

LAMPIRAN

UJI KENORMALAN DATA

- Produk Cup 240 ml

One-Sample Kolmogorov-Smirnov Test

		demand
N		12
Normal Parameters ^a	Mean	49062.5000
	Std. Deviation	2132.34026
Most Extreme Differences	Absolute	.152
	Positive	.108
	Negative	-.152
Kolmogorov-Smirnov Z		.525
Asymp. Sig. (2-tailed)		.946

a. Test distribution is Normal.

- Produk Botol 600 ml

One-Sample Kolmogorov-Smirnov Test

		demandd
N		12
Normal Parameters ^a	Mean	18375.0000
	Std. Deviation	932.37234
Most Extreme Differences	Absolute	.177
	Positive	.156
	Negative	-.177
Kolmogorov-Smirnov Z		.613
Asymp. Sig. (2-tailed)		.846

a. Test distribution is Normal.

PERAMALAN PERMINTAAN

1. Produk Cup 240 ml

- *Simple Average*

01-14-2013 Month	Actual Data	Forecast by SA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
1	45000								
2	48000	45000	3000	3000	3000	9000000	6.25	1	
3	51000	46500	4500	7500	3750	1.4625E+07	7.536765	2	
4	49500	48000	1500	9000	3000	1.05E+07	6.034611	3	
5	51000	48375	2625	11625	2906.25	9597656	5.812723	4	
6	49500	48900	600	12225	2445	7750125	4.892602	5	
7	48000	49000	-1000	11225	2204.167	6625104	4.424391	5.092628	
8	46500	48857.14	-2357.145	8867.855	2226.021	6472394	4.516496	3.983725	
9	48000	48562.5	-562.5	8305.355	2018.081	5702895	4.098419	4.115473	
10	48750	48500	250	8555.355	1821.627	5076185	3.700019	4.696546	
11	51000	48525	2475	11030.36	1886.964	5181129	3.815311	5.845555	
12	52500	48750	3750	14780.36	2056.331	5988526	4.117815	7.187731	
13		49062.5							
14		49062.5							
15		49062.5							
16		49062.5							
17		49062.5							
18		49062.5							
19		49062.5							
20		49062.5							
21		49062.5							
22		49062.5							
23		49062.5							
24		49062.5							
CFE		14780.36							
MAD		2056.331							
MSE		5988526							
MAPE		4.117815							
Trk. Signal		7.187731							
R-square									

• *Moving Average*

01-14-2013 Month	Actual Data	Forecast by 2-MA	Forecast by 3-MA	Forecast by 4-MA	Forecast by 5-MA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
1	45000											
2	48000											
3	51000	46500										
4	49500	49500	48000									
5	51000	50250	49500	48375								
6	49500	50250	50500	49875	48900	600	600	600	360000	1.212121	1	
7	48000	50250	50000	50250	49800	-1800	-1200	1200	1800000	2.481061	-1	1
8	46500	48750	49500	49500	49800	-3300	-4500	1900	4830000	4.019632	-2.368421	
9	48000	47250	48000	48750	48900	-900	-5400	1650	3825000	3.483474	-3.272727	
10	48750	47250	47500	48000	48600	150	-5250	1350	3064500	2.848318	-3.888889	
11	51000	48375	47750	47812.5	48150	2850	-2400	1600	3907500	3.304971	-1.5	0.26784
12	52500	49875	49250	48562.5	48450	4050	1650	1950	5692500	3.934872	0.8461539	0.1159476
13		51750	50750	50062.5	49350							
14		51750	50750	50062.5	49350							
15		51750	50750	50062.5	49350							
16		51750	50750	50062.5	49350							
17		51750	50750	50062.5	49350							
18		51750	50750	50062.5	49350							
19		51750	50750	50062.5	49350							
20		51750	50750	50062.5	49350							
21		51750	50750	50062.5	49350							
22		51750	50750	50062.5	49350							
23		51750	50750	50062.5	49350							
24		51750	50750	50062.5	49350							
CFE		7500	4750	4125	1650							
MAD		1800	1861.111	2109.375	1950							
MSE		4809375	4576389	5985352	5692500							
MAPE		3.612196	3.748565	4.236838	3.934872							
Trk.Signal		4.166667	2.552239	1.955556	0.8461539							
R-square		0.8015123	0.4371217	0.2787724	0.1159476							
		m=2	m=3	m=4	m=5							

• *Weighted Moving Average*

01-14-2013 Month	Actual Data	Forecast by 2-WMA	Forecast by 3-WMA	Forecast by 4-WMA	Forecast by 5-WMA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
1	45000											
2	48000											
3	51000	46500										
4	49500	49500	48000									
5	51000	50250	49500	48375								
6	49500	50250	50500	49875	48900	600	600	600	360000	1.212121	1	
7	48000	50250	50000	50250	49800	-1800	-1200	1200	1800000	2.481061	-1	1
8	46500	48750	49500	49500	49800	-3300	-4500	1900	4830000	4.019632	-2.368421	
9	48000	47250	48000	48750	48900	-900	-5400	1650	3825000	3.483474	-3.272727	
10	48750	47250	47500	48000	48600	150	-5250	1350	3064500	2.848318	-3.888889	
11	51000	48375	47750	47812.5	48150	2850	-2400	1600	3907500	3.304971	-1.5	0.26784
12	52500	49875	49250	48562.5	48450	4050	1650	1950	5692500	3.934872	0.8461539	0.1159476
13		51750	50750	50062.5	49350							
14		51750	50750	50062.5	49350							
15		51750	50750	50062.5	49350							
16		51750	50750	50062.5	49350							
17		51750	50750	50062.5	49350							
18		51750	50750	50062.5	49350							
19		51750	50750	50062.5	49350							
20		51750	50750	50062.5	49350							
21		51750	50750	50062.5	49350							
22		51750	50750	50062.5	49350							
23		51750	50750	50062.5	49350							
24		51750	50750	50062.5	49350							
CFE		7500	4750	4125	1650							
MAD		1800	1861.111	2109.375	1950							
MSE		4809375	4576389	5985352	5692500							
MAPE		3.612196	3.748565	4.236838	3.934872							
Trk.Signal		4.166667	2.552239	1.955556	0.8461539							
R-square		0.8015123	0.4371217	0.2787724	0.1159476							
		m=2	m=3	m=4	m=5							
		w(1)=0.5	w(1)=0.3333333	w(1)=0.25	w(1)=0.2							
		w(2)=0.5	w(2)=0.3333333	w(2)=0.25	w(2)=0.2							
			w(3)=0.3333333	w(3)=0.25	w(3)=0.2							
				w(4)=0.25	w(4)=0.2							
					w(5)=0.2							

- *Single Exponential Smoothing*

01-14-2013 Month	Actual Data	Forecast by SES	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
1	45000								
2	48000	45000	3000	3000	3000	9000000	6.25	1	
3	51000	48000	3000.004	6000.004	3000.002	9000012	6.06618	2	
4	49500	51000	-1499.996	4500.008	2500	6750004	5.054219	1.800003	
5	51000	49500	1500	6000.008	2250	5625003	4.525958	2.666667	
6	49500	51000	-1500	4500.008	2100	4950003	4.226827	2.142861	
7	48000	49500	-1500	3000.008	2000	4500002	4.04319	1.500004	
8	46500	48000	-1500	1500.008	1928.571	4178573	3.92642	0.7777818	
9	48000	46500	1500	3000.008	1875	3937502	3.826243	1.600004	
10	48750	48000	750	3750.008	1750	3562501	3.572045	2.142862	
11	51000	48750	2250	6000.008	1800	3712501	3.656017	3.333338	
12	52500	51000	1500	7500.008	1772.727	3579547	3.583392	4.230773	
13		52500							
14		52500							
15		52500							
16		52500							
17		52500							
18		52500							
19		52500							
20		52500							
21		52500							
22		52500							
23		52500							
24		52500							
CFE		7500.008							
MAD		1772.727							
MSE		3579547							
MAPE		3.583392							
Trk.Signal		4.230773							
R-square									
		Alpha=1							
		F(0)=45000							

2. Produk Botol 600 ml

- *Simple Average*

01-14-2013 Month	Actual Data	Forecast by SA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
1	19500								
2	18000	19500	-1500	-1500	1500	2250000	8.333333	-1	
3	18000	18750	-750	-2250	1125	1406250	6.25	-2	
4	18750	18500	250	-2000	833.3333	958333.3	4.611111	-2.4	
5	16500	18562.5	-2062.5	-4062.5	1140.625	1782227	6.583333	-3.561644	
6	17250	18150	-900	-4962.5	1092.5	1587781	6.310145	-4.542334	
7	18750	18000	750	-4212.5	1035.417	1416901	5.925121	-4.06841	
8	19500	18107.14	1392.857	-2819.643	1086.48	1491637	6.099083	-2.59521	0.4467427
9	18000	18281.25	-281.25	-3100.893	985.8259	1315070	5.532011	-3.145477	0.4643077
10	18750	18250	500	-2600.893	931.8453	1196729	5.213639	-2.791121	0.3750041
11	19500	18300	1200	-1400.893	958.6608	1221056	5.30766	-1.461302	0.2350558
12	18000	18409.09	-409.0918	-1809.984	908.7	1125265	5.031757	-1.991839	0.2452266
13		18375							
14		18375							
15		18375							
16		18375							
17		18375							
18		18375							
19		18375							
20		18375							
21		18375							
22		18375							
23		18375							
24		18375							
CFE		-1809.984							
MAD		908.7							
MSE		1125265							
MAPE		5.031757							
Trk. Signal		-1.991839							
R-square		0.2452266							

• *Moving Average*

01-14-2013 Month	Actual Data	Forecast by 2-MA	Forecast by 3-MA	Forecast by 4-MA	Forecast by 5-MA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
1	19500											
2	18000											
3	18000	18750										
4	18750	18000	18500									
5	16500	18375	18250	18562.5								
6	17250	17625	17750	17812.5	18150	-900	-900	900	810000	5.217391	-1	
7	18750	16875	17500	17625	17700	1050	150	975	956250	5.408696	0.1538462	0.1
8	19500	18000	17500	17812.5	17850	1650	1800	1200	1545000	6.42631	1.5	0.4514286
9	18000	19125	18500	18000	18150	-150	1650	937.5	1164375	5.028066	1.76	0.296
10	18750	18750	18750	18375	18000	750	2400	900	1044000	4.822453	2.666667	0.4461538
11	19500	18375	18750	18750	18450	1050	3450	925	1053750	4.916147	3.72973	0.6058537
12	18000	19125	18750	18937.5	18900	-900	2550	921.4286	1018929	4.928126	2.767442	0.4530776
13		18750	18750	18562.5	18750							
14		18750	18750	18562.5	18750							
15		18750	18750	18562.5	18750							
16		18750	18750	18562.5	18750							
17		18750	18750	18562.5	18750							
18		18750	18750	18562.5	18750							
19		18750	18750	18562.5	18750							
20		18750	18750	18562.5	18750							
21		18750	18750	18562.5	18750							
22		18750	18750	18562.5	18750							
23		18750	18750	18562.5	18750							
24		18750	18750	18562.5	18750							
CFE		0	750	375	2550							
MAD		1050	861.1111	937.5	921.4286							
MSE		1434375	1145833	1283203	1018929							
MAPE		5.766575	4.727958	5.18365	4.928126							
Trk.Signal		0	0.8709677	0.4	2.767442							
R-square		0.5486111	0.2890626	0.2162163	0.4530776							
		m=2	m=3	m=4	m=5							

• *Weighted Moving Average*

01-14-2013 Month	Actual Data	Forecast by 2-WMA	Forecast by 3-WMA	Forecast by 4-WMA	Forecast by 5-WMA	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
1	19500											
2	18000											
3	18000	18750										
4	18750	18000	18500									
5	16500	18375	18250	18562.5								
6	17250	17625	17750	17812.5	18150	-900	-900	900	810000	5.217391	-1	
7	18750	16875	17500	17625	17700	1050	150	975	956250	5.408696	0.1538462	0.1
8	19500	18000	17500	17812.5	17850	1650	1800	1200	1545000	6.42631	1.5	0.4514286
9	18000	19125	18500	18000	18150	-150	1650	937.5	1164375	5.028066	1.76	0.296
10	18750	18750	18750	18375	18000	750	2400	900	1044000	4.822453	2.666667	0.4461538
11	19500	18375	18750	18750	18450	1050	3450	925	1053750	4.916147	3.72973	0.6058537
12	18000	19125	18750	18937.5	18900	-900	2550	921.4286	1018929	4.928126	2.767442	0.4530776
13		18750	18750	18562.5	18750							
14		18750	18750	18562.5	18750							
15		18750	18750	18562.5	18750							
16		18750	18750	18562.5	18750							
17		18750	18750	18562.5	18750							
18		18750	18750	18562.5	18750							
19		18750	18750	18562.5	18750							
20		18750	18750	18562.5	18750							
21		18750	18750	18562.5	18750							
22		18750	18750	18562.5	18750							
23		18750	18750	18562.5	18750							
24		18750	18750	18562.5	18750							
CFE		0	750	375	2550							
MAD		1050	861.1111	937.5	921.4286							
MSE		1434375	1145833	1283203	1018929							
MAPE		5.766575	4.727958	5.18365	4.928126							
Trk.Signal		0	0.8709677	0.4	2.767442							
R-square		0.5486111	0.2890626	0.2162163	0.4530776							
		m=2	m=3	m=4	m=5							
		w(1)=0.5	w(1)=0.3333333	w(1)=0.25	w(1)=0.2							
		w(2)=0.5	w(2)=0.3333333	w(2)=0.25	w(2)=0.2							
			w(3)=0.3333333	w(3)=0.25	w(3)=0.2							
				w(4)=0.25	w(4)=0.2							
					w(5)=0.2							

- *Single Exponential Smoothing*

01-14-2013 Month	Actual Data	Forecast by SES	Forecast Error	CFE	MAD	MSE	MAPE (%)	Tracking Signal	R-square
1	19500								
2	18000	19500	-1500	-1500	1500	2250000	8.333333	-1	
3	18000	19065	-1065	-2565	1282.5	1692113	7.125	-2	
4	18750	18756.15	-6.150391	-2571.15	857.0501	1128088	4.760934	-3	
5	16500	18754.37	-2254.367	-4825.518	1206.379	2116609	6.986408	-4	
6	17250	18100.6	-850.6016	-5676.119	1135.224	1837992	6.575331	-5	
7	18750	17853.93	896.0723	-4780.047	1095.365	1665484	6.275951	-4.363884	
8	19500	18113.79	1386.211	-3393.836	1136.915	1702069	6.394926	-2.985128	0.6159768
9	18000	18515.79	-515.791	-3909.627	1059.274	1522566	5.953748	-3.690855	0.6591488
10	18750	18366.21	383.7891	-3525.838	984.2203	1369758	5.519651	-3.582367	0.5452831
11	19500	18477.51	1022.49	-2503.348	988.0472	1337330	5.49204	-2.533632	0.3451385
12	18000	18774.03	-774.0313	-3277.379	968.5912	1270221	5.383688	-3.383655	0.3900009
13		18549.56							
14		18549.56							
15		18549.56							
16		18549.56							
17		18549.56							
18		18549.56							
19		18549.56							
20		18549.56							
21		18549.56							
22		18549.56							
23		18549.56							
24		18549.56							
CFE		-3277.379							
MAD		968.5912							
MSE		1270221							
MAPE		5.383688							
Trk.Signal		-3.383655							
R-square		0.3900009							
		Alpha=0.29							
		F(0)=19500							

PENGENDALIAN PERSEDIAAN *SUPPLIER* DAN DISTRIBUTOR SAAT INI

Pengendalian persediaan *supplier* saat ini:

Pengendalian persediaan pada *supplier* saat ini menggunakan metode Q karena *supplier* memiliki *safety stock* di gudang setiap harinya. *Lead time* selama 1 hari atau 0,0033 tahun.

Tabel C.1 Data *Supplier*

Keterangan	Jumlah
Kebutuhan Cup (D_1)	52.500 karton
Kebutuhan Botol (D_2)	18.750 karton
Standar deviasi Cup (d_1)	2.132,340
Standar deviasi Botol (d_2)	932,372
Biaya Pesan (C)	Rp 3.503 /pesan
Biaya Simpan (H)	Rp 68 /unit/bln
<i>Lead time</i> (L)	1 hari=0,0033 tahun
Biaya <i>stockout</i> cup (π)	Rp 1.630/karton
Biaya <i>stockout</i> botol (π)	Rp 9.100/karton

Langkah-langkah perhitungan biaya persediaan pada *supplier* untuk produk cup adalah sebagai berikut:

$$Q = \sqrt{\frac{2CR}{H}} = \sqrt{\frac{2 \times \text{Rp } 3.503 \times 52.500}{\text{Rp } 68}} = 2.325,74 \text{ unit}$$

$$F(K) = (\pi R - HQ) / \pi R$$

$$= (\text{Rp } 1.630 \times 52.500 - \text{Rp } 68 \times 2.325,74) / (\text{Rp } 1.630 \times 52.500)$$

$$= 0,9981$$

Dari tabel, $K = 2,9$

Dari tabel, $E(K) = E(2,9) = 0,0005$ maka $N_k = \sigma_L \cdot E(K) = 122,494 \times 0,0005 = 0,061$

$$\sigma_L = \sigma \cdot \sqrt{L} = 2132,340 \times \sqrt{0,0033} = 122,494$$

$$Q = \sqrt{\frac{2R(C + \pi N_k)}{H}} = \sqrt{\frac{2 \times 52.500 (\text{Rp } 3.503 + \text{Rp } 1.630 \times 0,061)}{\text{Rp } 68}} = 2.358,51 \text{ unit}$$

$$|Q_{\text{new}} - Q_{\text{old}}| = |2.358,51 - 2.325,74| = 32,77 > 0,1 \rightarrow \text{toleransi} = 0,1$$

Karena $|Q_{\text{new}} - Q_{\text{old}}| > \text{toleransi}$, maka kembali menghitung $F(K)$.

$$\begin{aligned}
 F(K) &= (\pi R - HQ) / \pi R \\
 &= (\text{Rp } 1.630 \times 52.500 - \text{Rp } 68 \times 2.358,51) / (\text{Rp } 1.630 \times 52.500) \\
 &= 0,9981
 \end{aligned}$$

Dari tabel, $K = 2,9$

Dari tabel, $E(K) = E(2,9) = 0,0005$ maka $N_k = \sigma_L \cdot E(K) = 122,494 \times 0,0005 = 0,061$

$$Q = \sqrt{\frac{2R(C + \pi N_k)}{H}} = \sqrt{\frac{2 \times 52.500 (\text{Rp } 3.503 + \text{Rp } 1.630 \times 0,061)}{\text{Rp } 68}} = 2.358,51 \text{ unit} \approx 2.358 \text{ unit}$$

$$|Q_{\text{new}} - Q_{\text{old}}| = |2.358,51 - 2.358,51| = 0 < 0,1$$

$$\mu = R L = 52.500 \times 0,0033 = 173,25$$

$$B = \mu + K\sigma_L = 173,25 + (2,9 \times 122,494) = 528,48 \text{ unit} \approx 528 \text{ unit} \rightarrow \text{diperoleh } Q^* = 2.358 \text{ unit dan } B^* = 528 \text{ unit}$$

Menghitung ongkos pengadaan per bulan:

$$O_p = \frac{AD}{Q^*} = \frac{\text{Rp } 3.503 \times 52.500}{2.358} = \text{Rp } 77.993,00$$

$$D_L = LD = 0,0033 \times 52.500 = 173,25$$

$$\begin{aligned}
 \text{Ongkos simpan} &= H \left(\frac{Q^*}{2} + B^* - D_L \right) \\
 &= \text{Rp } 68 \left(\frac{2.358}{2} + 528 - 173,25 \right) \\
 &= \text{Rp } 317.458,00
 \end{aligned}$$

$$\text{Ongkos kekurangan persediaan} = \frac{\pi D}{Q^*} N_k = \frac{\text{Rp } 9.100 \times 52.500}{2.358} * 0,061 = \text{Rp } 12.359,00$$

$TC = O. \text{ Pengadaan} + O. \text{ Simpan} + O. \text{ Kekurangan Persediaan}$

$$= \text{Rp } 77.993,00 + \text{Rp } 317.458,00 + \text{Rp } 12.359,00$$

$$= \text{Rp } 407.810,00$$

Perhitungan biaya persediaan pada *supplier* untuk produk botol adalah sebagai berikut:

$$Q = \sqrt{\frac{2CR}{H}} = \sqrt{\frac{2 \times \text{Rp } 3.503 \times 18.750}{\text{Rp } 68}} = 1.389,89 \text{ unit}$$

$$\begin{aligned}
 F(K) &= (\pi R - HQ) / \pi R \\
 &= (\text{Rp } 9.100 \times 18.750 - \text{Rp } 68 \times 1.389,89) / (\text{Rp } 9.100 \times 18.750) \\
 &= 0,9994
 \end{aligned}$$

Dari tabel, $K = 3,0$

Dari tabel, $E(K)=E(3,0)=0,0004$ maka $N_k = \sigma_L \cdot E(K) = 53,561 \times 0,0004 = 0,021$

$$\sigma_L = \sigma \cdot \sqrt{L} = 932,372 \times \sqrt{0,0033} = 53,561$$

$$Q = \sqrt{\frac{2R(C+\pi Nk)}{H}} = \sqrt{\frac{2 \times 18.750 (\text{Rp } 3.503 + \text{Rp } 9.100 \times 0,021)}{\text{Rp } 68}} = 1.427,30 \text{ unit}$$

$$|Q_{\text{new}} - Q_{\text{old}}| = |1.427,30 - 1.389,89| = 37,41 > 0,1 \rightarrow \text{toleransi} = 0,1$$

Karena $|Q_{\text{new}} - Q_{\text{old}}| > \text{toleransi}$, maka kembali menghitung $F(K)$.

$$F(K) = (\pi R - HQ) / \pi R$$

$$= (\text{Rp } 9.100 \times 18.750 - \text{Rp } 68 \times 1.427,30) / (\text{Rp } 9.100 \times 18.750)$$

$$= 0,9994$$

Dari tabel, $K = 3,0$

Dari tabel, $E(K)=E(3,0)=0,0004$ maka $N_k = \sigma_L \cdot E(K) = 53,561 \times 0,0004 = 0,021$

$$\sigma_L = \sigma \cdot \sqrt{L} = 932,372 \times \sqrt{0,0033} = 53,561$$

$$Q = \sqrt{\frac{2R(C+\pi Nk)}{H}} = \sqrt{\frac{2 \times 18.750 (\text{Rp } 3.503 + \text{Rp } 9.100 \times 0,021)}{\text{Rp } 68}} = 1.427,30 \text{ unit} \approx 1.427 \text{ unit}$$

$$|Q_{\text{new}} - Q_{\text{old}}| = |1.427,30 - 1.427,30| = 0 < 0,1$$

$$\mu = R L = 18.750 \times 0,0033 = 61,875$$

$$B = \mu + K\sigma_L = 61,875 + (3,0 \times 53,561) = 222,558 \text{ unit} \approx 225 \text{ unit} \rightarrow \text{diperoleh } Q^* =$$

$$1.427 \text{ unit dan } B^* = 225 \text{ unit}$$

Menghitung ongkos pengadaan per tahun:

$$O_p = \frac{AD}{Q^*} = \frac{\text{Rp } 3.503 \times 18.750}{1.427} = \text{Rp } 46.028,00$$

$$D_L = LD = 0,0033 \times 18.750 = 61,875$$

$$\text{Ongkos simpan} = H \left(\frac{Q^*}{2} + B^* - D_L \right)$$

$$= \text{Rp } 68 \left(\frac{1.427}{2} + 225 - 61,875 \right)$$

$$= \text{Rp } 164.843,00$$

$$\text{Ongkos kekurangan persediaan} = \frac{\pi D}{Q^*} Nk = \frac{\text{Rp } 9.100 \times 52.500}{1.427} * 0,021 = \text{Rp } 7.031,00$$

$$\begin{aligned}
 TC &= O. \text{ Pengadaan} + O. \text{ Simpan} + O. \text{ Kekurangan Persediaan} \\
 &= \text{Rp } 46.028,00 + \text{Rp } 164.843,00 + \text{Rp } 7.031,00 \\
 &= \text{Rp } 217.902,00
 \end{aligned}$$

Pengendalian persediaan distributor saat ini:

Pengendalian persediaan pada distributor saat ini menggunakan metode periodik. Interval pemesanan produk tetap yaitu setiap 1 hari sekali ($t = 0.0033$ tahun) dengan *lead time* pengiriman 1 hari sama dengan 0.0033 tahun dan permintaan yang bervariasi setiap harinya.

Tabel C.2 Data Distributor

Keterangan	Jumlah
Kebutuhan Cup (D_1)	52.500 karton
Kebutuhan Botol (D_2)	18.750 karton
Standar deviasi Cup (d_1)	2.132,340
Standar deviasi Botol (d_2)	932,372
Biaya Pesan (C)	Rp 3.503 /pesan
Biaya Simpan (H)	Rp 144/unit/bln
Harga beli Cup (p_1)	Rp 10.500 /karton
Harga beli Botol (p_2)	Rp 21.750 /karton
<i>Lead time</i> (L)	1 hari=0,0033 tahun
Biaya <i>stockout</i> cup (π)	Rp 3.500/karton
Biaya <i>stockout</i> botol (π)	Rp 7.250/karton

Langkah-langkah perhitungan biaya persediaan pada distributor untuk produk cup adalah sebagai berikut:

$$\mu_{L+t} = R(L + t) = 52.500 \times (0,0033 + 0,0033) = 346,50 \text{ unit}$$

$$\sigma_{L+t} = \sigma \sqrt{(L + t)} = 2132,340 \cdot \sqrt{(0,0033 + 0,0033)} = 173,232 \text{ unit}$$

$$t = \sqrt{\frac{2C}{RH}} = \sqrt{\frac{2 \times \text{Rp } 3.503}{52.500 \times \text{Rp } 144}} = 0,0304 \text{ bulan}$$

$$F'(K) = \frac{Ht}{\pi} = \frac{\text{Rp } 144 \times 0,0033}{\text{Rp } 3.500} = 0,0001$$

Dari tabel, $K = 3,0$

$$E = \mu_{L+t} + K \cdot \sigma_{L+t} = 346,50 + (3,0 \cdot 173,232) = 866,196 \text{ unit.}$$

$$\sigma_L = \sigma \cdot \sqrt{L} = 2132,340 \times \sqrt{0,0033} = 122,494$$

$$\mu_L = R \times L = 52.500 \times 0,0033 = 173,25$$

$$N_k = \sigma_L \cdot E(K) = 122,494 \times 0,0004 = 0,049$$

Menghitung ongkos pengadaan per bulan:

$$O_p = \frac{C}{t} = \frac{\text{Rp } 3.503}{0,0033} = \text{Rp } 1.061.515,152/\text{tahun} = \text{Rp } 88.460,00/\text{bulan}$$

$$\begin{aligned} \text{Ongkos simpan} &= H \left(E - \mu_L - \frac{R.t}{2} \right) \\ &= \text{Rp } 144 \left(866,196 - 173,25 - \frac{52.500 \times 0,0033}{2} \right) \\ &= \text{Rp } 250.870,00 \end{aligned}$$

$$\text{Ongkos kekurangan persediaan} = \frac{\pi}{t} N_k = \frac{\text{Rp } 3.500}{0,0033} * 0,049 = \text{Rp } 51.970,00$$

$$\begin{aligned} \text{TC} &= \text{O. Pengadaan} + \text{O. Simpan} + \text{O. Kekurangan Persediaan} \\ &= \text{Rp } 88.460,00 + \text{Rp } 250.870,00 + \text{Rp } 51.970,00 \\ &= \text{Rp } 391.300,00 \end{aligned}$$

Perhitungan biaya persediaan pada distributor untuk produk botol adalah sebagai berikut:

$$\mu_{L+t} = R(L + t) = 18.750 \times (0,0033 + 0,0033) = 123,75 \text{ unit}$$

$$\sigma_{L+t} = \sigma \sqrt{(L + t)} = 932,372 \cdot \sqrt{(0,0033 + 0,0033)} = 75,746 \text{ unit}$$

$$t = \sqrt{\frac{2C}{RH}} = \sqrt{\frac{2 \times \text{Rp } 3.503}{18.750 \times \text{Rp } 144}} = 0,0509 \text{ bulan}$$

$$F'(K) = \frac{Ht}{\pi} = \frac{\text{Rp } 144 \times 0,0033}{\text{Rp } 7.250} = 0,0005$$

Dari tabel, $K = 3,0$

$$E = \mu_{L+t} + K * \sigma_{L+t} = 123,75 + (3,0 * 75,746) = 350,988 \text{ unit.}$$

$$\sigma_L = \sigma \cdot \sqrt{L} = 932,372 \times \sqrt{0,0033} = 53,561$$

$$\mu_L = R \times L = 18.750 \times 0,0033 = 61,875$$

$$N_k = \sigma_L \cdot E(K) = 53,561 \times 0,0004 = 0,021$$

Menghitung ongkos pengadaan per bulan:

$$O_p = \frac{C}{t} = \frac{\text{Rp } 3.503}{0,0033} = \text{Rp } 1.061.515,152/\text{tahun} = \text{Rp } 88.460,00/\text{bulan}$$

$$\begin{aligned} \text{Ongkos simpan} &= H \left(E - \mu_L - \frac{R.t}{2} \right) \\ &= \text{Rp } 144 \left(350,988 - 61,875 - \frac{18.750 \times 0,0033}{2} \right) \\ &= \text{Rp } 133.558,00 \end{aligned}$$

$$\text{Ongkos kekurangan persediaan} = \frac{\pi}{t} Nk = \frac{\text{Rp } 7.250}{0.0033} * 0.021 = \text{Rp } 46.137,00$$

$$\text{TC} = \text{O. Pengadaan} + \text{O. Simpan} + \text{O. Kekurangan Persediaan}$$

$$= \text{Rp } 88.460,00 + \text{Rp } 133.558,00 + \text{Rp } 46.137,00$$

$$= \text{Rp } 268.155,00$$

PENGENDALIAN PERSEDIAAN USULAN DENGAN *JOINT ECONOMIC LOT SIZE*

Pengendalian persediaan produk cup 240 ml:

Tabel D.1
Data Produk Cup untuk Metode *Joint Economic Lot Size*

Keterangan	Notasi	Jumlah	Satuan
Permintaan tahunan	D	52.500	unit/bln
Kec produksi tahunan	P	75.000	unit/bln
S.dev permintaan	σ	2132,340	unit/bln
B. Kirim	F	73.535	per kirim
B. Pesan	A	3.503	per pesan
B. Simpan Supp	h_v	68	unit/bln
B. Simpan Dist	h_b	144	unit/bln
B. Setup	K	1277,167	per setup
B. Backorder	π	13.656	per unit

Langkah 1 : Menetapkan $m=1$ dengan $TC(Q^*_{m-1}, k^*_{m-1}, m-1) = \infty$

Langkah 2 : Menghitung lot pengiriman

$$Q = \sqrt{\frac{2D \left\{ \left(\frac{A}{n} + F \right) \right\} + \frac{k}{m}}{h_b + h_v \left\{ (m-1) - (m-2) \frac{D}{P} \right\}}}$$

$$Q = \sqrt{\frac{2 \times 52.500 \left\{ \left(\frac{3.503}{300} + 73.535 \right) \right\} + \frac{1.277,167}{1}}{144 + 68 \left\{ (1-1) - (1-2) \frac{52.500}{75.000} \right\}}}$$

$$Q = 6.814,2633$$

Langkah 3 : Menggunakan nilai Q untuk mendapatkan nilai k pada persamaan

$$F(k) = 1 - \frac{h_b Q}{\pi D} = 1 - \frac{144 \times 6.814,2633}{13.656 \times 52.500} = 0,9993$$

Dari tabel distribusi normal standar, diperoleh nilai $k= 3,216$

$$f(k) = \frac{1}{\sqrt{2\pi}} e^{\left[-\frac{k^2}{2} \right]} = \frac{1}{\sqrt{2\pi}} e^{\left[-\frac{3,216^2}{2} \right]} = 0,0023$$

$$\text{Maka, } \psi_k = f(k) - k[1-F(k)] = 0,0023 - 3,216[1-0,9993] = 0,0002$$

Langkah 4 : Menghitung Q^* .

$$Q^* = \frac{2D \left\{ \left(\frac{A}{n} + F \right) + \pi \sigma \psi(k) \sqrt{\frac{Q}{D} + \frac{K}{m}} \right\}}{\sqrt{h_b + h_v \left\{ (m-1) - (m-2) \frac{D}{P} \right\} + \frac{h_b \sigma}{D \sqrt{\frac{Q}{D}}} \left\{ k + \frac{\psi(k)}{[1-F(k)]} \right\}}}$$

$$Q^* = \frac{2 \times 52.500 \left\{ \left(\frac{3503}{300} + 73.535 \right) + 13.656 \times 2.132,340 \times 0,0002 \sqrt{\frac{6.814,2633}{52.500} + \frac{1.277,167}{1}} \right\}}{\sqrt{144 + 68 \left\{ (1-1) - (1-2) \frac{52.500}{75.000} \right\} + \frac{144 \times 2.132,340}{52.500 \sqrt{\frac{6.814,2633}{52.500}}} \left\{ 1,859 + \frac{0,0002}{[1-0,9993]} \right\}}}$$

$$Q^* = 6.407,2895$$

Langkah 5 : Tetapkan bahwa $Q^*_m = Q$ dan $k^*_m = k$ dan hitung $TC(Q^*_m, k^*_m, m)$.

$Q^*_1 \neq Q$, maka kembali ke langkah 3.

Berikut adalah rangkuman dari langkah 3 sampai langkah 5:

Tabel D.2
Rangkuman Langkah 3-5 Produk Cup

m	Q	k	Q*	Q=Q*?	TC (Rp)
1	6814,2633	3,216	6407,2895	tidak	
1	6407,2895	3,234	6400,3247	tidak	
1	6400,3247	3,234	6400,2047	tidak	
1	6400,2047	3,234	6400,2026	tidak	
1	6400,2026	3,234	6400,2026	ya	984.962,045
2	6055,9139	3,250	5741,4572	tidak	
2	5741,4572	3,265	5736,8754	tidak	
2	5736,8754	3,265	5736,8082	tidak	
2	5736,8082	3,265	5736,8072	tidak	
2	5736,8072	3,265	5736,8072	ya	735.433,072
3	5512,5423	3,276	5257,8718	tidak	
3	5257,8718	3,290	5254,6240	tidak	
3	5254,6240	3,290	5254,5824	tidak	
3	5254,5824	3,290	5254,5818	tidak	
3	5254,5818	3,290	5254,5818	ya	839.900,106

Diperoleh nilai $Q^*_5 = Q = 6.400,2026$ pada $m = 1$, maka dilanjutkan dengan menghitung TC_{Gab}^* .

$$TC_{Gab}^* = \left(A \frac{D}{nQ^*} \right) + \left(\frac{Q^*}{2} + k\sigma \sqrt{\frac{Q^*}{D}} \right) h_b + \left(\frac{D}{Q^*} \right) k\sigma \sqrt{\frac{Q^*}{D}} \psi(k) + \frac{Q^*}{2} h_v \left\{ (m-1) - (m-2) \frac{D}{P} \right\} + \frac{KD}{mQ^*}$$

$$TC_{Gab}^* = \left(3.503 \frac{52.500}{300 \times 6.400,2026} \right) + \left(\frac{6.400,2026}{2} + 3,234 \times 2.132,340 \sqrt{\frac{6.400,2026}{52.500}} \right) 144 + \left(\frac{52.500}{6.400,2026} \right) 3,234 \times$$

$$2.132,340 \sqrt{\frac{6.400,2026}{52.500}} 0,0002 + \frac{6.400,2026}{2} 68 \left\{ (1-1) - (1-2) \frac{52.500}{75.000} \right\} + \frac{1277,166 \times 52.500}{1 \times 6.400,2026}$$

$$= \text{Rp } 984.962,045$$

Langkah 6 : Jika $TC(Q^*_m, k^*_m, m) \leq TC(Q^*_{m-1}, k^*_{m-1}, m-1)$ ulangi langkah 1 sampai 5 dengan $m = m+1$, dan jika $TC(Q^*_m, k^*_m, m) \leq TC(Q^*_{m-1}, k^*_{m-1}, m-1)$ diperoleh nilai Q^* , k^* dan m^* yang optimal.

Dari Tabel D.2 di atas diperoleh nilai $Q^* = 5.736,8072$, $k^* = 3,265$ dan $m^* = 2$ dengan $TC_{Gab}^* = Rp 735.433,072$

Pengendalian persediaan produk botol 600 ml:

Tabel D.2
Data Produk Botol untuk Metode *Joint Economic Lot Size*

Keterangan	Notasi	Jumlah	Satuan
Permintaan tahunan	D	18.750	unit/th
Kec produksi tahunan	P	21.250	unit/th
S.dev permintaan	σ	932,372	unit/th
B. Kirim	F	73.535	per kirim
B. Pesan	A	3.503	per pesan
B. Simpan Supp	h_v	68	/unit/th
B. Simpan Dist	h_b	144	/unit/th
B. Setup	K	1277,167	per setup
B. Backorder	π	13.656	/unit/th

Langkah 1 : Menetapkan $m=1$ dengan $TC(Q^*_{m-1}, k^*_{m-1}, m-1) = \infty$

Langkah 2 : Menghitung lot pengiriman

$$Q = \sqrt{\frac{2D \left\{ \frac{A}{n} + F \right\} + \frac{k}{m}}{h_b + h_v \left\{ (m-1) - (m-2) \frac{D}{P} \right\}}}$$

$$Q = \sqrt{\frac{2 \times 118.750 \left\{ \frac{3.503}{300} + 73.535 \right\} + \frac{1.277,167}{1}}{144 + 68 \left\{ (1-1) - (1-2) \frac{18.750}{21.250} \right\}}}$$

$$Q = 3.788,8884$$

Langkah 3 : Menggunakan nilai Q untuk mendapatkan nilai k pada persamaan

$$F(k) = 1 - \frac{h_b Q}{\pi D} = 1 - \frac{144 \times 3.788,8884}{13.656 \times 18.750} = 0,9990$$

Dari tabel distribusi normal standar, diperoleh nilai $k = 3,087$

$$f(k) = \frac{1}{\sqrt{2\pi}} e^{\left[-\frac{k^2}{2} \right]} = \frac{1}{\sqrt{2\pi}} e^{\left[-\frac{3,087^2}{2} \right]} = 0,0034$$

$$\text{Maka, } \psi_k = f(k) - k[1-F(k)] = 0,0034 - 3,087[1-0,9990] = 0,0003$$

Langkah 4 : Menghitung Q^* .

$$Q^* = \frac{2D \left\{ \left(\frac{A}{n} + F \right) + \pi \sigma \psi(k) \sqrt{\frac{Q}{D} + \frac{K}{m}} \right\}}{\sqrt{h_b + h_v \left\{ (m-1) - (m-2) \frac{D}{P} \right\} + \frac{h_b \sigma}{D \sqrt{\frac{Q}{D}}} \left\{ k + \frac{\psi(k)}{[1 - F(k)]} \right\}}}$$

$$Q^* = \frac{2 \times 18.750 \left\{ \left(\frac{3503}{300} + 73.535 \right) + 13.656 \times 932,372 \times 0,0003 \sqrt{\frac{3.788,8884}{243.750} + \frac{1.277,167}{1}} \right\}}{\sqrt{144 + 68 \left\{ (1-1) - (1-2) \frac{18.750}{21.250} \right\} + \frac{144 \times 932,372}{18.750 \sqrt{\frac{3.788,8884}{18.750}}} \left\{ 3,087 + \frac{0,0003}{[1 - 0,9990]} \right\}}}$$

Q* = 3.602,0369

Langkah 5 : Tetapkan bahwa Q*_m = Q dan k*_m = k dan hitung TC(Q*_m, k*_m, m).

Q*_1 ≠ Q, maka kembali ke langkah 3.

Tabel D.3
Rangkuman Langkah 3-5 Produk Botol

m	Q	k	Q*	Q=Q*?	TC (Rp)
1	3788,8884	3,087	3602,0369	tidak	
1	3602,0369	3,102	3599,1724	tidak	
1	3599,1724	3,102	3599,1283	tidak	
1	3599,1283	3,102	3599,1276	tidak	
1	3599,1276	3,102	3599,1276	ya	564.653,275
2	3619,1008	3,100	3449,3151	tidak	
2	3449,3151	3,114	3446,8606	tidak	
2	3446,8606	3,115	3446,8250	tidak	
2	3446,8250	3,115	3446,8244	tidak	
2	3446,8244	3,115	3446,8244	ya	432.290,864
3	3477,8647	3,112	3322,3177	tidak	
3	3322,3177	3,126	3320,1903	tidak	
3	3320,1903	3,126	3320,1610	tidak	
3	3320,1610	3,126	3320,1606	tidak	
3	3320,1606	3,126	3320,1606	ya	474.452,795

Diperoleh nilai Q*_5 = Q = 3.599,1276 pada m = 1, maka dilanjutkan dengan menghitung TC_{Gab}*.

$$TC_{Gab}^* = \left(A \frac{D}{nQ^*} \right) + \left(\frac{Q^*}{2} + k\sigma \sqrt{\frac{Q^*}{D}} \right) h_b + \left(\frac{D}{Q^*} \right) k\sigma \sqrt{\frac{Q^*}{D} \psi(k) + \frac{Q^*}{2} h_v \left\{ (m-1) - (m-2) \frac{D}{P} \right\} + \frac{KD}{mQ^*}}$$

$$TC_{Gab}^* = \left(3.503 \frac{18.750}{300 \times 3.599,1276} \right) + \left(\frac{3.599,1276}{2} + 3,102 \times 932,372 \sqrt{\frac{3.599,1276}{18.750}} \right) 144 + \left(\frac{18.750}{3.599,1276} \right) 3,102 \times$$

$$932,372 \sqrt{\frac{3.599,1276}{18.750}} 0,0003 + \frac{3.599,1276}{2} 68 \left\{ (1-1) - (1-2) \frac{18.750}{21.250} \right\} + \frac{1277,166 \times 18.750}{1 \times 3.599,1276}$$

= Rp 564.653,275

Langkah 6 : Jika $TC(Q_m^*, k_m^*, m) \leq TC(Q_{m-1}^*, k_{m-1}^*, m-1)$ ulangi langkah 1 sampai 5 dengan $m = m+1$, dan jika $TC(Q_m^*, k_m^*, m) \leq TC(Q_{m-1}^*, k_{m-1}^*, m-1)$ diperoleh nilai Q^* , k^* dan m^* yang optimal.

Dari Tabel D.3 di atas diperoleh nilai $Q^* = 3.446,8244$, $k^* = 3,115$ dan $m^* = 2$ dengan $TC_{Gab}^* = Rp 432.290,864$

KOMENTAR DOSEN PENGUJI

Nama : Bella regina
NRP : 0923046
Judul Tugas Akhir : Usulan Pengendalian Persediaan Produk AMDK Dengan
Menggunakan Metode *Joint Economic Lot Size*

Komentar-Komentar Dosen Penguji:

1. Saran dijabarkan lebih jelas untuk dapat dimengerti perusahaan.
2. Teori persediaan perlu ditingkatkan.
3. Pada abstrak masih banyak *space* yang dapat dimanfaatkan untuk mengungkap hasil penelitian.
4. Penyajian tabel diperbaiki sehingga mudah dibandingkan.

DATA PENULIS

Nama : Bella Regina
Alamat di Bandung : Jalan Babakan Jeruk Indah 1 no. 10
Alamat Asal : Jalan Rangka Gede no 131 Karawang
No. Telp. Asal : (0267) 400846
No. HP : 089650005750
Alamat email : reginabellaa@gmail.com
Pendidikan : SMA Yos Sudarso Karawang
Jurusan Teknik Industri, Universitas Kristen Maranatha
Nilai Tugas Akhir : A
Tanggal USTA : 7 Februari 2013