MANUALISASI POLINOMIAL NEWTON, LAGRANGE, SPLINE

Disusun untuk memenuhi tugas mata kuliah

Sains Komputasi

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TEKNIK INFORMATIKA

FAKULTAS TEKNIK

UNIVERSITAS NEGERI SURABAYA

DATASET

Dataset yang digunakan adalah data pasangan mata uang gbpusd pada tanggal 8 November hingga 15 November 2024. X adalah open(x), dan y adalah price(y). data tersebut diambil dari investing.com

Date	Price	Open	High	Low	Vol.	Change %
11/15/2024	1.2617	1.2664	1.2697	1.2594		-0.38%
11/14/2024	1.2665	1.2703	1.272	1.2627		-0.30%
11/13/2024	1.2703	1.2747	1.2768	1.2683		-0.35%
11/12/2024	1.2747	1.2867	1.2874	1.2716		-0.95%
11/11/2024	1.2869	1.2913	1.2926	1.2853		-0.40%
11/08/2024	1.2921	1.2986	1.2989	1.2881		-0.50%

POLINOMIAL NEWTON

Membuat tabel beda bagi

	x	f(x)	ST-1	ST-2	ST-3	ST-4
0	1.2664	1.2617	1.230769	-44.2329	686.1993	293696.7
1	1.2703	1.2665	0.863636	-30.303	7999.247	-
2	1.2747	1.2703	0.366667	137.6812	-	-
3	1.2867	1.2747	2.652174	-	-	-
4	1.2913	1.2869	-	-	-	-

Dibawah ini adalah rumus serta contoh perhitungannya
ST-1

$$f[x_0, x_1] = \frac{f(x_1) - f(x_0)}{x_1 - x_0}$$

$$f[x_0, x_1] = \frac{1.2665 - 1.2617}{1.2703 - 1.2664} = 2.1303$$

$$f[x_1, x_2] = \frac{1.2703 - 1.2665}{1.2747 - 1.2703} = 0.8636$$

Dilanjutkan hingga $f[x_3, x_4]$

ST-2

$$f[x_0, x_1, x_2] = \frac{f[x_1, x_2] - f[x_0, x_1]}{x_2 - x_0}$$

$$f[x_0, x_1, x_2] = \frac{0.8636 - 1.2308}{1.2747 - 1.2664} = -44.2329$$

$$f[x_1, x_2, x_3] = \frac{0.3667 - 0.8636}{1.2913 - 1.2747} = 137.6812$$

Dilanjutkan hingga $f[x_2, x_3, x_4]$

ST-3

$$f[x_0, x_1, x_2, x_3] = \frac{f[x_1, x_2, x_3] - f[x_0, x_1, x_2]}{x_3 - x_0}$$

$$f[x_0, x_1, x_2, x_3] = \frac{-30.3030 - (-44.2329)}{1.2867 - 1.2664} = 686.1993$$

$$f[x_1, x_2, x_3, x_4] = \frac{137.6812 - (-30.3030)}{1.2913 - 1.2703} = 7999.247$$

ST-4

$$f[x_0, x_1, x_2, x_3, x_4] = \frac{f[x_1, x_2, x_3, x_4] - f[x_0, x_1, x_2, x_3]}{x_4 - x_0}$$

$$f[x_0, x_1, x_2, x_3, x_4] = \frac{7999.2471 - 686.1993}{1.2913 - 1.2664} = 293696.7010$$

Orde 1

Membuat bentuk polynomial newton untuk derajat 1

x	y
1.2664	1.2617

ORDE 1				
f(x0)	ST-1	x-x0	p(x)	galat
1.2617	1.230769	0	1.2617	0

$P(x) = f(x_0) + f[x_0, x_1](x - x_0)$
$P(x) = 1.2617 + 1.230769 * (1.2664 - 1.2664) = 1.2617$
galat = y – p(x) = 1.2617 – 1.2617 = 0

dilanjutkan hingga semua x ditemukan galatnya

x	y
1.2703	1.2665

ORDE 1				
f(x0)	ST-1	x-x0	p(x)	galat
1.2665	1.230769	0.0039	1.2713	-0.0048

x	y
1.2747	1.2703

ORDE 1				
f(x0)	ST-1	x-x0	p(x)	galat
1.2703	1.230769	0.0083	1.280515	-0.01022

x	y
1.2867	1.2747
ORDE 1				

f(x0)	ST-1	x-x0	p(x)	galat
1.2617	1.230769	0.0203	1.286685	-0.01198

x	y
1.2913	1.2869
ORDE 1				

f(x0)	ST-1	x-x0	p(x)	galat
1.2747	1.230769	0.0249	1.305346	-0.01845

Setelah semua x ditemukan galatnya maka akan lanjut menghitung (y-pred)^2,(y-yrata)^2,(y-ypred yang nantinya digunakan untuk evaluasi performa

Date	Open(X)	Price(Y)	y-ypred^2	y-yrata2^2	y-pred
11/15/2024	1.2664	1.2617	0	-0.01032	0
11/14/2024	1.2703	1.2665	2.304E-05	-0.00552	-0.00379
11/13/2024	1.2747	1.2703	0.000104354	-0.00172	-0.00804
11/12/2024	1.2867	1.2747	0.000143631	0.00268	-0.0094
11/11/2024	1.2913	1.2869	0.000340261	0.01488	-0.01433
jumlah			0.000611286	0.03512	3.556738

Evaluasi Performa

RSS	TSS	RSE	R Square	yrata
0.000611286	0.03512	0.011056995	0.982594371	1.27202

R	MSE	RMSE	MAPE
0.991258983	0.000122	0.011056995	0.711347657

Orde 2

Membuat bentuk polynomial newton untuk derajat 2

x	y
1.2664	1.2617

ORDE 2						
f(x0)	ST-1	x-x0	ST-2	x-x1	p(x)	galat
1.2617	1.230769	0	-44.2329	-0.0039	1.2617	0

$$P(x) = f(x_0) + f[x_0, x_1](x - x_0) + f[x_0, x_1, x_2](x - x_0)(x - x_1)$$

$$P(x) = 1.2617 + 1.203769 + ((-44.2329) * 0 * (-0.0039)) = 1.2617$$

Galat = y – p(x) = 1.2617-1.2617 = 0

dilanjutkan hingga semua x ditemukan galatnya

x	y
1.2703	1.2665

ORDE 2						
f(x0)	ST-1	x-x0	ST-2	x-x1	p(x)	galat
1.2665	1.230769	0.0039	-44.2329	0	1.2713	-0.0048

x	y
1.2747	1.2703

ORDE 2						
f(x0)	ST-1	x-x0	ST-2	x-x1	p(x)	galat
1.2703	1.230769	0.0083	-44.2329	0.0044	1.2789	-0.0086

x	y
1.2867	1.2747

ORDE 2						
f(x0)	ST-1	x-x0	ST-2	x-x1	p(x)	galat
1.2747	1.230769	0.0203	-44.2329	0.0164	1.284959	-0.01026

x	y
1.2913	1.2869

ORDE 2						
f(x0)	ST-1	x-x0	ST-2	x-x1	p(x)	galat
1.2869	1.230769	0.0249	-44.2329	0.021	1.294417	-0.00752

Setelah semua x ditemukan galatnya maka akan lanjut menghitung (y-pred)^2,(y-yrata)^2,(y-ypred yang nantinya digunakan untuk evaluasi performa

Date	Open(X)	Price(Y)	y-ypred^2	y-yrata2^2	(y-pred)/yi
11/15/2024	1.2664	1.2617	0	-0.01032	0
11/14/2024	1.2703	1.2665	2.304E-05	-0.00552	-0.00379
11/13/2024	1.2747	1.2703	7.396E-05	-0.00172	-0.00677
11/12/2024	1.2867	1.2747	0.000105239	0.00268	-0.00805
11/11/2024	1.2913	1.2869	5.6502E-05	0.01488	-0.00584
jumlah			0.000258741	0.03512	2.444889

Evaluasi Performa

RSS	TSS	RSE	R Square	yrata
0.000258741	0.03512	0.007194	0.992632658	1.27202

R	MSE	RMSE	MAPE
0.996309519	5.17E-05	0.007194	0.488977728

Orde 3

Membuat bentuk polynomial newton untuk derajat 3

x	y
1.2664	1.2617

ORDE 3								
f(x0)	ST-1	x-x0	ST-2	x-x1	ST-3	x-x2	p(x)	galat
1.2617	1.230769	0	-44.2329	-0.0039	686.1993	-0.0083	1.2617	0

$P(x) = f(x_0) + f[x_0, x_1](x - x_0) + f[x_0, x_1, x_2](x - x_0)(x - x_1) +$

$f[x_0, x_1, x_2, x_3](x - x_0)(x - x_1)(x - x_2)$

$P(x) = 1.2617 + 1.203769 + (-44.2329) * 0 * (-0.0039) + 686.1994 * 0 * (-0.0039) *$

$(-0.083) = 1.2617$

Galat = y-p(x) = 1.2617 – 1.2617 = 0

dilanjutkan hingga semua x ditemukan galatnya

x	y
1.2703	1.2665

ORDE 3								
f(x0)	ST-1	x-x0	ST-2	x-x1	ST-3	x-x2	p(x)	galat
1.2665	1.230769	0.0039	-44.2329	0	686.1993	-0.0044	1.2713	-0.0048

x	y
1.2747	1.2703

ORDE 3								
f(x0)	ST-1	x-x0	ST-2	x-x1	ST-3	x-x2	p(x)	galat
1.2703	1.230769	0.0083	-44.2329	0.0044	686.1993	0	1.2789	-0.0086

x	y
1.2867	1.2747

ORDE 3								
f(x0)	ST-1	x-x0	ST-2	x-x1	ST-3	x-x2	p(x)	galat
1.2747	1.230769	0.0203	-44.2329	0.0164	686.1993	0.012	1.2877	-0.013

x	y
1.2913	1.2869

ORDE 3								
f(x0)	ST-1	x-x0	ST-2	x-x1	ST-3	x-x2	p(x)	galat
1.2869	1.230769	0.0249	-44.2329	0.021	686.1993	0.0166	1.300373	-0.01347

Setelah semua x ditemukan galatnya maka akan lanjut menghitung (y-pred)^2,(y-yrata)^2,(y-ypred yang nantinya digunakan untuk evaluasi performa

Date	Open(X)	Price(Y)	y-ypred^2	y-yrata2^2	(y-pred)/yi
11/15/2024	1.2664	1.2617	0	-0.01032	0
11/14/2024	1.2703	1.2665	2.3E-05	-0.00552	-0.00379
11/13/2024	1.2747	1.2703	7.4E-05	-0.00172	-0.00677
11/12/2024	1.2867	1.2747	0.000169	0.00268	-0.0102
11/11/2024	1.2913	1.2869	0.000182	0.01488	-0.01047
jumlah			0.000448	0.03512	3.122792

Evaluasi Performa

RSS	TSS	RSE	R Square	yrata
0.000447524	0.03512	0.009461	0.987257	1.27202

R	MSE	RMSE	MAPE
0.993608215	8.95E-05	0.009461	0.624558

POLINOMIAL LAGRANGE

Orde 1

x
1.2725

X Prediksi	x0	x1	ax0	ax1
1.2725	1.2703	1.2747	1.2665	1.2703

L0	L1	ax0*L0	ax1*L1	y(x)
0.5	0.5	0.63325	0.63515	1.2684

Dengan

$$L_0(x) = \frac{x - x_1}{x_0 - x_1} \ dan \ L_1(x) = \frac{x - x_0}{x_1 - x_0}$$

Dihitung menggunakan rumus Polinomial lagrange

$$P_1(x) = y_0 L_0(x) + y_1 L_1(x)$$

$$P_1(x) = 1.2665 * 0.5 + 1.2703 * 0.5 = 1.2684$$

Persamaan Orde 1	
0.0038	0.000745
0.0044	-0.0044
0.863636364	-0.16942

Untuk memudahkan perhitungan x yang lain maka orde 1 memiliki persamaan berikut ini

0.863636363636377x –(-0.169422727272698)= y prediksi
0.863636363636377 *** 1.2725 - (**-0.169422727272698) = 1.2684

Date	Open(X)	Price(Y)	y pred	(y-ypred)^2	y-yrata2^2	(y-ypred)/yi
11/15/2024	1.2664	1.2617	1.263132	2.0501E-06	0.000107	-0.00113
11/14/2024	1.2703	1.2665	1.2665	1.38494E-28	3.05E-05	9.29E-15
11/13/2024	1.2747	1.2703	1.2703	1.38494E-28	2.96E-06	9.26E-15
11/12/2024	1.2867	1.2747	1.280664	3.5565E-05	7.18E-06	-0.00468
11/11/2024	1.2913	1.2869	1.284636	5.12405E-06	0.000221	0.001759
jumlah			6.365232	4.27391E-05	0.000369	0.757228

Contoh untuk x = 1.2664

0.863636363636377 * **1.2664 − (**-0.169422727272698) = 1.2631

Dilanjutkan hingga x terakhir ditemukan yprediksinya

Evaluasi Performa

RSS	TSS	y rata	RMSE	MAPE
4.27391E-05	0.000369	1.27202	0.002923666	0.151446

RSE	R Square	R	MSE
0.002923666	0.884028	0.940227	8.54782E-06

Orde 2

x
1.2725

X Prediksi	x0	x1	x2	ax0	ax1	ax2
1.2725	1.2703	1.2747	1.2867	1.2665	1.2703	1.2747

L0	L1	L2	ax0*L0	ax1*L1	ax2*L2	y(x)
0.432927	0.591667	-0.02459	0.548302	0.751594	-0.03135	1.268547

Dengan

$$L_0(x) = \frac{(x - x_1)(x - x_2)}{(x_0 - x_1)(x_0 - x_2)}; \; L_1(x) = \frac{(x - x_0)(x - x_2)}{(x_1 - x_0)(x_1 - x_2)}; dan$$

$$L_2(x) = \frac{(x - x_0)(x - x_1)}{(x_2 - x_0)(x_2 - x_1)}$$

$$P_2(x) = y_0 L_0(x) + y_1 L_1(x) + y_2 L_2(x)$$

$$P_2(x) = 1.2665 * 0.432927 + 1.2703 * 0.591667 + 1.2747 * 0.02459 = 1.268547$$

PERSAMAAN ORDE 2			
KOMPONEN 1			
1.2665	1.2703	1.2747	
7.216E-05	-5.3E-05	0.000197	
17551.275	-24058.7	6477.134	-30.303
KOMPONEN 2			
-3.244013	-3.24816	-3.24411	
7.216E-05	-5.3E-05	0.000197	
-44955.84	61518.13	-16484.3	77.98485
KOMPONEN 3			
2.0772582	2.076299	2.06406	
7.216E-05	-5.3E-05	0.000197	
28786.838	-39323.8	10488.11	-48.8988

Untuk memudahkan perhitungan x yang lain maka orde 2 memiliki persamaan berikut ini
-30.3030303030309x^2 + 77.9848484848517x -48.8988018181808 = y prediksi
-30.3030303030309*(1.2725^2) + 77.9848484848517* 1.2725 -48.8988018181808 = 1.2685

Date	Open(X)	Price(Y)	Y pred	(y-ypred)^2	(y-yrata)^2	(y-ypred)/yi
11/15/2024	1.2664	1.2617	1.262151	0.000450909	0.000107	-0.00036
11/14/2024	1.2703	1.2665	1.2665	-4.05787E-12	3.05E-05	-3.2E-12
11/13/2024	1.2747	1.2703	1.2703	-4.06319E-12	2.96E-06	-3.2E-12
11/12/2024	1.2867	1.2747	1.2747	-4.0814E-12	7.18E-06	-3.2E-12
11/11/2024	1.2913	1.2869	1.274073	0.012827273	0.000221	0.009968
jumlah			6.347724	0.013278182	0.000369	1.032496

Contoh untuk x = 1.2664

-30.3030303030309*(**1.2664**^2) + (77.9848484848517* **1.2664**) -48.8988018181808 = 1.2621

Evaluasi Performa

RSS	TSS	yrata2
0.013278	0.000369	1.27202

RSE	R Square	R	MAPE	MSE	RMSE
0.066529	0.727821	0.853124	0.206499151	0.002656	0.051533

Orde 3

x
1.2725

X Prediksi	x0	x1	x2	x3	ax0	ax1	ax2	ax3
1.2725	1.2703	1.2747	1.2867	1.2664	1.2665	1.2703	1.2747	1.2617

L0	L1	L2	L3	ax0*L0	ax1*L1	ax2*L2	ax3*L3	y(x)
0.677142	0.434839	-0.00739	-0.10459	0.8576	0.552376	-0.00942	-0.13196	1.268594

$P_3(x) = y_0 L_0(x) + y_1 L_1(x) + y_2 L_2(x) + y3L3(x)$

$P_3(x) = (1.2665 * 0.677142) + (1.2703 * 0.434839) + (1.2747 * 0.00739) + (1.26 * 0.10459)$

$= 1.268594$

PERSAMAAN ORDE 3				
Komponen 1				
1.2665	1.2703	1.2747	1.2617	
2.814E-07	-4.4E-07	4E-06	-6.6E-07	
4500326.9	-2898640	319070.6	-1920071	686.1993
Komponen 2				
-4.847909	-4.85687	-4.85839	-4.83446	
2.814E-07	-4.4E-07	4E-06	-6.6E-07	
-17226351	11082660	-1216106	7357137	-2659.61
Komponen 3				
6.1854764	6.189765	6.172403	6.174637	
2.814E-07	-4.4E-07	4E-06	-6.6E-07	
21979207	-1.4E+07	1545016	-9396643	3436.177
Komponen 4				
-2.63064	-2.62943	-2.61393	-2.62874	
2.814E-07	-4.4E-07	4E-06	-6.6E-07	
-9347603	5999966	-654293	4000451	-1478.59

Untuk memudahkan perhitungan x yang lain maka orde 3 memiliki persamaan berikut ini
$686.199273651931x^3 + -2659.61278715637x^2 + 3436.17747065611x + -1478.58866806189 = $ y prediksi
$686.199273651931 * \mathbf{1.2725}^3 + -2659.61278715637 * \mathbf{1.2725}^2 + 3436.17747065611 * \mathbf{1.2725} + $

$-1478.58866806189 = 1.2685$

Date	Open(X)	Price(Y)	y pred	(y-ypred)^2	(y-yrata)^2	(y-ypred)/yi
11/15/2024	1.2664	1.2617	1.2617	1.55411E-17	0.000107	-3.12453E-09
11/14/2024	1.2703	1.2665	1.2665	1.56429E-17	3.05E-05	-3.12287E-09
11/13/2024	1.2747	1.2703	1.2703	1.57435E-17	2.96E-06	-3.12352E-09
11/12/2024	1.2867	1.2747	1.2747	1.60356E-17	7.18E-06	-3.14148E-09
11/11/2024	1.2913	1.2869	1.275173	0.00013752	0.000221	0.009112524
jumlah				0.00013752	0.000369	0.911253641

Contoh untuk x = 1.2664

$686.199273651931 * \mathbf{1.2664}^3 + -2659.61278715637 * \mathbf{1.2664}^2 + 3436.17747065611 * \mathbf{1.2664} + $

$-1478.58866806189 = 1.2617$

Evaluasi Performa

RSS	TSS	y rata2
0.000138	0.000369	1.27202

RSE	R Square	R	MSE	RSME	MAPE
0.006771	0.788555	0.888006	2.75041E-05	0.005244	0.182250728

POLINOMIAL SPLINE

Open(X)	Price(Y)
1.2687	1.2642
1.2739	1.27
1.28	1.2715
1.2881	1.2777

Data diatas akan digunakan untuk mengisi $S_i(x)$ dimana x adalah untuk interval 1 = 1.2687, interval 2 = 1.2739, interval 3 = 1.28 dan interval 4 = 1.2881

Orde 1

m1	
x1	x2
1.2664	1.2703
1.230769231	
a1	s1
1.2617	1.264531

m2	
x2	x3
1.2703	1.2747
0.863636364	
a2	s2
1.2665	1.269609

m3	
x3	x4
1.2747	1.2867
0.366666667	
a3	s3
1.2703	1.272243

m4	
x4	x5
1.2867	1.2913
2.652173913	
a4	s4
1.2747	1.278413

$$S_i(x) = y_i + \frac{(y_{i+1} - y_i)}{(x_{i+1} - x_i)}(x - x_l)$$

$$S_i(1.2687) = 1.2617 + 1.230769231 * (1.2687 - 1.2664) = 1.264531$$

Dilanjutkan hingga interval ke 4 dengan x = 1.2881

Open(X)	Price(Y)	y pred	y-ypred^2	(y-yrata)^2	(y-ypred)/yi
1.2687	1.2642	1.264531	-0.00033	-0.00665	-0.000261643
1.2739	1.27	1.269609	0.000391	-0.00085	0.000307802
1.28	1.2715	1.272243	-0.00074	0.00065	-0.000584611
1.2881	1.2777	1.278413	-0.00071	0.00685	-0.000558068
Jumlah			0.002178	0.015	0.17121249

Evaluasi Performa

RSS	TSS	yrata2
0.002178	0.015	1.27085

RSE	R Square	R	MSE	RMSE	MAPE
0.033	0.854796	0.924552	0.000545	0.023335	0.042803122

Orde 2

Langkah 1: Interval 1 [1.2664,1.2703]

1.1. Syarat Interpolasi:

- $c_1 = y_1 = 1.2617$

1.2. Persamaan dari $S(1.2703) = 1.2665$

$S(1.2703) = a_1(1.2703 - 1.2664)^2 + b_1(1.2703 - 1.2664) + 1.2617 = 1.2665$

$a_1(0.0039)2 + b_1(0.0039) + 1.2617 = 1. (0.0039)2 + b_1(0.0039) + 1.2617 = 1.2665$

$0.00001521a_1 + 0.0039b_1 + 1.2617 = 1.2665$

$0.00001521a_1 + 0.0039b_1 = 0.0048 (1)$

1.3. Kekontinuan Turunan Pertama:

Turunan pertama pada batas $x_2 = 1.2703$:

$S'(1.2703) = 2a_1(1.2703 - 1.2664) + b_1$

$S'(1.2703) = 2a\_1 (1.2703 - 1.2664) + b\_1$

$S'(1.2703) = 0.0078a_1 + b_1 (2)$

Langkah 2: Interval 2 [1.2703,1.2747]

2.1. Syarat Interpolasi:

- $c_2 = y_2 = 1.2665$

2.2. Persamaan dari $S(1.2747) = 1.2703$

$S(1.2747) = a_2(1.2747 - 1.2703)2 + b_2(1.2747 - 1.2703) + 1.2665 = 1.2703$

$a_2(1.2747 - 1.2703)2 + b_2(1.2747 - 1.2703) + 1.2665 = 1.2703$
$a_2(0.0044)2 + b_2(0.0044) + 1.2665 = 1.2703$

$0.00001936a_2 + 0.0044b_2 + 1.2665 = 1.2703$

$0.00001936a_2 + 0.0044b_2 = 0.0038 (3)$

2.3. Kekontinuan Turunan Pertama:

Turunan pertama pada batas $x_3 = 1.2747$

$S'(1.2747) = 2a_2(1.2747 - 1.2703) + b_2$

$S'(1.2747) = 2a_2(0.0044) + b_2$

$S'(1.2747) = 2a_2(0.0044) + b_2 \quad S'(1.2747) = 0.0088a_2 + b_2 (4)$

Langkah 3: Interval 3 [1.2747,1.2867]

3.1. Syarat Interpolasi:

- $c_3 = y_3 = 1.2703$

3.2. Persamaan dari $S(1.2867) = 1.2747$

$S(1.2867) = a_3(1.2867-1.2747)^2 + b_3(1.2867-1.2747) + 1.2703 = 1.2747$

$a_3(0.012)^2 + b_3(0.012) + 1.2703 = 1.2747$

$0.000144a_3 + 0.012b_3 + 1.2703 = 1.2747$

$0.000144a_3 + 0.012b_3 = 0.0044 (5)$

3.3. Kekontinuan Turunan Pertama:

Turunan pertama pada batas $x_4 = 1.2867$

$S'(1.2867) = 2a_3(1.2867-1.2747) + b_3$

$S'(1.2867) = 2a_3(0.012) + b_3$

$S'(1.2867) = 0.024a_3 + b_3 (6)$

Interval 4 [1.2867,1.2913]

4.1. Syarat Interpolasi:

- $c_4 = y_4 = 1.2747$

4.2. Persamaan dari $S(1.2913) = 1.2869$

$S(1.2913) = a_4(1.2913-1.2867)^2 + b_4(1.2913-1.2867) + 1.2747 = 1.2869$

$a_4(0.0046)^2 + b_4(0.0046) + 1.2747 = 1.2869$

$0.00002116a_4 + 0.0046b_4 + 1.2747 = 1.2869$

$0.00002116a_4 + 0.0046b_4 = 0.0122 (7)$

4.3. Kekontinuan Turunan Pertama:

Turunan pertama pada batas $x_5 = 1.2913$

$S'(1.2913) = 2a_4(1.2913-1.2867) + b_4$

$S'(1.2913) = 2a_4(0.0046)$

$S'(1.2913) = 0.0092a_4 + b_4 (8)$

Menyusun Matriks Augmented

$$
\left(
\begin{array}{cccccccc|c}
0.00001521 & 0.0039 & 0 & 0 & 0 & 0 & 0 & 0 & 0.0048 \\
0.0078 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & S'(1.2703) \\
0 & 0.00001936 & 0.0044 & 0 & 0 & 0 & 0 & 0 & 0.0038 \\
0 & 0.0088 & 1 & 0 & 0 & 0 & 0 & 0 & S'(1.2747) \\
0 & 0 & 0.000144 & 0.012 & 0 & 0 & 0 & 0 & 0.0044 \\
0 & 0 & 0.024 & 1 & 0 & 0 & 0 & 0 & S'(1.2867) \\
0 & 0 & 0 & 0.00002116 & 0.0046 & 0 & 0 & 0 & 0.0122 \\
0 & 0 & 0 & 0.0092 & 1 & 0 & 0 & 0 & S'(1.2913)
\end{array}
\right)
$$

Setelah itu matriks ini dimasukkan ke sebuah program untuk menghitung Solusi sistem persaman menggunakan singular value decomposition karena matriks tersebut adalah matriks yang hampir singular. Setelah itu didapatkan nilai untuk a1 b1 c1 dst.

a1	b1	c1
-311.8958	2.4366	1.2687
a2	b2	c2
-0.0092	0.0047	1.2739
a3	b3	c3
0.0092	-44663670.4	1.28
a4	b4	c4
121744339	36023351	1.2881

s(1.2687)
1.27265425
s(1.2739)
1.2739168
s(1.28)
-236716.17
s(1.2881)
50672.5984

$S_i(x) = a_i x^2 + b_i x + c_{i,}$

$S_1(1.2687) = -311.8958^2 + 2.4366 + 1.2687$

Dilanjutkan hingga ke $S_4(1.2881)$

Open(X)	Price(Y)	y pred	y-ypred^2	y-yrata^2	y-ypred/yi
1.2687	1.2642	1.272654	-0.00845	-0.00665	-0.006687432
1.2739	1.27	1.273917	-0.00392	-0.00085	-0.003084095
1.28	1.2715	-236716	236717.4	0.00065	186171.8006
1.2881	1.2777	50672.6	-50671.3	0.00685	-39658.23018
Jumlah			287388.8	0.015	22583004.06

Evaluasi Performa

RSS	TSS	yrata
287388.78	0.015	1.27085

RSE	R square	R	MSE	RMSE	MAPE
379.07043	0.0081	0.089999	71847.19	268.0432696	5645751

Orde 3

a1	b1	c1	d1
-311.8958	2.4366	1.2687	1.2617
a2	b2	c2	d2
-0.0092	0.0047	1.2739	1.2665
a3	b3	c3	d3
0.0092	-44663670.4	1.28	1.2703
a4	b4	c4	d4
121744339	36023351	1.2881	1.2747

s(1.2687)
1.2646271
s(1.2739)
1.2710861
s(1.28)
-1253.3254
s(1.2881)
72.2163378

$$S_i(x) = a_i + b_i(x - x_i) + c_i(x - x_i)^2 + d_i(x - x_i)^3$$

$$S_1(1.2687) = -311.8958 + (2.4366(1.2687 - 1.2664)) + (1.2687(1.2687 - 1.2664)^2) + (1.2617(1.2687 - 1.2664)^3) = 1.2646271$$

Dilanjutkan hingga $S_4(1.2881)$

	Open(X)	Price(Y)	y pred	y-ypred^2	y-yrata^2	y-ypred/yi
	1.2687	1.2642	1.264627	-0.00043	-0.00665	-0.000337846
	1.2739	1.27	1.271086	-0.00109	-0.00085	-0.000855197
	1.28	1.2715	-1253.33	1254.597	0.00065	986.7061868
	1.2881	1.2777	72.21634	-70.9386	0.00685	-55.52057429
Jumlah				1325.537	0.015	104222.7954

Evaluasi Performa

RSS	TSS	yrata
1325.5371	0.015	1.27085

RSE	R square	R	MSE	RMSE	MAPE
25.744291	0.000957	-0.03094	331.3843	18.20396294	26055.7