	Potong & Bentuk Screw	A	Manual	1 orang	25.56	16	408.96	2758.28	0.1482	1716.15
	Potong & Bentuk Screw	B			38.34	26	996.84		0.3613	4183.85
	Potong & Bentuk Screw	C			51.12	18	920.16		0.3335	3861.93
	Potong & Bentuk Screw	D			25.56	12	306.72		0.1111	1286.53
	Potong & Bentuk Screw	E			15.70	8	125.60		0.0455	526.89
X	Bor Duduk P.Block	A	Bor	1 orang	5.86	16	93.76	2463.84	0.0380	440.04
	Bor Duduk Motor				8.74		139.84		0.0567	656.58
	Bor Plat Depan Kunci				6.80		108.80		0.0441	510.67
	Bor Plat Atas Kunci				6.16		98.56		0.0400	463.20
	Bor Duduk P.Block	B			5.86	26	152.36		0.0618	715.64
	Bor Duduk As Drat				2.80		72.80		0.0295	341.61
	Bor Duduk Motor				8.74		227.24		0.0922	1067.67
	Bor Plat Depan Kunci				13.60		353.60		0.1435	1661.73
	Bor Plat Atas Kunci	12.32			320.32	0.1300	1505.40			
	Bor Duduk P.Block	C			5.86	18	105.48		0.0428	495.62
	Bor Duduk As Drat				2.80		50.40		0.0204	236.23
	Bor Duduk Motor				8.74		157.32		0.0638	738.80
	Bor Plat Depan Kunci				13.60		244.80		0.0993	1149.89
	Bor Plat Atas Kunci	12.32			221.76	0.0900	1042.20			
	Bor Duduk Motor	E			8.74	8	69.92		0.0283	327.71
	Bor Duduk P.Block				5.86		46.88		0.0190	220.02
XI	Penyambungan Screw"	A	Las	1 orang	20.35	16	325.60	2186.48	0.1489	1724.26
	Penyambungan Screw"	B			29.60	26	769.60		0.3519	4075.00
	Penyambungan Screw"	C			40.70	18	732.60		0.3350	3879.30
	Penyambungan Screw"	D			20.35	12	244.20		0.1116	1292.32
	Penyambungan Screw"	E			14.31	8	114.48		0.0523	605.63

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)			
XII	Bubut Pipa 1	A	Bubut	1 orang	18.33	16	293.28	7863.32	0.0372	430.77			
	Bubut As Pipa 1,2				43.84		701.44		0.0892	1032.93			
	Bubut Pipa 1	B			18.33	26	476.58		0.0606	701.74			
	Bubut As Pipa 1,2				43.84		1139.84		0.1449	1677.94			
	Bubut Pipa 2				18.33		476.58		0.0606	701.74			
	Bubut As Pipa 3				21.92		569.92		0.0724	838.39			
	Bubut As Drat				21.66		563.16		0.0716	829.12			
	Bubut As Pipa 1,2	C			43.84	18	789.12		0.1003	1161.47			
	Bubut Pipa 1				18.33		329.94		0.0419	485.20			
	Bubut Pipa 2				18.33		329.94		0.0419	485.20			
	Bubut As Pipa 3				21.92		394.56		0.0501	580.15			
	Bubut As Drat				21.66		389.88		0.0495	573.21			
	Bubut Pipa 1	D			18.33	12	219.96		0.0279	323.08			
	Bubut As Pipa 1,2				43.84		526.08		0.0669	774.70			
	Bubut Badan Pipa	E			20.71	8	165.68		0.0210	243.18			
	Bubut Pipa 1				18.33		146.64		0.0186	215.38			
Bubut As Pipa 1,2	43.84		350.72	0.0446	516.46								
XIII	Tekuk Badan 1,2	A	Tekuk	1 regu (3 orang)	13.04	16	208.64	2152.8 (42.22%)	0.0969	473.75			
	Tekuk Tutup 1,3				7.66		122.56		0.0569	278.18			
	Tekuk Badan 3,4	B			13.04	26	339.04		0.1574	769.54			
	Tekuk Badan 1,2				13.04		339.04		0.1574	769.54			
	Tekuk Tutup 2,4				7.66		199.16		0.0925	452.23			
	Tekuk Tutup 1,3				7.66		199.16		0.0925	452.23			
	Tekuk Badan 3,4	C			13.04	18	234.72		0.1090	532.90			
	Tekuk Badan 1,2				13.04		234.72		0.1090	532.90			
	Tekuk Tutup 2,4				7.66		137.88		0.0640	312.90			
	Tekuk Tutup 1,3				7.66		137.88		0.0640	312.90			
	Tekuk Corong Keluar				A		Tekuk		1 orang	2.06	16	32.96	192.8 (10.14%)

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
XIII	Tekuk Corong Keluar	B	Tekuk	1 orang	2.06	26	53.56	192.8 (10.14%)	0.2778	326.19
	Tekuk Corong Keluar	C			2.06	18	37.08		0.1923	225.80
	Tekuk Hopper	E			8.65	8	69.20		0.3589	421.42
	Rol Badan 1,2	A	Rol Besar	1 regu (3 orang)	23.36	16	373.76	2429.44 (47.64%)	0.1538	848.47
	Rol Badan 3,4	B			23.36	26	607.36		0.2500	1379.17
	Rol Badan 1,2				23.36		607.36		0.2500	1379.17
	Rol Badan 3,4	C			23.36	18	420.48		0.1730	954.39
	Rol Badan 1,2				23.36		420.48		0.1730	954.39
	Rol Corong Masuk	A	Rol Sedang	1 regu (2 orang)	4.42	16	70.72	324.48 (10.14%)	0.2179	255.86
	Rol Corong Masuk	B			4.42	26	114.92		0.3541	415.78
	Rol Corong Masuk	C			4.42	18	79.56		0.2451	287.79
	Rol Corong Masuk	E			4.42	8	35.36		0.1089	127.87
	Rol Corong Keluar				2.99		23.92		0.0737	86.53
XIV	Bor Flens Rumah 1, 2	A	Bor	1 orang	30.44	16	487.04	7044.40	0.0691	800.17
	Bor Flens Keluar				8.38		134.08		0.0190	220.02
	Bor Tutup Samping				38.38		614.08		0.0871	1008.61
	Bor Flens Masuk				9.74		155.84		0.0221	255.91
	Bor Flens Rumah 3, 4	B			30.44	26	791.44		0.1123	1300.43
	Bor Flens Rumah 1, 2				30.44		791.44		0.1123	1300.43
	Bor Flens Keluar				8.38		217.88		0.0309	357.82
	Bor Tutup Samping				38.38		997.88		0.1416	1639.72
	Bor Flens Masuk				9.74		253.24		0.0359	415.72
	Bor Flens Rumah 3, 4	C			30.44	18	547.92		0.0777	899.76
	Bor Flens Rumah 1, 2				30.44		547.92		0.0777	899.76
	Bor Flens Keluar				8.38		150.84		0.0214	247.81
	Bor Tutup Samping				38.38		690.84		0.0980	1134.84
	Bor Flens Masuk				9.74		175.32		0.0248	287.18

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
XIV	Bor Flens Rumah 1, 2	E	Bor	1 orang	19.78	8	158.24	7044.40	0.0224	259.39
	8.38				67.04		0.0095		110.01	
	32.92				263.36		0.0373		431.93	
XV	Pasang Pipa 1 + As	A	Manual	1 regu (2 orang)	48.68	16	778.88	5153.36	0.1511	1749.73
	Pasang Pipa 1 + As	B			35.02	26	910.52		0.1766	2045.02
	Pasang Pipa 2 + As	B			35.02		910.52		0.1766	2045.02
	Pasang Pipa 1 + As	C			48.68	18	876.24		0.1700	1968.60
	Pasang Pipa 2 + As	C			48.68		876.24		0.1700	1968.60
	Pasang Pipa 1 + As	D			48.68	12	584.16		0.1133	1312.01
	Pasang Pipa 1 + As	E			27.10	8	216.80		0.0420	486.36
	XVI	Bor Pipa 1 + As			A	Bor	1 orang		80.54	16
Bor Pipa 1 + As		B	80.54	26	2094.04			0.2096	2427.16	
Bor Pipa 2 + As			80.54		2094.04			0.2096	2427.16	
Bor Pipa 1 + As		C	80.54	18	1449.72			0.1451	1680.25	
Bor Pipa 2 + As			80.54		1449.72			0.1451	1680.25	
Bor Pipa 1 + As		D	80.54	12	966.48			0.0967	1119.78	
Bor Pipa 1 + As		E	80.54	8	644.32			0.0645	746.91	
XVII	Kerja Bangku Flens Keluar	A	Manual gerinda	1 orang	1.64	16	26.24	2143.96 (84.64%)	0.0103	119.27
	Kerja Bangku Flens Rumah 1,2				10.76		172.16		0.0679	786.28
	Kerja Bangku Tutup Samping				6.66		106.56		0.0420	486.36
	Kerja Bangku Duduk P.Block				1.30		20.80		0.0082	94.95
	Kerja Bangku Duduk Motor				5.86		93.76		0.0370	428.46
	Kerja Bangku Flens Rumah 3,4	B			10.76	26	279.76		0.1104	1278.43
	Kerja Bangku Flens Rumah 1,2				10.76		279.76		0.1104	1278.43
	Kerja Bangku Flens Keluar				1.64		42.64		0.0168	194.54
	Kerja Bangku Duduk P.Block				1.30		33.80		0.0133	154.01
	Kerja Bangku Tutup Samping				6.66		173.16		0.0683	790.91
	Kerja Bangku Duduk As Drat				0.65		16.90		0.0066	76.42

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
XVII	Kerja Bangku Duduk Motor	B	Manual gerinda	1 orang	5.86	26	152.36	2143.96 (84.64%)	0.0601	695.95
	Kerja Bangku Flens Rumah 3,4	C			10.76	18	193.68		0.0764	884.71
	Kerja Bangku Flens Rumah 1,2				10.76		193.68		0.0764	884.71
	Kerja Bangku Flens Keluar				1.64		29.52		0.0116	134.32
	Kerja Bangku Tutup Samping				6.66		119.88		0.0473	547.73
	Kerja Bangku Duduk P.Block				1.30		23.40		0.0092	106.53
	Kerja Bangku Duduk As Drat				0.65		11.70		0.0046	53.26
	Kerja Bangku Duduk Motor				5.86		105.48		0.0416	481.72
	Kerja Bangku Flens Keluar	E			1.43	8	11.44		0.0045	52.11
	Kerja Bangku Duduk Motor				5.86		46.88		0.0185	214.23
	Kerja Bangku Duduk P.Block				1.30		10.40		0.0041	47.47
	Sambung Pipa 1 & 2				B		6.63		26	172.38
	Pasang As Drat	2.21				57.46	0.0226			261.70
	Sambung Pipa 1 & 3	C			6.63	18	119.34		0.0471	545.41
	Pasang As Drat				2.21		39.78		0.0157	181.80
XVIII	Rakit Screw 1 + Pipa 1	A	Las + Hidroulic	1 regu (2 orang)	79.03	16	1264.48	8226.20	0.1537	1779.84
	Rakit Screw 1 + Pipa 1	B			55.03	26	1430.78		0.1739	2013.76
	Rakit Screw 2 + Pipa 2				55.03		1430.78		0.1739	2013.76
	Rakit Screw 1 + Pipa 1	C			79.03	18	1422.54		0.1729	2002.18
	Rakit Screw 2 + Pipa 2				79.03		1422.54		0.1729	2002.18
	Rakit Screw 1 + Pipa 1	D			79.03	12	948.36		0.1152	1334.01
	Rakit Screw 1 + Pipa 1	E			38.34	8	306.72		0.0372	430.77

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
XIX	Pasang Flens Rumah 1,2	E	Las	1 orang	8.72	8	69.76	2744.40	0.0254	294.13
	Sambung Corong Masuk				1.72		13.76		0.0050	57.90
	Sambung Hopper				1.93		15.44		0.0056	64.84
	Sambung Hopper + Corong Masuk				1.38		11.04		0.0040	46.32
	Pasang Corong Masuk + Hopper				7.46		59.68		0.0217	251.28
	Sambung Corong Keluar				2.53		20.24		0.0073	84.53
	Sambung Corong Keluar + Flens Keluar				4.84		38.72		0.0141	163.27
	Pasang Corong Keluar + Flens Keluar				2.76		22.08		0.0080	92.64
XX	Pasang Pipa Screw	A	Manual	1 orang	5.19	16	83.04	4720.88 (76.55%)	0.0134	155.17
	Pasang P.Block + Ddkn P.Block + Tutup Samping				15.48		247.68		0.0401	464.35
	Pasang Tutup Samping + Badan + Duduk p.block				32.04		512.64		0.0831	962.29
	Pasang Tutup 1, 2				0.88		14.08		0.0022	25.47
	Sambung Badan 1,2,3,4	B			21.34	26	554.84		0.0899	1041.04
	Pasang Pipa Screw				7.92		205.92		0.0333	385.61
	Pasang P.Block + Ddkn P.Block + Tutup Samping				15.48		402.48		0.0652	755.01
	Pasang Tutup Samping + Badan + Duduk p.block				32.04		833.04		0.1350	1563.30
	Pasang Tutup 1, 2, 3, 4				1.76		45.76		0.0074	85.69
	Sambung Badan 1,2,3,4	C			21.34	18	384.12		0.0622	720.27
	Pasang Pipa Screw				7.92		142.56		0.0231	267.49
	Pasang P.Block + Ddkn P.Block + Tutup Samping				15.48		278.64		0.0451	522.25

SK	Operasi	Tipe	Mesin	Jumlah Operator	Wb/unit (menit)	Jumlah permintaan (unit/bulan)	Wb total (menit/bulan)	Total Wb SK (menit)	Proporsi	Jam kerja tersedia (menit/bulan)
XX	Pasang Tutup Samping + Badan + Duduk p.block	C	Manual	1 orang	32.04	18	576.72	4720.88 (76.55%)	0.0935	1082.73
	Pasang Tutup 1, 2				1.76		31.68		0.0051	59.05
	Pasang Pipa Screw	E			4.68	8	37.44		0.0060	69.48
	Pasang P.Block + Ddkn P.Block + Tutup Samping				15.48		123.84		0.0200	231.60
	Pasang Tutup Samping + Badan + Duduk p.block				30.80		246.40		0.0399	462.04
	Pasang Duduk Motor	A	Las		5.67	16	90.72	1445.84 (23.45%)	0.0147	170.22
	Pasang Plat Depan Kunci + Cincin + Plat Atas Kunci				4.24		67.84		0.0110	127.38
	Pasang Plat Keping 1,2,3				5.68		90.88		0.0147	170.22
	Pasang Duduk As Drat	B			0.65	26	16.90		0.0027	31.26
	Pasang Duduk Motor				5.67		147.42		0.0239	276.76
	Pasang Plat Depan Kunci + Cincin + Plat Atas Kunci				8.48		220.48		0.0357	413.40
	Pasang Plat Keping 1,2,3				11.36		295.36		0.0479	554.68
	Pasang Duduk As Drat				C		0.65		18	11.70
	Pasang Duduk Motor	5.67				102.06	0.0165			191.07
	Pasang Plat Depan Kunci + Cincin + Plat Atas Kunci	8.48				152.64	0.0247			286.02
	Pasang Plat Keping 1,2,3	11.36				204.48	0.0331			383.29
	Pasang Duduk Motor	E			5.67	8	45.36		0.0073	84.53

Tabel Jumlah Hari Kerja (Bulan Jun-Agt 04)

Bulan	Jumlah		Total Hari Kerja
	Hari Kerja	Lembur	
Jun/04	21	2	23
Jul/04	22	-	22
Agt/04	21	2	23
			68

Tabel Absensi Karyawan Divisi Screw Conveyor (Bulan Maret-Agustus 04)

SK	Nama	Absen Bulan			Total Absen	Tingkat Kehadiran
	Pekerja	Jun	Jul	Agt	(3 bulan)	(%)
I	Hendrik	0	0	0	0	100
II	Lasno	0	0	0	0	100
III	Supry	1	1	1	3	95.59
IV	Joko	0	0	0	0	100
V	Yanto	0	1	2	3	95.59
VI	Aris	0	0	0	0	100
VII	Refan	0	0	0	0	100
VIII	Heri	1	2	1	4	94.16
IX	Mansur	0	0	0	0	100
X	Asep	0	0	0	0	100
XI	Soni	1	1	0	2	98.54
XII	Endang	0	0	0	0	100
XIII	Bowo	0	0	0	0	100
	Adi	0	0	0	0	100
	Heri	0	0	0	0	100
XIV	Anton	0	0	1	1	99.27
XV	Talyo	0	0	0	0	100
	Wahyu	0	0	0	0	100
XVI	Rustandi	0	0	0	0	100
XVII	Partono	0	0	0	0	100
XVIII	Herman	0	0	0	0	100
	Bayu	0	1	0	1	99.27
XIX	Erwin	0	0	0	0	100
XX	Budi	0	0	0	0	100

Contoh perhitungan tingkat kehadiran (stasiun kerja I → Hendrik) :

$$\begin{aligned}
 \text{tingkat kehadiran} &= \frac{\text{total hari ker ja} - \text{total absen}}{\text{total hari ker ja}} \times 100\% \\
 &= \frac{100 - 0}{100} \times 100\% \\
 &= 100\%
 \end{aligned}$$

Produk A, B, C, D, E

Operasi : Potong Pipa Screw 1

Uji Kenormalan Data (Program Statgraph Plus)

Goodness-of-Fit Tests for Col_1

Chi-Square Test					
	Lower Limit	Upper Limit	Observed Frequency	Expected Frequency	Chi-Square
at or below		254.286	5	5.82	0.11
	254.286	258.571	10	10.68	0.04
	258.571	262.857	16	11.65	1.62
above	262.857		5	7.85	1.03

Chi-Square = 2.8153 with 1 d.f. P-Value = 0.093366

Estimated Kolmogorov statistic DPLUS = 0.147795

Estimated Kolmogorov statistic DMINUS = 0.0707207

Estimated overall statistic DN = 0.147795

Approximate P-Value = 0.416809

The StatAdvisor

This pane shows the results of tests run to determine whether Col_1 can be adequately modeled by a normal distribution. The chi-square test divides the range of Col_1 into nonoverlapping intervals and compares the number of observations in each class to the number expected based on the fitted distribution. The Kolmogorov-Smirnov test computes the maximum distance between the cumulative distribution of Col_1 and the CDF of the fitted normal distribution. In this case, the maximum distance is 0.147795.

The lowest P-value amongst the tests performed equals 0.093366. Because the P-value for this test is less than 0.10, we can reject the idea that Col_1 comes from a normal distribution with 90% confidence.

Jumlah data anda sudah cukup !

Uji Verifikasi

Dilihat dari hasil perhitungan ukuran kesalahan MAD yang telah dilakukan terhadap metode – metode peramalan ternyata peramalan dengan metode *Single Exponential Smoothing* memberikan nilai ukuran kesalahan terkecil (dapat dilihat pada lampiran 4). Sebelum data hasil peramalan ini digunakan harus dilakukan uji verifikasi terlebih dahulu untuk mengetahui apakah hasil peramalan terpilih mencerminkan pola data masa lalu. Perhitungan uji verifikasi dapat dilihat pada tabel dibawah ini.

t	dt	dt'	(dt' - dt)	MRt
1	54	-	-	-
2	56	54	2	-
3	61	55	-6	8
4	64	58	-6	0
5	61	61	0	6
6	59	61	2	2
7	65	60	-5	7
8	67	62.5	-4.5	0.5
9	66	64.75	-1.25	3.25
10	59	65.375	6.375	7.625
11	54	62.188	8.188	1.813
12	68	58.094	-9.906	18.094
13	72	63.047	-8.953	0.953
14	68	67.523	-0.477	8.476
15	63	67.762	4.762	5.239
16	79	65.381	-13.619	18.381
17	62	72.19	10.19	23.809
18	63	67.095	4.095	6.095
19	73	65.048	-7.952	12.047
20	76	69.024	-6.976	0.976
21	79	72.512	-6.488	0.488
22	61	75.756	14.756	21.244
23	77	68.378	-8.622	23.378
24	82	72.689	-9.311	0.689
Total	1589	1488.312	-42.688	176.057

$$\overline{MRlcl} = \frac{\sum^n MRt}{n-1}$$

$$MRt = |(d_t - d_{t-1}) - (d_{t-1} - d_{t-2})|$$

$$\begin{aligned} MRt(t=3) &= |-6 - (-2)| \\ &= |-8| \\ &= 8 \end{aligned}$$

$$\begin{aligned} \overline{MR} &= \frac{\sum^n MRt}{n-1} \\ &= \frac{8 + 0 + 6 + \dots + 21.244 + 23.378 + 0.689}{23-1} \\ &= \frac{176.057}{22} \\ &= 8.002 \end{aligned}$$

$$\begin{aligned} UCL &= 2.66 \times \overline{MR} \\ &= 2.66 \times 8.002 \\ &= 21.286 \end{aligned}$$

$$\begin{aligned} LCL &= -2.66 \times \overline{MR} \\ &= -2.66 \times 8.002 \\ &= -21.286 \end{aligned}$$

$$2/3UCL = 14.190$$

$$1/3UCL = 7.095$$

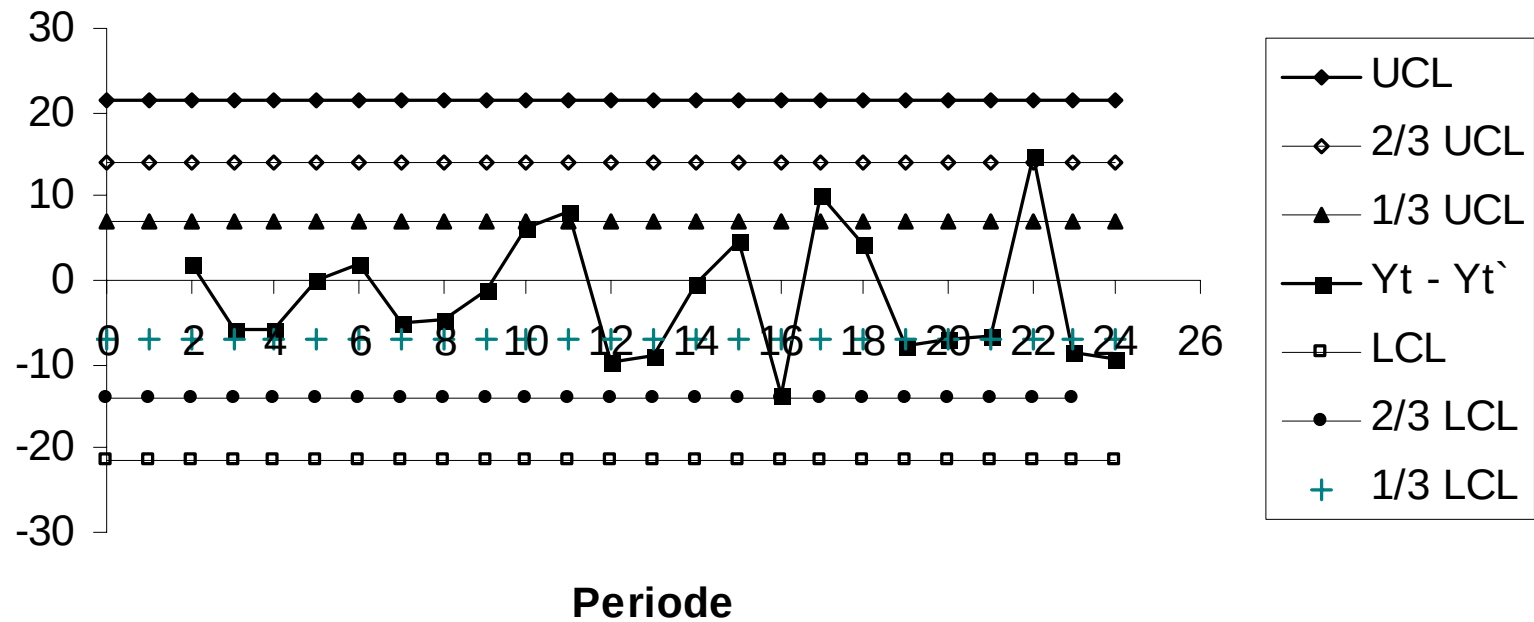
$$2/3LCL = -14.190$$

$$1/3LCL = -7.095$$

Out of Control jika :

1. Ada titik diluar UCL atau LCL.
2. Dari 3 titik berturut – turut ada 2 titik atau lebih berada di A.
3. Dari 5 titik berturut – turut ada 4 titik atau lebih berada di B.
4. Ada 8 titik berturut – turut ada di salah satu sisi.

Grafik Uji Verifikasi



I. Menentukan Interval Pengamatan dan Angka Bilangan Random

Jam kerja :

Senin – Kamis : 7.30 – 16.15

Istirahat : 12.00 – 12.30

Total jam kerja tersedia / hari : 8.75 jam.

Interval pengamatan : 5 menit

$$\begin{aligned} \text{bilangan random terbesar} &= \frac{\text{jumlah jam kerja per hari} \times 60 \text{ menit / jam}}{\text{interval pengamatan}} \\ &= \frac{8.75 \text{ jam} \times 60 \text{ menit / jam}}{5 \text{ menit}} \\ &= 105 \end{aligned}$$

$$\begin{aligned} \text{Istirahat pukul 12.00} &= \frac{\sum \text{jam kerja dari awal kerja s/d mulai istirahat} \times 60 \text{ menit / jam}}{\text{interval pengamatan}} \\ &= \frac{4.5 \text{ jam} \times 60 \text{ menit / jam}}{5 \text{ menit}} \\ &= 54 \end{aligned}$$

$$\begin{aligned} \text{Istirahat pukul 12.30} &= \frac{\sum \text{jam kerja dari awal kerja s/d mulai istirahat} \times 60 \text{ menit / jam}}{\text{interval pengamatan}} \\ &= \frac{5 \text{ jam} \times 60 \text{ menit / jam}}{5 \text{ menit}} \\ &= 60 \end{aligned}$$

Maka bilangan random yang dapat dipakai adalah 0 – 53 dan 60 – 104.

Bilangan random 54 – 60 tidak dapat dipakai karena bilangan random 54 - 60 menunjukkan waktu istirahat sehingga sampling pekerjaan tidak dapat dilakukan.

Sedangkan bilangan random 105 tidak dipakai karena bilangan random 105 menunjukkan pukul 16:15 (pekerja sudah pulang)

Lembar Pengamatan

Hari I : Senin / 27 September 2004

Stasiun Kerja II : Las Plasma

Nama Pekerja : Lasno

No urut	Bilangan Random	Jam Kunjungan	Kegiatan
1	5	7:55	potong screw
2	6	8:00	membuat ukuran
3	7	8:05	membuat ukuran
4	8	8:10	membuat ukuran
5	9	8:15	potong screw
6	15	8:45	potong screw
7	16	8:50	potong screw
8	22	9:20	potong screw
9	24	9:30	potong screw
10	25	9:35	potong screw
11	27	9:45	menumpuk hasil potongan screw
12	28	9:50	potong badan
13	30	10:00	tidak ada di tempat
14	38	10:40	membuat ukuran
15	39	10:45	potong screw
16	43	11:05	potong screw
17	47	11:25	potong screw
18	52	11:50	potong screw
19	53	11:55	potong screw
20	62	12:40	potong screw
21	63	12:45	potong screw
22	65	12:55	membuat ukuran
23	68	13:10	membuat ukuran
24	69	13:15	istirahat / mengobrol
25	70	13:20	potong screw
26	71	13:25	potong screw
27	73	13:35	potong screw
28	77	13:55	potong screw
29	79	14:05	potong screw
30	81	14:15	potong screw
31	83	14:25	istirahat / mengobrol
32	85	14:35	potong screw
33	86	14:40	menumpuk hasil potongan screw
34	90	15:00	membuat ukuran
35	92	15:10	potong badan
36	93	15:15	potong badan
37	99	15:45	potong screw
38	100	15:50	potong screw
39	102	16:00	potong screw
40	103	16:05	tidak ada di tempat

Hari II : 28 September 2004
 Stasiun Kerja II : Las Plasma
 Nama Pekerja : Lasno

No urut	Bilangan Random	Jam Kunjungan	Kegiatan
1	0	7:30	belum hadir
2	1	7:35	menyiapkan peralatan
3	2	7:40	potong screw
4	5	7:55	potong screw
5	6	8:00	potong screw
6	7	8:05	potong badan
7	10	8:20	istirahat / mengobrol
8	12	8:30	potong screw
9	13	8:35	potong screw
10	18	9:00	potong screw
11	24	9:30	potong screw
12	26	9:40	potong screw
13	27	9:45	membuat ukuran
14	29	9:55	membuat ukuran
15	30	10:00	potong screw
16	34	10:20	potong screw
17	35	10:25	menumpuk hasil potongan screw
18	41	10:55	potong badan
19	44	11:10	potong badan
20	45	11:15	potong screw
21	47	11:25	potong screw
22	48	11:30	istirahat / mengobrol
23	50	11:40	membuat ukuran
24	51	11:45	membuat ukuran
25	52	11:50	potong screw
26	63	12:45	potong screw
27	64	12:50	potong screw
28	65	12:55	potong screw
29	66	13:00	potong screw
30	67	13:05	potong screw
31	71	13:25	potong screw
32	84	14:30	tidak ada di tempat
33	90	15:10	mengantarkan hasil potongan
34	92	15:10	membuat ukuran
35	94	15:20	potong badan
36	95	15:25	potong badan
37	96	15:30	potong screw
38	97	15:35	potong screw
39	100	15:50	potong screw
40	102	16:00	tidak ada di tempat

Hari III : 29 September 2004
 Stasiun Kerja II : Las Plasma
 Nama Pekerja : Lasno

No urut	Bilangan Random	Jam Kunjungan	kegiatan
1	1	7:35	menyiapkan peralatan
2	3	7:50	membuat ukuran
3	8	8:10	membuat ukuran
4	10	8:20	membuat ukuran
5	14	8:40	potong screw
6	15	8:45	potong screw
7	16	8:50	potong screw
8	17	8:55	potong screw
9	19	9:05	potong screw
10	21	9:15	istirahat / mengobrol
11	25	9:35	Menumpuk hasil potongan screw
12	27	9:45	potong badan
13	28	9:50	potong badan
14	30	10:00	membuat ukuran
15	32	10:10	potong screw
16	33	10:15	potong screw
17	34	10:20	potong screw
18	35	10:25	potong screw
19	40	10:50	istirahat / mengobrol
20	41	10:55	potong screw
21	45	11:15	potong screw
22	46	11:20	membuat ukuran
23	52	11:50	membuat ukuran
24	61	12:35	tidak ada di tempat
25	70	13:20	potong screw
26	74	13:40	potong screw
27	77	13:55	potong screw
28	79	14:05	potong screw
29	81	14:15	potong screw
30	82	14:20	potong screw
31	85	14:35	potong screw
32	88	14:50	potong screw
33	89	14:55	mengantarkan hasil potongan
34	91	15:05	membuat ukuran
35	92	15:10	istirahat / mengobrol
36	93	15:15	potong badan
37	96	15:30	potong screw
38	97	15:35	potong screw
39	98	15:40	potong screw
40	99	15:45	potong screw

II. Ringkasan Hasil Pengamatan

No	Elemen kegiatan	Total	Aktifitas
1	Potong badan	11	Produktif
2	Membuat ukuran	19	Produktif
3	Potong Screw	70	Produktif
4	Menumpuk hasil potongan screw	4	Produktif
5	Mengantarkan hasil potongan screw	2	Produktif
6	Menyiapkan peralatan	2	Produktif
7	Tidak ada di tempat	5	Tidak Produktif
8	Istirahat / mengobrol	6	Tidak Produktif
9	Belum hadir	1	Tidak Produktif
		120	

III Pengujian Keseragaman Data

Aktivitas	Hari Ke			Jumlah
	1	2	3	
Produktif	36	35	36	107
Tidak Produktif	4	5	4	13
Jumlah	40	40	40	120
% Produktif (Pi)	90	87.5	90	

$$p = \frac{\sum_{i=1}^3 P_i}{k}$$

$$= \frac{90\% + 87.5\% + 90\%}{3}$$

$$= 89.16\%$$

$$BKA = p + c\sqrt{p(1-p)/n}$$

$$= 89.16\% + 2\sqrt{89.16\%(1-89.16\%)/120}$$

$$= 89.16\% + 2 \times 2.838\%$$

$$= 94.836\%$$

$$BKB = p - c\sqrt{p(1-p)/n}$$

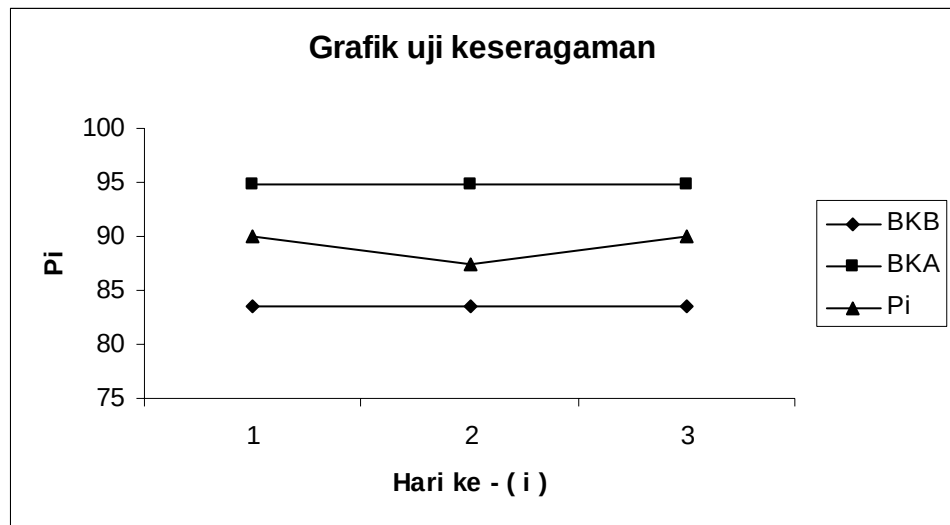
$$= 89.16\% - 2 \times 2.838\%$$

$$= 83.484\%$$

Keterangan : P = persentase produktif

Pi = persentase produktif hari ke i

K = jumlah hari pengamatan



Data seragam karena semua P_i masih terletak diantara batas kelas atas dan batas kelas bawah.

IV Uji Kecukupan Data

Tingkat kepercayaan = 95%

Tingkat Ketelitian = 10%

$$\begin{aligned}
 N' &= \frac{(c/\alpha)^2(1-p)}{p} \\
 &= \frac{(2/0.1)^2(1-89.16\%)}{89.16\%} \\
 &= \frac{400 \times 10.84\%}{89.16\%} \\
 &= 48.63 \sim 49 \text{ data}
 \end{aligned}$$

Karena jumlah pengamatan yang dilakukan ($N = 120$) > jumlah pengamatan minimum ($N' = 100$) maka jumlah pengamatan sudah mencukupi.

Ringkasan Uji Kecukupan dan Keseragaman Data

Sampling pendahuluan							
SK	% utilisasi (p)	n	minimal n	Jml data	BAK	BKB	Keterangan
II	89.16	120	48.63	cukup	94.84	83.48	Seragam
III	82.5	120	84.85	cukup	89.44	75.56	Seragam
IV	80.83	120	94.87	cukup	88.02	73.64	Seragam
V	79.16	120	105.31	cukup	86.58	71.74	Seragam
VI	88.33	120	52.85	cukup	94.19	82.47	Seragam
IX	81.66	120	89.84	cukup	88.73	74.59	Seragam
X	77.5	120	116.13	cukup	85.12	69.88	Seragam
XI	90.25	120	43.21	cukup	95.67	84.83	Seragam
XIII	81.66	120	89.84	cukup	88.73	74.59	Seragam
XIV	94.16	120	24.81	cukup	98.44	89.88	Seragam
XV	89.74	120	45.73	cukup	95.28	84.20	Seragam
XVI	93.33	120	28.59	cukup	97.89	88.77	Seragam
XVII	75	120	133.33	tidak cukup			
	75.56	134	129.38	cukup	82.98	68.14	Seragam
XVIII	95.83	120	17.41	cukup	99.48	92.18	Seragam
XIX	79.16	120	105.31	cukup	86.58	71.74	Seragam
XX	88.33	120	52.85	cukup	94.19	82.47	Seragam