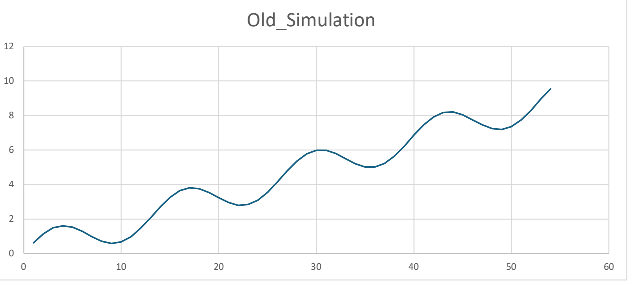
Index	Old_Simulation
1	0.625063471
2	1.148131491
3	1.489903076
4	1.611416557
5	1.52271873
6	1.2806294
7	0.976098704
8	0.713970279
9	0.589653056
10	0.667892323
11	0.968363593
12	1.461294712
13	2.074090298
14	2.707484564
15	3.257628415
16	3.63919637
17	3.804371877
18	3.753486727
19	3.534947226
20	3.234463562
21	2.955978889
22	2.79854148
23	2.83426602
24	3.092287752
25	3.552279741
26	4.148975719
27	4.786692137
28	5.360618201
29	5.780136775
30	5.988987117
31	5.977783159
32	5.786101954
33	5.493677596
34	5.202660002
35	5.01488608
36	5.009220534
37	5.224008093
38	5.648541632
39	6.225444555
40	6.863437361
41	7.457647758
42	7.912945251
43	8.165108118
44	8.195113052
45	8.033367932
46	7.752945931
47	7.453326387
48	7.238260181
49	7.192684679
50	7.363824764
51	7.75068508
52	8.3042715
53	8.938492555
54	9.549315187



NOTE

In part (a) of Question 1.

We use the function from the previous week, sin(t/2.1) + t/6 to simulate the original dataset.

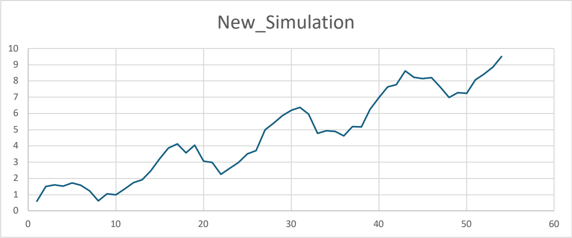
Meanwhile expanding it to 54 data points.

Index	Old_Simulation	Error	New_Simulation
1	0.625063471	0.652469202	1.277532674
2	1.148131491	-0.201234257	0.946897234
3	1.489903076	0.119362548	1.609265625
4	1.611416557	-0.008504338	1.602912219
5	1.52271873	0.102931114	1.625649844
6	1.2806294	0.150149363	1.430778763
7	0.976098704	0.367769803	1.343868507
8	0.713970279	-0.043110418	0.670859861
9	0.589653056	0.093194566	0.682847622
10	0.667892323	-0.187502549	0.480389773
11	0.968363593	-0.226354438	0.742009155
12	1.461294712	0.080818707	1.542113419
13	2.074090298	0.676798175	2.750888473
14	2.707484564	0.087415409	2.794899973
15	3.257628415	0.01481063	3.272439045
16	3.63919637	-0.0666857	3.57251067
17	3.804371877	-0.072248271	3.732123606
18	3.753486727	0.19052385	3.944010578
19	3.534947226	-0.294438352	3.240508874
20	3.234463562	-0.130413221	3.104050341
21	2.955978889	-0.195955138	2.760023751
22	2.79854148	-0.108362862	2.690178618
23	2.83426602	0.176867224	3.011133245
24	3.092287752	0.007112401	3.099400153
25	3.552279741	-0.325155393	3.227124347
26	4.148975719	0.043735335	4.192711054
27	4.786692137	0.235181689	5.021873825
28	5.360618201	0.072859245	5.433477447
29	5.780136775	-0.145467617	5.634669159
30	5.988987117	0.207311445	6.196298562
31	5.977783159	-0.109132063	5.868651096
32	5.786101954	-0.203073476	5.583028479
33	5.493677596	-0.116111816	5.37756578
34	5.202660002	0.085743015	5.288403017
35	5.01488608	0.182553321	5.197439401
36	5.009220534	0.288211037	5.297431571
37	5.224008093	-0.124903925	5.099104168
38	5.648541632	0.052881444	5.701423076
39	6.225444555	0.258059013	6.483503568
40	6.863437361	0.465436586	7.328873947
41	7.457647758	-0.049725799	7.407921959
42	7.912945251	-0.069781471	7.84316378
43	8.165108118	0.509731523	8.67483964
44	8.195113052	0.193514205	8.388627256
45	8.033367932	-0.410680121	7.622687812
46	7.752945931	0.18767433	7.940620262
47	7.453326387	0.033579109	7.486905497
48	7.238260181	-0.100068992	7.13819119
49	7.192684679	-0.117774859	7.07490982
50	7.363824764	0.352012498	7.715837262
51	7.75068508	-0.083495953	7.667189127
52	8.3042715	0.105439575	8.409711076
53	8.938492555	0.013553796	8.952046351
54	9.549315187	0.079746955	9.629062143

Index	Old_Simulation	Error	New_Simulation
1	0.625063471	-0.024975593	0.600087879
2	1.148131491	0.356922342	1.505053833
3	1.489903076	0.121491861	1.611394937
4	1.611416557	-0.082406732	1.529009825
5	1.52271873	0.194915771	1.717634501
6	1.2806294	0.288729004	1.569358404
7	0.976098704	0.23724216	1.213340864
8	0.713970279	-0.086464094	0.627506185
9	0.589653056	0.456910347	1.046563402
10	0.667892323	0.308810114	0.976702436
11	0.968363593	0.365815344	1.334178937
12	1.461294712	0.271399016	1.732693728
13	2.074090298	-0.163811016	1.910279282
14	2.707484564	-0.232228855	2.475255709
15	3.257628415	-0.037888245	3.21974017
16	3.63919637	0.219211008	3.858407379
17	3.804371877	0.330006428	4.134378305
18	3.753486727	-0.189742538	3.56374419
19	3.534947226	0.515806131	4.050753357
20	3.234463562	-0.171095528	3.063368034
21	2.955978889	0.036488013	2.992466902
22	2.79854148	-0.540018844	2.258522636
23	2.83426602	-0.197420253	2.636845767
24	3.092287752	-0.113082418	2.979205334
25	3.552279741	-0.046048656	3.506231084
26	4.148975719	-0.438268392	3.710707327
27	4.786692137	0.207700312	4.994392448
28	5.360618201	0.044154731	5.404772932
29	5.780136775	0.077210306	5.857347081
30	5.988987117	0.202891579	6.191878695
31	5.977783159	0.393638614	6.371421773
32	5.786101954	0.166786372	5.952888327
33	5.493677596	-0.722024679	4.771652916
34	5.202660002	-0.262956814	4.939703188
35	5.01488608	-0.118051144	4.896834936
36	5.009220534	-0.392675475	4.616545059
37	5.224008093	-0.041177742	5.182830351
38	5.648541632	-0.47190634	5.176635291
39	6.225444555	0.025725964	6.251170519
40	6.863437361	0.130195916	6.993633277
41	7.457647758	0.164658334	7.622306093
42	7.912945251	-0.133102219	7.779843031
43	8.165108118	0.463529664	8.628637782
44	8.195113052	0.030311752	8.225424803
45	8.033367932	0.109494693	8.142862625
46	7.752945931	0.460453792	8.213399724
47	7.453326387	0.179406228	7.632732616
48	7.238260181	-0.247563215	6.990696966
49	7.192684679	0.090995989	7.283680668
50	7.363824764	-0.130341053	7.233483711
51	7.75068508	0.322933144	8.073618224
52	8.3042715	0.121754925	8.426026426
53	8.938492555	-0.079034476	8.859458079
54	9.549315187	-0.039681534	9.509633654

NOTE

In order to prevent the values of the data from changing with each refresh, this table serves as an example.



NOTE

In part (b) of Question 1.

We use NORM.INV(RAND(),0, 0.25) to generate disturbances that follow Gaussian Process with a expected value of 0 and a variance of 0.25.

The white block will refresh data automatically.

Thus, we have blue block to restore data.

Index	D_bar_6.5_to_42.5	D_bar_7_to_42	L+T	New_Simulation
1			0.300048375	0.600087879
2			0.460868253	1.505053833
3			0.621688131	1.611394937
4			0.782508009	1.529009825
5			0.943327887	1.717634501
6			1.104147766	1.569358404
7	1.288627078	1.343218386	1.264967644	1.213340864
8	1.397809695	1.438234773	1.425787522	0.627506185
9	1.478659851	1.545674236	1.5866074	1.046563402
10	1.61268862	1.709746852	1.747427278	0.976702436
11	1.806805083	1.907502742	1.908247156	1.334178937
12	2.0082004	2.091299808	2.069067034	1.732693728
13	2.174399216	2.292624736	2.229886912	1.910279282
14	2.410850257	2.5123445	2.390706791	2.475255709
15	2.613838744	2.694918057	2.551526669	3.21974017
16	2.775997369	2.829406544	2.712346547	3.858407379
17	2.882815719	2.937093504	2.873166425	4.134378305
18	2.991371288	3.043309272	3.033986303	3.56374419
19	3.095247255	3.161745247	3.194806181	4.050753357
20	3.228243239	3.27972039	3.355626059	3.063368034
21	3.33119754	3.405141385	3.516445938	2.992466902
22	3.47908523	3.543517128	3.677265816	2.258522636
23	3.607949026	3.679739392	3.838085694	2.636845767
24	3.751529758	3.861035362	3.998905572	2.979205334
25	3.970540966	4.067235484	4.15972545	3.506231084
26	4.163930001	4.28432668	4.320545328	3.710707327
27	4.404723359	4.47885611	4.481365206	4.994392448
28	4.55298886	4.664704716	4.642185084	5.404772932
29	4.776420573	4.870586788	4.803004963	5.857347081
30	4.964753003	5.032975492	4.963824841	6.191878695
31	5.101197981	5.171056283	5.124644719	6.371421773
32	5.240914586	5.301994918	5.285464597	5.952888327
33	5.36307525	5.415441003	5.446284475	4.771652916
34	5.467806756	5.53400927	5.607104353	4.939703188
35	5.600211784	5.673751743	5.767924231	4.896834936
36	5.747291702	5.813456883	5.928744109	4.616545059
37	5.879622063	5.97367273	6.089563988	5.182830351
38	6.067723397	6.162412417	6.250383866	5.176635291
39	6.257101437	6.397568508	6.411203744	6.251170519
40	6.53803558	6.674439602	6.572023622	6.993633277
41	6.810843624	6.924839361	6.7328435	7.622306093
42	7.038835098	7.137758094	6.893663378	7.779843031
43	7.23668109		7.054483256	8.628637782
44			7.215303135	8.225424803
45			7.376123013	8.142862625
46			7.536942891	8.213399724
47			7.697762769	7.632732616
48			7.858582647	6.990696966

摘要輸出

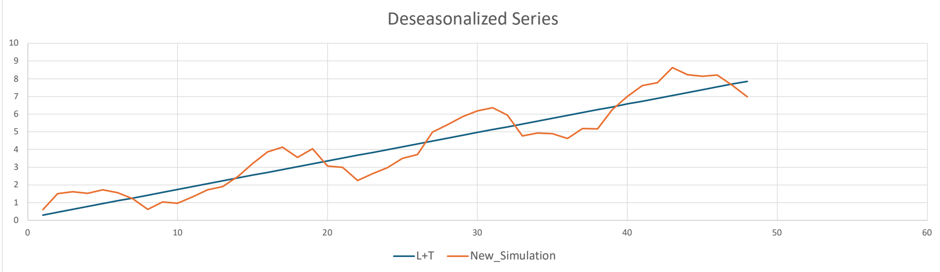
迴歸統計	
R 的倍數	0.99837599
R 平方	0.996754618
調整的 R 平方	0.996659166
標準誤	0.098092218
觀察值個數	36

L =	0.139228497
T =	0.160819878

ANOVA

	自由度	SS	MS	F	顯著值
迴歸	1	100.477884	100.477884	10442.42524	6.68641E-44
殘差	34	0.327150827	0.009622083		
總和	35	100.8050348			

	係數	標準誤	t 統計	P-值	下限 95%	上限 95%	下限 95.0%	上限 95.0%
截距	0.139228497	0.04188001	3.324461842	0.002130939	0.054118075	0.224338918	0.054118075	0.224338918
X 變數 1	0.160819878	0.001573762	102.1881854	6.68641E-44	0.157621609	0.164018147	0.157621609	0.164018147



NOTE

In part (c) of Question 1.

D_bar_6.5_to_42.5 stands for the moving average of data.

For instance, D_6.5 is the average of y_1 to y_12

and D_7.5 is the average of y_1 to y_13, and so on.

To make analysis more precise, D_bar_7_to_42 is the moving average of D_bar_6.5_to_42.5, D_7 means the average of D_bar_6.5 and D_bar_7.5.

After calculating D_bar we need, we can get L and T by regression analysis.

In excel, we set X be D_bar_7_to_42(from 1.343218386 to 7.137758094) and Y be Index(from 7 to 42). We can estimate L and T.

Index	New_Simulation	L+T	Seasonality Factor	Seasonality Factor_Average
1	0.600087879	0.300048375	1.999970434	1.13766035
2	1.505053833	0.460868253	3.265692142	1.497030048
3	1.611394937	0.621688131	2.591966706	1.485843264
4	1.529009825	0.782508009	1.953986167	1.401236657
5	1.717634501	0.943327887	1.82082447	1.402853004
6	1.569358404	1.104147766	1.421330054	1.242972134
7	1.213340864	1.264967644	0.959187272	1.17338462
8	0.627506185	1.425787522	0.440111991	0.904822375
9	1.046563402	1.5866074	0.659623422	0.872673525
10	0.976702436	1.747427278	0.558937387	0.785961767
11	1.334178937	1.908247156	0.699164641	0.806678694
12	1.732693728	2.069067034	0.837427545	0.812666611
13	1.910279282	2.229886912	0.856670924	1.13766035
14	2.475255709	2.390706791	1.035365658	1.497030048
15	3.21974017	2.551526669	1.26188772	1.485843264
16	3.858407379	2.712346547	1.42253481	1.401236657
17	4.134378305	2.873166425	1.438962348	1.402853004
18	3.56374419	3.033986303	1.17460787	1.242972134
19	4.050753357	3.194806181	1.267918342	1.17338462
20	3.063368034	3.355626059	0.912905067	0.904822375
21	2.992466902	3.516445938	0.850991869	0.872673525
22	2.258522636	3.677265816	0.614185308	0.785961767
23	2.636845767	3.838085694	0.687021077	0.806678694
24	2.979205334	3.998905572	0.745005172	0.812666611
25	3.506231084	4.15972545	0.84289964	1.13766035
26	3.710707327	4.320545328	0.858851614	1.497030048
27	4.994392448	4.481365206	1.114480123	1.485843264
28	5.404772932	4.642185084	1.164273469	1.401236657
29	5.857347081	4.803004963	1.219517183	1.402853004
30	6.191878695	4.963824841	1.247400723	1.242972134
31	6.371421773	5.124644719	1.243290437	1.17338462
32	5.952888327	5.285464597	1.126275319	0.904822375
33	4.771652916	5.446284475	0.876129945	0.872673525
34	4.939703188	5.607104353	0.880972223	0.785961767
35	4.896834936	5.767924231	0.848976987	0.806678694
36	4.616545059	5.928744109	0.778671667	0.812666611
37	5.182830351	6.089563988	0.851100401	1.13766035
38	5.176635291	6.250383866	0.828210779	1.497030048
39	6.251170519	6.411203744	0.975038506	1.485843264
40	6.993633277	6.572023622	1.064152182	1.401236657
41	7.622306093	6.7328435	1.132108015	1.402853004
42	7.779843031	6.893663378	1.128549888	1.242972134
43	8.628637782	7.054483256	1.223142428	1.17338462
44	8.225424803	7.215303135	1.139997121	0.904822375
45	8.142862625	7.376123013	1.103948865	0.872673525
46	8.213399724	7.536942891	1.089752151	0.785961767
47	7.632732616	7.697762769	0.991552071	0.806678694
48	6.990696966	7.858582647	0.88956206	0.812666611

NOTE

In part (d) of Question 1.

We use index multiply T and plus L(the formula is t * T + L) to get

a regression line(L+T) of dataset.

Furthermore, we still need to estimate S_t to make L+T fluctuate like dataset.

Hence, we use L+T divide simulation and get S_t of every data point.

We assume that there are 4 cycles in these 48 data points, so every cycle

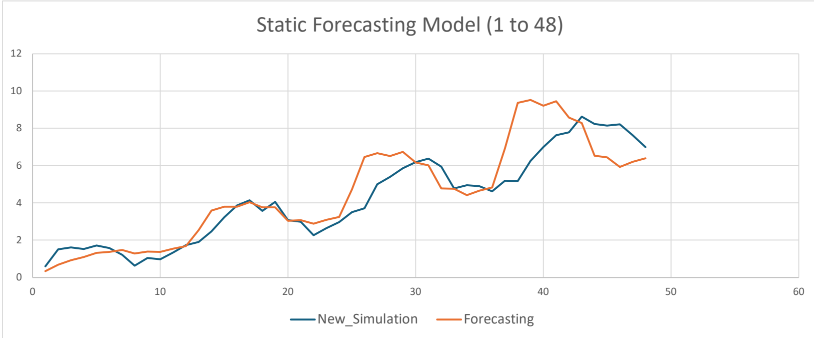
has 12 periods.

Taking the average of S_t in the same period can estimate the overall seasonality

factor of that period.

Index	New_Simulation	Forecasting	E_t	E_t^2	| E_t | / | D_t |
1	0.600087879	0.341353139	-0.258734739	0.066943665	0.431161416
2	1.505053833	0.689933623	-0.815120209	0.664420956	0.54158874
3	1.611394937	0.923731122	-0.687663815	0.472881523	0.426750637
4	1.529009825	1.096478907	-0.432530919	0.187082996	0.282883021
5	1.717634501	1.323350361	-0.39428414	0.155459983	0.229550664
6	1.569358404	1.372424904	-0.196933499	0.038782803	0.125486631
7	1.213340864	1.484293578	0.270952714	0.073415373	0.223311291
8	0.627506185	1.290084452	0.662578266	0.439009959	1.055891211
9	1.046563402	1.384590273	0.33802687	0.114262165	0.322987475
10	0.976702436	1.373411031	0.396708595	0.157377709	0.406171399
11	1.334178937	1.539342324	0.205163386	0.042092015	0.153775015
12	1.732693728	1.681461695	-0.051232033	0.002624721	0.029567853
13	1.910279282	2.536853925	0.626574643	0.392595783	0.32800159
14	2.475255709	3.578959902	1.103704193	1.218162945	0.44589502
15	3.21974017	3.791168713	0.571428543	0.326530579	0.177476601
16	3.858407379	3.800639407	-0.057767971	0.003337138	0.014971973
17	4.134378305	4.030630151	-0.103748154	0.01076368	0.025094016
18	3.56374419	3.771160429	0.20741624	0.043021496	0.058201776
19	4.050753357	3.748736437	-0.30201692	0.09121422	0.07455821
20	3.063368034	3.03624554	-0.027122494	0.00073563	0.008853815
21	2.992466902	3.068709272	0.07624237	0.005812899	0.0254781
22	2.258522636	2.890190339	0.631667702	0.399004086	0.279681812
23	2.636845767	3.096101955	0.459256188	0.210916246	0.174168771
24	2.979205334	3.249777039	0.270571705	0.073209048	0.090820093
25	3.506231084	4.73235471	1.226123626	1.503379146	0.349698464
26	3.710707327	6.467986181	2.757278854	7.602586679	0.74306018
27	4.994392448	6.658606304	1.664213855	2.769607757	0.333216477
28	5.404772932	6.504799908	1.100026975	1.210059347	0.203528805
29	5.857347081	6.737909941	0.880562859	0.775390949	0.150334759
30	6.191878695	6.169895954	-0.021982741	0.000483241	0.003550254
31	6.371421773	6.013179296	-0.358242477	0.128337672	0.056226458
32	5.952888327	4.782406629	-1.170481698	1.370027405	0.196624165
33	4.771652916	4.752828272	-0.018824644	0.000354367	0.003945099
34	4.939703188	4.406969646	-0.532733543	0.283805028	0.107847278
35	4.896834936	4.652861586	-0.24397335	0.059522995	0.049822662
36	4.616545059	4.818092383	0.201547324	0.040621324	0.04365761
37	5.182830351	6.927855496	1.745025145	3.045112757	0.336693472
38	5.176635291	9.357012459	4.180377168	17.47555327	0.807547168
39	6.251170519	9.526043895	3.274873376	10.72479563	0.523881626
40	6.993633277	9.208960408	2.215327132	4.907674301	0.316763411
41	7.622306093	9.445189731	1.822883638	3.322904757	0.239151199
42	7.779843031	8.568631479	0.788788448	0.622187215	0.101388736
43	8.628637782	8.277622155	-0.351015627	0.12321197	0.040680306
44	8.225424803	6.528567717	-1.696857086	2.87932397	0.206294158
45	8.142862625	6.436947272	-1.705915353	2.910147193	0.209498236
46	8.213399724	5.923748953	-2.289650771	5.242500653	0.278770162
47	7.632732616	6.209621217	-1.423111399	2.025246053	0.186448481
48	6.990696966	6.386407727	-0.604289239	0.365165485	0.086441916

MSE =	1.553701183
MAPE =	23.97%



NOTE

In part (e) of Question 1.

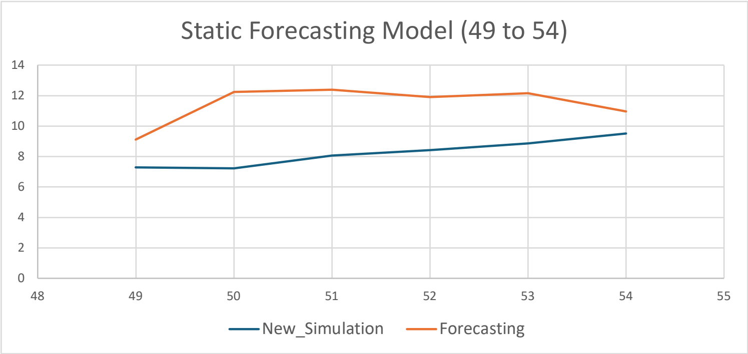
We use index multiply T and plus L, then multiply S_t to estimate the data.

The formula is (t * T + L) * S_t.

E_t is the gap between data and forecasting which is used to estimate MSE and MAPE.

Index	New_Simulation	Forecasting	E_t	E_t^2	| E_t | / | D_t |
49	7.283680668	9.123356281	1.839675614	3.384406363	0.252574996
50	7.233483711	12.24603874	5.012555027	25.1257079	0.692965551
51	8.073618224	12.39348149	4.319863262	18.6612186	0.535059145
52	8.426026426	11.91312091	3.487094483	12.15982793	0.413848035
53	8.859458079	12.15246952	3.293011441	10.84392435	0.371694455
54	9.509633654	10.967367	1.457733351	2.124986522	0.153290169

MSE =	12.05001195
MAPE =	40.32%



NOTE

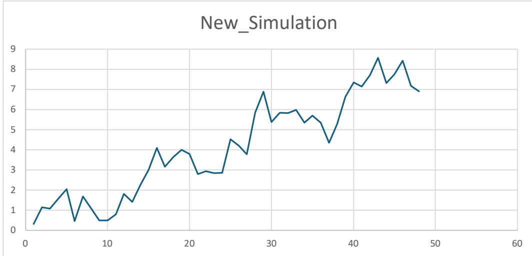
In part (f) of Question 1.

We use y_49 to y_54 which is generated before.

By the same parameters and formula to forecast and make comparison through MSE and MAPE like 1.(e).

Index	Old_Simulation	Error	New_Simulation
1	0.625063471	-0.868799916	-0.243736445
2	1.148131491	-0.061424298	1.086707193
3	1.489903076	-0.387468866	1.10243421
4	1.611416557	-0.711312404	0.900104153
5	1.52271873	0.345721248	1.868439978
6	1.2806294	-0.305009062	0.975620338
7	0.976098704	-0.268690383	0.707408321
8	0.713970279	-0.444204409	0.26976587
9	0.589653056	0.49023771	1.079890766
10	0.667892323	-0.42028248	0.247609843
11	0.968363593	-0.003168024	0.965195569
12	1.461294712	-0.01637724	1.444917472
13	2.074090298	0.007031627	2.081121925
14	2.707484564	0.454088343	3.161572907
15	3.257628415	0.132335657	3.389964073
16	3.63919637	-0.134787975	3.504408395
17	3.804371877	0.161151534	3.965523412
18	3.753486727	0.095265717	3.848752445
19	3.534947226	-0.241937074	3.293010152
20	3.234463562	0.110765109	3.345228672
21	2.955978889	0.544877628	3.500856518
22	2.79854148	0.047741306	2.846282786
23	2.83426602	-0.488325425	2.345940596
24	3.092287752	0.209662178	3.30194993
25	3.552279741	-0.12339204	3.4288877
26	4.148975719	-0.20837687	3.940598849
27	4.786692137	0.037066937	4.823759073
28	5.360618201	-1.219627094	4.140991107
29	5.780136775	0.20760852	5.987745295
30	5.988987117	0.391285541	6.380272658
31	5.977783159	-0.586448298	5.391334861
32	5.786101954	-0.975618632	4.810483322
33	5.493677596	-0.421282099	5.072395497
34	5.202660002	0.343059426	5.545719428
35	5.01488608	-0.544052756	4.470833324
36	5.009220534	-0.644071067	4.365149467
37	5.224008093	0.146587837	5.370595929
38	5.648541632	-0.006063012	5.64247862
39	6.225444555	0.412921276	6.638365831
40	6.863437361	-0.495869275	6.367568086
41	7.457647758	0.523426841	7.981074599
42	7.912945251	0.609357626	8.522302877
43	8.165108118	0.154135114	8.319243232
44	8.195113052	-0.052132826	8.142980226
45	8.033367932	-1.186987621	6.846380311
46	7.752945931	-0.087052682	7.66589325
47	7.453326387	1.064736832	8.518063219
48	7.238260181	-0.294937588	6.943322594
49	7.192684679	-1.303899893	5.888784786
50	7.363824764	0.601831507	7.965656271
51	7.75068508	-0.035241106	7.715443974
52	8.3042715	-0.354789262	7.949482238
53	8.938492555	-0.083178362	8.855314194
54	9.549315187	-0.28803368	9.261281507

Index	Old_Simulation	Error	New_Simulation
1	0.625063471	-0.305198719	0.319864752
2	1.148131491	-0.00367526	1.144456231
3	1.489903076	-0.401236675	1.088666401
4	1.611416557	-0.044286505	1.567130052
5	1.52271873	0.526316379	2.049035109
6	1.2806294	-0.821129346	0.459500054
7	0.976098704	0.712768912	1.688867616
8	0.713970279	0.369987099	1.083957378
9	0.589653056	-0.096422523	0.493230532
10	0.667892323	-0.17727189	0.490620433
11	0.968363593	-0.185307164	0.783056429
12	1.461294712	0.352926935	1.814221646
13	2.074090298	-0.667750728	1.406339571
14	2.707484564	-0.436830581	2.270653983
15	3.257628415	-0.251284636	3.006343779
16	3.63919637	0.454302583	4.093498953
17	3.804371877	-0.648391121	3.155980757
18	3.753486727	-0.123523427	3.629963301
19	3.534947226	0.454808819	3.989756044
20	3.234463562	0.562235841	3.796699403
21	2.955978889	-0.163608588	2.792370301
22	2.79854148	0.131562855	2.930104335
23	2.83426602	0.010103546	2.844369566
24	3.092287752	-0.234393057	2.857894694
25	3.552279741	0.964317942	4.516597683
26	4.148975719	0.057314639	4.206290358
27	4.786692137	-1.003106021	3.783586116
28	5.360618201	0.47310205	5.833720251
29	5.780136775	1.114970298	6.895107073
30	5.988987117	-0.613301012	5.375686104
31	5.977783159	-0.143701009	5.834082149
32	5.786101954	0.040573247	5.826675202
33	5.493677596	0.488930669	5.982608265
34	5.202660002	0.145739652	5.348399654
35	5.01488608	0.681833385	5.696719465
36	5.009220534	0.336879993	5.346100526
37	5.224008093	-0.880167045	4.343841048
38	5.648541632	-0.377336096	5.271205536
39	6.225444555	0.406852212	6.632296767
40	6.863437361	0.48205554	7.345492901
41	7.457647758	-0.315199523	7.142448235
42	7.912945251	-0.21027772	7.70266753
43	8.165108118	0.394798755	8.559906873
44	8.195113052	-0.890056272	7.30505678
45	8.033367932	-0.294935058	7.738432874
46	7.752945931	0.665569956	8.418515888
47	7.453326387	-0.292052374	7.161274013
48	7.238260181	-0.335015953	6.903244228
49	7.192684679	-0.048476375	7.144208304
50	7.363824764	0.336297903	7.700122667
51	7.75068508	0.036887734	7.787572814
52	8.3042715	0.197123916	8.501395416
53	8.938492555	-0.124679259	8.813813297
54	9.549315187	0.176477378	9.725792565



NOTE

In part (g) of Question 1.

This page repeat 1.(b).

We use NORM.INV(RAND(),0, 0.5) to generate disturbances that follow Gaussian Process with a expected value of 0 and a variance of 0.5.

We would like to observe if there will be effects when the variance increments.

Index	D_bar_6.5_to_42.5	D_bar_7_to_42	L+T	New_Simulation
1			0.170832289	0.319864752
2			0.341664578	1.144456231
3			0.512496868	1.088666401
4			0.683329157	1.567130052
5			0.854161446	2.049035109
6			1.024993735	0.459500054
7	1.081883886	1.12715367	1.195826024	1.688867616
8	1.172423454	1.219348361	1.366658314	1.083957378
9	1.266273267	1.346176491	1.537490603	0.493230532
10	1.426079715	1.531345086	1.708322892	0.490620433
11	1.636610457	1.682733192	1.879155181	0.783056429
12	1.728855928	1.860958563	2.049987471	1.814221646
13	1.993061198	2.088931549	2.22081976	1.406339571
14	2.184801901	2.297832818	2.391652049	2.270653983
15	2.410863736	2.506661226	2.562484338	3.006343779
16	2.602458717	2.704103879	2.733316627	4.093498953
17	2.805749042	2.891637089	2.904148917	3.155980757
18	2.977525137	3.021011514	3.074981206	3.629963301
19	3.064497891	3.194091979	3.245813495	3.989756044
20	3.323686067	3.404337582	3.416645784	3.796699403
21	3.484989098	3.517374195	3.587478073	2.792370301
22	3.549759293	3.622268513	3.758310363	2.930104335
23	3.694777734	3.850574664	3.929142652	2.844369566
24	4.006371594	4.079110044	4.099974941	2.857894694
25	4.151848494	4.228695415	4.27080723	4.516597683
26	4.305542336	4.390124661	4.44163952	4.206290358
27	4.474706986	4.607633568	4.612471809	3.783586116
28	4.74056015	4.841322455	4.783304098	5.833720251
29	4.94208476	5.060932672	4.954136387	6.895107073
30	5.179780585	5.283455828	5.124968676	5.375686104
31	5.387131071	5.379932877	5.295800966	5.834082149
32	5.372734684	5.41710615	5.466633255	5.826675202
33	5.461477616	5.580173893	5.637465544	5.982608265
34	5.69887017	5.761860697	5.808297833	5.348399654
35	5.824851224	5.835157106	5.979130122	5.696719465
36	5.845462988	5.942420547	6.149962412	5.346100526
37	6.039378106	6.152954137	6.320794701	4.343841048
38	6.266530167	6.328129399	6.49162699	5.271205536
39	6.389728632	6.46288799	6.662459279	6.632296767
40	6.536047349	6.663968859	6.833291568	7.345492901
41	6.791890369	6.852913475	7.004123858	7.142448235
42	6.913936581	6.978817568	7.174956147	7.70266753
43	7.043698556		7.345788436	8.559906873
44			7.516620725	7.30505678
45			7.687453015	7.738432874
46			7.858285304	8.418515888
47			8.029117593	7.161274013
48			8.199949882	6.903244228

摘要輸出

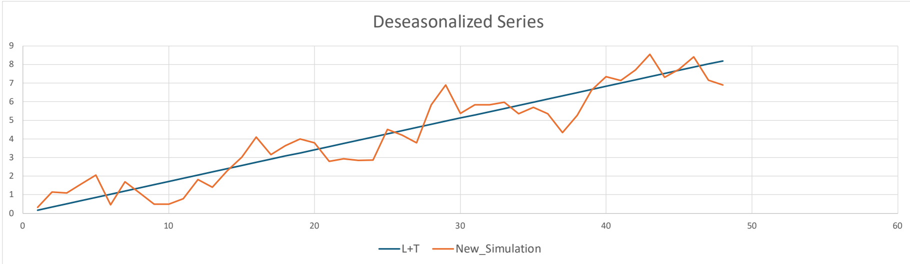
迴歸統計	
R 的倍數	0.998683028
R 平方	0.99736779
調整的 R 平方	0.997290373
標準誤	0.093812039
觀察值個數	36

L =	-0.082220594
T =	0.170832289

ANOVA

	自由度	SS	MS	F	顯著值
迴歸	1	113.378562	113.378562	12882.90463	1.90106E-45
殘差	34	0.299223756	0.008800699		
總和	35	113.6777857			

	係數	標準誤	t 統計	P-值	下限 95%	上限 95%	下限 95.0%	上限 95.0%
截距	-0.082220594	0.040052608	-2.052814956	0.04785033	-0.163617287	-0.0008239	-0.163617287	-0.0008239
X 變數 1	0.170832289	0.001505092	113.5028838	1.90106E-45	0.167773574	0.173891004	0.167773574	0.173891004



NOTE

In part (g) of Question 1.

This page repeat 1.(c) to calculate L and T.

Index	New_Simulation	L+T	Seasonality Factor	Seasonality Factor_Average
1	0.319864752	0.088611696	3.60973515	1.510482947
2	1.144456231	0.259443985	4.41118815	1.79542211
3	1.088666401	0.430276274	2.530156709	1.39633922
4	1.567130052	0.601108563	2.60706659	1.620031021
5	2.049035109	0.771940852	2.654393925	1.554977377
6	0.459500054	0.942773142	0.487391965	0.96308092
7	1.688867616	1.113605431	1.51657631	1.268802812
8	1.083957378	1.28443772	0.843915872	1.011823084
9	0.493230532	1.455270009	0.338927161	0.807498656
10	0.490620433	1.626102298	0.301715601	0.778862033
11	0.783056429	1.796934588	0.435773475	0.760588623
12	1.814221646	1.967766877	0.921969806	0.841186623
13	1.406339571	2.138599166	0.657598485	1.510482947
14	2.270653983	2.309431455	0.983209083	1.79542211
15	3.006343779	2.480263745	1.212106489	1.39633922
16	4.093498953	2.651096034	1.544077959	1.620031021
17	3.155980757	2.821928323	1.118377363	1.554977377
18	3.629963301	2.992760612	1.212914687	0.96308092
19	3.989756044	3.163592901	1.26114711	1.268802812
20	3.796699403	3.334425191	1.138636852	1.011823084
21	2.792370301	3.50525748	0.796623448	0.807498656
22	2.930104335	3.676089769	0.797070942	0.778862033
23	2.844369566	3.846922058	0.739388405	0.760588623
24	2.857894694	4.017754347	0.711316434	0.841186623
25	4.516597683	4.188586637	1.078310675	1.510482947
26	4.206290358	4.359418926	0.964874088	1.79542211
27	3.783586116	4.530251215	0.835182407	1.39633922
28	5.833720251	4.701083504	1.240930999	1.620031021
29	6.895107073	4.871915793	1.415276324	1.554977377
30	5.375686104	5.042748083	1.066023132	0.96308092
31	5.834082149	5.213580372	1.11901644	1.268802812
32	5.826675202	5.384412661	1.082137564	1.011823084
33	5.982608265	5.55524495	1.076929698	0.807498656
34	5.348399654	5.72607724	0.934042527	0.778862033
35	5.696719465	5.896909529	0.966051698	0.760588623
36	5.346100526	6.067741818	0.881069216	0.841186623
37	4.343841048	6.238574107	0.696287481	1.510482947
38	5.271205536	6.409406396	0.822417118	1.79542211
39	6.632296767	6.580238686	1.007911276	1.39633922
40	7.345492901	6.751070975	1.088048537	1.620031021
41	7.142448235	6.921903264	1.031861897	1.554977377
42	7.70266753	7.092735553	1.085993898	0.96308092
43	8.559906873	7.263567842	1.178471387	1.268802812
44	7.30505678	7.434400132	0.982602046	1.011823084
45	7.738432874	7.605232421	1.017514317	0.807498656
46	8.418515888	7.77606471	1.082619063	0.778862033
47	7.161274013	7.946896999	0.901140912	0.760588623
48	6.903244228	8.117729288	0.850391037	0.841186623

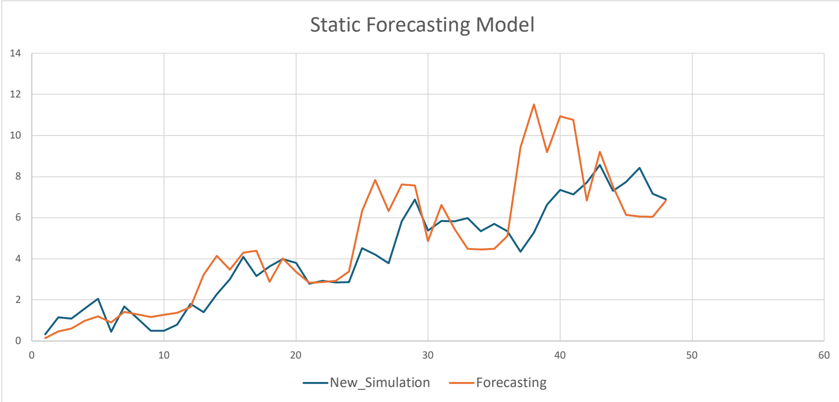
NOTE

In part (g) of Question 1.

This page repeat 1.(d) to calculate S_t.

Index	New_Simulation	Forecasting	E_t	E_t^2	| E_t | / | D_t |
1	0.319864752	0.133846455	-0.186018297	0.034602807	0.581552971
2	1.144456231	0.465811466	-0.678644765	0.460558717	0.592984464
3	1.088666401	0.600811637	-0.487854764	0.238002271	0.448121448
4	1.567130052	0.97381452	-0.593315532	0.352023321	0.37860006
5	2.049035109	1.200350562	-0.848684547	0.72026546	0.414187411
6	0.459500054	0.907966825	0.448466771	0.201122445	0.975988507
7	1.688867616	1.412945702	-0.275921913	0.076132902	0.163376875
8	1.083957378	1.299623735	0.215666356	0.046511977	0.198962026
9	0.493230532	1.175128577	0.681898044	0.464984943	1.382513854
10	0.490620433	1.266509342	0.77588891	0.6020036	1.581444347
11	0.783056429	1.366728003	0.583671574	0.340672506	0.745376134
12	1.814221646	1.655259175	-0.158962472	0.025269067	0.087620205
13	1.406339571	3.230317572	1.823978001	3.326895748	1.296968413
14	2.270653983	4.146404295	1.875750312	3.518439235	0.82608373
15	3.006343779	3.463289543	0.456945764	0.208799431	0.151993849
16	4.093498953	4.294857815	0.201358862	0.040545391	0.049189914
17	3.155980757	4.388034702	1.232053945	1.517956924	0.390387027
18	3.629963301	2.882270644	-0.747692656	0.559044308	0.205978021
19	3.989756044	4.013975569	0.024219525	0.000586585	0.006070428
20	3.796699403	3.373848378	-0.422851025	0.178802989	0.111373322
21	2.792370301	2.830490704	0.038120403	0.001453165	0.013651629
22	2.930104335	2.863166752	-0.066937583	0.00448064	0.022844778
23	2.844369566	2.92592515	0.081555584	0.006651313	0.02867264
24	2.857894694	3.379681213	0.521786518	0.272261171	0.182577237
25	4.516597683	6.326788689	1.810191006	3.276791478	0.400786418
26	4.206290358	7.826997124	3.620706766	13.10951749	0.86078384
27	3.783586116	6.325767449	2.542181333	6.462685928	0.67189731
28	5.833720251	7.615901111	1.78218086	3.176168619	0.305496456
29	6.895107073	7.575718842	0.680611769	0.46323238	0.098709384
30	5.375686104	4.856574464	-0.51911164	0.269476895	0.096566583
31	5.834082149	6.615005437	0.780923287	0.609841181	0.133855381
32	5.826675202	5.448073022	-0.37860218	0.143339611	0.064977396
33	5.982608265	4.485852831	-1.496755433	2.240276827	0.250184429
34	5.348399654	4.459824161	-0.888575493	0.789566407	0.166138574
35	5.696719465	4.485122297	-1.211597168	1.467967698	0.212683313
36	5.346100526	5.104103251	-0.241997275	0.058562681	0.045266129
37	4.343841048	9.423259805	5.079418757	25.80049491	1.169338081
38	5.271205536	11.50758995	6.236384417	38.8924906	1.183104012
39	6.632296767	9.188245354	2.555948587	6.532873181	0.385379104
40	7.345492901	10.93694441	3.591451506	12.89852392	0.488932677
41	7.142448235	10.76340298	3.620954748	13.11131328	0.506962687
42	7.70266753	6.830878284	-0.871789246	0.76001649	0.113180173
43	8.559906873	9.216035304	0.656128431	0.430504518	0.076651352
44	7.30505678	7.522297666	0.217240886	0.047193602	0.029738425
45	7.738432874	6.141214959	-1.597217916	2.55110507	0.206400694
46	8.418515888	6.05648157	-2.362034317	5.579206116	0.280576095
47	7.161274013	6.044319444	-1.116954569	1.24758751	0.155971489
48	6.903244228	6.828525289	-0.074718939	0.00558292	0.010823743

MSE =	3.190049713
MAPE =	39.06%



NOTE

In part (g) of Question 1.

This page repeat 1.(e) to calculate MSE and MAPE.

We can see the performance of this model is worse than the first model.

My thought is that the reason is the larger variance.

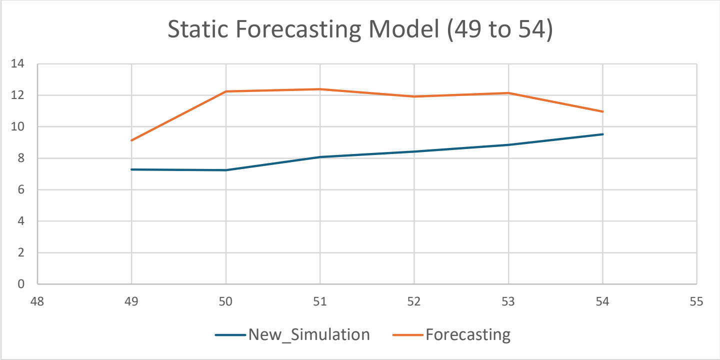
Even though the expected value is zero, it still affects S_t more than before.

Once there is an outlier, it will boost or sharply decrease S_t.

It will severely affect the performance of the model.

Index	New_Simulation	Forecasting	E_t	E_t^2	| E_t | / | D_t |
49	7.192684679	12.51973092	5.327046243	28.37742167	0.740620016
50	7.363824764	15.18818278	7.824358018	61.22057839	1.062539953
51	7.75068508	12.05072326	4.300038181	18.49032835	0.554794594
52	8.3042715	14.2579877	5.953716202	35.44673662	0.716946237
53	8.938492555	13.95108712	5.012594567	25.1261043	0.560787463
54	9.549315187	8.805182103	-0.744133084	0.553734046	0.077925283

MSE =	28.2024839
MAPE =	61.89%



NOTE

In part (g) of Question 1.

This page repeat 1.(f) to calculate MSE and MAPE of future.

We can see the performance of this model is worse than the first model.

I think the reason is the same as part (e).

However, the prediction of future are both worth than MAPE of y_49 to y_54.

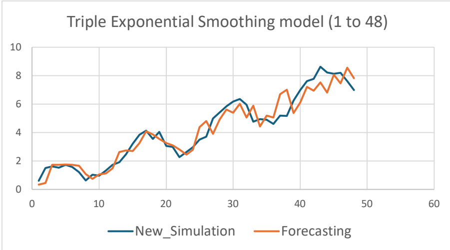
My thought is the average of S_t.

When L+T is tiny, we need a larger S_t to make the regression line to reach the data, whereas L+T becomes larger and larger, we do not need the large S_t anymore. S_t should become smaller accordingly.

To conclude, we can observe that the forecasting is lower than the data in the first cycle, and have a great performance in the second cycle. Nonetheless, it becomes higher than the data in the third cycle, and the gap is even larger in the fourth cycle. The phenomenon fits my hypothesis. Thus, I think this is the reason why MSE and MAPE is larger than before.

Index	New_Simulation	L_t	T_t	S_t	Forecasting	E_t	E_t^2	| E_t | / | D_t |
1	0.600087879	0.139228497	0.160819878	1.13766035	0.341353139	-0.258734739	0.066943665	0.111556437
2	1.505053833	1.005359802	0.160819878	1.497030048	0.449181433	-1.055872399	1.114866524	0.740748603
3	1.611394937	1.084498599	0.160819878	1.485843264	1.732760222	0.121365284	0.014729532	0.009140858
4	1.529009825	1.091186002	0.160819878	1.401236657	1.744985899	0.215976074	0.046645664	0.030507106
5	1.717634501	1.224386658	0.160819878	1.402853004	1.75638021	0.038745709	0.00150123	0.00087401
6	1.569358404	1.262585348	0.160819878	1.242972134	1.721773124	0.15241472	0.023230247	0.014802385
7	1.213340864	1.034052128	0.160819878	1.17338462	1.6702018	0.456860936	0.208721915	0.172022489
8	0.627506185	0.693513117	0.160819878	0.904822375	1.081146927	0.453640741	0.205789922	0.327948834
9	1.046563402	1.199261089	0.160819878	0.872673525	0.745553786	-0.301009616	0.090606789	0.086575537
10	0.976702436	1.242684412	0.160819878	0.785961767	1.06897164	0.092269204	0.008513606	0.008716683
11	1.334178937	1.653916172	0.160819878	0.806678694	1.132177008	-0.20200193	0.04080478	0.030584188
12	1.732693728	2.132108917	0.160819878	0.812666611	1.474775396	-0.257918332	0.066521866	0.038392166
13	1.910279282	1.667155813	0.160819878	1.145831282	2.62730954	0.717030258	0.514132391	0.269139908
14	2.475255709	1.653444239	0.160819878	1.497030048	2.736534537	0.261278828	0.068266626	0.027579626
15	3.21974017	2.16694469	0.160819878	1.485843264	2.695712117	-0.524028053	0.2746054	0.085288062
16	3.858407379	2.753572967	0.160819878	1.401236657	3.261749041	-0.596658338	0.356001172	0.092266352
17	4.134378305	2.947121539	0.160819878	1.402853004	4.088464758	-0.045913547	0.002108054	0.000509884
18	3.56374419	2.867115113	0.160819878	1.242972134	3.863084575	0.299340386	0.089604667	0.025143406
19	4.050753357	3.452195714	0.160819878	1.17338462	3.552932349	-0.497821008	0.247825756	0.061180164
20	3.063368034	3.385601549	0.160819878	0.904822375	3.269137349	0.205769315	0.042341011	0.013821719
21	2.992466902	3.429079508	0.160819878	0.872673525	3.094868089	0.102401187	0.010486003	0.003504133
22	2.258522636	2.873578246	0.160819878	0.785961767	2.821523665	0.563001029	0.316970158	0.140344025
23	2.636845767	3.26876833	0.160819878	0.806678694	2.447784316	-0.189061451	0.035744232	0.013555678
24	2.979205334	3.665962516	0.160819878	0.812666611	2.787111826	-0.192093508	0.036899916	0.012385825
25	3.506231084	3.05998897	0.160819878	1.145831282	4.384846975	0.878615891	0.771965884	0.220169711
26	3.710707327	2.478712656	0.160819878	1.497030048	4.821647626	1.110940299	1.234188348	0.332601911
27	4.994392448	3.361318499	0.160819878	1.485843264	3.921931635	-1.072460813	1.150172196	0.230292715
28	5.404772932	3.857144977	0.160819878	1.401236657	4.935349404	-0.469423528	0.220358449	0.040771084
29	5.857347081	4.175310645	0.160819878	1.402853004	5.636614068	-0.220733014	0.048723063	0.008318282
30	6.191878695	4.981510467	0.160819878	1.242972134	5.389689409	-0.802189287	0.643507652	0.10392769
31	6.371421773	5.429951667	0.160819878	1.17338462	6.033931338	-0.337490435	0.113899793	0.017876668
32	5.952888327	6.579068436	0.160819878	0.904822375	5.058655186	-0.89423314	0.799652909	0.134330239
33	4.771652916	5.467855709	0.160819878	0.872673525	5.881722095	1.110069178	1.23225358	0.258244596
34	4.939703188	6.284915368	0.160819878	0.785961767	4.423923811	-0.515779378	0.266028367	0.053855132
35	4.896834936	6.070366023	0.160819878	0.806678694	5.19963729	0.302802354	0.091689266	0.01872419
36	4.616545059	5.680736721	0.160819878	0.812666611	5.063876729	0.44733167	0.200105623	0.04334532
37	5.182830351	4.523205495	0.160819878	1.145831282	6.693438285	1.510607935	2.281936333	0.440287676
38	5.176635291	3.457936798	0.160819878	1.497030048	7.012126731	1.835491439	3.369028823	0.650814406
39	6.251170519	4.207153387	0.160819878	1.485843264	5.37690523	-0.874265289	0.764339795	0.122271468
40	6.993633277	4.99104362	0.160819878	1.401236657	6.120564255	-0.873069022	0.762249517	0.10899192
41	7.622306093	5.433431778	0.160819878	1.402853004	7.227307186	-0.394998907	0.156024136	0.020469414
42	7.779843031	6.25906472	0.160819878	1.242972134	6.953498918	-0.826344113	0.682844593	0.087770999
43	8.628637782	7.353631226	0.160819878	1.17338462	7.53299385	-1.095643931	1.200435625	0.139122264
44	8.225424803	9.090651416	0.160819878	0.904822375	6.799243494	-1.42618131	2.033993128	0.247281226
45	8.142862625	9.330938077	0.160819878	0.872673525	8.073514068	-0.069348557	0.004809222	0.000590606
46	8.213399724	10.45012629	0.160819878	0.785961767	7.460158855	-0.753240869	0.567371806	0.069078801
47	7.632732616	9.46192415	0.160819878	0.806678694	8.559624195	0.92689158	0.859128001	0.112558378
48	6.990696966	8.602170769	0.160819878	0.812666611	7.820082778	0.829385811	0.687880824	0.098399462

Alpha =	1
Beta =	0
Gamma =	0.002575604
MSE =	0.500551001
MAPE =	12.24%



NOTE

In part (a) of Question 2.

We compare the result of

triple exponential smoothing model

with static model like part (e)

of Question 1.

We use alpha to forget the previous data

of L. Beta is for T, and Gamma is for S.

The core concept of estimation is

take average of present data and

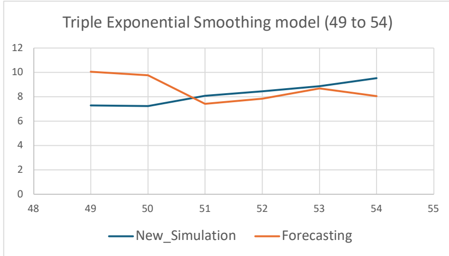
previos data by the weight.

The performance is better because of the lager S in the previous cycle can be forgot.

It avoid the boost like static model, the model is robust even at the larger index(t).

Index	New_Simulation	L_t	T_t	S_t	Forecasting	E_t	E_t^2	| E_t | / | D_t |
49	7.283680668	6.356678146	0.160819878	1.145831282	10.04090881	2.757228138	7.602307006	0.37854874
50	7.233483711	4.831889460	0.160819878	1.497030048	9.756890381	2.523406669	6.367581219	0.348850812
51	8.073618224	5.433694402	0.160819878	1.485843264	7.418383538	-0.655234686	0.429332494	0.081157502
52	8.426026426	6.013278617	0.160819878	1.401236657	7.839238486	-0.58678794	0.344320086	0.069639936
53	8.859458079	6.315314614	0.160819878	1.402853004	8.661352622	-0.198105457	0.039245772	0.0223609
54	9.509633654	7.650721520	0.160819878	1.242972134	8.049654709	-1.459978944	2.131538518	0.153526308

Alpha =	1
Beta =	0
Gamma =	0.002575604
MSE =	2.819054182
MAPE =	17.57%



NOTE

In part (b) of Question 2.

We compare the result of triple exponential smoothing model in the future with static model like part (f) of Question 1.

The performance is also better than the static model because of S_t is more proper to fit the status of data.