# LAMPIRAN 1

- **Pengujian Distribusi Data**

**Pengujian Distribusi Data :**

1. Kompon Dumper Yamaha

| | | |
|---|---|---|
| Normal | | |
| mean | = | 4822.67 |
| sigma | = | 1711.25 |
| Kolmogorov-Smirnov | | |
| data points | | 24 |
| ks stat | | 0.144 |
| alpha | | 5.e-002 |
| ks stat(24,5.e-002) | | 0.269 |
| p-value | | 0.649 |
| result | | DO NOT REJECT |

2. Kompon Dumper Kharisma

| | | |
|---|---|---|
| Normal | | |
| mean | = | 4280.79 |
| sigma | = | 959.318 |
| Kolmogorov-Smirnov | | |
| data points | | 24 |
| ks stat | | 0.133 |
| alpha | | 5.e-002 |
| ks stat(24,5.e-002) | | 0.269 |
| p-value | | 0.737 |
| result | | DO NOT REJECT |

3. Kompon Dumper GB-4

| | | |
|---|---|---|
| Normal | | |
| mean | = | 3520.46 |
| sigma | = | 963.849 |
| Kolmogorov-Smirnov | | |
| data points | | 24 |
| ks stat | | 0.178 |
| alpha | | 5.e-002 |
| ks stat(24,5.e-002) | | 0.269 |
| p-value | | 0.389 |
| result | | DO NOT REJECT |

4. Kompon Dumper Suzuki

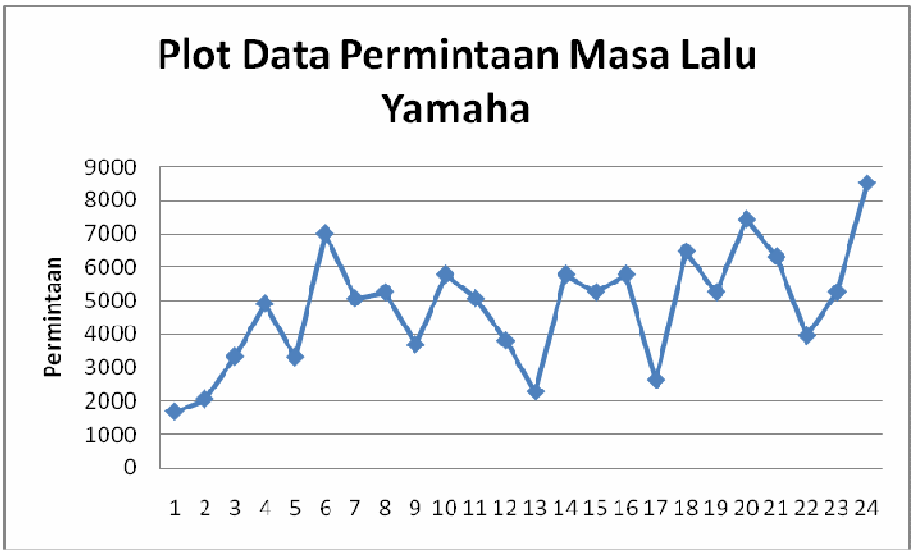
| | | |
|---|---|---|
| Normal | | |
| mean | = | 4486.92 |
| sigma | = | 1054.81 |
| Kolmogorov-Smirnov | | |
| data points | | 24 |
| ks stat | | 0.102 |
| alpha | | 5.e-002 |
| ks stat(24,5.e-002) | | 0.269 |
| p-value | | 0.941 |
| result | | DO NOT REJECT |

# LAMPIRAN 2

- **Penentuan Metode Peramalan Terbaik**
- **Uji Tracking Signal**

## 1.1 Penentuan Metode Peramalan Terbaik

### 1. Kompon untuk Produk Yamaha




Gambar L1.1
Plot Data Permintaan Masa Lalu Produk Yamaha

### a. Metode Pegels A-1: (Pola Konstan)

$S_t = \alpha.P(1-\alpha).Q$

$P = X_t$

$Q = S_{t-1}$

Sehingga :

Pemulusan keseluruham : $S_t = \alpha.X_t(1-\alpha).S_{t-1}$

Ramalan : $F_{t+m} = S_t$

So = Rata-rata $X_t$ = 4,822.667

Tabel L1.1

Metode Peramalan Pola Konstan Produk Yamaha

| t | Xt=dt | St | Ft+m =dt' | dt-dt' | Idt-dt'I |
|---|---|---|---|---|---|
| 1 | 1,678 | 4,193.734 | - | - | - |
| 2 | 2,051 | 3,765.187 | 4,193.734 | -2,142.734 | 2,142.734 |
| 3 | 3,321 | 3,676.350 | 3,765.187 | -444.187 | 444.187 |
| 4 | 4,905 | 3,922.080 | 3,676.350 | 1,228.650 | 1,228.650 |

Tabel L1.1

Metode Peramalan Pola Konstan Produk Yamaha (lanjutan)

| t | Xt=dt | St | Ft+m =dt' | dt-dt' | Idt-dt'I |
|---|---|---|---|---|---|
| 5 | 3,306 | 3,798.864 | 3,922.080 | -616.080 | 616.080 |
| 6 | 6,998 | 4,438.691 | 3,798.864 | 3,199.136 | 3,199.136 |
| 7 | 5,051 | 4,561.153 | 4,438.691 | 612.309 | 612.309 |
| 8 | 5,255 | 4,699.922 | 4,561.153 | 693.847 | 693.847 |
| 9 | 3,677 | 4,495.338 | 4,699.922 | -1,022.922 | 1,022.922 |
| 10 | 5,778 | 4,751.870 | 4,495.338 | 1,282.662 | 1,282.662 |
| 11 | 5,053 | 4,812.096 | 4,751.870 | 301.130 | 301.130 |
| 12 | 3,795 | 4,608.677 | 4,812.096 | -1,017.096 | 1,017.096 |
| 13 | 2,264 | 4,139.742 | 4,608.677 | -2,344.677 | 2,344.677 |
| 14 | 5,778 | 4,467.393 | 4,139.742 | 1,638.258 | 1,638.258 |
| 15 | 5,255 | 4,624.915 | 4,467.393 | 787.607 | 787.607 |
| 16 | 5,780 | 4,855.932 | 4,624.915 | 1,155.085 | 1,155.085 |
| 17 | 2,627 | 4,410.145 | 4,855.932 | -2,228.932 | 2,228.932 |
| 18 | 6,473 | 4,822.716 | 4,410.145 | 2,062.855 | 2,062.855 |
| 19 | 5,255 | 4,909.173 | 4,822.716 | 432.284 | 432.284 |
| 20 | 7,427 | 5,412.738 | 4,909.173 | 2,517.827 | 2,517.827 |
| 21 | 6,306 | 5,591.391 | 5,412.738 | 893.262 | 893.262 |
| 22 | 3,946 | 5,262.313 | 5,591.391 | -1,645.391 | 1,645.391 |
| 23 | 5,253 | 5,260.450 | 5,262.313 | -9.313 | 9.313 |
| 24 | 8,512 | 5,910.760 | 5,260.450 | 3,251.550 | 3,251.550 |
| 25 | | | 5,910.760 | | 31,527.794 |

Contoh perhitungan :

$S_1 = (0.2 * 1{,}678) + (0.8 * 4{,}822.667) = 4{,}193.734$

$F_2 = 4{,}193.734$

$$MAD = \frac{\sum_{t=1}^{n} |d_t - d_t'|}{n} = \frac{31{,}527.794}{23} = 1{,}370.774$$

**b. Metode Pegels A-2 : (Musiman Aditif)**

$P = X_t - C_{t-L}$

$Q = S_{t-1}$

$S_t = \alpha.P + (1-\alpha).Q$

Sehingga :

Pemulusan keseluruhan : $S_t = \alpha.(X_t - C_{t-L}) + (1-\alpha).S_{t-1}$

Pemulusan musiman : $C_t = \gamma.(X_t - S_t) + (1-\gamma).C_{t-L}$

Ramalan : $F_{t+m} = S_t + C_{t-L+m}$

**Inisialisasi I :**

So = Rata-rata $X_t = \dfrac{4{,}239 + 5{,}406.333}{2} = 4{,}822.667$

*Seasonal Index Estimates = demand – trend line estimates*

Tabel L1.2

*Seasonal Index Estimates*

| Periode | 2007 | 2008 | Average |
|---|---|---|---|
| Januari | 1,678-4,822.667 = -3,144.667 | -2,558.667 | -2,851.667 = $C_{-11}$ |
| Februari | 2,051-4,822.667 = -2,771.667 | 955.333 | -908.167 = $C_{-10}$ |
| Maret | -1,501.667 | 432.333 | -534.667 = $C_{-9}$ |
| April | 82.333 | 957.333 | 519.833 = $C_{-8}$ |
| Mei | -1,516.667 | -2,195.667 | -1,856.167 = $C_{-7}$ |
| Juni | 2,175.333 | 1,650.333 | 1,912.833 = $C_{-6}$ |
| Juli | 228.333 | 432.333 | 330.333 = $C_{-5}$ |
| Agustus | 432.333 | 2,604.333 | 1,518.333 = $C_{-4}$ |
| September | -1,145.667 | 1,483.333 | 168.833 = $C_{-3}$ |
| Oktober | 955.333 | -876.667 | 39.333 = $C_{-2}$ |
| November | 230.333 | 430.333 | 330.333 = $C_{-1}$ |
| Desember | -1,027.667 | 3,689.333 | 1,330.833 = $C_0$ |
| | | | -0.004 |

Tabel L1.3

Metode Peramalan Musiman Aditif Produk Yamaha

| t | Xt=dt | St | Ct | Ft+m = dt' | dt-dt' | Idt-dt'I |
|---|---|---|---|---|---|---|
| 1 | 1,678 | 4,764.067 | -2,863.387 | - | - | - |
| 2 | 2,051 | 4,403.087 | -980.363 | 3,855.900 | -1,804.900 | 1,804.900 |
| 3 | 3,321 | 4,293.603 | -556.564 | 3,868.420 | -547.420 | 547.420 |
| 4 | 4,905 | 4,311.916 | 523.496 | 4,813.436 | 91.564 | 91.564 |
| 5 | 3,306 | 4,481.966 | -1,822.157 | 2,455.749 | 850.251 | 850.251 |
| 6 | 6,998 | 4,602.606 | 1,936.961 | 6,394.799 | 603.201 | 603.201 |
| 7 | 5,051 | 4,626.218 | 335.055 | 4,932.939 | 118.061 | 118.061 |
| 8 | 5,255 | 4,448.308 | 1,482.751 | 6,144.551 | -889.551 | 889.551 |

Tabel L1.3

Metode Peramalan Musiman Aditif Produk Yamaha (lanjutan)

| t | Xt=dt | St | Ct | Ft+m = dt' | dt-dt' | Idt-dt'I |
|---|---|---|---|---|---|---|
| 9 | 3,677 | 4,260.280 | 131.227 | 4,617.141 | -940.141 | 940.141 |
| 10 | 5,778 | 4,555.957 | 98.468 | 4,299.613 | 1,478.387 | 1,478.387 |
| 11 | 5,053 | 4,589.299 | 337.001 | 4,886.290 | 166.710 | 166.710 |
| 12 | 3,795 | 4,164.273 | 1,245.828 | 5,920.132 | -2,125.132 | 2,125.132 |
| 13 | 2,264 | 4,354.552 | -2,813.611 | 1,300.886 | 963.114 | 963.114 |
| 14 | 5,778 | 4,820.875 | -814.902 | 3,374.189 | 2,403.811 | 2,403.811 |
| 15 | 5,255 | 5,014.633 | -495.915 | 4,264.311 | 990.689 | 990.689 |
| 16 | 5,780 | 5,063.740 | 529.654 | 5,538.129 | 241.871 | 241.871 |
| 17 | 2,627 | 4,947.625 | -1,879.390 | 3,241.583 | -614.583 | 614.583 |
| 18 | 6,473 | 4,870.134 | 1,897.335 | 6,884.586 | -411.586 | 411.586 |
| 19 | 5,255 | 4,881.040 | 332.514 | 5,205.189 | 49.811 | 49.811 |
| 20 | 7,427 | 5,086.566 | 1,559.438 | 6,363.791 | 1,063.209 | 1,063.209 |
| 21 | 6,306 | 5,296.686 | 210.857 | 5,217.793 | 1,088.207 | 1,088.207 |
| 22 | 3,946 | 5,018.682 | -16.268 | 5,395.154 | -1,449.154 | 1,449.154 |
| 23 | 5,253 | 4,999.479 | 326.492 | 5,355.684 | -102.684 | 102.684 |
| 24 | 8,512 | 5,435.817 | 1,418.101 | 6,245.307 | 2,266.693 | 2,266.693 |
| 25 | | | | 2,622.205 | | 21,260.730 |

Contoh Perhitungan :

$S_1 = 0.2(1{,}678 - (-2{,}851.667)) + (1 - 0.2)4{,}822.667 = 4{,}764.067$

$C_1 = 0.05(1{,}678 - 4{,}764.067) + (1 - 0.05)(-2{,}851.667) = -2{,}863.387$

$F_2 = 4{,}764.067 + (-908.167) = 3{,}855.9$

$$MAD = \frac{\sum_{t=1}^{n} |d_t - d_t'|}{n} = \frac{21260.730}{23} = 924.380$$

**c. Metode Pegels B-1 : (Trend Aditif)**

Inisialisasi $A_0$ :

Demand rata-rata 2007 = 4,239 = $S_{6.5} = a$

Demand rata-rata 2008 = 5,406.333 = $S_{18.5} = t$

$S_t = A_0(t-a) + S_a$

$S_{18.5} = A_0(18.5-6.5) + S_{6.5}$

$5{,}406.33 = 12A_0 + 4{,}239$

$A_0 = \dfrac{5{,}406.333 - 4{,}239}{12} = 97.278$

Inisialisasi $S_0$ :

$S_t = A_0(t-a) + S_a$

$S_{6.5} = 97.278(6.5-0) + S_0$

$4{,}239 = 52.689_0 + S_0$

$S_0 = 4{,}239 - 632.306$

$S_0 = 3606.694$

Inisialisasi I :

*Trend Line sales estimates* = $S_{t-1}$ + *trend line estimates*

Tabel L1.4

*Trend Line Sales Estimates*

| Periode | 2007 | 2008 |
|---|---|---|
| Januari | 3,606.694+97.278 = 3,703.972 | 4,871.308 |
| Februari | 3,703.972+97.278 = 3,801.250 | 4,879.414 |
| Maret | 3,898.528 | 4,887.520 |
| April | 3,995.806 | 4,895.626 |
| Mei | 4,093.084 | 4,903.732 |
| Juni | 4,190.362 | 4,911.838 |
| Juli | 4,287.640 | 4,919.944 |
| Agustus | 4,384.918 | 4,928.050 |
| September | 4,482.196 | 4,936.156 |
| Oktober | 4,579.474 | 4,944.262 |
| November | 4,676.752 | 4,952.368 |
| Desember | 4,774.030 | 4,960.474 |

$S_t = \alpha.P + (1-\alpha).Q$

$P = X_t$

$Q = S_{t-1} + A_{t-1}$

Pemulusan keseluruhan : $S_t = \alpha.X_t + (1-\alpha).(S_{t-1} + A_{t-1})$

Pemulusan Trend : $A_t = \beta.(S_t - S_{t-1}) + (1-\beta).A_{t-1}$

Ramalan : $F_{t+m} = S_t + mA_t$

Tabel L1.5

Metode Peramalan Trend Aditif Produk Yamaha

| t | Xt=dt | St | At | Ft+m = dt' | dt-dt' | Idt-dt'I |
|---|---|---|---|---|---|---|
| 1 | 1,678 | 3,298.778 | 56.759 | - | - | - |
| 2 | 2,051 | 3,094.629 | 30.668 | 3,355.536 | -1,304.536 | 1,304.54 |
| 3 | 3,321 | 3,164.437 | 34.582 | 3,125.297 | 195.703 | 195.703 |
| 4 | 4,905 | 3,540.215 | 68.702 | 3,199.019 | 1,705.981 | 1,705.98 |
| 5 | 3,306 | 3,548.334 | 62.643 | 3,608.917 | -302.917 | 302.917 |
| 6 | 6,998 | 4,288.381 | 130.384 | 3,610.977 | 3,387.023 | 3,387.02 |
| 7 | 5,051 | 4,545.212 | 143.028 | 4,418.765 | 632.235 | 632.235 |
| 8 | 5,255 | 4,801.592 | 154.364 | 4,688.240 | 566.760 | 566.76 |
| 9 | 3,677 | 4,700.165 | 128.784 | 4,955.956 | -1,278.956 | 1,278.96 |
| 10 | 5,778 | 5,018.759 | 147.765 | 4,828.949 | 949.051 | 949.051 |
| 11 | 5,053 | 5,143.820 | 145.495 | 5,166.525 | -113.525 | 113.525 |
| 12 | 3,795 | 4,990.452 | 115.609 | 5,289.315 | -1,494.315 | 1,494.32 |
| 13 | 2,264 | 4,537.648 | 58.767 | 5,106.060 | -2,842.060 | 2,842.06 |
| 14 | 5,778 | 4,832.733 | 82.399 | 4,596.416 | 1,181.584 | 1,181.58 |
| 15 | 5,255 | 4,983.105 | 89.196 | 4,915.132 | 339.868 | 339.868 |
| 16 | 5,780 | 5,213.842 | 103.350 | 5,072.302 | 707.698 | 707.698 |
| 17 | 2,627 | 4,779.154 | 49.547 | 5,317.192 | -2,690.192 | 2,690.19 |
| 18 | 6,473 | 5,157.560 | 82.433 | 4,828.700 | 1,644.300 | 1,644.30 |
| 19 | 5,255 | 5,242.994 | 82.733 | 5,239.993 | 15.007 | 15.007 |
| 20 | 7,427 | 5,745.982 | 124.758 | 5,325.727 | 2,101.273 | 2,101.27 |
| 21 | 6,306 | 5,957.792 | 133.463 | 5,870.740 | 435.260 | 435.26 |
| 22 | 3,946 | 5,662.204 | 90.558 | 6,091.255 | -2,145.255 | 2,145.26 |
| 23 | 5,253 | 5,652.810 | 80.563 | 5,752.763 | -499.763 | 499.763 |
| 24 | 8,512 | 6,289.098 | 136.136 | 5,733.373 | 2,778.627 | 2,778.63 |
| | | | | 6,425.234 | | 29,311.889 |

Contoh Perhitungan :

$$S_1 = (0.2 * 1{,}678) + 0.8(3606.694 + 97.278) = 3{,}298.778$$

$$A_1 = 0.1(3{,}298.778 - 3606.694) + (0.9 * 97.278) = 56.759$$

$$F_2 = 3{,}298.778 + (1 * 56.759) = 3{,}355.536$$

$$MAD = \frac{\sum_{t=1}^{n} |d_t - d_t'|}{n} = \frac{29{,}311.889}{23} = 1{,}274.430$$

**d. Metode Pegels B-2 : (Trend Aditif – Musiman Aditif)**

$S_t = \alpha.P + (1-\alpha).Q$

$P = X_t - C_{t-L}$

$Q = S_{t-1} + A_{t-1}$

$S_t = \alpha.P + (1-\alpha).Q$

$P = X_t$

$Q = S_{t-1} + A_{t-1}$

Sehingga :

Pemulusan keseluruhan : $S_t = \alpha.(X_t - C_{t-L}) + (1-\alpha).(S_{t-1} + A_{t-1})$

Pemulusan Trend : $A_t = \beta.(S_t - S_{t-1}) + (1-\beta).A_{t-1}$

Pemulusan musiman : $C_t = \gamma.(X_t - S_t) + (1-\gamma).C_{t-L}$

Ramalan : $F_{t+m} = S_t + mA_t + C_{t-L+m}$

Inisialisasi I :

*Seasonal index estimates = demand - trend line estimates*

Tabel L1.6

*Seasonal index estimates*

| Periode | 2007 | 2008 | Average | |
|---|---|---|---|---|
| Januari | -2,025.972 | -2,607.308 | -2,316.640 | = $C_{-11}$ |
| Februari | -1,750.250 | 898.586 | -425.832 | = $C_{-10}$ |
| Maret | -577.528 | 367.480 | -105.024 | = $C_{-9}$ |
| April | 909.194 | 884.374 | 896.784 | = $C_{-8}$ |
| Mei | -787.084 | -2,276.732 | -1,531.908 | = $C_{-7}$ |
| Juni | 2,807.638 | 1,561.162 | 2,184.400 | = $C_{-6}$ |
| Juli | 763.360 | 335.056 | 549.208 | = $C_{-5}$ |
| Agustus | 870.082 | 2,498.950 | 1,684.516 | = $C_{-4}$ |
| September | -805.196 | 1,369.844 | 282.324 | = $C_{-3}$ |
| Oktober | 1,198.526 | -998.262 | 100.132 | = $C_{-2}$ |
| November | 376.248 | 300.632 | 338.440 | = $C_{-1}$ |
| Desember | -979.030 | 3,551.526 | 1,286.248 | = $C_0$ |
| | | | 2,942.648 | |

Tabel L1.7

Metode Peramalan Trend Aditif –Musiman Aditif Produk Yamaha

| t | Xt=dt | St | At | Ct | Ft+m = dt' | dt-dt' | Idt-dt'I |
|---|---|---|---|---|---|---|---|
| 1 | 1,678 | 3,762.106 | 103.091 | -2,305.013 | - | - | - |
| 2 | 2,051 | 3,587.524 | 75.324 | -481.367 | 3,439.365 | -1,388.365 | 1,388.37 |
| 3 | 3,321 | 3,615.483 | 70.588 | -114.497 | 3,557.824 | -236.824 | 236.824 |
| 4 | 4,905 | 3,750.500 | 77.030 | 909.670 | 4,582.855 | 322.145 | 322.145 |
| 5 | 3,306 | 4,029.606 | 97.238 | -1,491.493 | 2,295.622 | 1,010.378 | 1,010.38 |
| 6 | 6,998 | 4,264.195 | 110.973 | 2,211.870 | 6,311.244 | 686.756 | 686.756 |
| 7 | 5,051 | 4,400.493 | 113.506 | 554.273 | 4,924.376 | 126.624 | 126.624 |
| 8 | 5,255 | 4,325.296 | 94.635 | 1,646.775 | 6,198.515 | -943.515 | 943.515 |
| 9 | 3,677 | 4,214.880 | 74.130 | 241.314 | 4,702.255 | -1,025.255 | 1,025.26 |
| 10 | 5,778 | 4,566.782 | 101.907 | 155.686 | 4,389.142 | 1,388.858 | 1,388.86 |
| 11 | 5,053 | 4,677.863 | 102.825 | 340.275 | 5,007.129 | 45.871 | 45.871 |
| 12 | 3,795 | 4,326.301 | 57.386 | 1,195.371 | 6,066.936 | -2,271.936 | 2,271.94 |
| 13 | 2,264 | 4,420.752 | 61.093 | -2,297.600 | 2,078.674 | 185.326 | 185.326 |
| 14 | 5,778 | 4,837.349 | 96.643 | -410.266 | 4,000.478 | 1,777.522 | 1,777.52 |
| 15 | 5,255 | 5,021.093 | 105.353 | -97.077 | 4,819.495 | 435.505 | 435.505 |
| 16 | 5,780 | 5,075.223 | 100.231 | 899.425 | 6,036.116 | -256.116 | 256.116 |
| 17 | 2,627 | 4,964.062 | 79.092 | -1,533.771 | 3,683.961 | -1,056.961 | 1,056.96 |
| 18 | 6,473 | 4,886.749 | 63.451 | 2,180.589 | 7,255.024 | -782.024 | 782.024 |
| 19 | 5,255 | 4,900.305 | 58.462 | 544.294 | 5,504.473 | -249.473 | 249.473 |
| 20 | 7,427 | 5,123.058 | 74.891 | 1,679.634 | 6,605.542 | 821.458 | 821.458 |
| 21 | 6,306 | 5,371.297 | 92.226 | 275.983 | 5,439.263 | 866.737 | 866.737 |
| 22 | 3,946 | 5,128.880 | 58.761 | 88.758 | 5,619.208 | -1,673.208 | 1,673.21 |
| 23 | 5,253 | 5,132.659 | 53.263 | 329.278 | 5,527.917 | -274.917 | 274.917 |
| 24 | 8,512 | 5,612.063 | 95.877 | 1,280.599 | 6,381.292 | 2,130.708 | 2,130.71 |
| | | | | | 3,410.340 | | 19,956.482 |

Contoh Perhitungan :

$$S_1 = 0.2 * (1{,}678 - (-2{,}316.640) + 0.8(3606.694 + 97.278) = 3{,}762.106$$

$$A_1 = 0.1 * (3{,}762.106 - 3606.694) + (0.9 * 97.278) = 103.091$$

$$C_1 = 0.05 * (1{,}678 - 3{,}762.106) + (0.95 * (-2{,}316.640) = -2{,}305.013$$

$$F_2 = 3{,}762.106 + (1 * 103.091) + (-425.832) = 3{,}439.365$$

$$MAD = \frac{\sum_{t=1}^{n} |d_t - d_t'|}{n} = \frac{19{,}956.482}{23} = 867.673$$

Tabel L1.8

Hasil Pengujian Kesalahan

| Metode | MAD | Kesimpulan |
|---|---|---|
| A-1 | 1370.774 | - |
| A-2 | 924.380 | - |
| B-1 | 1274.430 | - |
| B-2 | **867.673** | **Terpilih** |

Tabel L1.9

Hasil Peramalan satu tahun kedepan

| Periode | Peramalan | | |
|---|---|---|---|
| Januari | 3,410.340 | = | 3,411 |
| Februari | 5,393.552 | = | 5,394 |
| Maret | 5,706.741 | = | 5,707 |
| April | 6,703.243 | = | 6,704 |
| Mei | 4,270.046 | = | 4,271 |
| Juni | 7,984.407 | = | 7,985 |
| Juli | 6,348.112 | = | 6,349 |
| Agustus | 7,483.451 | = | 7,484 |
| September | 6,079.801 | = | 6,080 |
| Oktober | 5,892.576 | = | 5,893 |
| November | 6,133.096 | = | 6,134 |
| Desember | 7,084.416 | = | 7,085 |
| $\mu$ | 6,041.417 | | |
| $\sigma$ | 1,282.674 | | |

**2. Kompon untuk Produk Kharisma**

Tabel L1.10

Hasil Pengujian Kesalahan

| Metode | MAD | Kesimpulan |
|---|---|---|
| A-1 | 815.308 | - |
| A-2 | **738.403** | **Terpilih** |
| B-1 | 844.485 | - |
| B-2 | 759.621 | - |

Tabel L1.11

Hasil Peramalan satu tahun kedepan

| Periode | Peramalan |
|---|---|
| Januari | 3,875.947 = 3,876 |
| Februari | 3,451.810 = 3,452 |
| Maret | 4,442.721 = 4,443 |
| April | 3,983.170 = 3,984 |
| Mei | 4,821.909 = 4,822 |
| Juni | 4,263.360 = 4,264 |
| Juli | 4,591.081 = 4,592 |
| Agustus | 4,768.177 = 4,769 |
| September | 5,598.375 = 5,599 |
| Oktober | 4,878.333 = 4,879 |
| November | 4,743.979 = 4,744 |
| Desember | 4,575.916 = 4,576 |
| $\mu$ | 4,500 |
| $\sigma$ | 557.115 |

### 3. Kompon untuk Produk GB-4

Tabel L1.12

Hasil Pengujian Kesalahan

| Metode | MAD | Kesimpulan |
|---|---|---|
| A-1 | 889.482 | - |
| A-2 | **771.560** | **Terpilih** |
| B-1 | 861.133 | - |
| B-2 | 802.612 | - |

Tabel L1.13

Hasil Peramalan satu tahun kedepan

| Periode | Peramalan |
|---|---|
| Januari | 3,402.91 = 3,403 |
| Februari | 2,534.276 = 2,535 |
| Maret | 3,964.509 = 3,965 |
| April | 3,640.295 = 3,641 |
| Mei | 3,955.704 = 3,956 |
| Juni | 3,879.631 = 3,880 |
| Juli | 4,094.993 = 4,095 |
| Agustus | 3,163.302 = 3,164 |
| September | 3,892.51 = 3,893 |

Tabel L1.13

Hasil Peramalan satu tahun kedepan (lanjutan)

| Periode | Peramalan |
|---|---|
| Oktober | 3,056.176 = 3,057 |
| November | 2,862.669 = 2,863 |
| Desember | 3,784.123 = 3,785 |
| $\mu$ | 3,519.75 |
| $\sigma$ | 507.1317069 |

**4. Kompon untuk Produk Suzuki**

Tabel L1.14

Hasil Pengujian Kesalahan

| Metode | MAD | Kesimpulan |
|---|---|---|
| A-1 | 942.021 | - |
| A-2 | **520.752** | **Terpilih** |
| B-1 | 950.845 | - |
| B-2 | 523.899 | - |

Tabel L1.15

Hasil Peramalan satu tahun kedepan

| Periode | Peramalan |
|---|---|
| Januari | 3,696.644 = 3,697 |
| Februari | 3,964.437 = 3,965 |
| Maret | 3,301.632 = 3,302 |
| April | 5,086.928 = 5,087 |
| Mei | 3,301.024 = 3,302 |
| Juni | 3,693.842 = 3,694 |
| Juli | 5,323.455 = 5,324 |
| Agustus | 5,359.426 = 5,360 |
| September | 4,586.823 = 4,587 |
| Oktober | 3,515.521 = 3,516 |
| November | 5,023.779 = 5,024 |
| Desember | 6,051.065 = 6,052 |
| $\mu$ | 4,409.167 |
| $\sigma$ | 942.642 |

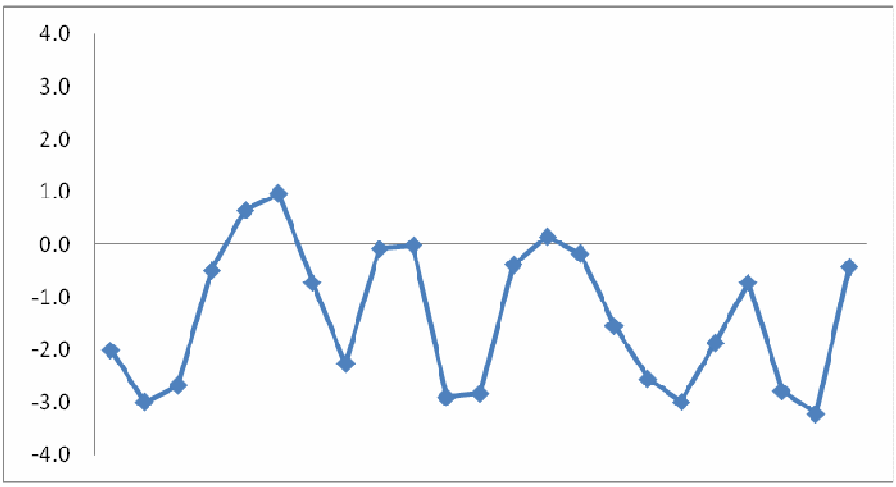
## 1.2 Uji Tracking Signal

### 1. Kompon untuk Produk Yamaha

Tabel L1.16

Uji *Tracking Signal* Produk Yamaha

| t | dt | dt' | error (dt-dt') | error kumulatif | Absolut error | Kum. Absolut error | MAD | Tracking Signal |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5)=4 | (6)=4 | (7)=6 | (8)=7/1 | (9)=5/8 |
| 1 | 1,678 | - | - | - | - | - | - | - |
| 2 | 2,051 | 3,439.365 | -1,388.365 | -1,388.365 | 1,388.37 | 1,388.365 | 694.183 | -2.0 |
| 3 | 3,321 | 3,557.824 | -236.824 | -1,625.189 | 236.824 | 1,625.189 | 541.730 | -3.0 |
| 4 | 4,905 | 4,582.855 | 322.145 | -1,303.044 | 322.145 | 1,947.334 | 486.834 | -2.7 |
| 5 | 3,306 | 2,295.622 | 1,010.378 | -292.666 | 1,010.38 | 2,957.712 | 591.542 | -0.5 |
| 6 | 6,998 | 6,311.244 | 686.756 | 394.090 | 686.756 | 3,644.468 | 607.411 | 0.6 |
| 7 | 5,051 | 4,924.376 | 126.624 | 520.714 | 126.624 | 3,771.092 | 538.727 | 1.0 |
| 8 | 5,255 | 6,198.515 | -943.515 | -422.801 | 943.515 | 4,714.607 | 589.326 | -0.7 |
| 9 | 3,677 | 4,702.255 | -1,025.255 | -1,448.056 | 1,025.26 | 5,739.862 | 637.762 | -2.3 |
| 10 | 5,778 | 4,389.142 | 1,388.858 | -59.198 | 1,388.86 | 7,128.720 | 712.872 | -0.1 |
| 11 | 5,053 | 5,007.129 | 45.871 | -13.328 | 45.871 | 7,174.591 | 652.236 | 0.0 |
| 12 | 3,795 | 6,066.936 | -2,271.936 | -2,285.264 | 2,271.94 | 9,446.527 | 787.211 | -2.9 |
| 13 | 2,264 | 2,078.674 | 185.326 | -2,099.937 | 185.326 | 9,631.853 | 740.912 | -2.8 |
| 14 | 5,778 | 4,000.478 | 1,777.522 | -322.416 | 1,777.52 | 11,409.375 | 814.955 | -0.4 |
| 15 | 5,255 | 4,819.495 | 435.505 | 113.089 | 435.505 | 11,844.880 | 789.659 | 0.1 |
| 16 | 5,780 | 6,036.116 | -256.116 | -143.027 | 256.116 | 12,100.996 | 756.312 | -0.2 |
| 17 | 2,627 | 3,683.961 | -1,056.961 | -1,199.988 | 1,056.96 | 13,157.957 | 773.997 | -1.6 |
| 18 | 6,473 | 7,255.024 | -782.024 | -1,982.012 | 782.024 | 13,939.981 | 774.443 | -2.6 |
| 19 | 5,255 | 5,504.473 | -249.473 | -2,231.485 | 249.473 | 14,189.454 | 746.813 | -3.0 |
| 20 | 7,427 | 6,605.542 | 821.458 | -1,410.027 | 821.458 | 15,010.912 | 750.546 | -1.9 |
| 21 | 6,306 | 5,439.263 | 866.737 | -543.290 | 866.737 | 15,877.649 | 756.079 | -0.7 |
| 22 | 3,946 | 5,619.208 | -1,673.208 | -2,216.498 | 1,673.21 | 17,550.857 | 797.766 | -2.8 |
| 23 | 5,253 | 5,527.917 | -274.917 | -2,491.415 | 274.917 | 17,825.774 | 775.034 | -3.2 |
| 24 | 8,512 | 6,381.292 | 2,130.708 | -360.707 | 2,130.71 | 19,956.482 | 831.520 | -0.4 |




Gambar L1.2

Uji *Tracking Signal* Produk Yamaha

Dari gambar uji *Tracking Signal* diatas terlihat bahwa semua nilainya berada di antara batas UCL dan LCL. Dengan demikian metode Pegels Trend Aditif - Musiman Aditif dapat digunakan untuk peramalan.

**2. Kompon untuk Produk Kharisma**

Tabel L1.17

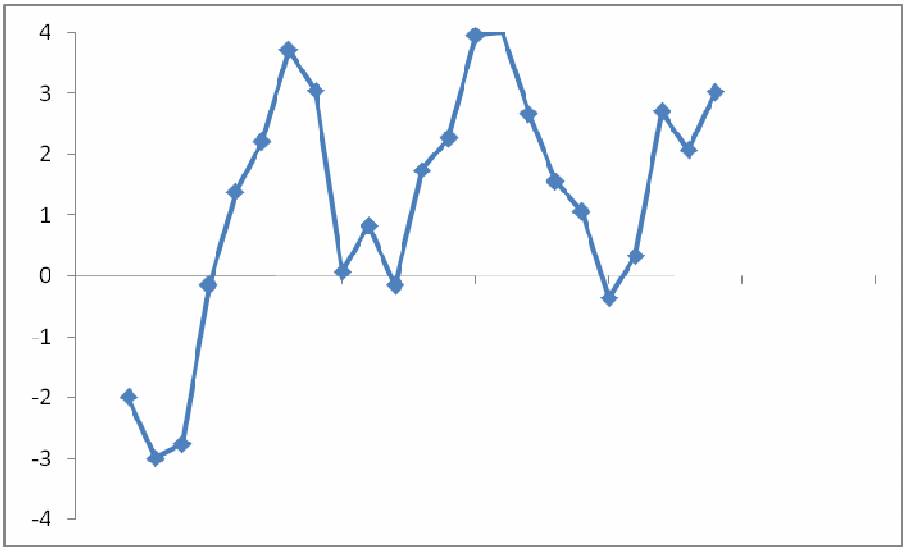
Uji *Tracking Signal* Produk Kharisma

| t | dt | dt' | error (dt-dt') | error kumulatif | Absolut error | Kum. Absolut error | MAD | Tracking Signal |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5)=4 | (6)=4 | (7)=6 | (8)=7/1 | (9)=5/8 |
| 1 | 2,579 | - | - | - | - | - | - | - |
| 2 | 2,907 | 3,021.500 | -114.500 | -114.500 | 114.500 | 114.500 | 57.250 | -2.0 |
| 3 | 2,853 | 3,951.600 | -1,098.600 | -1,213.100 | 1,098.600 | 1,213.100 | 404.367 | -3.0 |
| 4 | 3,550 | 3,326.380 | 223.620 | -989.480 | 223.620 | 1,436.720 | 359.180 | -2.8 |
| 5 | 5,158 | 4,238.604 | 919.396 | -70.084 | 919.396 | 2,356.116 | 471.223 | -0.1 |
| 6 | 4,649 | 3,859.483 | 789.517 | 719.433 | 789.517 | 3,145.633 | 524.272 | 1.4 |
| 7 | 4,737 | 4,330.387 | 406.613 | 1,126.046 | 406.613 | 3,552.246 | 507.464 | 2.2 |
| 8 | 5,579 | 4,611.709 | 967.291 | 2,093.337 | 967.291 | 4,519.537 | 564.942 | 3.7 |
| 9 | 5,158 | 5,580.167 | -422.167 | 1,671.170 | 422.167 | 4,941.704 | 549.078 | 3.0 |
| 10 | 3,099 | 4,727.734 | -1,628.734 | 42.436 | 1,628.730 | 6,570.434 | 657.043 | 0.1 |
| 11 | 4,839 | 4,352.487 | 486.513 | 528.949 | 486.513 | 7,056.947 | 641.541 | 0.8 |

Tabel L1.17

Uji *Tracking Signal* Produk Kharisma (lanjutan)

| t | dt | dt' | error (dt-dt') | error kumulatif | Absolut error | Kum. Absolut error | MAD | Tracking Signal |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5)=4 | (6)=4 | (7)=6 | (8)=7/1 | (9)=5/8 |
| 12 | 3,608 | 4,237.290 | -629.290 | -100.341 | 629.290 | 7,686.237 | 640.520 | -0.2 |
| 13 | 4,649 | 3,345.532 | 1,303.468 | 1,203.127 | 1,303.468 | 8,989.705 | 691.516 | 1.7 |
| 14 | 3,550 | 3,249.265 | 300.735 | 1,503.862 | 300.735 | 9,290.440 | 663.603 | 2.3 |
| 15 | 5,510 | 4,222.132 | 1,287.868 | 2,791.729 | 1,287.868 | 10,578.308 | 705.221 | 4.0 |
| 16 | 4,002 | 4,118.306 | -116.306 | 2,675.423 | 116.306 | 10,694.614 | 668.413 | 4.0 |
| 17 | 4,129 | 4,992.165 | -863.165 | 1,812.259 | 863.165 | 11,557.779 | 679.869 | 2.7 |
| 18 | 3,512 | 4,258.692 | -746.692 | 1,065.567 | 746.692 | 12,304.471 | 683.582 | 1.6 |
| 19 | 4,050 | 4,413.353 | -363.353 | 702.214 | 363.353 | 12,667.824 | 666.728 | 1.1 |
| 20 | 3,608 | 4,566.363 | -958.363 | -256.149 | 958.363 | 13,626.187 | 681.309 | -0.4 |
| 21 | 5,579 | 5,101.850 | 477.150 | 221.001 | 477.150 | 14,103.336 | 671.587 | 0.3 |
| 22 | 6,102 | 4,377.640 | 1,724.360 | 1,945.361 | 1,724.360 | 15,827.696 | 719.441 | 2.7 |
| 23 | 4,263 | 4,744.592 | -481.592 | 1,463.768 | 481.592 | 16,309.288 | 709.099 | 2.1 |
| 24 | 5,069 | 4,395.034 | 673.966 | 2,137.735 | 673.966 | 16,983.255 | 707.636 | 3.0 |




Gambar L1.3

Uji *Tracking Signal* Produk Kharisma

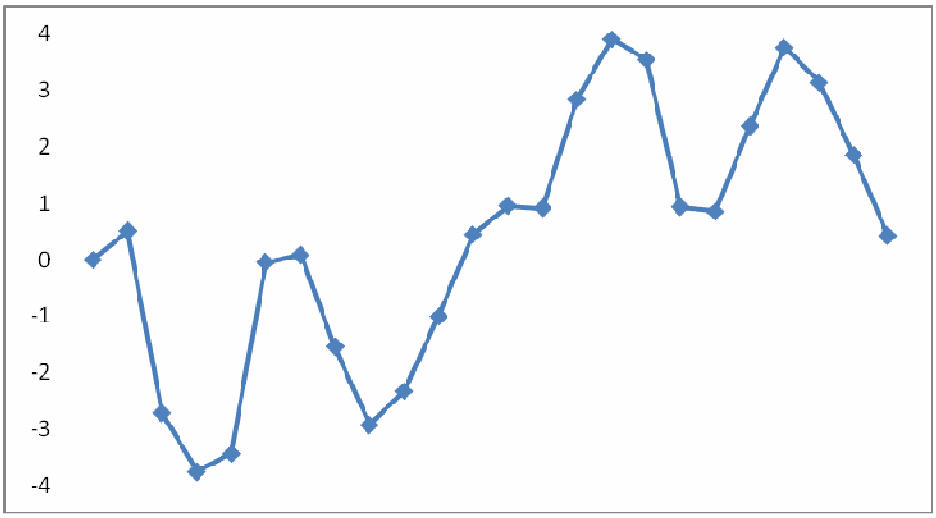
Dari gambar uji *Tracking Signal* diatas terlihat bahwa semua nilainya berada di antara batas UCL dan LCL. Dengan demikian metode Pegels Musiman Aditif dapat digunakan untuk peramalan.

**3. Kompon untuk Produk GB-4**

Tabel L1.18

Uji *Tracking Signal* Produk GB-4

| t | dt | dt' | error (dt-dt') | error kumulatif | Absolut error | Kum. Absolut error | MAD | Tracking Signal |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5)=4 | (6)=4 | (7)=6 | (8)=7/1 | (9)=5/8 |
| 1 | 3,076 | | | | | | | |
| 2 | 2,538 | 2,474.900 | 63.100 | 63.100 | 63.100 | 63.1 | 31.55 | 0.5 |
| 3 | 2,545 | 3,862.520 | -1,317.520 | -1,254.420 | 1,317.520 | 1380.62 | 460.2067 | -2.7 |
| 4 | 2,574 | 3,298.516 | -724.516 | -1,978.936 | 724.516 | 2105.14 | 526.284 | -3.8 |
| 5 | 3,826 | 3,510.613 | 315.387 | -1,663.549 | 315.387 | 2420.52 | 484.1046 | -3.4 |
| 6 | 5,180 | 3,550.190 | 1,629.810 | -33.739 | 1,629.810 | 4050.33 | 675.0555 | 0.0 |
| 7 | 4,113 | 4,029.652 | 83.348 | 49.609 | 83.348 | 4133.68 | 590.5259 | 0.1 |
| 8 | 2,020 | 3,069.322 | -1,049.322 | -999.713 | 1,049.322 | 5183.00 | 647.8754 | -1.5 |
| 9 | 2,573 | 3,589.957 | -1,016.957 | -2,016.670 | 1,016.957 | 6199.96 | 688.8844 | -2.9 |
| 10 | 3,076 | 2,609.566 | 466.434 | -1,550.236 | 466.434 | 6666.39 | 666.6394 | -2.3 |
| 11 | 3,392 | 2,525.353 | 866.647 | -683.589 | 866.647 | 7533.04 | 684.8219 | -1.0 |
| 12 | 4,631 | 3,625.682 | 1,005.318 | 321.729 | 1,005.318 | 8538.36 | 711.5299 | 0.5 |
| 13 | 3,707 | 3,380.126 | 326.874 | 648.603 | 326.874 | 8865.23 | 681.941 | 1.0 |
| 14 | 2,538 | 2,604.621 | -66.621 | 581.982 | 66.621 | 8931.85 | 637.9896 | 0.9 |
| 15 | 5,281 | 3,911.576 | 1,369.424 | 1,951.406 | 1,369.424 | 10301.28 | 686.7519 | 2.8 |
| 16 | 4,651 | 3,898.141 | 752.859 | 2,704.265 | 752.859 | 11054.14 | 690.8836 | 3.9 |
| 17 | 4,113 | 4,441.513 | -328.513 | 2,375.752 | 328.513 | 11382.65 | 669.5676 | 3.5 |
| 18 | 2,712 | 4,407.410 | -1,695.410 | 680.341 | 1,695.410 | 13078.06 | 726.5589 | 0.9 |
| 19 | 4,086 | 4,173.008 | -87.008 | 593.333 | 87.008 | 13165.07 | 692.8983 | 0.9 |
| 20 | 4,225 | 3,133.967 | 1,091.033 | 1,684.367 | 1,091.033 | 14256.10 | 712.8051 | 2.4 |
| 21 | 5,133 | 4,075.573 | 1,057.427 | 2,741.793 | 1,057.427 | 15313.53 | 729.2156 | 3.8 |
| 22 | 3,076 | 3,561.259 | -485.259 | 2,256.535 | 485.259 | 15798.79 | 718.1267 | 3.1 |
| 23 | 2,405 | 3,306.447 | -901.447 | 1,355.088 | 901.447 | 16700.23 | 726.0971 | 1.9 |
| 24 | 3,020 | 4,065.638 | -1,045.638 | 309.450 | 1,045.638 | 17745.87 | 739.4113 | 0.4 |




Gambar L1.4

Uji *Tracking Signal* Produk GB-4

Dari gambar uji *Tracking Signal* diatas terlihat bahwa semua nilainya berada di antara batas UCL dan LCL. Dengan demikian metode Pegels Musiman Aditif dapat digunakan untuk peramalan.

**4. Kompon untuk Produk Suzuki**

Tabel L1.19

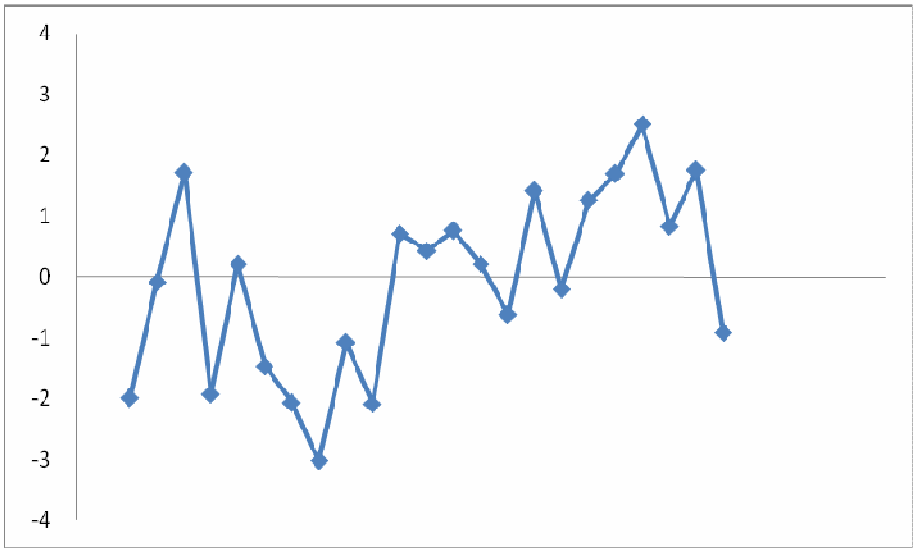
Uji *Tracking Signal* Produk Suzuki

| t | dt | dt' | error (dt-dt') | RSFE kumulatif | Absolut error | Kum. Absolut error | MAD | Tracking Signal |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5)=4 | (6)=4 | (7)=6 | (8)=7/1 | (9)=5/8 |
| 1 | 3,841 | - | - | - | - | - | - | - |
| 2 | 3,857 | 4,047.600 | -190.600 | -190.600 | 190.600 | 190.600 | 95.300 | -2.0 |
| 3 | 3,541 | 3,360.980 | 180.020 | -10.580 | 180.020 | 370.620 | 123.540 | -0.1 |
| 4 | 5,482 | 5,186.484 | 295.516 | 284.936 | 295.516 | 666.136 | 166.534 | 1.7 |
| 5 | 2,526 | 3,412.087 | -886.087 | -601.151 | 886.087 | 1,552.223 | 310.445 | -1.9 |
| 6 | 4,365 | 3,689.870 | 675.130 | 73.979 | 675.130 | 2,227.353 | 371.226 | 0.2 |
| 7 | 4,715 | 5,399.896 | -684.896 | -610.917 | 684.896 | 2,912.249 | 416.036 | -1.5 |
| 8 | 5,126 | 5,318.417 | -192.417 | -803.333 | 192.417 | 3,104.666 | 388.083 | -2.1 |
| 9 | 4,139 | 4,500.433 | -361.433 | -1,164.767 | 361.433 | 3,466.099 | 385.122 | -3.0 |
| 10 | 4,111 | 3,399.647 | 711.353 | -453.413 | 711.353 | 4,177.452 | 417.745 | -1.1 |

Tabel L1.19

Uji *Tracking Signal* Produk Suzuki (lanjutan)

| t | dt | dt' | error (dt-dt') | RSFE kumulatif | Absolut error | Kum. Absolut error | MAD | Tracking Signal |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5)=4 | (6)=4 | (7)=6 | (8)=7/1 | (9)=5/8 |
| 11 | 4,587 | 5,004.917 | -417.917 | -871.331 | 417.917 | 4,595.369 | 417.761 | -2.1 |
| 12 | 7,228 | 6,013.834 | 1,214.166 | 342.835 | 1,214.166 | 5,809.535 | 484.128 | 0.7 |
| 13 | 3,715 | 3,861.687 | -146.687 | 196.148 | 146.687 | 5,956.222 | 458.171 | 0.4 |
| 14 | 4,213 | 4,079.710 | 133.290 | 329.439 | 133.290 | 6,089.512 | 434.965 | 0.8 |
| 15 | 3,232 | 3,471.168 | -239.168 | 90.271 | 239.168 | 6,328.680 | 421.912 | 0.2 |
| 16 | 4,870 | 5,218.894 | -348.894 | -258.623 | 348.894 | 6,677.574 | 417.348 | -0.6 |
| 17 | 4,159 | 3,270.715 | 888.285 | 629.661 | 888.285 | 7,565.859 | 445.051 | 1.4 |
| 18 | 3,230 | 3,958.732 | -728.732 | -99.071 | 728.732 | 8,294.591 | 460.811 | -0.2 |
| 19 | 6,030 | 5,338.986 | 691.014 | 591.943 | 691.014 | 8,985.605 | 472.927 | 1.3 |
| 20 | 5,730 | 5,546.909 | 183.091 | 775.035 | 183.091 | 9,168.696 | 458.435 | 1.7 |
| 21 | 5,158 | 4,795.727 | 362.273 | 1,137.308 | 362.273 | 9,530.969 | 453.856 | 2.5 |
| 22 | 3,129 | 3,879.702 | -750.702 | 386.606 | 750.702 | 10,281.671 | 467.349 | 0.8 |
| 23 | 5,579 | 5,153.081 | 425.919 | 812.525 | 425.919 | 10,707.590 | 465.547 | 1.7 |
| 24 | 5,123 | 6,392.705 | -1,269.705 | -457.180 | 1,269.705 | 11,977.295 | 499.054 | -0.9 |




Gambar L1.5

Uji *Tracking Signal* Produk Suzuki

Dari gambar uji *Tracking Signal* diatas terlihat bahwa semua nilainya berada di antara batas UCL dan LCL. Dengan demikian metode Pegels Musiman Aditif dapat digunakan untuk peramalan.

# LAMPIRAN 3

- **Perhitungan Pengendalian Persediaan**

1. **Perhitungan Pengendalian Persediaan Metode Periodic Review**

R = rata-rata permintaan (kg / bulan)

σ = standar deviasi permintaan (kg / bulan)

C = biaya pesan ke supplier (Rp / pesan)

P = harga beli (Rp / kg)

F = i = persentase biaya simpan per bulan

H = biaya simpan = i * P = (Rp / kg / bulan)

L = lead time (bulan)

π = biaya stockout (Rp / kg)

$\mu_L$ = rata-rata permintaan selama lead time = R * L = (kg)

$\sigma_L$ = standar deviasi permintaan selama lead time = σ * $\sqrt{L}$ (kg)

**BAHAN BAKU DUMPER KHARISMA**

R = 4,500 kg / bulan

σ = 557.115 kg / bulan

C+nc = Rp 56,496.56 / pesan

P = Rp 5,000 / kg

i = 0.858% / *bulan*

H = i * P

= 0.858% * Rp 5,000

= Rp 42.9 /kg / bulan

L = 1 minggu = 0.25 bulan

π = Rp 11,886.548 / kg

1. Hitung t

| Item | R (kg) | P (Rp) | R*P (Rp) |
|---|---|---|---|
| Kompon Dumper Yamaha | 6,041.417 | 5,500 | 33,227,793.5 |
| Kompon Dumper Kharisma | 4,500 | 5,000 | 22,500,000 |
| Kompon Dumper GB-4 | 3,519.75 | 5,000 | 17,598,750 |
| Kompon Dumper Suzuki | 4,409.17 | 6,000 | 26,455,020 |
| | | | 99,781,563.5 |

$$t = \sqrt{\frac{2(C + nc)}{F\sum(R_i * P_i)}}$$

$$= \sqrt{\frac{2 * 56{,}496.56}{0.858\% * 99{,}781{,}563.5}}$$

$$= 0.363 \text{ bulan}$$

Konversi ke hari jumlah hari kerja :

$$0.363 * 24 = 8.712 \text{ hari}$$

$$= 8 \text{ atau } 9 \text{ hari}$$

Konversi ke bulan :

$8/24 = 0.333$ bulan atau

$9/24 = 0.375$ bulan

2. Hitung F'(k)

Untuk t = 8 hari = 0.333 bulan

$$F'(K) = \frac{Ht}{Ht + \pi}$$

$$= \frac{42.9 * 0.333}{(42.9 * 0.333) + 11{,}886.548}$$

$$= 0.00120$$

Untuk t = 9 hari = 0.375 bulan

$$F'(K) = \frac{Ht}{Ht + \pi}$$

$$= \frac{42.9 * 0.375}{(42.9 * 0.375) + 11{,}886.548}$$

$$= 0.00135$$

3. Cari nilai k

Untuk t = 8 hari = 0.333 bulan

$$\frac{3.04 - x}{3.04 - 3.03} = \frac{0.00118 - 0.00120}{0.00118 - 0.00122}$$

$$x = 3.035$$

k = 3.035

Untuk t = 9 hari = 0.375 bulan

k = 3

4. Hitung E

Untuk t = 8 hari = 0.333 bulan

$$\mu_{L+t} = R(L+t)$$
$$= 4{,}500(0.25 + 0.333)$$
$$= 2{,}623.5 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 557.115\ \sqrt{0.25 + 0.333}$$
$$= 425.382 \text{ kg}$$

$$E = \mu_{L+t} + K\sigma_{L+t}$$
$$= 2{,}623.5 + (3.035 * 425.382)$$
$$= 3{,}914.534$$
$$= 3{,}915 \text{ kg}$$

Untuk t = 9 hari = 0.375 bulan

$$\mu_{L+t} = R(L+t)$$
$$= 4{,}500(0.25 + 0.375)$$
$$= 2812.5 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 557.115\ \sqrt{0.25 + 0.375}$$
$$= 440.438 \text{ kg}$$

$$E = \mu_{L+t} + K\sigma_{L+t}$$
$$= 2{,}812.5 + (3 * 440.438)$$
$$= 4{,}133.814$$
$$= 4{,}134 \text{ kg}$$

Jadi jumlah inventori maksimum (E) untuk t = 8 hari = 3,915kg

Jadi jumlah inventori maksimum (E) untuk t = 9 hari = 4,134 kg

**BAHAN BAKU DUMPER GB-4**

R = 3,519.75 kg / bulan

σ = 507.132 kg / bulan

C+nc = Rp 56,496.56 / pesan

P = Rp 5,000 / kg

i = 0.858% / *bulan*

H = i * P

= 0.858% * Rp 5,000

= Rp 42.9 /kg / bulan

L = 1 minggu = 0.25 bulan

$\pi$ = Rp 9,599.333 / kg

1. Hitung F'(k)

   Untuk t = 8 hari = 0.333 bulan

$$F'(K) = \frac{Ht}{Ht + \pi}$$
$$= \frac{42.9 * 0.333}{(42.9 * 0.333) + 9{,}599.333}$$
$$= 0.00149$$

   Untuk t = 9 hari = 0.375 bulan

$$F'(K) = \frac{Ht}{Ht + \pi}$$
$$= \frac{42.9 * 0.375}{(42.9 * 0.375) + 9{,}599.375}$$
$$= 0.00167$$

2. Cari nilai k

   Untuk t = 8 hari = 0.333 bulan

   k = 2.97

   Untuk t = 9 hari = 0. 375 bulan

$$\frac{2.94 - x}{2.94 - 2.93} = \frac{0.00164 - 0.00167}{0.00164 - 0.00169}$$
$$x = 2.934$$

   k = 2.934

3. Hitung E

   Untuk t = 8 hari = 0.333 bulan

$$\mu_{L+t} = R(L + t)$$
$$= 3519.75(0.25 + 0.333)$$
$$= 2{,}052.014 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 507.132\ \sqrt{0.25 + 0.333}$$
$$= 387.218 \text{ kg}$$

$$E = \mu_{L+t} + K\sigma_{L+t}$$
$$= 2{,}052.014 + (2.97 * 387.218)$$
$$= 3{,}202.051$$
$$= 3{,}203 \text{ kg}$$

Untuk t = 9 hari = 0. 375 bulan

$$\mu_{L+t} = R(L+t)$$
$$= 3{,}519.75(0.25 + 0.375)$$
$$= 2{,}199.84 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 507.132\ \sqrt{0.25 + 0.375}$$
$$= 400.923 \text{ kg}$$

$$E = \mu_{L+t} + K\sigma_{L+t}$$
$$= 2{,}199.84 + (2.934 * 400.923)$$
$$= 3{,}376.148$$
$$= 3{,}377 \text{ kg}$$

Jadi jumlah inventori maksimum (E) untuk t = 8 hari = 3,203 kg

Jadi jumlah inventori maksimum (E) untuk t = 9 hari = 3,377 kg

**BAHAN BAKU DUMPER SUZUKI**

R = 4,409.167 kg / bulan

σ = 942.642 kg / bulan

C+nc = Rp 56,496.56 / pesan

P = Rp 6,000 / kg

i = 0.858% / *bulan*

H = i * P

= 0.858% * Rp 6,000

= Rp 51.48 /kg / bulan

L = 1 minggu = 0.25 bulan

$\pi$ = Rp 6,996 / kg

1. Hitung F'(k)

   Untuk t = 8 hari = 0.333 bulan

$$F'(K) = \frac{Ht}{Ht + \pi}$$
$$= \frac{51.48 * 0.333}{(51.48 * 0.333) + 6{,}996}$$
$$= 0.00244$$

   Untuk t = 9 hari = 0.375 bulan

$$F'(K) = \frac{Ht}{Ht + \pi}$$
$$= \frac{51.48 * 0.375}{(51.48 * 0.375) + 6{,}996}$$
$$= 0.00275$$

2. Cari nilai k

   Untuk t = 8 hari = 0.333 bulan

$$\frac{2.82 - x}{2.82 - 2.81} = \frac{0.00240 - 0.00244}{0.00240 - 0.00248}$$
$$x = 2.815$$

   k = 2.815

   Untuk t = 9 hari = 0.375 bulan

$$\frac{2.78 - x}{2.78 - 2.77} = \frac{0.00272 - 0.00275}{0.00272 - 0.00280}$$
$$x = 2.776$$

   k = 2.776

3. Hitung E

   Untuk t = 8 hari = 0.333 bulan

$$\mu_{L+t} = R(L + t)$$
$$= 4{,}409.167(0.25 + 0.333)$$
$$= 2{,}570.54 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 942.642\ \sqrt{0.25 + 0.333}$$
$$= 719.749 \text{ kg}$$

$$E = \mu_{L+t} + K\sigma_{L+t}$$
$$= 2{,}570.54 + (2.815 * 719.749)$$
$$= 4{,}596.633$$
$$= 4{,}597 \text{ kg}$$

Untuk t = 9 hari = 0.375 bulan

$$\mu_{L+t} = R(L+t)$$
$$= 4{,}409.167(0.25 + 0.375)$$
$$= 2{,}755.729 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 942.642\ \sqrt{0.25 + 0.375}$$
$$= 745.224 \text{ kg}$$

$$E = \mu_{L+t} + K\sigma_{L+t}$$
$$= 2{,}755.729 + (2.776 * 745.224)$$
$$= 4{,}824.481$$
$$= 4{,}825 \text{ kg}$$

Jadi jumlah inventori maksimum (E) untuk t = 8 hari = 4,597 kg

Jadi jumlah inventori maksimum (E) untuk t = 9 hari = 4,825 kg

**2. Perhitungan Pengendalian Persediaan Metode Continuous Review**

R = rata-rata permintaan (kg / bulan)

σ = standar deviasi permintaan (kg / bulan)

C = biaya pesan ke supplier (Rp / pesan)

P = harga beli (Rp / kg)

F = i = persentase biaya simpan per bulan

H = biaya simpan = i * P = (Rp / kg / bulan)

L = lead time (bulan)

π = biaya stockout (Rp / kg)

$\mu_L$ = rata-rata permintaan selama lead time = R * L = (kg)

$\sigma_L$ = standar deviasi permintaan selama lead time = σ * $\sqrt{L}$ (kg)

**BAHAN BAKU DUMPER KHARISMA**

R = 4,500 kg / bulan

σ = 557.115 kg / bulan

C = Rp 51,624.14 / pesan

P = Rp 5,000 / kg

i = 0.858 %

H = i * P

= 0.858 % * Rp 5,000 = Rp 42.9 / kg / bulan

L = 1 minggu = 0.25 bulan

π = Rp 11,886.548 / kg

$\mu_L$ = R * L = 4,500 * 0.25 = 1125 kg

$\sigma_L = \sigma * \sqrt{L}$ = 557.115 * $\sqrt{0.25}$ = 278.557 kg

1. Hitung Q

$$Q = \sqrt{\frac{2CR}{H}}$$

$$= \sqrt{\frac{2 * 51{,}624.14 * 4{,}500}{42.9}}$$

$$= 3290.933\,kg \rightarrow Q_{lama}$$

2. Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$

$$= \frac{(42.9 * 3290.933)}{(11{,}886.548 * 4{,}500) + (42.9 * 3290.933)}$$

$$= 0.00263$$

3. Cari nilai k

$$\frac{2.8 - x}{2.8 - 2.79} = \frac{0.00256 - 0.00263}{0.00256 - 0.00264}$$

$$x = 2.791$$

k = 2.791

4. Cari nilai E(k)

$$\frac{0.00076 - x}{0.00076 - 0.00079} = \frac{0.00256 - 0.00263}{0.00256 - 0.00264}$$
$$x = 0.000816$$

E(k) = 0.000816

$N_k = \sigma_l . E(K) = 278.557 * 0.000816 = 0.2273$

5. Hitung Q baru

$$Q = \sqrt{\frac{2R(C + \pi N_k)}{H}}$$
$$= \sqrt{\frac{2 * 4{,}500(51{,}624.14 + (11{,}886.548 * 0.2273))}{42.9}}$$
$$= 3{,}375.952\ kg \rightarrow Q_{baru}$$

6. Cek optimalitas, jika $|Q_{baru} - Q_{lama}| < \varepsilon$ maka optimal

$\varepsilon$ = toleransi = 10% = 0.1

$|3375.952 - 3290.933| = 85.019 > 0.1 \rightarrow$ belum optimal

Karena belum optimal, maka lakukan perhitungan kembali F'(k) dan seterusnya.

1. Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$
$$= \frac{(42.9 * 3375.952)}{(11{,}886.548 * 4{,}500) + (42.9 * 3375.9528)}$$
$$= 0.00270$$

2. Cari nilai k

$$\frac{2.79 - x}{2.79 - 2.78} = \frac{0.00264 - 0.00270}{0.00264 - 0.00272}$$
$$x = 2.783$$

k = 2.783

3. Cari nilai E(k)

$$\frac{0.00079 - x}{0.00079 - 0.00081} = \frac{0.00264 - 0.00270}{0.00264 - 0.00272}$$

$$x = 0.000805$$

E(k) = 0.000805

$N_k = \sigma_l . E(K) = 278.557 * 0.000805 = 0.2242$

4. Hitung Q baru

$$Q = \sqrt{\frac{2R(C + \pi N_k)}{H}}$$

$$= \sqrt{\frac{2 * 4{,}500(51{,}624.14 + (11{,}886.548 * 0.2242))}{42.9}}$$

$$= 3374.807\ kg \rightarrow Q_{baru}$$

5. Cek optimalitas, jika $\left|Q_{baru} - Q_{lama}\right| < \varepsilon$ maka optimal

$\varepsilon$ = toleransi = 10% = 0.1

$\left|3374.807 - 3375.952\right| = -1.145 < 0.1 \rightarrow$ Sudah optimal

Karena sudah optimal, hitung nilai B

$B = \mu_L + K\sigma_L = 1125 + 2.783(278.557) = 1900.224 \approx 1901$ kg

Q = 3374.807 ≈ 3375 kg

**BAHAN BAKU DUMPER GB-4**

R = 3,519.75 kg / bulan

σ = 507.132 kg / bulan

C = Rp 51,624.14 / pesan

P = Rp 5,000 / kg

i = 0.858 %

H = i * P

= 0.858 % * Rp 5,000 = Rp 42.9 / kg / bulan

L = 1 minggu = 0.25 bulan

π = Rp 9,599.333/ kg

$\mu_L$ = R * L = 3,519.75* 0.25 = 879.937 kg

$\sigma_L = \sigma * \sqrt{L} = 507.132 * \sqrt{0.25} = 253.566$ kg

1. Hitung Q

$$Q = \sqrt{\frac{2CR}{H}}$$
$$= \sqrt{\frac{2 * 51624.14 * 3519.75}{42.9}}$$
$$= 2910.507\ kg \rightarrow Q_{lama}$$

2. Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$
$$= \frac{(42.9 * 2910.507)}{(9{,}599.333 * 3519.75) + (42.9 * 2910.507)}$$
$$= 0.00368$$

3. Cari nilai k

k = 2.68

4. Cari nilai E(k)

E(k) = 0.00113

$$N_k = \sigma_l . E(K) = 253.566 * 0.00113 = 0.2865$$

5. Hitung Q baru

$$Q = \sqrt{\frac{2R(C + \pi N_k)}{H}}$$
$$= \sqrt{\frac{2 * 3{,}519.75(51{,}624.14 + (9{,}599.333 * 0.2865))}{42.9}}$$
$$= 2987.028\ kg \rightarrow Q_{baru}$$

6. Cek optimalitas, jika $|Q_{baru} - Q_{lama}| < \varepsilon$ maka optimal

$\varepsilon$ = toleransi = 10% = 0.1

$|2987.028 - 2910.507| = 78.521 > 0.1 \rightarrow$ belum optimal

Karena belum optimal, maka lakukan perhitungan kembali F'(k) dan seterusnya.

1. Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$
$$= \frac{(42.9 * 2987.028)}{(9{,}599.333 * 3519.75) + (42.9 * 2987.028)}$$
$$= 0.00378$$

2. Cari nilai k

$$\frac{2.67 - x}{2.67 - 2.66} = \frac{0.00379 - 0.00378}{0.00379 - 0.00391}$$
$$x = 2.671$$

k = 2.671

3. Cari nilai E(k)

$$\frac{0.00117 - x}{0.00117 - 0.00121} = \frac{0.00379 - 0.00378}{0.00379 - 0.00391}$$
$$x = 0.001167$$

E(k) = 0.001167

$$N_k = \sigma_l . E(K) = 253.566 * 0.001167 = 0.2959$$

4. Hitung Q baru

$$Q = \sqrt{\frac{2R(C + \pi N_k)}{H}}$$
$$= \sqrt{\frac{2 * 3{,}519.75(51{,}624.14 + (9{,}599.333 * 0.2959))}{42.9}}$$
$$= 2989.505\, kg \rightarrow Q_{baru}$$

5. Cek optimalitas, jika $|Q_{baru} - Q_{lama}| < \varepsilon$ maka optimal

$\varepsilon$ = toleransi = 10% = 0.1

$|2989.505 - 2987.028| = 2.477 > 0.1 \rightarrow$ belum optimal

Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$
$$= \frac{(42.9 * 2989.505)}{(9{,}599.333 * 3519.75) + (42.9 * 2989.505)}$$
$$= 0.00378$$

Karena nilai F'(k) sama dengan nilai F'(k) yang sebelumnya maka nilai Q pasti sama. Sehingga nilai Q sudah optimal.

$B = \mu_L + K\sigma_L = 879.937 + 2.671(253.566) = 1557.212 \approx 1558 \text{ kg}$

Q = 2989.505 ≈ 2990kg

**BAHAN BAKU DUMPER SUZUKI**

R = 4,409.167 kg / bulan

σ = 942.642 kg / bulan

C = Rp 51,624.14 / pesan

P = Rp 6,000 / kg

i = 0.858 %

H = i * P

= 0.858 % * Rp 6,000 = Rp 51.48 / kg / bulan

L = 1 minggu = 0.25 bulan

π = Rp 6,996 / kg

$\mu_L$ = R * L = 4,409.167* 0.25 = 1,102.291 kg

$\sigma_L$ = σ * $\sqrt{L}$ = 942.642 * $\sqrt{0.25}$ = 471.321 kg

1. Hitung Q

$$Q = \sqrt{\frac{2CR}{H}}$$

$$= \sqrt{\frac{2 * 51{,}624.14 * 4{,}409.167}{51.48}}$$

$$= 2{,}973.722\, kg \rightarrow Q_{lama}$$

2. Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$

$$= \frac{(51.48 * 2{,}973.722)}{(6{,}996 * 4{,}409.167) + (51.48 * 2{,}973.722)}$$

$$= 0.00494$$

3. Cari nilai k

k = 2.58

4. Cari nilai E(k)

   E(k) = 0.00156

   $N_k = \sigma_l . E(K) = 471.321 * 0.00156 = 0.7352$

5. Hitung Q baru

$$Q = \sqrt{\frac{2R(C + \pi N_k)}{H}}$$
$$= \sqrt{\frac{2 * 4{,}409.167(51{,}624.14 + (6{,}996 * 0.7352))}{51.48}}$$
$$= 3{,}118.346\, kg \rightarrow Q_{baru}$$

6. Cek optimalitas, jika $|Q_{baru} - Q_{lama}| < \varepsilon$ maka optimal

   $\varepsilon$ = toleransi = 10% = 0.1

   $|3{,}118.346 - 2{,}973.722| = 144.624 > 0.1 \rightarrow$ belum optimal

   Karena belum optimal, maka lakukan perhitungan kembali F'(k) dan seterusnya.

1. Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$
$$= \frac{(51.48 * 3{,}118.346)}{(6{,}996 * 4{,}409.167) + (51.48 * 3{,}118.346)}$$
$$= 0.00518$$

2. Cari nilai k

$$\frac{2.57 - x}{2.57 - 2.56} = \frac{0.00508 - 0.00518}{0.00508 - 0.00523}$$
$$x = 2.563$$

   k = 2.563

3. Cari nilai E(k)

$$\frac{0.00161 - x}{0.00161 - 0.00166} = \frac{0.00508 - 0.00518}{0.00508 - 0.00523}$$
$$x = 0.001643$$

   E(k) = 0.001643

   $N_k = \sigma_l . E(K) = 471.321 * 0.001643 = 0.7744$

4. Hitung Q baru

$$Q = \sqrt{\frac{2R(C + \pi N_k)}{H}}$$
$$= \sqrt{\frac{2 * 4{,}409.167(51{,}624.14 + (6{,}996 * 0.7744))}{51.48}}$$
$$= 3{,}125.869kg \rightarrow Q_{baru}$$

5. Cek optimalitas, jika $|Q_{baru} - Q_{lama}| < \varepsilon$ maka optimal

   $\varepsilon$ = toleransi = 10% = 0.1

   $|3{,}125.869 - 3{,}118.346| = 7.523 > 0.1 \rightarrow$ belum optimal

   Karena belum optimal, maka lakukan perhitungan kembali F'(k) dan seterusnya.

1. Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$
$$= \frac{(51.48 * 3{,}125.869)}{(6{,}996 * 4{,}409.167) + (51.48 * 3{,}125.869)}$$
$$= 0.00519$$

2. Cari nilai k

$$\frac{2.57 - x}{2.57 - 2.56} = \frac{0.00508 - 0.00519}{0.00508 - 0.00523}$$
$$x = 2.563$$

   k = 2.563

3. Cari nilai E(k)

$$\frac{0.00161 - x}{0.00161 - 0.00166} = \frac{0.00508 - 0.00519}{0.00508 - 0.00523}$$
$$x = 2.563$$

   E(k) = 0.00164

$$N_k = \sigma_l . E(K) = 471.321 * 0.00164 = 0.7763$$

4. Hitung Q baru

$$Q = \sqrt{\frac{2R(C + \pi N_k)}{H}}$$

$$= \sqrt{\frac{2 * 4{,}409.167(51{,}624.14 + (6{,}996 * 0.773))}{51.48}}$$

$$= 3{,}125.601\,kg \rightarrow Q_{baru}$$

5. Cek optimalitas, jika $|Q_{baru} - Q_{lama}| < \varepsilon$ maka optimal

$\varepsilon$ = toleransi = 10% = 0.1

$|3{,}125.601 - 3{,}125.869| = -0.268 < 0.1 \rightarrow$ sudah optimal

Karena sudah optimal, hitung nilai B

$B = \mu_L + K\sigma_L = 1{,}102.291 + 2.563(471.321\ ) = 2{,}310.287 \approx 2{,}311$ kg

Q = 3,125.601 ≈ 3,126 kg

**3. Perhitungan Pengendalian Persediaan Metode Optional**

R = total permintaan (kg / bulan)

σ = standar deviasi permintaan (kg / bulan)

C = biaya pesan ke supplier (Rp / pesan)

P = harga beli (Rp / kg)

i = persentase biaya simpan per bulan

H = biaya simpan = i * P = (Rp / kg / bulan)

L = lead time (bulan)

π = biaya stockout (Rp / kg)

$\mu_{L+t}$ = rata-rata permintaan selama lead time dan periode pemesanan

= R *( L+t) (kg)

$\sigma_{L+t}$ = standar deviasi permintaan selama lead time dan periode pemesanan

= σ * $\sqrt{L+t}$ (kg)

t = periode pemesanan

**UNTUK BAHAN BAKU DUMPER KHARISMA**

R = 4,500 kg / bulan

σ = 557.115 kg / bulan

C+nc = Rp 56,496.56 / pesan

$$C = \frac{(C + nc)}{4\ item} = \frac{56{,}496.56}{4} = \text{Rp}\,14{,}124.14 / item$$

P = Rp 5,000 / kg

i = $0.858\% / bulan$

H = i * P

= 0.858 % * Rp 5,000 = Rp 42.9/ kg / bulan

L = 1 minggu = 0.25 bulan

π = Rp 11,886.548/ kg

1. Hitung Q

$$Q = \sqrt{\frac{2CR}{H}}$$

$$= \sqrt{\frac{2 * 14{,}124.14 * 4500}{42.9}}$$

$$= 1{,}721.367$$

2. Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$

$$= \frac{(42.9 * 1{,}721.367)}{(11{,}886.548 * 4500) + (42.9 * 1{,}721.367)}$$

$$= 0.00114$$

3. Cari nilai k

   k = 3.05

4. Hitung B

   Untuk t = 8 hari = 0.333 bulan

$$\mu_{L+t} = R(L + t)$$

$$= 4{,}500(0.25 + 0.333)$$

$$= 2623.5\,\text{kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 557.115\sqrt{0.25+0.333}$$
$$= 425.38\,\text{kg}$$

$$B = \mu_{L+t} + K\sigma_{L+t} + \left(\frac{Rt}{2}\right)$$
$$= 2{,}623.5 + 3.05(425.38) + \left(\frac{4{,}500(0.333)}{2}\right)$$
$$= 4{,}670.159\,\text{kg}$$

$$E = Q + B - \left(\frac{Rt}{2}\right)$$
$$= 1{,}721.367 + 4{,}670.159 - \left(\frac{4{,}500(0.333)}{2}\right)$$
$$= 5{,}642.276\,\text{kg}$$

Untuk t = 9 hari = 0.375 bulan

$$\mu_{L+t} = R(L+t)$$
$$= 4{,}500(0.25+0.375)$$
$$= 2{,}812.5\,\text{kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 557.115\sqrt{0.25+0.375}$$
$$= 440.438\,\text{kg}$$

$$B = \mu_{L+t} + K\sigma_{L+t} + \left(\frac{Rt}{2}\right)$$
$$= 2{,}812.5 + 3.05(440.438) + \left(\frac{4{,}500(0.375)}{2}\right)$$
$$= 4{,}999.586\,\text{kg}$$

$$E = Q + B - \left(\frac{Rt}{2}\right)$$
$$= 1{,}721.367 + 4{,}999.586 - \left(\frac{4{,}500(0.375)}{2}\right)$$
$$= 5{,}877.506\,\text{kg}$$

Jadi jumlah B dan E untuk t = 8 hari = 0.333 bulan

B = 4,670.159 ≈ 4671 kg

E = 5,641.276 ≈ 5762 kg

Jadi jumlah B dan E untuk t = 9 hari = 0.375 bulan

B = 4,999.586 ≈ 5,000 kg

E = 5,877.506 ≈ 5,878 kg

**UNTUK BAHAN BAKU DUMPER GB-4**

R = 3,519.75 kg / bulan

σ = 507.132 kg / bulan

C+nc = Rp 56,496.56 / pesan

$$C = \frac{(C + nc)}{4\ item} = \frac{56{,}496.56}{4} = \text{Rp}\,14{,}124.14 / item$$

P = Rp 5,000 / kg

i = 0.858% / *bulan*

H = i * P

= 0.858% * Rp 5,000 = Rp 42.9 / kg / bulan

L = 1 minggu = 0.25 bulan

π = Rp 9,599.333/ kg

1. Hitung Q

$$Q = \sqrt{\frac{2CR}{H}}$$

$$= \sqrt{\frac{2 * 14{,}124.14 * 3{,}519.75}{42.9}}$$

$$= 1{,}522.381$$

2. Hitung F'(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$

$$= \frac{(42.9 * 1{,}522.381)}{(9{,}599.333 * 3{,}519.75) + (42.9 * 1{,}522.381)}$$

$$= 0.00193$$

3. Cari nilai k

   k = 2.89

4. Hitung B

   Untuk t = 8 hari = 0.333 bulan

$$\mu_{L+t} = R(L+t)$$
$$= 3{,}519.75(0.25 + 0.333)$$
$$= 2052.014 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 507.132\sqrt{0.25 + 0.333}$$
$$= 387.217 \text{ kg}$$

$$B = \mu_{L+t} + K\sigma_{L+t} + \left(\frac{Rt}{2}\right)$$
$$= 2{,}052.014 + 2.89(387.217) + \left(\frac{3{,}519.75(0.333)}{2}\right)$$
$$= 3{,}757.109 \text{ kg}$$

$$E = Q + B - \left(\frac{Rt}{2}\right)$$
$$= 1{,}522.381 + 3{,}757.109 - \left(\frac{3{,}519.75(0.333)}{2}\right)$$
$$= 4{,}693.452 \text{ kg}$$

   Untuk t = 9 hari = 0.375 bulan

$$\mu_{L+t} = R(L+t)$$
$$= 3{,}519.75(0.25 + 0.375)$$
$$= 2{,}199.84 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 507.132\sqrt{0.25 + 0.375}$$
$$= 400.923 \text{ kg}$$

$$B = \mu_{L+t} + K\sigma_{L+t} + \left(\frac{Rt}{2}\right)$$
$$= 2{,}199.84 + 2.89(400.923) + \left(\frac{3{,}519.75(0.375)}{2}\right)$$
$$= 4{,}018.461 \text{ kg}$$

$$E = Q + B - \left(\frac{Rt}{2}\right)$$

$$= 1{,}522.381 + 4{,}018.461 - \left(\frac{3{,}519.75(0.375)}{2}\right)$$

$$= 4{,}880.898 \text{ kg}$$

Jadi jumlah B dan E untuk t = 8 hari = 0.333 bulan

B = 3,757.109 ≈ 3,758 kg

E = 4,693.452 ≈ 4,694 kg

Jadi jumlah B dan E untuk t = 8 hari = 0.333 bulan

B = 4,018.461 ≈ 4,019 kg

E = 4,880.898 ≈ 4,881 kg

**<u>UNTUK BAHAN BAKU DUMPER SUZUKI</u>**

R = 4,409.167 kg / bulan

σ = 942.642 kg / bulan

C+nc = Rp 56,4996.56 / pesan

$$C = \frac{(C + nc)}{4\ item} = \frac{56{,}496.56}{4} = \text{Rp}\,14{,}124.14 / item$$

P = Rp 6,000 / kg

i = 0.858%

H = i * P

= 0.858% * Rp 6,000 = Rp 51.48 / kg / bulan

L = 1 minggu = 0.25 bulan

π = Rp 6,996 / kg

1. Hitung Q

$$Q = \sqrt{\frac{2CR}{H}}$$

$$= \sqrt{\frac{2 * 14{,}124.14 * 4{,}409.167}{51.48}}$$

$$= 1{,}555.446$$

2. Hitung F’(k)

$$F'(k) = \frac{HQ}{(\pi R + HQ)}$$
$$= \frac{(51.48 * 1{,}555.446)}{(6{,}996 * 4409.167) + (51.48 * 1{,}555.44)}$$
$$= 0.00259$$

3. Cari nilai k

$$\frac{2.8 - x}{2.8 - 2.79} = \frac{0.00256 - 0.00259}{0.00256 - 0.00264}$$
$$x = 2.796$$

k = 2.796

4. Hitung B

Untuk t = 8 hari = 0.333 bulan

$$\mu_{L+t} = R(L + t)$$
$$= 4{,}409.167(0.25 + 0.333)$$
$$= 2{,}570.544 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L + t}$$
$$= 942.642\sqrt{0.25 + 0.333}$$
$$= 719.749 \text{ kg}$$

$$B = \mu_{L+t} + K\sigma_{L+t} + \left(\frac{Rt}{2}\right)$$
$$= 2{,}570.544 + 2.796(719.749) + \left(\frac{4{,}409.167(0.333)}{2}\right)$$
$$= 5{,}317.088 \text{ kg}$$

$$E = Q + B - \left(\frac{Rt}{2}\right)$$
$$= 1{,}555.446 + 5{,}317.088 - \left(\frac{4{,}409.167(0.333)}{2}\right)$$
$$= 6{,}138.408 \text{ kg}$$

Untuk t = 9 hari = 0.375 bulan

$$\mu_{L+t} = R(L+t)$$
$$= 4{,}409.167(0.25 + 0.375)$$
$$= 2{,}755.729 \text{ kg}$$

$$\sigma_{L+t} = \sigma\sqrt{L+t}$$
$$= 942.642\sqrt{0.25 + 0.375}$$
$$= 745.224\text{kg}$$

$$B = \mu_{L+t} + K\sigma_{L+t} + \left(\frac{Rt}{2}\right)$$
$$= 2{,}755.729 + 2.796(745.224) + \left(\frac{4{,}409.167(0.375)}{2}\right)$$
$$= 5{,}666.094 \text{ kg}$$

$$E = Q + B - \left(\frac{Rt}{2}\right)$$
$$= 1{,}555.446 + 5{,}666.094 - \left(\frac{4{,}409.167(0.375)}{2}\right)$$
$$= 6{,}394.821 \text{ kg}$$

Jadi jumlah B dan E untuk t = 8 hari = 0.333 bulan

B = 5,317.088 ≈ 5,318 kg

E = 6,138.408 ≈ 6,139 kg

Jadi jumlah B dan E untuk t = 9 hari = 0.375 bulan

B = 5,666.094 ≈ 5,667 kg

E = 6,394.821 ≈ 6,395 kg

# LAMPIRAN 4

- **Model Simulasi**

Model ini sama untuk seluruh item, dengan melakukan perubahan pada parameter-parameternya, yaitu distribusi permintaan, inventory awal, batas maksimum persediaan.

Contoh input model simulasi metode pengendalian perusahaan untuk item Yamaha

```
************************************************************************

                        Formatted Listing of Model:
      E:\TA\REVISI SEMINAR ISI\PROMODEL\PERUSAHAAN\PERUSAHAAN
YAMAHA.MOD

************************************************************************

  Time Units:                         Minutes
  Distance Units:                     Feet
  Initialization Logic:               ORDER 3199 Yamaha TO Gudang

************************************************************************
                                  Locations
************************************************************************

  Name          Cap             Units Stats       Rules      Cost
  ------------- --------------- ----- ----------- ---------- --------
----
  Kantor_Gudang inf             1     Time Series Oldest, ,
  Gudang        inv_max_Yamaha  1     Time Series Oldest, ,


************************************************************************
                                   Entities
************************************************************************

  Name         Speed (fpm)  Stats       Cost
  ------------ ------------ ----------- ------------
  Yamaha       150          Time Series
  Kharisma     150          Time Series
  GB4          150          Time Series
  Suzuki       150          Time Series
  review       150          Time Series
  demand       150          Time Series
  inf_brg_dtg  150          Time Series


************************************************************************
                                  Processing
************************************************************************
                                    Process
Routing

 Entity      Location      Operation            Blk  Output
Destination Rule     Move Logic
```

```
 ---------- ------------ ------------------   ---- ---------- ---
-------- -------  ------------
 Yamaha      Gudang                              1    Yamaha
EXIT        SEND 1
 review      Kantor_Gudang Q = inv_max_Yamaha-
(CONTENTS(Gudang)+on_arrival)
                           IF Q<0 then {Q=0}

                           IF Q > 0 THEN
                           { pemesanan = 1
                            INC frek_pemesanan, 1}
                           Else
                           {pemesanan = 0}

                           INC on_arrival, Q
                           wait 6 day
                           ORDER 1 inf_brg_dtg TO kantor_Gudang
                                                   1    review
EXIT        FIRST 1
 demand      Kantor_Gudang IF CLOCK(DAY) mod 24 = 0 THEN
                           {
                            D=ROUND(N(6041.417,1282.674)/24)
                            IF D<0 then {D=0 }
                           }
                           IF D >= CONTENTS(Gudang) THEN
                           {
                            SEND CONTENTS(Gudang) Yamaha TO exit
                           }
                            ELSE
                           {
                            SEND D Yamaha TO exit
                           }
                           IF D >= CONTENTS(Gudang) THEN
                           {lost_sales_Yamaha = D - CONTENTS(Gudang)
                           INC jml_lost_sales_Yamaha,
lost_sales_Yamaha}

                           //debug

                                                   1    demand
EXIT        FIRST 1
 inf_brg_dtg Kantor_Gudang ORDER Q Yamaha TO Gudang
                           DEC on_arrival, Q
                                                   1    inf_brg_dtg
EXIT        FIRST 1
```

## Arrivals

| Entity | Location | Qty each | First Time | Occurrences | Frequency | Logic |
|---|---|---|---|---|---|---|
| review | Kantor_Gudang | 1 | 0 | inf | 24 day | |
| demand | Kantor_Gudang | 1 | 1 day | INF | 1 day | |

## Variables (global)

| ID | Type | Initial value | Stats |
|---|---|---|---|
| D | Integer | 0 | Time Series |
| Q | Integer | 0 | Time Series |
| lost_sales_Yamaha | Integer | 0 | Time Series |
| jml_lost_sales_Yamaha | Integer | 0 | Time Series |
| pemesanan | Integer | 0 | Time Series |
| frek_pemesanan | Integer | 0 | Time Series |
| on_arrival | Integer | 0 | Time Series |

## Macros

| ID | Text |
|---|---|
| inv_max_Yamaha | 8000 |

Contoh output model simulasi metode pengendalian perusahaan untuk item Yamaha

```
-------------------------------------------------------------------------------
General Report
Output from E:\TA\REVISI SEMINAR ISI\PROMODEL\PERUSAHAAN\PERUSAHAAN YAMAHA.MOD
Date: Jan/22/2010   Time: 10:04:58 PM
-------------------------------------------------------------------------------
Scenario        : Normal Run
Replication     : 1 of 1
Simulation Time : 0 sec
-------------------------------------------------------------------------------
```

LOCATIONS

| Location Name | Scheduled Hours | Capacity | Total Entries | Average Minutes Per Entry | Average Contents | Maximum Contents | Current Contents | % Util |
|---|---|---|---|---|---|---|---|---|
| Kantor Gudang | 6912 | 999999 | 313 | 331.24 | 0.25 | 2 | 1 | 0.00 |
| Gudang | 6912 | 8000 | 62685 | 28299.64 | 4277.5 | 8000 | 2547 | 53.47 |

LOCATION STATES BY PERCENTAGE (Multiple Capacity)

| Location Name | Scheduled Hours | % Empty | % Partially Occupied | % Full | % Down |
|---|---|---|---|---|---|
| Kantor Gudang | 6912 | 75.00 | 25.00 | 0.00 | 0.00 |
| Gudang | 6912 | 5.90 | 87.50 | 6.60 | 0.00 |

FAILED ARRIVALS

| Entity Name | Location Name | Total Failed |
|---|---|---|
| review | Kantor Gudang | 0 |
| demand | Kantor Gudang | 0 |

ENTITY ACTIVITY

| Entity Name | Total Exits | Current Quantity In System | Average Minutes In System | Average Minutes In Move Logic | Average Minutes Wait For Res, etc. | Average Minutes In Operation | Average Minutes Blocked |
|---|---|---|---|---|---|---|---|
| Yamaha | 60138 | 2547 | 28400.43 | 0.00 | 0.00 | 0.00 | 28400.43 |
| Kharisma | 0 | 0 | - | - | - | - | - |
| GB4 | 0 | 0 | - | - | - | - | - |
| Suzuki | 0 | 0 | - | - | - | - | - |
| review | 12 | 1 | 8640.00 | 0.00 | 0.00 | 8640.00 | 0.00 |
| demand | 288 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| inf brg dtg | 12 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

ENTITY STATES BY PERCENTAGE

| Entity Name | % In Move Logic | % Wait For Res, etc. | % In Operation | % Blocked |
|---|---|---|---|---|
| Yamaha | 0.00 | 0.00 | 0.00 | 100.00 |
| Kharisma | - | - | - | - |
| GB4 | - | - | - | - |
| Suzuki | - | - | - | - |
| review | 0.00 | 0.00 | 100.00 | 0.00 |
| demand | - | - | - | - |
| inf brg dtg | - | - | - | - |

VARIABLES

| Variable Name | Total Changes | Average Minutes Per Change | Minimum Value | Maximum Value | Current Value | Average Value |
|---|---|---|---|---|---|---|
| D | 12 | 34560.00 | 0 | 351 | 317 | 224.25 |
| Q | 13 | 31901.53 | 0 | 8000 | 5136 | 4957.17 |
| lost sales Yamaha | 22 | 16101.81 | 0 | 351 | 184 | 171.09 |
| jml lost sales Yamaha | 22 | 16101.81 | 0 | 4763 | 4763 | 2236.41 |
| pemesanan | 13 | 31901.53 | 0 | 1 | 1 | 0.91 |
| frek pemesanan | 12 | 34560.00 | 0 | 12 | 12 | 5.58 |
| on arrival | 25 | 16588.80 | 0 | 8000 | 5136 | 1239.29 |

Model ini sama untuk seluruh item, dengan melakukan perubahan pada parameter-parameternya, yaitu distribusi permintaan, inventory awal, batas maksimum persediaan. Contoh input model simulasi metode pengendalian Usulan Periodic Review untuk item Yamaha

```
************************************************************************
                    Formatted Listing of Model:
  E:\TA\REVISI SEMINAR ISI\PROMODEL\PERIODIC REVIEW\PERIODIC REVIEW
                              YAMAHA.MOD

************************************************************************
  Time Units:                          Minutes
  Distance Units:                      Feet
  Initialization Logic:                ORDER 3199 Yamaha TO Gudang

************************************************************************
                                  Locations
************************************************************************
  Name          Cap             Units Stats       Rules      Cost
  ------------- --------------- ----- ----------- ---------- --------
----
  Kantor_Gudang inf             1     Time Series Oldest, ,
  Gudang        inv_max_Yamaha  1     Time Series Oldest, ,


************************************************************************
                                  Entities
************************************************************************

  Name         Speed (fpm)  Stats       Cost
  ------------ ------------ ----------- ------------
  Yamaha       150          Time Series
  Kharisma     150          Time Series
  GB4          150          Time Series
  Suzuki       150          Time Series
  review       150          Time Series
  demand       150          Time Series
  inf_brg_dtg  150          Time Series
```

```
************************************************************************
                                  Processing
************************************************************************
                                     Process
Routing

 Entity      Location      Operation            Blk  Output
Destination Rule     Move Logic
 ----------- ------------- ------------------   ---- ----------- ---
-------- -------  ------------
 Yamaha      Gudang                             1    Yamaha
EXIT        SEND 1
 review      Kantor_Gudang Q = inv_max_Yamaha-
(CONTENTS(Gudang)+on_arrival)
                           IF Q<0 then {Q=0}

                          IF Q > 0 THEN
                          { pemesanan = 1
                           INC frek_pemesanan, 1}
                          Else
                          {pemesanan = 0}

                          INC on_arrival, Q
                          wait 6 day
                          ORDER 1 inf_brg_dtg TO kantor_Gudang



                                             1    review
EXIT        FIRST 1
 demand      Kantor_Gudang IF CLOCK(DAY) mod 24 = 0 THEN
                          {
                           D=ROUND(N(6041.417,1282.674)/24)
                           IF D<0 then {D=0 }
                          }
                          IF D >= CONTENTS(Gudang) THEN
                          {
                           SEND CONTENTS(Gudang) Yamaha TO exit
                          }
                           ELSE
                          {
                           SEND D Yamaha TO exit
                          }
                          IF D >= CONTENTS(Gudang) THEN
                          {lost_sales_Yamaha = D - CONTENTS(Gudang)
                          INC jml_lost_sales_Yamaha,
lost_sales_Yamaha}

                          //debug

                                             1    demand
EXIT        FIRST 1
 inf_brg_dtg Kantor_Gudang ORDER Q Yamaha TO Gudang
                          DEC on_arrival, Q
```

```
                                                    1    inf_brg_dtg
EXIT        FIRST 1
```

**********

Arrivals

**********

| Entity | Location | Qty each | First Time | Occurrences | Frequency | Logic |
|---|---|---|---|---|---|---|
| review | Kantor_Gudang | 1 | 0 | inf | 8 day | |
| demand | Kantor_Gudang | 1 | 1 day | INF | 1 day | |

**********

Variables (global)

**********

| ID | Type | Initial value | Stats |
|---|---|---|---|
| D | Integer | 0 | Time Series |
| Q | Integer | 0 | Time Series |
| lost_sales_Yamaha | Integer | 0 | Time Series |
| jml_lost_sales_Yamaha | Integer | 0 | Time Series |
| on_arrival | Integer | 0 | Time Series |
| frek_pemesanan | Integer | 0 | Time Series |
| pemesanan | Integer | 0 | Time Series |

**********

Macros

**********

| ID | Text |
|---|---|
| inv_max_Yamaha | 6243 |

Contoh output model simulasi metode pengendalian Usulan Periodic Review untuk item Yamaha

```
-------------------------------------------------------------------------------
General Report
Output from E:\TA\REVISI SEMINAR ISI\PROMODEL\PERIODIC REVIEW\PERIODIC REVIEW YAMAHA.MOD
Date: Jan/22/2010   Time: 10:16:10 PM
-------------------------------------------------------------------------------
Scenario        : Normal Run
Replication     : 1 of 1
Simulation Time : 0 sec
-------------------------------------------------------------------------------


LOCATIONS

                                                 Average
Location        Scheduled                 Total  Minutes  Average  Maximum  Current
Name                Hours  Capacity     Entries  Per Entry Contents Contents Contents  % Util
-------------  ---------  --------  -------  ---------  -------- --------  --------  ------
Kantor Gudang       6912    999999      361     861.60     0.75         2         1    0.00
Gudang              6912      6243    69115   23165.42  3860.62      6243      4214   61.84

LOCATION STATES BY PERCENTAGE (Multiple Capacity)

                                          %       |
Location        Scheduled       %  Partially      % |     %
Name                Hours   Empty   Occupied   Full | Down
-------------  ---------  -----  ---------  ---- | ----
Kantor Gudang       6912  25.00      75.00  0.00 | 0.00
Gudang              6912   0.00      93.75  6.25 | 0.00

FAILED ARRIVALS

Entity  Location         Total
Name    Name            Failed
------  -------------  ------
review  Kantor Gudang       0
demand  Kantor Gudang       0

ENTITY ACTIVITY

                                  Average  Average    Average    Average   Average
                        Current   Minutes  Minutes    Minutes    Minutes   Minutes
Entity        Total    Quantity       In   In Move  Wait For         In
Name          Exits  In System   System    Logic  Res, etc.  Operation   Blocked
------------  -----  ---------  --------  -------  ---------  ---------  --------
Yamaha        64901       4214  23898.21     0.00       0.00       0.00  23898.21
Kharisma          0          0         -        -          -          -         -
GB4               0          0         -        -          -          -         -
Suzuki            0          0         -        -          -          -         -
review           36          1   8640.00     0.00       0.00    8640.00      0.00
demand          288          0      0.00     0.00       0.00       0.00      0.00
inf brg dtg      36          0      0.00     0.00       0.00       0.00      0.00
```

ENTITY STATES BY PERCENTAGE

| Entity Name | % In Move Logic | % Wait For Res, etc. | % In Operation | % Blocked |
|---|---|---|---|---|
| Yamaha | 0.00 | 0.00 | 0.00 | 100.00 |
| Kharisma | - | - | - | - |
| GB4 | - | - | - | - |
| Suzuki | - | - | - | - |
| review | 0.00 | 0.00 | 100.00 | 0.00 |
| demand | - | - | - | - |
| inf brg dtg | - | - | - | - |

VARIABLES

| Variable Name | Total Changes | Average Minutes Per Change | Minimum Value | Maximum Value | Current Value | Average Value |
|---|---|---|---|---|---|---|
| D | 12 | 34560.00 | 0 | 351 | 317 | 224.25 |
| Q | 37 | 11208.64 | 0 | 3044 | 1712 | 1831 |
| lost sales Yamaha | 0 | 0.00 | 0 | 0 | 0 | 0 |
| jml lost sales Yamaha | 0 | 0.00 | 0 | 0 | 0 | 0 |
| on arrival | 73 | 5681.09 | 0 | 3044 | 1712 | 1373.25 |
| frek pemesanan | 34 | 12197.64 | 0 | 34 | 34 | 15.66 |
| pemesanan | 37 | 11208.64 | 0 | 1 | 1 | 0.91 |

Model ini sama untuk seluruh item, dengan melakukan perubahan pada parameter-parameternya, yaitu distribusi permintaan, inventory awal, batas maksimum persediaan.

Contoh input model simulasi metode pengendalian Usulan Continuous Review untuk item Yamaha

```
************************************************************************

                    Formatted Listing of Model:
   E:\TA\REVISI SEMINAR ISI\PROMODEL\CONTINUOUS\CONTINUOUS REVIEW
                              YAMAHA.MOD

************************************************************************

  Time Units:                         Minutes
  Distance Units:                     Feet
  Initialization Logic:               ORDER 3199 Yamaha TO Gudang


************************************************************************
                                  Locations
************************************************************************

  Name          Cap  Units Stats       Rules      Cost
  ------------- ---- ----- ----------- ---------- ------------
  Kantor_Gudang inf  1     Time Series Oldest, ,
  Gudang        7140 1     Time Series Oldest, ,


************************************************************************
                                   Entities
************************************************************************

  Name         Speed (fpm)  Stats       Cost
  ------------ ------------ ----------- ------------
  GB4          150          Time Series
  Yamaha       150          Time Series
  Kharisma     150          Time Series
  Suzuki       150          Time Series
  review       150          Time Series
  demand       150          Time Series
  inf_brg_dtg  150          Time Series
```

```
************************************************************************
                                Processing
************************************************************************

                                     Process
Routing

 Entity      Location      Operation            Blk  Output
Destination Rule     Move Logic
 ----------- ------------- -------------------   ---- ----------- ---
-------- -------  ------------
 Yamaha      Gudang                             1    Yamaha
EXIT        SEND 1
 review      Kantor_Gudang IF (CONTENTS(Gudang)+on_arrival) <=
Reorder_Point THEN
                           {
                           INC on_arrival, Q
                           pemesanan = 1
                           INC frek_pemesanan, 1
                           wait 6 day
                           ORDER 1 inf_brg_dtg TO kantor_Gudang}
                           Else
                           {pemesanan = 0}



                                                1    review
EXIT        FIRST 1
 demand      Kantor_Gudang IF CLOCK(DAY) mod 24 = 0 THEN
                           {
                            D=ROUND(N(6041.417,1282.674)/24)
                            IF D<0 then {D=0}
                           }
                           IF D>= CONTENTS(Gudang) THEN
                           {
                            SEND CONTENTS(Gudang)Yamaha TO exit
                           }
                            ELSE
                           {
                            SEND D Yamaha TO exit
                           }
                           IF D>= CONTENTS(Gudang) THEN
                           {Lost_sales = D - CONTENTS(Gudang)
                           INC Jml_lost_sales, Lost_sales}

                           //debug


                                                1    demand
EXIT        FIRST 1

 inf_brg_dtg Kantor_Gudang ORDER Q Yamaha TO Gudang
                           DEC on_arrival, Q
```

```
                                                    1    inf_brg_dtg
EXIT        FIRST 1


************************************************************************
                                   Arrivals
************************************************************************

  Entity   Location      Qty each   First Time Occurrences Frequency
Logic
  -------- ------------- ---------- ---------- ----------- ---------
- ------------
  review   Kantor_Gudang 1          0          inf         1 day
  demand   Kantor_Gudang 1          1 day      INF         1 day


************************************************************************
                              Variables (global)
************************************************************************

  ID              Type         Initial value Stats
  --------------- ------------ ------------- -----------
  D               Integer      0             Time Series
  Lost_sales      Integer      0             Time Series
  Jml_lost_sales  Integer      0             Time Series
  Pemesanan       Integer      0             Time Series
  frek_pemesanan  Integer      0             Time Series
  on_arrival      Integer      0             Time Series


************************************************************************
                                   Macros
************************************************************************

  ID                  Text
  ------------------- ------------
  Reorder_Point       3153
  Q                   3844
```

Contoh output model simulasi metode pengendalian Usulan Continuous Review untuk item Yamaha

```
-------------------------------------------------------------------------------
General Report
Output from E:\TA\REVISI SEMINAR ISI\PROMODEL\CONTINUOUS\CONTINUOUS REVIEW YAMAHA.MOD
Date: Jan/22/2010   Time: 10:34:12 PM
-------------------------------------------------------------------------------
Scenario        : Normal Run
Replication     : 1 of 1
Simulation Time : 0 sec
-------------------------------------------------------------------------------
```

LOCATIONS

| Location Name | Scheduled Hours | Capacity | Total Entries | Average Minutes Per Entry | Average Contents | Maximum Contents | Current Contents | % Util |
|---|---|---|---|---|---|---|---|---|
| Kantor Gudang | 6912 | 999999 | 594 | 247.27 | 0.35 | 2 | 0 | 0.00 |
| Gudang | 6912 | 7140 | 68547 | 21510.48 | 3555.36 | 5984 | 3646 | 49.79 |

LOCATION STATES BY PERCENTAGE (Multiple Capacity)

| Location Name | Scheduled Hours | % Empty | % Partially Occupied | % Full | % Down |
|---|---|---|---|---|---|
| Kantor Gudang | 6912 | 64.58 | 35.42 | 0.00 | 0.00 |
| Gudang | 6912 | 0.00 | 100.00 | 0.00 | 0.00 |

FAILED ARRIVALS

| Entity Name | Location Name | Total Failed |
|---|---|---|
| review | Kantor Gudang | 0 |
| demand | Kantor Gudang | 0 |

ENTITY ACTIVITY

| Entity Name | Total Exits | Current Quantity In System | Average Minutes In System | Average Minutes In Move Logic | Average Minutes Wait For Res, etc. | Average Minutes In Operation | Average Minutes Blocked |
|---|---|---|---|---|---|---|---|
| GB4 | 0 | 0 | - | - | - | - | - |
| Yamaha | 64901 | 3646 | 21990.83 | 0.00 | 0.00 | 0.00 | 21990.83 |
| Kharisma | 0 | 0 | - | - | - | - | - |
| Suzuki | 0 | 0 | - | - | - | - | - |
| review | 289 | 0 | 508.23 | 0.00 | 0.00 | 508.23 | 0.00 |
| demand | 288 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| inf brg dtg | 17 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

ENTITY STATES BY PERCENTAGE

| Entity Name | % In Move Logic | % Wait For Res, etc. | % In Operation | % Blocked |
|---|---|---|---|---|
| GB4 | - | - | - | - |
| Yamaha | 0.00 | 0.00 | 0.00 | 100.00 |
| Kharisma | - | - | - | - |
| Suzuki | - | - | - | - |
| review | 0.00 | 0.00 | 100.00 | 0.00 |
| demand | - | - | - | - |
| inf brg dtg | - | - | - | - |

VARIABLES

| Variable Name | Total Changes | Average Minutes Per Change | Minimum Value | Maximum Value | Current Value | Average Value |
|---|---|---|---|---|---|---|
| D | 12 | 34560.00 | 0 | 351 | 317 | 224.25 |
| Lost sales | 0 | 0.00 | 0 | 0 | 0 | 0 |
| Jml lost sales | 0 | 0.00 | 0 | 0 | 0 | 0 |
| Pemesanan | 289 | 1435.01 | 0 | 1 | 0 | 0.05 |
| frek pemesanan | 17 | 23124.70 | 0 | 17 | 17 | 8.05 |
| on arrival | 34 | 11816.47 | 0 | 3844 | 0 | 1361.42 |

Model ini sama untuk seluruh item, dengan melakukan perubahan pada parameter-parameternya, yaitu distribusi permintaan, inventory awal, batas maksimum persediaan.

Contoh input model simulasi metode pengendalian Usulan Optional untuk item Yamaha

```
************************************************************************

                        Formatted Listing of Model:
       E:\TA\Revisi Seminar Isi\Promodel\Optional\OPTIONAL
YAMAHA.MOD

************************************************************************
  Time Units:                          Minutes
  Distance Units:                      Feet
  Initialization Logic:                ORDER 3199 Yamaha TO Gudang

************************************************************************
Locations
************************************************************************
  Name          Cap             Units Stats       Rules      Cost
  ------------- --------------- ----- ----------- ---------- --------
----
  Kantor_Gudang inf             1     Time Series Oldest, ,
  Gudang        inv_max_Yamaha 1     Time Series Oldest, ,


************************************************************************
                              Entities
************************************************************************

  Name         Speed (fpm)  Stats       Cost
  ------------ ------------ ----------- ------------
  GB4          150          Time Series
  Yamaha       150          Time Series
  Kharisma     150          Time Series
  Suzuki       150          Time Series
  review       150          Time Series
  demand       150          Time Series
  inf_brg_dtg 150          Time Series
```

```
*********************************************************************
                                  Processing
*********************************************************************
                                     Process
Routing

 Entity      Location      Operation            Blk  Output
Destination Rule     Move Logic
 ----------- ------------- ------------------   ---- ----------- ---
-------- -------  ------------
 Yamaha      Gudang                             1    Yamaha
EXIT        SEND 1
 review      Kantor_Gudang Q = Inv_max_Yamaha-
(CONTENTS(Gudang)+on_arrival)
                           IF (CONTENTS(Gudang)+on_arrival) <=
Reorder_Point THEN
                           {
                           INC on_arrival, Q
                           pemesanan = 1
                           INC frek_pemesanan, 1
                           wait 6 day
                           ORDER 1 inf_brg_dtg TO kantor_Gudang}
                           Else
                           {pemesanan = 0}



                                                1    review
EXIT        FIRST 1
 demand      Kantor_Gudang IF CLOCK( DAY) mod 24 = 0 THEN
                           {
                            D=ROUND(N(6041.417,1282.674)/24)
                            IF D<0 then {D=0 }
                           }
                           IF D >= CONTENTS(Gudang) THEN
                           {
                             SEND CONTENTS(Gudang) Yamaha TO exit
                           }
                            ELSE
                           {
                            SEND D Yamaha TO exit
                           }
                           IF D >= CONTENTS(Gudang) THEN
                           {lost_sales = D - CONTENTS(Gudang)
                           INC jml_lost_sales, lost_sales}

                           //debug

                                                1    demand
EXIT        FIRST 1
 inf_brg_dtg Kantor_Gudang ORDER Q Yamaha TO Gudang
                           DEC on_arrival, Q
```

```
                                                    1    inf_brg_dtg
EXIT        FIRST 1


*********************************************************************
                                  Arrivals
*********************************************************************
  Entity   Location      Qty each   First Time Occurrences Frequency
Logic
  -------- ------------- ---------- ---------- ----------- ---------
- ------------
  review   Kantor_Gudang 1          0          inf         8 day
  demand   Kantor_Gudang 1          1 day      INF         1 day


*********************************************************************
                           Variables (global)
*********************************************************************
  ID              Type         Initial value Stats
  --------------- ------------ ------------- -----------
  D               Integer      0             Time Series
  Q               Integer      0             Time Series
  delivery        Integer      0             Time Series
  lost_sales      Integer      0             Time Series
  jml_lost_sales  Integer      0             Time Series
  Frek_pemesanan  Integer      0             Time Series
  Pemesanan       Integer      0             Time Series
  on_arrival      Integer      0             Time Series


*********************************************************************
                                   Macros
*********************************************************************
  ID                   Text
  -------------------- ------------
  inv_max_Yamaha       8163
  Reorder_point        7267
```

Contoh output model simulasi metode pengendalian Usulan Optional untuk item Yamaha

```
-------------------------------------------------------------------------------
General Report
Output from E:\TA\REVISI SEMINAR ISI\PROMODEL\OPTIONAL\OPTIONAL YAMAHA.MOD
Date: Jan/22/2010   Time: 10:36:58 PM
-------------------------------------------------------------------------------
Scenario        : Normal Run
Replication     : 1 of 1
Simulation Time : 0 sec
-------------------------------------------------------------------------------
```

LOCATIONS

| Location Name | Scheduled Hours | Capacity | Total Entries | Average Minutes Per Entry | Average Contents | Maximum Contents | Current Contents | % Util |
|---|---|---|---|---|---|---|---|---|
| Kantor Gudang | 6912 | 999999 | 358 | 796.42 | 0.68 | 2 | 1 | 0.00 |
| Gudang | 6912 | 8163 | 71035 | 33515.19 | 5740.62 | 8163 | 6134 | 70.32 |

LOCATION STATES BY PERCENTAGE (Multiple Capacity)

| Location Name | Scheduled Hours | % Empty | % Partially Occupied | % Full | % Down |
|---|---|---|---|---|---|
| Kantor Gudang | 6912 | 31.25 | 68.75 | 0.00 | 0.00 |
| Gudang | 6912 | 0.00 | 93.75 | 6.25 | 0.00 |

FAILED ARRIVALS

| Entity Name | Location Name | Total Failed |
|---|---|---|
| review | Kantor Gudang | 0 |
| demand | Kantor Gudang | 0 |

ENTITY ACTIVITY

| Entity Name | Total Exits | Current Quantity In System | Average Minutes In System | Average Minutes In Move Logic | Average Minutes Wait For Res, etc. | Average Minutes In Operation | Average Minutes Blocked |
|---|---|---|---|---|---|---|---|
| GB4 | 0 | 0 | - | - | - | - | - |
| Yamaha | 64901 | 6134 | 34924.94 | 0.00 | 0.00 | 0.00 | 34924.94 |
| Kharisma | 0 | 0 | - | - | - | - | - |
| Suzuki | 0 | 0 | - | - | - | - | - |
| review | 36 | 1 | 7920.00 | 0.00 | 0.00 | 7920.00 | 0.00 |
| demand | 288 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| inf brg dtg | 33 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

ENTITY STATES BY PERCENTAGE

| Entity Name | % In Move Logic | % Wait For Res, etc. | % In Operation | % Blocked |
|---|---|---|---|---|
| GB4 | - | - | - | - |
| Yamaha | 0.00 | 0.00 | 0.00 | 100.00 |
| Kharisma | - | - | - | - |
| Suzuki | - | - | - | - |
| review | 0.00 | 0.00 | 100.00 | 0.00 |
| demand | - | - | - | - |
| inf brg dtg | - | - | - | - |

VARIABLES

| Variable Name | Total Changes | Average Minutes Per Change | Minimum Value | Maximum Value | Current Value | Average Value |
|---|---|---|---|---|---|---|
| D | 12 | 34560.00 | 0 | 351 | 317 | 224.25 |
| Q | 37 | 11208.64 | 0 | 4964 | 1712 | 1884.33 |
| delivery | 0 | 0.00 | 0 | 0 | 0 | 0 |
| lost sales | 0 | 0.00 | 0 | 0 | 0 | 0 |
| jml lost sales | 0 | 0.00 | 0 | 0 | 0 | 0 |
| Frek pemesanan | 34 | 12197.64 | 0 | 34 | 34 | 15.66 |
| Pemesanan | 37 | 11208.64 | 0 | 1 | 1 | 0.91 |
| on arrival | 67 | 6189.85 | 0 | 4964 | 1712 | 1413.25 |

# LAMPIRAN 5

- **Tabel Distribusi Normal**

**Tabel Distribusi Normal**

| k | F'(k) | f(k) | E(k) |
|---|---|---|---|
| 0 | 0.5 | 0.398942 | 0.39894 |
| 0.01 | 0.496011 | 0.398922 | 0.39396 |
| 0.02 | 0.492022 | 0.398862 | 0.38902 |
| 0.03 | 0.488034 | 0.398763 | 0.38412 |
| 0.04 | 0.484047 | 0.398623 | 0.37926 |
| 0.05 | 0.480061 | 0.398444 | 0.37444 |
| 0.06 | 0.476078 | 0.398225 | 0.36966 |
| 0.07 | 0.472097 | 0.397966 | 0.36492 |
| 0.08 | 0.468119 | 0.397668 | 0.36022 |
| 0.09 | 0.464144 | 0.39733 | 0.35556 |
| 0.1 | 0.460172 | 0.396953 | 0.35094 |
| 0.11 | 0.456205 | 0.396536 | 0.34635 |
| 0.12 | 0.452242 | 0.39608 | 0.34181 |
| 0.13 | 0.448283 | 0.395585 | 0.33731 |
| 0.14 | 0.444330 | 0.395052 | 0.33285 |
| 0.15 | 0.440382 | 0.394479 | 0.32842 |
| 0.16 | 0.436441 | 0.393868 | 0.32404 |
| 0.17 | 0.432505 | 0.393219 | 0.31969 |
| 0.18 | 0.428576 | 0.392531 | 0.31539 |
| 0.19 | 0.424655 | 0.391806 | 0.31112 |
| 0.2 | 0.420740 | 0.391043 | 0.30689 |
| 0.21 | 0.416834 | 0.390242 | 0.30271 |
| 0.22 | 0.412936 | 0.389404 | 0.29856 |
| 0.23 | 0.409046 | 0.388529 | 0.29445 |
| 0.24 | 0.405165 | 0.387617 | 0.29038 |
| 0.25 | 0.401294 | 0.386668 | 0.28634 |
| 0.26 | 0.397432 | 0.385683 | 0.28235 |
| 0.27 | 0.393580 | 0.384663 | 0.27840 |
| 0.28 | 0.389739 | 0.383606 | 0.27448 |
| 0.29 | 0.385908 | 0.382515 | 0.27060 |
| 0.3 | 0.382089 | 0.381388 | 0.26676 |
| 0.31 | 0.378280 | 0.380226 | 0.26296 |
| 0.32 | 0.374484 | 0.379031 | 0.25920 |
| 0.33 | 0.370700 | 0.377801 | 0.25547 |
| 0.34 | 0.366928 | 0.376537 | 0.25178 |
| 0.35 | 0.363169 | 0.37524 | 0.24813 |
| 0.36 | 0.359424 | 0.373911 | 0.24452 |
| 0.37 | 0.355691 | 0.372548 | 0.24094 |

| | | | |
|---|---|---|---|
| 0.38 | 0.351973 | 0.371154 | 0.23740 |
| 0.39 | 0.348268 | 0.369728 | 0.23390 |
| 0.4 | 0.344578 | 0.36827 | 0.23044 |
| 0.41 | 0.340903 | 0.366782 | 0.22701 |
| 0.42 | 0.337243 | 0.365263 | 0.22362 |
| 0.43 | 0.333598 | 0.363714 | 0.22027 |
| 0.44 | 0.329969 | 0.362135 | 0.21695 |
| 0.45 | 0.326355 | 0.360527 | 0.21367 |
| 0.46 | 0.322758 | 0.35889 | 0.21042 |
| 0.47 | 0.319178 | 0.357225 | 0.20721 |
| 0.48 | 0.315614 | 0.355533 | 0.20404 |
| 0.49 | 0.312067 | 0.353812 | 0.20090 |
| 0.5 | 0.308538 | 0.352065 | 0.19780 |
| 0.51 | 0.305026 | 0.350292 | 0.19473 |
| 0.52 | 0.301532 | 0.348493 | 0.19170 |
| 0.53 | 0.298056 | 0.346668 | 0.18870 |
| 0.54 | 0.294599 | 0.344818 | 0.18573 |
| 0.55 | 0.291160 | 0.342944 | 0.18281 |
| 0.56 | 0.287740 | 0.341046 | 0.17991 |
| 0.578 | 0.281632 | 0.337571 | 0.17479 |
| 0.58 | 0.280957 | 0.33718 | 0.17422 |
| 0.59 | 0.277595 | 0.335213 | 0.17143 |
| 0.6 | 0.274253 | 0.333225 | 0.16867 |
| 0.61 | 0.270931 | 0.331215 | 0.16595 |
| 0.62 | 0.267629 | 0.329184 | 0.16325 |
| 0.63 | 0.264347 | 0.327133 | 0.16059 |
| 0.64 | 0.261086 | 0.325062 | 0.15797 |
| 0.65 | 0.257846 | 0.322972 | 0.15537 |
| 0.66 | 0.254627 | 0.320864 | 0.15281 |
| 0.67 | 0.251429 | 0.318737 | 0.15028 |
| 0.68 | 0.248252 | 0.316593 | 0.14778 |
| 0.69 | 0.245097 | 0.314432 | 0.14531 |
| 0.7 | 0.241964 | 0.312254 | 0.14288 |
| 0.71 | 0.238852 | 0.31006 | 0.14048 |
| 0.72 | 0.235762 | 0.307851 | 0.13810 |
| 0.73 | 0.232695 | 0.305627 | 0.13576 |
| 0.74 | 0.229650 | 0.303389 | 0.13345 |
| 0.75 | 0.226627 | 0.301137 | 0.13117 |
| 0.76 | 0.223627 | 0.298872 | 0.12892 |
| 0.77 | 0.220650 | 0.296595 | 0.12669 |
| 0.7731 | 0.219732 | 0.295886 | 0.12601 |

| | | | |
|---|---|---|---|
| 0.79 | 0.214764 | 0.292004 | 0.12234 |
| 0.8 | 0.211855 | 0.289692 | 0.12021 |
| 0.81 | 0.208970 | 0.287369 | 0.11810 |
| 0.82 | 0.206108 | 0.285036 | 0.11603 |
| 0.83 | 0.203269 | 0.282694 | 0.11398 |
| 0.84 | 0.200454 | 0.280344 | 0.11196 |
| 0.85 | 0.197663 | 0.277985 | 0.10997 |
| 0.86 | 0.194895 | 0.275618 | 0.10801 |
| 0.87 | 0.192150 | 0.273244 | 0.10607 |
| 0.88 | 0.189430 | 0.270864 | 0.10417 |
| 0.89 | 0.186733 | 0.268477 | 0.10229 |
| 0.9 | 0.184060 | 0.266085 | 0.10043 |
| 0.91 | 0.181411 | 0.263688 | 0.09860 |
| 0.92 | 0.178786 | 0.261286 | 0.09680 |
| 0.93 | 0.176186 | 0.258881 | 0.09503 |
| 0.94 | 0.173609 | 0.256471 | 0.09328 |
| 0.95 | 0.171056 | 0.254059 | 0.09156 |
| 0.96 | 0.168528 | 0.251644 | 0.08986 |
| 0.97 | 0.166023 | 0.249228 | 0.08819 |
| 0.98 | 0.163543 | 0.246809 | 0.08654 |
| 0.99 | 0.161087 | 0.24439 | 0.08491 |
| 1 | 0.158655 | 0.241971 | 0.08332 |
| 1.01 | 0.156248 | 0.239551 | 0.08174 |
| 1.02 | 0.153864 | 0.237132 | 0.08019 |
| 1.03 | 0.151505 | 0.234714 | 0.07866 |
| 1.04 | 0.149170 | 0.232297 | 0.07716 |
| 1.05 | 0.146859 | 0.229882 | 0.07568 |
| 1.06 | 0.144572 | 0.22747 | 0.07422 |
| 1.07 | 0.142310 | 0.22506 | 0.07279 |
| 1.08 | 0.140071 | 0.222653 | 0.07138 |
| 1.09 | 0.137857 | 0.220251 | 0.06999 |
| 1.1 | 0.135666 | 0.217852 | 0.06862 |
| 1.11 | 0.133500 | 0.215458 | 0.06727 |
| 1.12 | 0.131357 | 0.213069 | 0.06595 |
| 1.13 | 0.129238 | 0.210686 | 0.06465 |
| 1.14 | 0.127143 | 0.208308 | 0.06336 |
| 1.15 | 0.125072 | 0.205936 | 0.06210 |
| 1.16 | 0.123024 | 0.203571 | 0.06086 |
| 1.17 | 0.121000 | 0.201214 | 0.05964 |
| 1.18 | 0.119000 | 0.198863 | 0.05844 |
| 1.19 | 0.117023 | 0.19652 | 0.05726 |

| | | | |
|---|---|---|---|
| 1.2 | 0.115070 | 0.194186 | 0.05610 |
| 1.21 | 0.113139 | 0.19186 | 0.05496 |
| 1.22 | 0.111232 | 0.189543 | 0.05384 |
| 1.23 | 0.109349 | 0.187235 | 0.05274 |
| 1.24 | 0.107488 | 0.184937 | 0.05165 |
| 1.25 | 0.105650 | 0.182649 | 0.05059 |
| 1.26 | 0.103835 | 0.180371 | 0.04954 |
| 1.27 | 0.102042 | 0.178104 | 0.04851 |
| 1.28 | 0.100273 | 0.175847 | 0.04750 |
| 1.29 | 0.098525 | 0.173602 | 0.04650 |
| 1.3 | 0.096800 | 0.171369 | 0.04553 |
| 1.31 | 0.095098 | 0.169147 | 0.04457 |
| 1.32 | 0.093418 | 0.166937 | 0.04363 |
| 1.33 | 0.091759 | 0.16474 | 0.04270 |
| 1.34 | 0.090123 | 0.162555 | 0.04179 |
| 1.35 | 0.088508 | 0.160383 | 0.04090 |
| 1.36 | 0.086915 | 0.158225 | 0.04002 |
| 1.37 | 0.085343 | 0.15608 | 0.03916 |
| 1.38 | 0.083793 | 0.153948 | 0.03831 |
| 1.39 | 0.082264 | 0.151831 | 0.03748 |
| 1.4 | 0.080757 | 0.149727 | 0.03667 |
| 1.41 | 0.079270 | 0.147639 | 0.03587 |
| 1.42 | 0.077804 | 0.145564 | 0.03508 |
| 1.43 | 0.076359 | 0.143505 | 0.03431 |
| 1.44 | 0.074934 | 0.14146 | 0.03356 |
| 1.45 | 0.073529 | 0.139431 | 0.03281 |
| 1.46 | 0.072145 | 0.137417 | 0.03208 |
| 1.47 | 0.070781 | 0.135418 | 0.03137 |
| 1.48 | 0.069437 | 0.133435 | 0.03067 |
| 1.49 | 0.068112 | 0.131468 | 0.02998 |
| 1.5 | 0.066807 | 0.129518 | 0.02931 |
| 1.51 | 0.065522 | 0.127583 | 0.02865 |
| 1.52 | 0.064255 | 0.125665 | 0.02800 |
| 1.53 | 0.063008 | 0.123763 | 0.02736 |
| 1.54 | 0.061780 | 0.121878 | 0.02674 |
| 1.55 | 0.060571 | 0.120009 | 0.02612 |
| 1.56 | 0.059380 | 0.118157 | 0.02552 |
| 1.57 | 0.058208 | 0.116323 | 0.02494 |
| 1.58 | 0.057053 | 0.114505 | 0.02436 |
| 1.59 | 0.055917 | 0.112704 | 0.02380 |
| 1.6 | 0.054799 | 0.110921 | 0.02324 |

| | | | |
|---|---|---|---|
| 1.61 | 0.053699 | 0.109155 | 0.02270 |
| 1.62 | 0.052616 | 0.107406 | 0.02217 |
| 1.63 | 0.051551 | 0.105675 | 0.02165 |
| 1.64 | 0.050503 | 0.103961 | 0.02114 |
| 1.65 | 0.049471 | 0.102265 | 0.02064 |
| 1.66 | 0.048457 | 0.100586 | 0.02015 |
| 1.67 | 0.047460 | 0.098925 | 0.01967 |
| 1.68 | 0.046479 | 0.097282 | 0.01920 |
| 1.69 | 0.045514 | 0.095657 | 0.01874 |
| 1.7 | 0.044565 | 0.094049 | 0.01829 |
| 1.71 | 0.043633 | 0.092459 | 0.01785 |
| 1.72 | 0.042716 | 0.090887 | 0.01742 |
| 1.73 | 0.041815 | 0.089333 | 0.01699 |
| 1.74 | 0.040930 | 0.087796 | 0.01658 |
| 1.75 | 0.040059 | 0.086277 | 0.01617 |
| 1.76 | 0.039204 | 0.084776 | 0.01578 |
| 1.77 | 0.038364 | 0.083293 | 0.01539 |
| 1.78 | 0.037538 | 0.081828 | 0.01501 |
| 1.79 | 0.036727 | 0.08038 | 0.01464 |
| 1.8 | 0.035930 | 0.07895 | 0.01428 |
| 1.81 | 0.035148 | 0.077538 | 0.01392 |
| 1.82 | 0.034380 | 0.076143 | 0.01357 |
| 1.83 | 0.033625 | 0.074766 | 0.01323 |
| 1.84 | 0.032884 | 0.073407 | 0.01290 |
| 1.85 | 0.032157 | 0.072065 | 0.01257 |
| 1.86 | 0.031443 | 0.07074 | 0.01226 |
| 1.87 | 0.030742 | 0.069433 | 0.01195 |
| 1.88 | 0.030054 | 0.068144 | 0.01164 |
| 1.89 | 0.029379 | 0.066871 | 0.01134 |
| 1.9 | 0.028717 | 0.065616 | 0.01105 |
| 1.91 | 0.028067 | 0.064378 | 0.01077 |
| 1.92 | 0.027429 | 0.063157 | 0.01049 |
| 1.93 | 0.026803 | 0.061952 | 0.01022 |
| 1.94 | 0.026190 | 0.060765 | 0.00996 |
| 1.95 | 0.025588 | 0.059595 | 0.00970 |
| 1.96 | 0.024998 | 0.058441 | 0.00945 |
| 1.97 | 0.024419 | 0.057304 | 0.00920 |
| 1.98 | 0.023852 | 0.056183 | 0.00896 |
| 1.99 | 0.023295 | 0.055079 | 0.00872 |
| 2 | 0.022750 | 0.053991 | 0.00849 |
| 2.01 | 0.022216 | 0.052919 | 0.00827 |

| | | | |
|---|---|---|---|
| 2.02 | 0.021692 | 0.051864 | 0.00805 |
| 2.03 | 0.021178 | 0.050824 | 0.00783 |
| 2.04 | 0.020675 | 0.0498 | 0.00762 |
| 2.05 | 0.020182 | 0.048792 | 0.00742 |
| 2.06 | 0.019699 | 0.0478 | 0.00722 |
| 2.07 | 0.019226 | 0.046823 | 0.00702 |
| 2.08 | 0.018763 | 0.045861 | 0.00683 |
| 2.09 | 0.018309 | 0.044915 | 0.00665 |
| 2.1 | 0.017864 | 0.043984 | 0.00647 |
| 2.11 | 0.017429 | 0.043067 | 0.00629 |
| 2.12 | 0.017003 | 0.042166 | 0.00612 |
| 2.13 | 0.016586 | 0.04128 | 0.00595 |
| 2.14 | 0.016177 | 0.040408 | 0.00579 |
| 2.15 | 0.015778 | 0.03955 | 0.00563 |
| 2.16 | 0.015386 | 0.038707 | 0.00547 |
| 2.17 | 0.015003 | 0.037878 | 0.00532 |
| 2.18 | 0.014629 | 0.037063 | 0.00517 |
| 2.19 | 0.014262 | 0.036262 | 0.00503 |
| 2.2 | 0.013903 | 0.035475 | 0.00489 |
| 2.21 | 0.013553 | 0.034701 | 0.00475 |
| 2.22 | 0.013209 | 0.033941 | 0.00462 |
| 2.23 | 0.012874 | 0.033194 | 0.00449 |
| 2.24 | 0.012545 | 0.03246 | 0.00436 |
| 2.25 | 0.012224 | 0.03174 | 0.00423 |
| 2.26 | 0.011911 | 0.031032 | 0.00411 |
| 2.27 | 0.011604 | 0.030337 | 0.00400 |
| 2.28 | 0.011304 | 0.029655 | 0.00388 |
| 2.29 | 0.011011 | 0.028985 | 0.00377 |
| 2.3 | 0.010724 | 0.028327 | 0.00366 |
| 2.31 | 0.010444 | 0.027682 | 0.00356 |
| 2.32 | 0.010170 | 0.027048 | 0.00345 |
| 2.33 | 0.009903 | 0.026426 | 0.00335 |
| 2.34 | 0.009642 | 0.025817 | 0.00325 |
| 2.35 | 0.009387 | 0.025218 | 0.00316 |
| 2.36 | 0.009137 | 0.024631 | 0.00307 |
| 2.37 | 0.008894 | 0.024056 | 0.00298 |
| 2.38 | 0.008656 | 0.023491 | 0.00289 |
| 2.39 | 0.008424 | 0.022937 | 0.00280 |
| 2.4 | 0.008198 | 0.022395 | 0.00272 |
| 2.41 | 0.007976 | 0.021862 | 0.00264 |
| 2.42 | 0.007760 | 0.021341 | 0.00256 |

| | | | |
|---|---|---|---|
| 2.43 | 0.007549 | 0.020829 | 0.00248 |
| 2.44 | 0.007344 | 0.020328 | 0.00241 |
| 2.45 | 0.007143 | 0.019837 | 0.00234 |
| 2.46 | 0.006947 | 0.019356 | 0.00227 |
| 2.47 | 0.006756 | 0.018885 | 0.00220 |
| 2.48 | 0.006569 | 0.018423 | 0.00213 |
| 2.49 | 0.006387 | 0.017971 | 0.00207 |
| 2.5 | 0.006210 | 0.017528 | 0.00200 |
| 2.51 | 0.006037 | 0.017095 | 0.00194 |
| 2.52 | 0.005868 | 0.01667 | 0.00188 |
| 2.53 | 0.005703 | 0.016254 | 0.00183 |
| 2.54 | 0.005543 | 0.015848 | 0.00177 |
| 2.55 | 0.005386 | 0.015449 | 0.00171 |
| 2.56 | 0.005234 | 0.01506 | 0.00166 |
| 2.57 | 0.005085 | 0.014678 | 0.00161 |
| 2.58 | 0.004940 | 0.014305 | 0.00156 |
| 2.59 | 0.004799 | 0.01394 | 0.00151 |
| 2.6 | 0.004661 | 0.013583 | 0.00146 |
| 2.61 | 0.004527 | 0.013234 | 0.00142 |
| 2.62 | 0.004396 | 0.012892 | 0.00137 |
| 2.63 | 0.004269 | 0.012558 | 0.00133 |
| 2.64 | 0.004145 | 0.012232 | 0.00129 |
| 2.65 | 0.004025 | 0.011912 | 0.00125 |
| 2.66 | 0.003907 | 0.0116 | 0.00121 |
| 2.67 | 0.003793 | 0.011295 | 0.00117 |
| 2.68 | 0.003681 | 0.010997 | 0.00113 |
| 2.69 | 0.003573 | 0.010706 | 0.00110 |
| 2.7 | 0.003467 | 0.010421 | 0.00106 |
| 2.71 | 0.003364 | 0.010143 | 0.00103 |
| 2.72 | 0.003264 | 0.009871 | 0.00099 |
| 2.73 | 0.003167 | 0.009606 | 0.00096 |
| 2.74 | 0.003072 | 0.009347 | 0.00093 |
| 2.75 | 0.002980 | 0.009094 | 0.00090 |
| 2.76 | 0.002890 | 0.008846 | 0.00087 |
| 2.77 | 0.002803 | 0.008605 | 0.00084 |
| 2.78 | 0.002718 | 0.00837 | 0.00081 |
| 2.79 | 0.002635 | 0.00814 | 0.00079 |
| 2.8 | 0.002555 | 0.007915 | 0.00076 |
| 2.81 | 0.002477 | 0.007697 | 0.00074 |
| 2.82 | 0.002401 | 0.007483 | 0.00071 |
| 2.83 | 0.002327 | 0.007274 | 0.00069 |

| | | | |
|---|---|---|---|
| 2.84 | 0.002256 | 0.007071 | 0.00066 |
| 2.85 | 0.002186 | 0.006873 | 0.00064 |
| 2.86 | 0.002118 | 0.006679 | 0.00062 |
| 2.87 | 0.002052 | 0.006491 | 0.00060 |
| 2.88 | 0.001988 | 0.006307 | 0.00058 |
| 2.89 | 0.001926 | 0.006127 | 0.00056 |
| 2.9 | 0.001866 | 0.005953 | 0.00054 |
| 2.91 | 0.001807 | 0.005782 | 0.00052 |
| 2.92 | 0.001750 | 0.005616 | 0.00051 |
| 2.93 | 0.001695 | 0.005454 | 0.00049 |
| 2.94 | 0.001641 | 0.005296 | 0.00047 |
| 2.95 | 0.001589 | 0.005143 | 0.00046 |
| 2.96 | 0.001538 | 0.004993 | 0.00044 |
| 2.97 | 0.001489 | 0.004847 | 0.00042 |
| 2.98 | 0.001441 | 0.004705 | 0.00041 |
| 2.99 | 0.001395 | 0.004567 | 0.00040 |
| 3 | 0.001350 | 0.004432 | 0.00038 |
| 3.01 | 0.001306 | 0.004301 | 0.00037 |
| 3.02 | 0.001264 | 0.004173 | 0.00036 |
| 3.03 | 0.001223 | 0.004049 | 0.00034 |
| 3.04 | 0.001183 | 0.003928 | 0.00033 |
| 3.05 | 0.001144 | 0.00381 | 0.00032 |
| 3.06 | 0.001107 | 0.003695 | 0.00031 |
| 3.07 | 0.001070 | 0.003584 | 0.00030 |
| 3.08 | 0.001035 | 0.003475 | 0.00029 |
| 3.09 | 0.001001 | 0.00337 | 0.00028 |
| 3.1 | 0.000968 | 0.003267 | 0.00027 |
| 3.11 | 0.000935 | 0.003167 | 0.00026 |
| 3.12 | 0.000904 | 0.00307 | 0.00025 |
| 3.13 | 0.000874 | 0.002975 | 0.00024 |
| 3.14 | 0.000845 | 0.002884 | 0.00023 |
| 3.15 | 0.000816 | 0.002794 | 0.00022 |
| 3.16 | 0.000789 | 0.002707 | 0.00021 |
| 3.17 | 0.000762 | 0.002623 | 0.000207 |
| 3.18 | 0.000736 | 0.002541 | 0.000199 |
| 3.19 | 0.000711 | 0.002461 | 0.000192 |
| 3.2 | 0.000687 | 0.002384 | 0.000185 |
| 3.21 | 0.000664 | 0.002309 | 0.00018 |
| 3.22 | 0.000641 | 0.002236 | 0.000172 |
| 3.23 | 0.000619 | 0.002165 | 0.000166 |
| 3.24 | 0.000598 | 0.002096 | 0.00016 |

| | | | |
|---|---|---|---|
| 3.25 | 0.000577 | 0.002029 | 0.00015 |
| 3.26 | 0.000557 | 0.001964 | 0.00015 |
| 3.27 | 0.000538 | 0.001901 | 0.00014 |
| 3.28 | 0.000519 | 0.00184 | 0.00014 |
| 3.29 | 0.000501 | 0.00178 | 0.00013 |
| 3.3 | 0.000483 | 0.001723 | 0.00013 |
| 3.31 | 0.000466 | 0.001667 | 0.00012 |
| 3.32 | 0.000450 | 0.001612 | 0.00012 |
| 3.33 | 0.000434 | 0.00156 | 0.00011 |
| 3.34 | 0.000419 | 0.001508 | 0.00011 |
| 3.35 | 0.000404 | 0.001459 | 0.00011 |
| 3.36 | 0.000390 | 0.001411 | 0.00010 |
| 3.37 | 0.000376 | 0.001364 | 0.00010 |
| 3.38 | 0.000362 | 0.001319 | 0.00009 |
| 3.39 | 0.000349 | 0.001275 | 0.00009 |
| 3.4 | 0.000337 | 0.001232 | 0.00009 |
| 3.41 | 0.000325 | 0.001191 | 0.00008 |
| 3.42 | 0.000313 | 0.001151 | 0.00008 |
| 3.43 | 0.000302 | 0.001112 | 0.00008 |
| 3.44 | 0.000291 | 0.001075 | 0.00007 |
| 3.45 | 0.000280 | 0.001038 | 0.00007 |
| 3.46 | 0.000270 | 0.001003 | 0.00007 |
| 3.47 | 0.000260 | 0.000969 | 0.00007 |
| 3.48 | 0.000251 | 0.000936 | 0.00006 |
| 3.49 | 0.000242 | 0.000904 | 0.00006 |
| 3.5 | 0.000233 | 0.000873 | 0.00006 |
| 3.51 | 0.000224 | 0.000843 | 0.00006 |
| 3.52 | 0.000216 | 0.000814 | 0.00005 |
| 3.53 | 0.000208 | 0.000785 | 0.00005 |
| 3.54 | 0.000200 | 0.000758 | 0.00005 |
| 3.55 | 0.000193 | 0.000732 | 0.00005 |
| 3.56 | 0.000185 | 0.000706 | 0.00005 |
| 3.57 | 0.000178 | 0.000681 | 0.00004 |
| 3.58 | 0.000172 | 0.000657 | 0.00004 |
| 3.59 | 0.000165 | 0.000634 | 0.00004 |
| 3.6 | 0.000159 | 0.000612 | 0.00004 |
| 3.61 | 0.000153 | 0.00059 | 0.00004 |
| 3.62 | 0.000147 | 0.000569 | 0.00004 |
| 3.63 | 0.000142 | 0.000549 | 0.00003 |
| 3.64 | 0.000136 | 0.000529 | 0.00003 |
| 3.65 | 0.000131 | 0.00051 | 0.00003 |

| | | | |
|---|---|---|---|
| 3.66 | 0.000126 | 0.000492 | 0.00003 |
| 3.67 | 0.000121 | 0.000474 | 0.00003 |
| 3.68 | 0.000117 | 0.000457 | 0.00003 |
| 3.69 | 0.000112 | 0.000441 | 0.00003 |
| 3.7 | 0.000108 | 0.000425 | 0.00003 |
| 3.71 | 0.000104 | 0.000409 | 0.00002 |
| 3.72 | 0.000100 | 0.000394 | 0.00002 |
| 3.73 | 0.000096 | 0.00038 | 0.00002 |
| 3.74 | 0.000092 | 0.000366 | 0.00002 |
| 3.75 | 0.000088 | 0.000353 | 0.00002 |
| 3.76 | 0.000085 | 0.00034 | 0.00002 |
| 3.77 | 0.000082 | 0.000327 | 0.00002 |
| 3.78 | 0.000078 | 0.000315 | 0.00002 |
| 3.79 | 0.000075 | 0.000303 | 0.00002 |
| 3.8 | 0.000072 | 0.000292 | 0.00002 |
| 3.81 | 0.000069 | 0.000281 | 0.00002 |
| 3.82 | 0.000067 | 0.000271 | 0.00002 |
| 3.83 | 0.000064 | 0.00026 | 0.00001 |
| 3.84 | 0.000062 | 0.000251 | 0.00001 |
| 3.85 | 0.000059 | 0.000241 | 0.00001 |
| 3.86 | 0.000057 | 0.000232 | 0.00001 |
| 3.87 | 0.000054 | 0.000223 | 0.00001 |
| 3.88 | 0.000052 | 0.000215 | 0.00001 |
| 3.89 | 0.000050 | 0.000207 | 0.00001 |
| 3.9 | 0.000048 | 0.000199 | 0.00001 |
| 3.91 | 0.000046 | 0.000191 | 0.00001 |
| 3.92 | 0.000044 | 0.000184 | 0.00001 |
| 3.93 | 0.000042 | 0.000177 | 0.00001 |
| 3.94 | 0.000041 | 0.00017 | 0.00001 |
| 3.95 | 0.000039 | 0.000163 | 0.00001 |
| 3.96 | 0.000037 | 0.000157 | 0.00001 |
| 3.97 | 0.000036 | 0.000151 | 0.00001 |
| 3.98 | 0.000034 | 0.000145 | 0.00001 |
| 3.99 | 0.000033 | 0.000139 | 0.00001 |
| 4 | 0.000032 | 0.000134 | 0.00001 |