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LAMPIRAN

Lampiran 1. Data Indeks Harga Saham Gabungan Tahun 2017-2022

Date	IHSG	KURS	INFLASI	SUKU BUNGA	Dow Jones	Nikkei 225	Shanghai
Jan-17	5294.10	13358.71	3.49	4.75	19864.09	19041.34	3159.17
Feb-17	5386.69	13340.84	3.83	4.75	20812.24	19118.99	3241.73
Mar-17	5568.11	13345.5	3.61	4.75	20663.22	18909.26	3222.51
Apr-17	5685.30	13306.39	4.17	4.75	20940.51	19196.74	3154.66
May-17	5738.15	13323.35	4.33	4.75	21008.65	19650.57	3117.18
Jun-17	5829.71	13298.25	4.37	4.75	21349.63	20033.43	3192.43
Jul-17	5840.94	13342.1	3.88	4.75	21891.12	19925.18	3273.03
Aug-17	5864.06	13341.82	3.82	4.5	21948.1	19646.24	3360.81
Sep-17	5900.85	13303.47	3.72	4.25	22405.09	20356.28	3348.94
Oct-17	6005.78	13526	3.58	4.25	23377.24	22011.61	3393.34
Nov-17	5952.14	13527.36	3.3	4.25	24272.35	22724.96	3317.19
Dec-17	6355.65	13556.21	3.61	4.25	24719.22	22764.94	3307.17
Jan-18	6605.63	13380.36	3.25	4.25	26149.39	23098.29	3480.83
Feb-18	6597.22	13590.05	3.18	4.25	25029.2	22068.24	3259.41
Mar-18	6188.99	13758.29	3.4	4.25	24103.11	21454.3	3168.90
Apr-18	5994.60	13802.95	3.41	4.25	24163.15	22467.87	3082.23
May-18	5983.59	14059.7	3.23	4.75	24415.84	22201.82	3095.47
Jun-18	5799.24	14036.14	3.12	5.25	24271.41	22304.51	2847.42
Jul-18	5936.44	14414.5	3.18	5.25	25415.19	22553.72	2876.40
Aug-18	6018.46	14559.86	3.2	5.5	25964.82	22865.15	2725.25
Sep-18	5976.55	14868.74	2.88	5.75	26458.31	24120.04	2821.35
Oct-18	5831.65	15178.87	3.16	5.75	25115.76	21920.46	2602.78
Nov-18	6056.12	14696.86	3.23	6	25538.46	22351.06	2588.19
Dec-18	6194.50	14496.95	3.13	6	23327.46	20014.77	2493.90
Jan-19	6532.97	14163.14	2.82	6	24999.67	20773.49	2584.57
Feb-19	6443.35	14035.21	2.57	6	25916	21385.16	2940.95
Mar-19	6468.75	14211	2.48	6	25928.68	21205.81	3090.76
Apr-19	6455.35	14142.58	2.83	6	26592.91	22258.73	3078.34
May-19	6209.12	14392.81	3.32	6	24815.04	20601.19	2898.70
Jun-19	6358.63	14226.53	3.28	6	26599.96	21275.92	2978.88
Jul-19	6390.50	14043.91	3.32	5.75	26864.27	21521.53	2932.51
Aug-19	6328.47	14242.05	3.49	5.5	26403.28	20704.37	2886.24
Sep-19	6169.10	14111.1	3.39	5.25	26916.83	21755.84	2905.19
Oct-19	6228.32	14117.57	3.13	5	27046.23	22927.04	2929.06
Nov-19	6011.83	14068.72	3	5	28051.41	23293.91	2871.98
Dec-19	6299.54	14017.45	2.72	5	28538.44	23656.62	3050.12

Date	IHSG	KURS	INFLASI	SUKU BUNGA	Dow Jones	Nikkei 225	Shanghai
Jan-20	5940.05	13732.23	2.68	5	28256.03	23205.18	2976.53
Feb-20	5452.70	13776.15	2.98	4.75	25409.36	21142.96	2880.30
Mar-20	4538.93	15194.57	2.96	4.5	21917.16	18917.01	2750.30
Apr-20	4716.40	15867.43	2.67	4.5	24345.72	20193.69	2860.08
May-20	4753.61	14906.19	2.19	4.5	25383.11	21877.89	2852.35
Jun-20	4905.39	14195.96	1.96	4.25	25812.88	22288.14	2984.67
Jul-20	5149.63	14582.41	1.54	4	26428.32	21710	3310.01
Aug-20	5238.49	14724.5	1.32	4	28430.05	23139.76	3395.68
Sep-20	4870.04	14847.96	1.42	4	27781.7	23185.12	3218.05
Oct-20	5128.23	14749.14	1.44	4	26501.6	22977.13	3224.53
Nov-20	5612.42	14236.81	1.59	3.75	29638.64	26433.62	3391.76
Dec-20	5979.07	14173.09	1.68	3.75	30606.48	27444.17	3473.07
Jan-21	5862.35	14061.9	1.55	3.75	29982.62	27663.39	3483.07
Feb-21	6241.80	14042.1	1.38	3.5	30932.37	28966.01	3509.08
Mar-21	5985.52	14417.39	1.37	3.5	32981.55	29178.8	3441.91
Apr-21	5995.62	14558.18	1.42	3.5	33874.85	28812.63	3446.86
May-21	5947.46	14323.19	1.68	3.5	34529.45	28860.08	3615.48
Jun-21	5985.49	14338.23	1.33	3.5	34502.51	28791.53	3591.20
Jul-21	6070.04	14511.19	1.52	3.5	34935.47	27283.59	3397.36
Aug-21	6150.30	14397.7	1.59	3.5	35360.73	28089.54	3543.94
Sep-21	6286.94	14256.96	1.6	3.5	33843.92	29452.66	3568.17
Oct-21	6591.35	14198.45	1.66	3.5	35819.56	28892.69	3547.34
Nov-21	6533.93	14263.5	1.75	3.5	34483.72	27821.76	3563.89
Dec-21	6581.48	14328.92	1.87	3.5	36338.3	28791.71	3639.78
Jan-22	6631.15	14335.24	2.18	3.5	35131.86	27001.98	3361.44
Feb-22	6888.17	14351.06	2.06	3.5	33892.6	26526.82	3462.31
Mar-22	7071.44	14348.64	2.64	3.5	34678.35	27821.43	3252.20
Apr-22	7228.91	14368.74	3.47	3.5	32977.21	26847.9	3047.06
May-22	7148.97	14608	3.55	3.5	32990.12	27279.8	3186.43
Jun-22	6911.58	14688.57	4.35	3.5	30775.43	26393.04	3398.62
Jul-22	6951.12	14984.38	4.94	3.5	32845.13	27801.64	3253.24
Aug-22	7178.59	14850.64	4.69	3.75	31510.43	28091.53	3202.14
Sep-22	7040.80	14971.77	5.95	4.25	28725.51	25937.21	3024.39
Oct-22	7098.89	15417.48	5.71	4.75	32732.95	27587.46	2893.48
Nov-22	7081.31	15658.73	5.42	5.25	34589.77	27968.99	3151.34
Dec-22	6850.62	15615	5.51	5.5	33147.25	26094.5	3089.26

Lampiran 2. Data setelah Normalisasi

Date	Y	X_1	X_2	X_3	X_4	X_5	X_6
Jan-17	0.2807	0.0235	0.4687	0.5	0.0000	0.0125	0.5806
Feb-17	0.3152	0.0166	0.5421	0.5	0.0576	0.0199	0.6526
Mar-17	0.3826	0.0184	0.4946	0.5	0.0485	0.0000	0.6359
Apr-17	0.4262	0.0032	0.6156	0.5	0.0653	0.0273	0.5766
May-17	0.4458	0.0098	0.6501	0.5	0.0695	0.0703	0.5439
Jun-17	0.4798	0.0000	0.6587	0.5	0.0902	0.1066	0.6096
Jul-17	0.4840	0.0171	0.5529	0.5	0.1230	0.0964	0.6799
Aug-17	0.4926	0.0170	0.5400	0.4	0.1265	0.0699	0.7565
Sep-17	0.5063	0.0020	0.5184	0.3	0.1542	0.1372	0.7462
Oct-17	0.5453	0.0886	0.4881	0.3	0.2133	0.2942	0.7849
Nov-17	0.5254	0.0892	0.4276	0.3	0.2676	0.3619	0.7185
Dec-17	0.6754	0.1004	0.4946	0.3	0.2947	0.3657	0.7097
Jan-18	0.7683	0.0320	0.4168	0.3	0.3815	0.3973	0.8613
Feb-18	0.7652	0.1136	0.4017	0.3	0.3135	0.2996	0.6681
Mar-18	0.6134	0.1791	0.4492	0.3	0.2573	0.2414	0.5891
Apr-18	0.5411	0.1964	0.4514	0.3	0.2610	0.3375	0.5134
May-18	0.5371	0.2964	0.4125	0.5	0.2763	0.3123	0.5250
Jun-18	0.4685	0.2872	0.3888	0.7	0.2675	0.3220	0.3085
Jul-18	0.5195	0.4345	0.4017	0.7	0.3370	0.3457	0.3338
Aug-18	0.5500	0.4911	0.4060	0.8	0.3703	0.3752	0.2019
Sep-18	0.5344	0.6113	0.3369	0.9	0.4003	0.4942	0.2858
Oct-18	0.4806	0.7320	0.3974	0.9	0.3188	0.2856	0.095
Nov-18	0.5640	0.5444	0.4125	1.0	0.3444	0.3264	0.0823
Dec-18	0.6155	0.4666	0.3909	1.0	0.2102	0.1049	0.0000
Jan-19	0.7413	0.3366	0.3240	1.0	0.3117	0.1768	0.0791
Feb-19	0.7080	0.2868	0.2700	1.0	0.3674	0.2348	0.3901
Mar-19	0.7174	0.3553	0.2505	1.0	0.3681	0.2178	0.5209
Apr-19	0.7124	0.3286	0.3261	1.0	0.4084	0.3177	0.5100
May-19	0.6209	0.4260	0.4320	1.0	0.3005	0.1605	0.3533
Jun-19	0.6765	0.3613	0.4233	1.0	0.4089	0.2245	0.4232
Jul-19	0.6883	0.2902	0.4320	0.9	0.4249	0.2478	0.3828
Aug-19	0.6653	0.3674	0.4687	0.8	0.3969	0.1703	0.3424
Sep-19	0.6060	0.3164	0.4471	0.7	0.4281	0.2700	0.3589
Oct-19	0.6280	0.3189	0.3909	0.6	0.4360	0.3811	0.3798
Nov-19	0.5475	0.2999	0.3629	0.6	0.4970	0.4159	0.3299
Dec-19	0.6545	0.2799	0.3024	0.6	0.5265	0.4503	0.4854

Date	Y	X_1	X_2	X_3	X_4	X_5	X_6
Jan-20	0.5209	0.1689	0.2937	0.6	0.5094	0.4075	0.4212
Feb-20	0.3397	0.1860	0.3585	0.5	0.3366	0.2119	0.3372
Mar-20	0.0000	0.7381	0.3542	0.4	0.1246	0.0007	0.2238
Apr-20	0.0660	1.0000	0.2916	0.4	0.2720	0.1218	0.3196
May-20	0.0798	0.6259	0.1879	0.4	0.3350	0.2816	0.3128
Jun-20	0.1362	0.3494	0.1382	0.3	0.3611	0.3205	0.4283
Jul-20	0.2270	0.4998	0.0475	0.2	0.3985	0.2656	0.7122
Aug-20	0.2601	0.5551	0.0000	0.2	0.5200	0.4012	0.7870
Sep-20	0.1231	0.6032	0.0216	0.2	0.4806	0.4055	0.6320
Oct-20	0.2191	0.5647	0.0259	0.2	0.4029	0.3858	0.6376
Nov-20	0.3991	0.3653	0.0583	0.1	0.5933	0.7137	0.7836
Dec-20	0.5354	0.3405	0.0778	0.1	0.6521	0.8095	0.8545
Jan-21	0.4920	0.2972	0.0497	0.1	0.6142	0.8303	0.8632
Feb-21	0.6330	0.2895	0.0130	0.0	0.6719	0.9538	0.8859
Mar-21	0.5378	0.4356	0.0108	0.0	0.7962	0.9740	0.8273
Apr-21	0.5415	0.4904	0.0216	0.0	0.8505	0.9393	0.8316
May-21	0.5236	0.3989	0.0778	0.0	0.8902	0.9438	0.9788
Jun-21	0.5378	0.4048	0.0022	0.0	0.8886	0.9373	0.9576
Jul-21	0.5692	0.4721	0.0432	0.0	0.9148	0.7943	0.7884
Aug-21	0.5990	0.4279	0.0583	0.0	0.9407	0.8707	0.9164
Sep-21	0.6498	0.3732	0.0605	0.0	0.8486	1.0000	0.9375
Oct-21	0.7630	0.3504	0.0734	0.0	0.9685	0.9469	0.9193
Nov-21	0.7416	0.3757	0.0929	0.0	0.8874	0.8453	0.9338
Dec-21	0.7593	0.4012	0.1188	0.0	1.0000	0.9373	1.0000
Jan-22	0.7778	0.4036	0.1857	0.0	0.9268	0.7676	0.7571
Feb-22	0.8733	0.4098	0.1598	0.0	0.8515	0.7225	0.8451
Mar-22	0.9415	0.4088	0.2851	0.0	0.8992	0.8453	0.6618
Apr-22	1.0000	0.4167	0.4644	0.0	0.7960	0.7529	0.4827
May-22	0.9703	0.5098	0.4816	0.0	0.7968	0.7939	0.6044
Jun-22	0.8820	0.5412	0.6544	0.0	0.6623	0.7098	0.7895
Jul-22	0.8967	0.6563	0.7819	0.0	0.7880	0.8434	0.6627
Aug-22	0.9813	0.6042	0.7279	0.1	0.7069	0.8709	0.6181
Sep-22	0.9301	0.6514	1.0000	0.3	0.5379	0.6666	0.4630
Oct-22	0.9517	0.8249	0.9482	0.5	0.7812	0.8231	0.3487
Nov-22	0.9451	0.9188	0.8855	0.7	0.8939	0.8593	0.5737
Dec-22	0.8594	0.9017	0.9050	0.8	0.8063	0.6815	0.5196

Lampiran 3. Nilai hasil estimasi MARS-DE (Data Normalisasi)

Date	Y	$\hat{Y}$	$Y - \hat{Y}$
Jan-17	0.2807	0.2801	0.0006
Feb-17	0.3152	0.3892	-0.0740
Mar-17	0.3826	0.3519	0.0307
Apr-17	0.4262	0.4182	0.0080
May-17	0.4458	0.4330	0.0128
Jun-17	0.4798	0.4718	0.0080
Jul-17	0.4840	0.4629	0.0211
Aug-17	0.4926	0.4318	0.0608
Sep-17	0.5063	0.5435	-0.0372
Oct-17	0.5453	0.5921	-0.0468
Nov-17	0.5254	0.5947	-0.0693
Dec-17	0.6754	0.6446	0.0308
Jan-18	0.7683	0.7906	-0.0223
Feb-18	0.7652	0.5981	0.1671
Mar-18	0.6134	0.5698	0.0436
Apr-18	0.5411	0.5576	-0.0165
May-18	0.5371	0.4905	0.0466
Jun-18	0.4685	0.5223	-0.0538
Jul-18	0.5195	0.5105	0.0090
Aug-18	0.5500	0.5531	-0.0031
Sep-18	0.5344	0.5290	0.0054
Oct-18	0.4806	0.4599	0.0207
Nov-18	0.5640	0.6073	-0.0433
Dec-18	0.6155	0.5295	0.0860
Jan-19	0.7413	0.6283	0.1130
Feb-19	0.7080	0.6685	0.0395
Mar-19	0.7174	0.6589	0.0585
Apr-19	0.7124	0.7322	-0.0198
May-19	0.6209	0.6456	-0.0247
Jun-19	0.6765	0.7505	-0.0740
Jul-19	0.6883	0.7413	-0.0530
Aug-19	0.6653	0.6573	0.0080
Sep-19	0.6060	0.6457	-0.0397
Oct-19	0.6280	0.5800	0.0480
Nov-19	0.5475	0.5997	-0.0522
Dec-19	0.6545	0.6261	0.0284

Date	Y	$\hat{Y}$	$Y - \hat{Y}$
Jan-20	0.5209	0.5968	-0.0759
Feb-20	0.3397	0.4615	-0.1218
Mar-20	0.0000	0.0472	-0.0472
Apr-20	0.0660	0.0396	0.0264
May-20	0.0798	0.0779	0.0019
Jun-20	0.1362	0.2232	-0.0870
Jul-20	0.2270	0.2036	0.0234
Aug-20	0.2601	0.2715	-0.0114
Sep-20	0.1231	0.1926	-0.0695
Oct-20	0.2191	0.1624	0.0567
Nov-20	0.3991	0.3959	0.0032
Dec-20	0.5354	0.5745	-0.0391
Jan-21	0.4920	0.5529	-0.0609
Feb-21	0.6330	0.5729	0.0601
Mar-21	0.5378	0.5006	0.0372
Apr-21	0.5415	0.5287	0.0128
May-21	0.5236	0.5939	-0.0703
Jun-21	0.5378	0.5984	-0.0606
Jul-21	0.5692	0.5494	0.0198
Aug-21	0.5990	0.6546	-0.0556
Sep-21	0.6498	0.6037	0.0461
Oct-21	0.7630	0.7019	0.0611
Nov-21	0.7416	0.6720	0.0696
Dec-21	0.7593	0.7324	0.0269
Jan-22	0.7778	0.8236	-0.0458
Feb-22	0.8733	0.8078	0.0655
Mar-22	0.9415	0.9428	-0.0013
Apr-22	1.0000	0.9305	0.0695
May-22	0.9703	0.9278	0.0425
Jun-22	0.8820	0.9640	-0.0820
Jul-22	0.8967	1.0314	-0.1347
Aug-22	0.9813	0.9653	0.0160
Sep-22	0.9301	0.8510	0.0791
Oct-22	0.9517	0.8200	0.1317
Nov-22	0.9451	0.9558	-0.0107
Dec-22	0.8594	0.9520	-0.0926

Lampiran 4. Nilai hasil estimasi MARS-DE

Date	Y	$\hat{Y}$	$Y - \hat{Y}$
Jan-17	5294.10	5292.36	1.74
Feb-17	5386.69	5585.74	-199.05
Mar-17	5568.11	5485.51	82.60
Apr-17	5685.30	5663.97	21.33
May-17	5738.15	5703.81	34.34
Jun-17	5829.71	5807.96	21.75
Jul-17	5840.94	5784.01	56.93
Aug-17	5864.06	5700.36	163.70
Sep-17	5900.85	6000.98	-100.13
Oct-17	6005.78	6131.57	-125.79
Nov-17	5952.14	6138.70	-186.56
Dec-17	6355.65	6272.96	82.69
Jan-18	6605.63	6665.52	-59.89
Feb-18	6597.22	6147.81	449.41
Mar-18	6188.99	6071.67	117.32
Apr-18	5994.60	6038.80	-44.20
May-18	5983.59	5858.42	125.17
Jun-18	5799.24	5944.00	-144.76
Jul-18	5936.44	5912.20	24.24
Aug-18	6018.46	6026.82	-8.36
Sep-18	5976.55	5962.06	14.49
Oct-18	5831.65	5775.96	55.69
Nov-18	6056.12	6172.53	-116.41
Dec-18	6194.50	5963.28	231.22
Jan-19	6532.97	6229.04	303.93
Feb-19	6443.35	6337.06	106.29
Mar-19	6468.75	6311.33	157.42
Apr-19	6455.35	6508.56	-53.21
May-19	6209.12	6275.71	-66.59
Jun-19	6358.63	6557.74	-199.11
Jul-19	6390.50	6533.03	-142.53
Aug-19	6328.47	6307.16	21.31
Sep-19	6169.10	6275.93	-106.83
Oct-19	6228.32	6099.19	129.13
Nov-19	6011.83	6152.09	-140.26
Dec-19	6299.54	6223.13	76.41

Date	Y	$\hat{Y}$	$Y - \hat{Y}$
Jan-20	5940.05	6144.21	-204.16
Feb-20	5452.70	5780.29	-327.59
Mar-20	4538.93	4665.90	-126.97
Apr-20	4716.40	4645.43	70.97
May-20	4753.61	4748.50	5.11
Jun-20	4905.39	5139.35	-233.96
Jul-20	5149.63	5086.62	63.01
Aug-20	5238.49	5269.27	-30.78
Sep-20	4870.04	5057.08	-187.04
Oct-20	5128.23	4975.75	152.48
Nov-20	5612.42	5603.82	8.60
Dec-20	5979.07	6084.32	-105.25
Jan-21	5862.35	6026.23	-163.88
Feb-21	6241.80	6079.99	161.81
Mar-21	5985.52	5885.42	100.10
Apr-21	5995.62	5961.08	34.54
May-21	5947.46	6136.47	-189.01
Jun-21	5985.49	6148.66	-163.17
Jul-21	6070.04	6016.68	53.36
Aug-21	6150.30	6299.68	-149.38
Sep-21	6286.94	6162.97	123.97
Oct-21	6591.35	6427.13	164.22
Nov-21	6533.93	6346.55	187.38
Dec-21	6581.48	6509.19	72.29
Jan-22	6631.15	6754.33	-123.18
Feb-22	6888.17	6711.88	176.29
Mar-22	7071.44	7075.00	-3.56
Apr-22	7228.91	7042.02	186.89
May-22	7148.97	7034.76	114.21
Jun-22	6911.58	7132.08	-220.50
Jul-22	6951.12	7313.32	-362.20
Aug-22	7178.59	7135.55	43.04
Sep-22	7040.80	6828.14	212.66
Oct-22	7098.89	6744.70	354.19
Nov-22	7081.31	7110.08	-28.77
Dec-22	6850.62	7099.76	-249.14

Lampiran 5. Sintaks MARS-DE

```
# Data
library(readxl)
data_IHSG <- read.csv("D:/~Bismillah Thesis/Bismillah_M.Stat/IHSG 17-22.csv")
Date <- data_IHSG$Date
attach(data_IHSG)
summary(data_IHSG)
View(data_IHSG)

# Standarisasi data min max normalizationn
data <- data.frame(x1, x2, x3, x4, x5, x6, y)

# Membangun model MARS dengan data tersebut
#Membuat Kombinasi Model#
#BF = 12# ; #MI = 1, 2 dan 3# ; #MO = 0, 1, 2, dan 3#
model1 <- earth(y ~ x1+x2+x3+x4+x5+x6, data = data, nk = 12, degree = 1,
minspan = 0)
summary(model1, style="bf")

# Define the objective function for MARS optimization
mars_objective <- function(params, data, y) {
  nk <- params[1]
  degree <- params[2]
  minspan <- params[3]
  mars_model <- earth(y ~ ., data = data, nk = nk, degree = degree, minspan =
minspan)
}

# Menentukan batasan dan menjalankan optimasi DE
result <- DEoptim(mars_objective, lower = lower_bounds, upper =
upper_bounds, data = data)
```

```
# Mengambil hasil terbaik dari optimasi
optimal_mars_model <- earth(y ~ ., data = data, nk = optimal_nk, degree =
optimal_degree, minspan = optimal_minspan)
summary(optimal_mars_model, style="bf")


# Membagi total_error_squared dengan jumlah data (72) untuk mendapatkan
MSE
mse_manual <- total_error_squared / 72
# Menampilkan hasil perhitungan MSE
print(paste("Mean Squared Error (MSE) manual:", mse_manual))
```

Lampiran 6. Output R MARS-DE

```
> # Data
> library(readxl)
> data_IHSG <- read.csv("D:/~Bismillah Thesis/Bismillah_M.S
tat/IHSG 17-22.csv")
> Date <- data_IHSG$Date
> attach(data_IHSG)
> summary(data_IHSG)
     Date                IHSG           KURS           INFLA
SI      TINGKAT.SUKU.BUNGA
 Length:72          Min.   :4539   Min.   :13298   Min.   :
1.320   Min.   :3.500
 Class :character   1st Qu.:5839   1st Qu.:13964   1st Qu.:
1.938   1st Qu.:3.688
 Mode  :character   Median :6037   Median :14239   Median :
3.130   Median :4.375
                    Mean   :6099   Mean   :14251   Mean   :
2.973   Mean   :4.510
                    3rd Qu.:6485   3rd Qu.:14565   3rd Qu.:
3.505   3rd Qu.:5.062
                    Max.   :7229   Max.   :15867   Max.   :
5.950   Max.   :6.000
   Dow.Jones       Nikkei.225       Shanghai
 Min.   :19864   Min.   :18909   Min.   :2494
 1st Qu.:24643   1st Qu.:21358   1st Qu.:2932
 Median :26547   Median :22815   Median :3178
 Mean   :27833   Mean   :23787   Mean   :3156
 3rd Qu.:32761   3rd Qu.:27281   3rd Qu.:3392
 Max.   :36338   Max.   :29453   Max.   :3640
> View(data_IHSG)
> # Standarisasi data min max normalizationn
> data <- data.frame(x1, x2, x3, x4, x5, x6, y)
> # Membangun model MARS dengan data tersebut
> #Membuat Kombinasi Model#
> #BF = 12# ; #MI = 1, 2 dan 3# ; #MO = 0, 1, 2, dan 3#
> model1 <- earth(y ~ x1+x2+x3+x4+x5+x6, data = data, nk =
12, degree = 1, minspan = 0)
```

```
> summary(model1, style="bf")
> # Define the objective function for MARS optimization
> mars_objective <- function(params, data, y) {
+   nk <- params[1]
+   degree <- params[2]
+   minspan <- params[3]
+
+   mars_model <- earth(y ~ ., data = data, nk = nk, degree
= degree, minspan = minspan)
+ }
> # Menentukan batasan dan menjalankan optimasi DE
> result <- DEoptim(mars_objective, lower = lower_bounds, u
pper = upper_bounds, data = data)
Iteration: 1 bestvalit: 0.006938 bestmemit:   24.701706
2.251400    0.115310
Iteration: 2 bestvalit: 0.006938 bestmemit:   15.177693
1.597067    0.217626
Iteration: 3 bestvalit: 0.006852 bestmemit:   34.389719
1.208189    0.357199
Iteration: 4 bestvalit: 0.006852 bestmemit:   30.831407
1.381015    0.434246
Iteration: 5 bestvalit: 0.006852 bestmemit:   30.740440
1.302733    0.441416
Iteration: 6 bestvalit: 0.006852 bestmemit:   30.740440
1.302733    0.441416
Iteration: 7 bestvalit: 0.006852 bestmemit:   30.831407
1.381015    0.148157
Iteration: 8 bestvalit: 0.006852 bestmemit:   28.949896
1.381015    0.148157
Iteration: 9 bestvalit: 0.006852 bestmemit:   30.741541
1.270362    0.405657
Iteration: 10 bestvalit: 0.006852 bestmemit:   28.949896
1.351493    0.026098
Iteration: 11 bestvalit: 0.006763 bestmemit:   34.825479
1.470336    2.894617
Iteration: 12 bestvalit: 0.006763 bestmemit:   34.825479
1.374552    2.894617
Iteration: 13 bestvalit: 0.006763 bestmemit:   34.794994
1.067570    2.549236
Iteration: 14 bestvalit: 0.006763 bestmemit:   34.794994
1.067570    2.549236
Iteration: 15 bestvalit: 0.006763 bestmemit:   34.794994
1.256621    2.549236
Iteration: 16 bestvalit: 0.006763 bestmemit:   34.794994
1.154753    2.549236
Iteration: 17 bestvalit: 0.006763 bestmemit:   34.794994
1.154753    2.549236
Iteration: 18 bestvalit: 0.006763 bestmemit:   34.825479
1.318798    2.652186
Iteration: 19 bestvalit: 0.006763 bestmemit:   34.772006
1.219311    2.541291
Iteration: 20 bestvalit: 0.006763 bestmemit:   34.772006
1.476912    2.541291
> # Mengambil hasil terbaik dari optimasi
> optimal_mars_model <- earth(y ~ ., data = data, nk = opti
mal_nk, degree = optimal_degree, minspan = optimal_minspan)
> summary(optimal_mars_model, style="bf")
Call: earth(formula=y~., data=data, degree=optimal_degree,
```

```
nk=optimal_nk,
            minspan=optimal_minspan)

y =
  0.1240871
  - 0.4218601 * bf1
  +  2.181199 * bf2
  -  1.655557 * bf3
  - 0.9916266 * bf4
  +  1.437386 * bf5
  - 0.9461363 * bf6
  + 0.6141025 * bf7
  + 0.2221782 * bf8
  +  3.931156 * bf9
  -  4.975676 * bf10

   bf1  h(x1-0.286846)
   bf2  h(x2-0.0734341)
   bf3  h(x2-0.25054)
   bf4  h(x3-0.2)
   bf5  h(x3-0.4)
   bf6  h(0.260957-x4)
   bf7  h(x4-0.260957)
   bf8  h(x6-0.32995)
   bf9  h(x6-0.827321)
  bf10  h(x6-0.854513)

Selected 11 of 24 terms, and 5 of 6 predictors
Termination condition: Reached nk 35
Importance: x2, x4, x1, x3, x6, x5-unused
Number of terms at each degree of interaction: 1 10 (additi
ve model)
GCV 0.006762794    RSS 0.2443059    GRSq 0.8735255    RSq 0
.9347431
> # Membagi total_error_squared dengan jumlah data (72) unt
uk mendapatkan MSE
> mse_manual <- total_error_squared / 72
> # Menampilkan hasil perhitungan MSE
> print(paste("Mean Squared Error (MSE) manual:", mse_manua
l))
[1] "Mean Squared Error (MSE) manual: 0.00339313792216245"
```