

Analisis Deret Waktu

Pertemuan 2

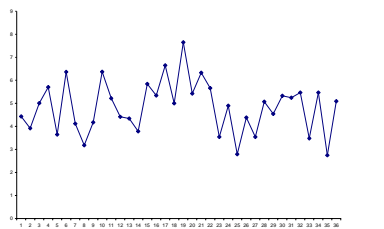
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Jenis Data

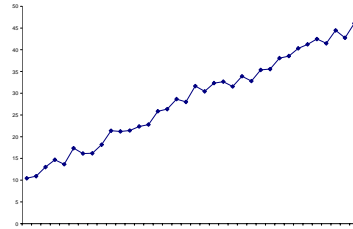
- **Cross section**
 - Beberapa pengamatan diamati bersama-sama pada periode waktu tertentu
 - Harga saham semua perusahaan yang tercatat di BEJ pada hari Rabu 27 Februari 2008
- **Time Series**
 - Satu pengamatan diamati selama sekian periode secara teratur
 - Harga saham P.T. TELKOM di BEJ dari 2 Januari 2008 hingga 27 Februari 2008
- **Longitudinal/panel**
 - Beberapa pengamatan diamati bersama-sama selama kurun waktu tertentu (gabungan *cross section* dan *time series*)
 - Harga saham P.T. TELKOM, P.T. INDOSAT, dan P.T. Mobile8 di BEJ dari 2 Januari 2008 hingga 27 Februari 2008

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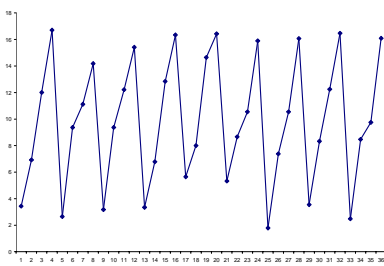
Pola Data Time Series



Konstan

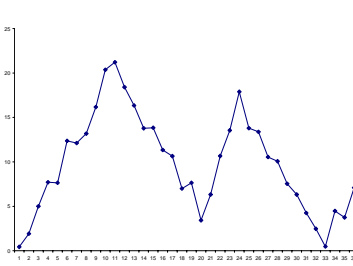


Trend



Seasonal

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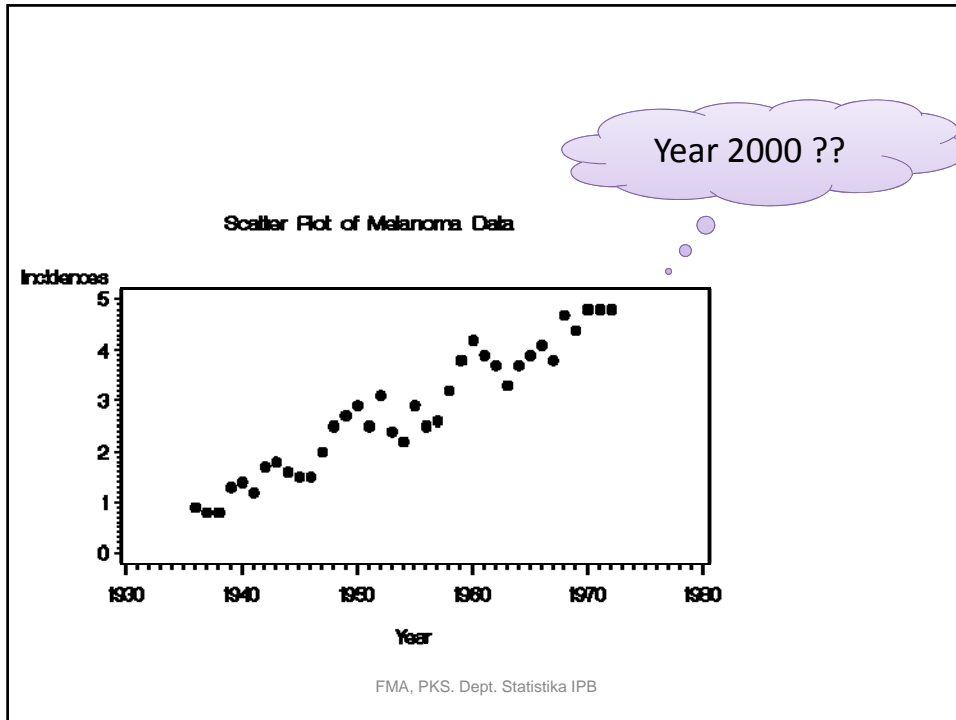
Cyclic

Metode Forecasting

Metode forecasting dapat dibedakan menjadi dua kelompok:

- Smoothing
 - Moving average, Single Exponential Smoothing, Double Exponential Smoothing, Metode Winter
- Modeling
 - ARIMA, ARCH/GARCH

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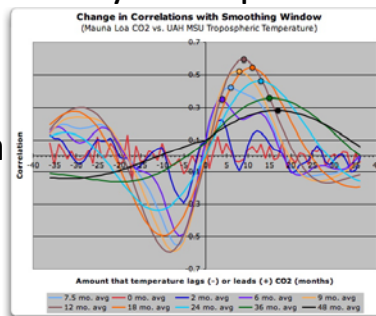


Smoothing

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Sekilas Tentang Smoothing

- Prinsip dasar: pengenalan pola data dengan menghaluskan variasi lokal.
- Prinsip penghalusan umumnya berupa rata-rata.
- Beberapa metode pen untuk pola data tertentu



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Metode Yang Dibahas

- Single Moving Average
- Double Moving Average
- Single Exponential Smoothing
- Double Exponential Smoothing
- Metode Winter untuk musiman aditif
- Metode Winter untuk musiman multiplikatif

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Ilustrasi

- All these methods will be illustrated with the following example: Suppose that a hospital would like to forecast the number of patients arrival from the following historical data:

Week	Patients Arrival
1	400
2	380
3	411
4	415

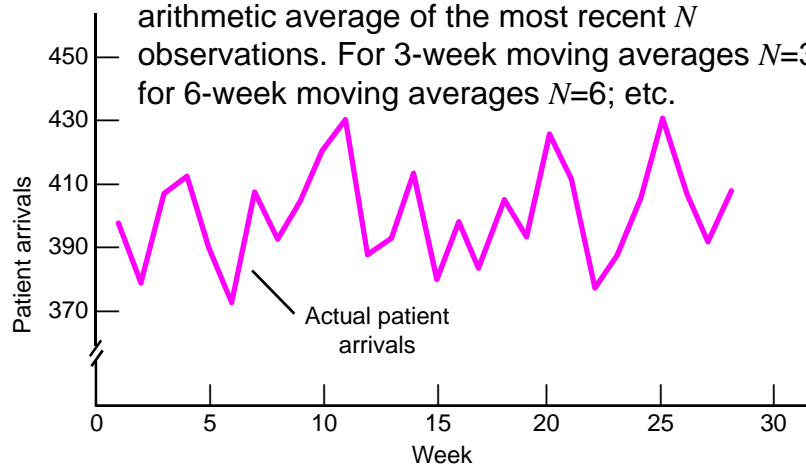


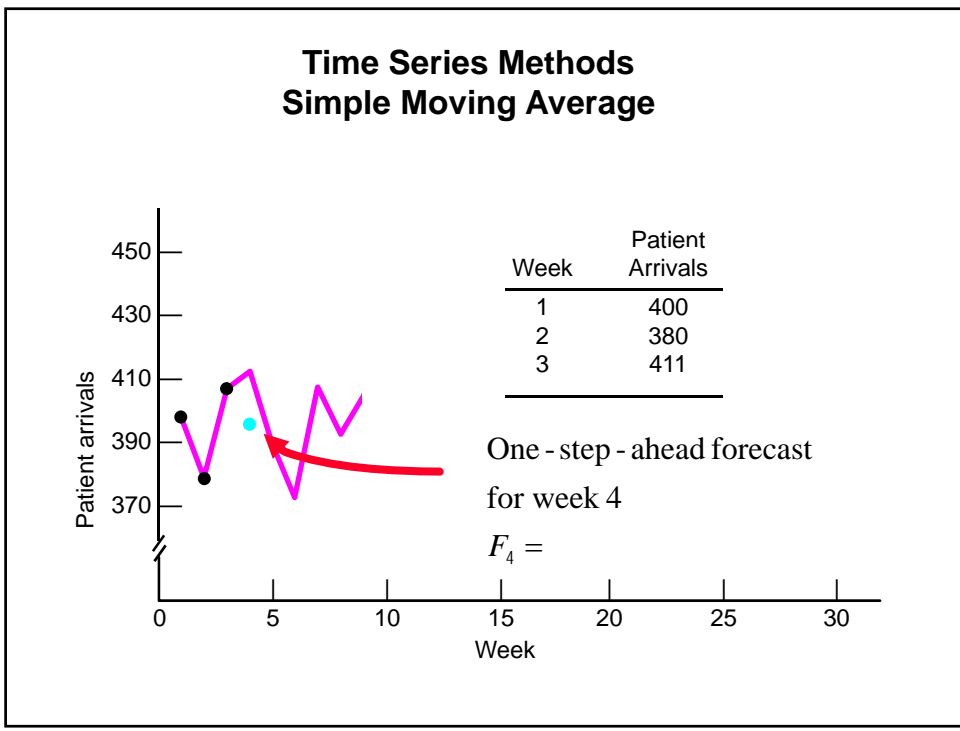
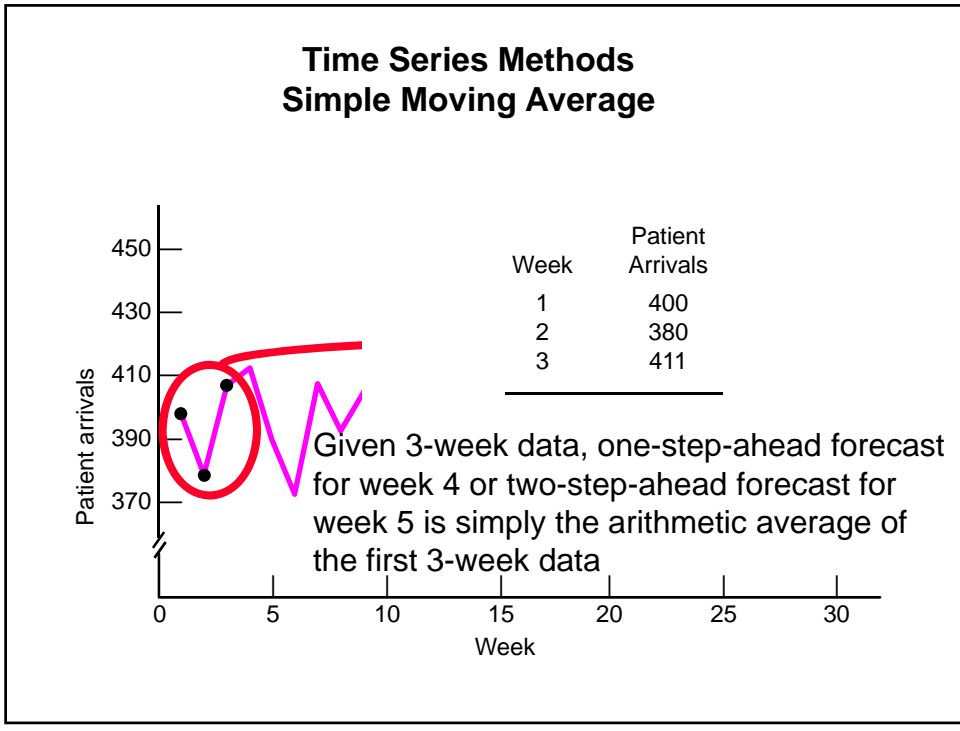
- Note: Although week 4 data is given, some methods require that forecast for period 4 is first computed before computing forecast for period 5.

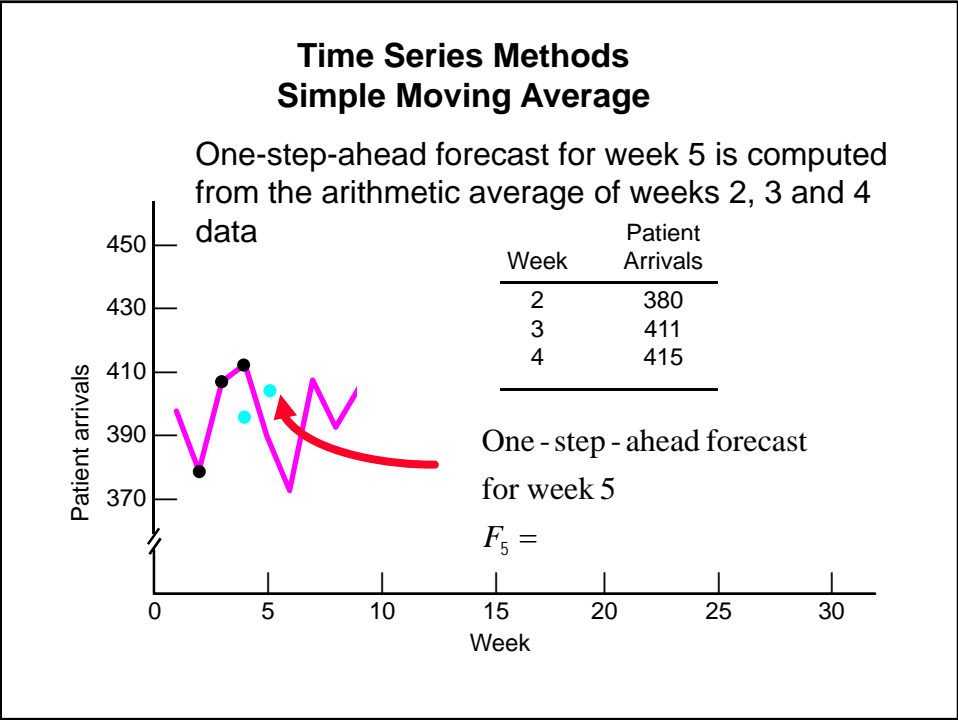
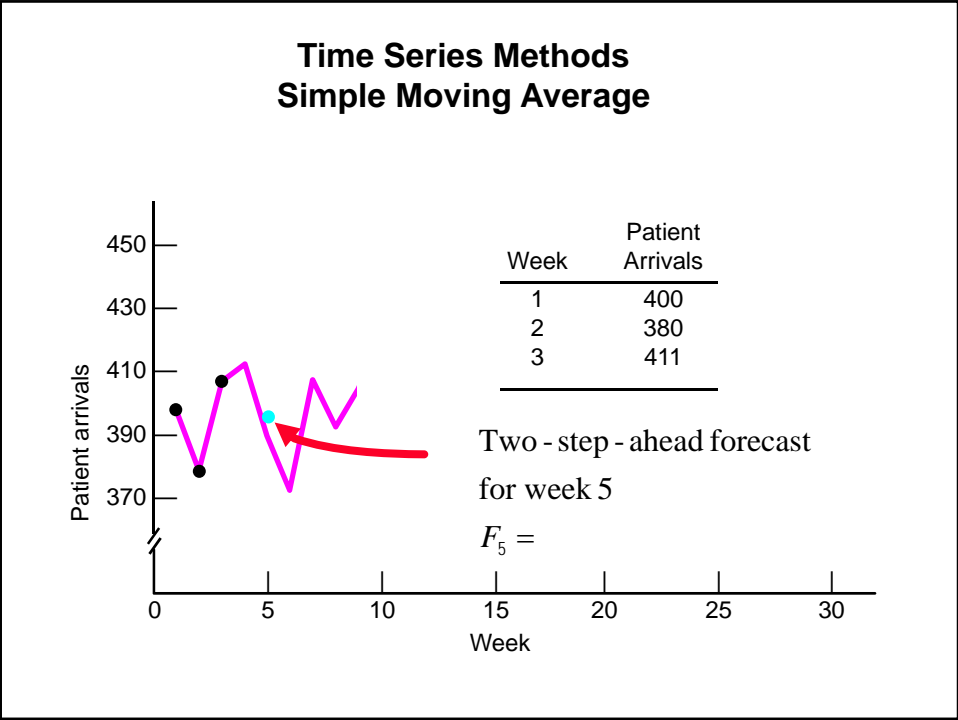
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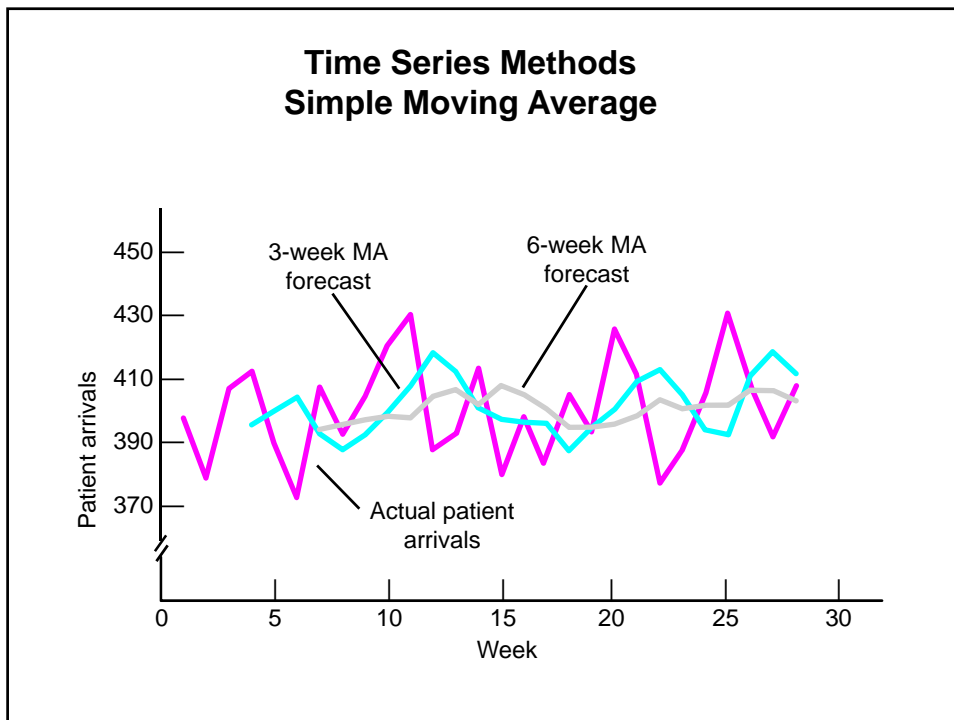
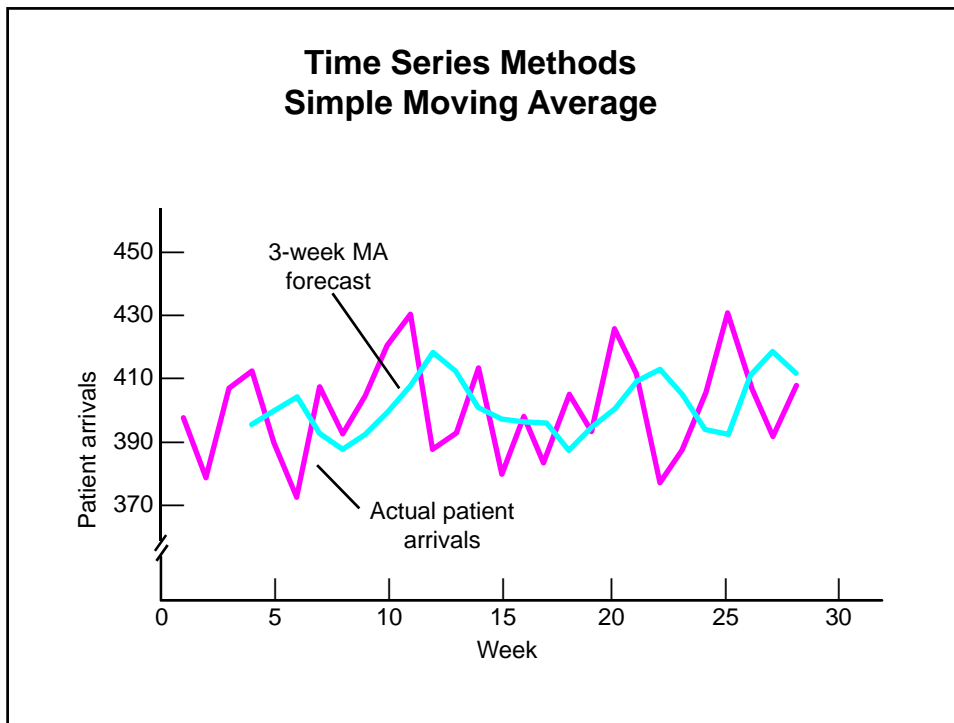
Time Series Methods Simple Moving Average

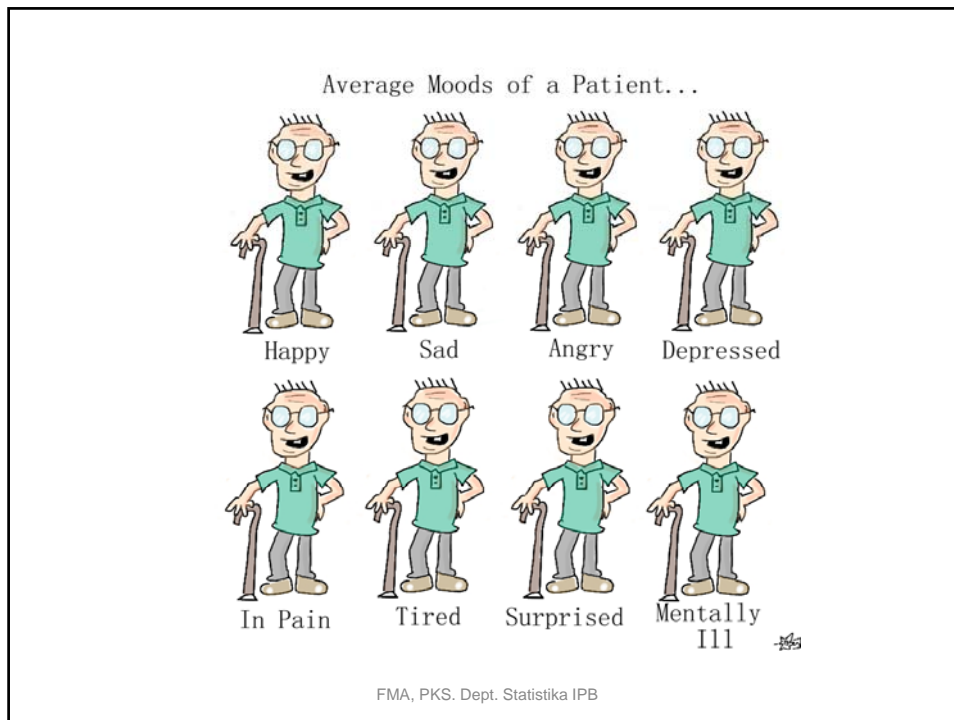
A moving average of order N is simply the arithmetic average of the most recent N observations. For 3-week moving averages $N=3$; for 6-week moving averages $N=6$; etc.











Single Moving Average

- Ide: data pada suatu periode dipengaruhi oleh data beberapa periode sebelumnya

- Cocok untuk pola data konstan/stasioner

- Prinsip dasar:

- Data *smoothing* pada periode ke- t merupakan rata-rata dari m buah data dari data periode ke- t hingga ke- $(t-m+1)$ ➔

$$S_t = \frac{1}{m} \sum_{i=t-m+1}^t X_i$$

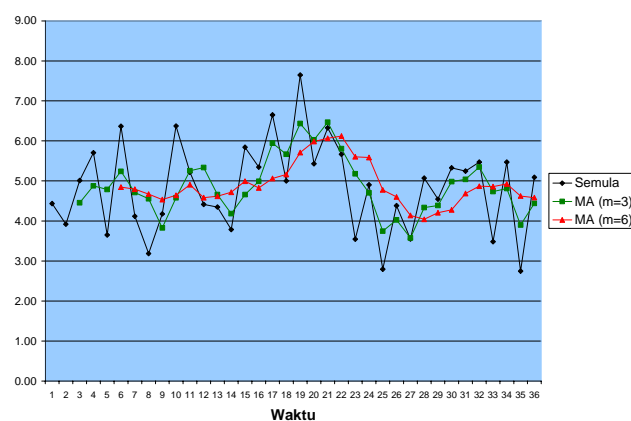
- Data *smoothing* pada periode ke- t berperan sebagai nilai *forecasting* pada periode ke- $t+1$

$$F_t = S_{t-1} \text{ dan } F_{n,h} = S_n$$

Ilustrasi MA dengan $m=3$

Periode (t)	Data (X_t)	Smoothing (S_t)	Forecasting (F_t)
1	5	-	-
2	7	-	-
3	6	6	-
4	4	5.6	6
5	5	5	5.6
6	6	5	5
7	8	6.3	5
8	7	7	6.3
9	8	7.6	7
10	7	7.3	7.6
11			7.3
12			7.3

Pengaruh Pemilihan Nilai m



MA dengan m yang lebih besar menghasilkan pola data yang lebih halus.

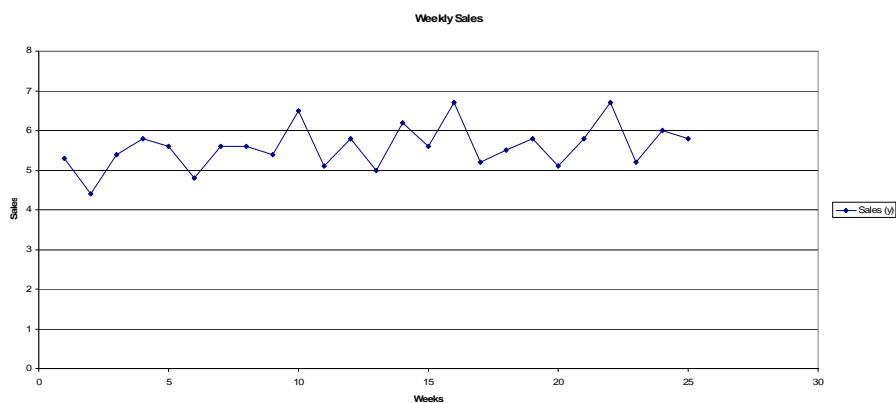
Example: Weekly Department Store Sales

- The weekly sales figures (in millions of dollars) presented in the following table are used by a major department store to determine the need for temporary sales personnel.



Period (t)	Sales (y)
1	5,3
2	4,4
3	5,4
4	5,8
5	5,6
6	4,8
7	5,6
8	5,6
9	5,4
10	6,5
11	5,1
12	5,8
13	5
14	6,2
15	5,6
16	6,7
17	5,2
18	5,5
19	5,8
20	5,1
21	5,8
22	6,7
23	5,2
24	6
25	5,8

Example: Weekly Department Store Sales



Example: Weekly Department Store Sales

- Use a three-week moving average ($k=3$) for the department store sales to forecast for the week 24 and 26.

$$\hat{y}_{24} = \frac{(y_{23} + y_{22} + y_{21})}{3} = \frac{5.2 + 6.7 + 5.8}{3} = 5.9$$

- The forecast error is

$$e_{24} = y_{24} - \hat{y}_{24} = 6 - 5.9 = .1$$

Example: Weekly Department Store Sales

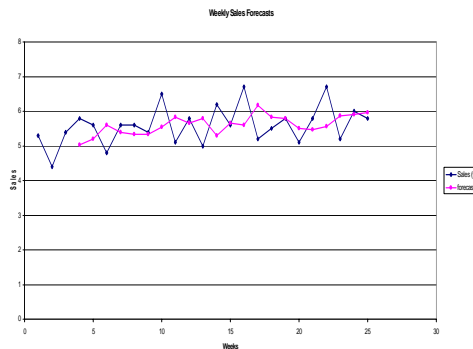
- The forecast for the week 26 is

$$\hat{y}_{26} = \frac{y_{25} + y_{24} + y_{23}}{3} = \frac{5.8 + 6 + 5.2}{3} = 5.7$$



Latihan: Weekly Department Store Sales

- RMSE = 0.63



Period (t)	Sales (y)	forecast
1	5.3	
2	4.4	
3	5.4	
4	5.8	5.033333
5	5.6	5.2
6	4.8	5.6
7	5.6	5.4
8	5.6	5.333333
9	5.4	5.333333
10	6.5	5.533333
11	5.1	5.833333
12	5.8	5.666667
13	5	5.8
14	6.2	5.3
15	5.6	5.666667
16	6.7	5.6
17	5.2	6.166667
18	5.5	5.833333
19	5.8	5.8
20	5.1	5.5
21	5.8	5.466667
22	6.7	5.666667
23	5.2	5.866667
24	6	5.9
25	5.8	5.966667
		5.666667

faculty.wiu.edu/F-Dehkordi/DS-533/.../Moving-average-methods.ppt

Double Moving Average

- Mirip dengan *single moving average*
- Cocok untuk data yang berpola tren
- Proses penghalusan dengan rata-rata dilakukan dua kali

– Tahap I:
$$S_{1,t} = \frac{1}{m} \sum_{i=t-m+1}^t X_i$$

– Tahap II:
$$S_{2,t} = \frac{1}{m} \sum_{i=t-m+1}^t S_{1,i}$$

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Double Moving Average (lanjutan)

- Forecasting dilakukan dengan formula

$$F_{2,t,t+h} = A_t + B_t(h)$$

dengan

$$A_t = 2S_{1,t} - S_{2,t}$$

$$B_t = \frac{2}{m-1}(S_{1,t} - S_{2,t})$$

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Ilustrasi DMA dengan $m=3$

t	X_t	$S_{1,t}$	$S_{2,t}$	A_t	B_t	$F_{2,t}$
1	12.50					
2	11.80					
3	12.85	12.38				
4	13.95	12.87				
5	13.30	13.37	12.87	13.87	0.50	
6	13.95	13.73	13.32	14.14	0.41	14.37
7	15.00	14.08	13.73	14.43	0.35	14.55
8	16.20	15.05	14.29	15.81	0.76	14.78
9	16.10	15.77	14.97	16.57	0.80	16.57
10						17.37
11						18.17
12						18.97

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Pemilihan Model (lanjutan)

