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On the Simulation Modelling of the amount of Synthetic Supplied between Interacting Industrial Assets Data

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Abstract
In this study, we applied a numerical method called ordinary differential equation of order 45 (ODE45) to predict the effect of decreasing and increasing the parameter value that drives the evolution of Synthetic Industries between time-dependent interacting Synthetic Industries data on biodiversity scenario. The full results that we have obtained which we have not seen elsewhere are presented and discussed quantitatively.

Keywords: Synthetic Industries, ODE45, Simulation, Biomass, Mathematical model

Introduction
Mathematical simulation plays a crucial role in the preservation of forestry biomass, which is an important resource for the production of bioenergy and other products. With the increasing demand for renewable energy sources and sustainable practices, the efficient management of forestry biomass has become a top priority for many industries.

Numerical simulations have a wide range of applications across various fields. By using numerical simulation, researchers can obtain insights into complex systems that are otherwise challenging or impossible to study experimentally. However, it is important to note that simulations are approximations and heavily dependent on the accuracy of the mathematical models and input data used. Mathematical modeling of synthetic industries involves creating mathematical and computational models to analyze and simulate the behaviour and processes within these industries. Synthetic industries refers to those that involve the production of artificial and synthesized products, such as chemical manufacturing, pharmaceuticals, plastics, or advanced materials.

Mathematical modeling in this context, aims to capture the essential aspects of the industry's operations and dynamics, allowing for prediction, optimization and decision making. Numerical simulation of biodiversity loss involves using mathematical models and computer simulation to study the impact of various factors on the decline of biodiversity[1]. These simulations help scientists understand how different variables, such as habitat destruction, climate change, pollution and species interactions, can lead to the loss of biodiversity within an ecosystem.

The author(s) in [2] worked on a comparison of numerical methods by saying forest plays a special role in carbon sequestration and thus mitigating climate change. However, the large uncertainty in biomass estimation is unable to meet the requirement of accurate carbon accounting. The use of a sustainable and rigorous method to accurately estimate forest biomass is significant. We reviewed the estimate methods, including allometric equation, mean biomass density, biomass expansion factor, geostatistics, etc. (LIDAR) would be the key tools to improve forest biomass estimation accuracy. However, prior to this, spatial variation of forest biomass at various levels should be explored using multi-source data and multiple approaches.

The authors in [3] worked on differential effects of a scenario of a non-additive environmental perturbation of biodiversity of ecospheric assets which can be seen as global environmental problem. The pattern of growth of ecospheric assets over time is driven by two inhibiting factors such as inter competition coefficient due to the interaction between the normal agricultural assets and ecospheric assets and the intra and the intrinsic growth rate of the normal agricultural assets variable.

In a similar research, the authors [4] worked on computational modelling of ecospheric asset with the application of ordinary differential equation of order 45 (ODE45) numerical simulation. It was a powerful tool for understanding and analyzing complex systems across various fields of science; addressing real world challenges, show casting its ability to provide valuable insights and predictions.

Since a mathematical model is not an exact quantification of a real life problem and model parameter values are not selected using a standard probability law, it is a good parties in numerical analysis to check the effect of decrease and increase between interacting synthetic industrial assets data due to relatively smaller or bigger degree value of the k parameter value which is one of the parameter values that drives the evolution of synthetic industries over time. Other related contributions to knowledge in the context of environmental modelling of the interaction of synthetic industries, forest biomass and wood resource can be seen in the works of [5-15]

Mathematical Formulation

The following non -linear first ordinary differential equation are considered by [3, 15]

$$\frac{dB}{dt} = \emptyset B - \emptyset \frac{B^2}{q} - d_1 BW \quad (1)$$

$$\frac{dW}{dt} = \alpha_1 BW - C_1 WS - d_2 W \quad (2)$$

$$\frac{dS}{dt} = k - C_2 WS - d_3 S \quad (3)$$

The initial conditions stated above are:

$B(0) = B_0 > 0, \qquad W(0) = W_0 > 0, \quad S(0) = S_0 > 0$

The parameters are defined as follows: B (t) is the population of the forest biomass at any time t.
W (t) is the population of the wood-based industries at any time t, S (t) is the population of the synthetic industries at any time t, $\emptyset$ is the intrinsic growth rate at which the forest population grows logistically without wood-based industries, q is the carrying capacity, C_1 is the competitive effect of forest density on wood base industries, C_2 is the competitive effect of wood-based industries on forest biomass, k is the amount of synthetic supplied to the synthetic industries, d_1 is the rate of depletion of forest biomass, d_2 is the natural rate of depletion of the wood industries
α_1 is the rate at which wood industries grow in the presence of forest biomass

METHOD OF ANALYSIS

To tackle this industrial problem, we have fully explored the application of numerical methods, namely ODE45 to model and predict the effect of decreasing and increasing the amount of synthetic supplied to the synthetic industries by 10%, 30%, 50%, 80%, 90%, 99%, 110%, and 130% on the loss and gain of biodiversity scenario for a fixed initial condition consisting of a point of value

RESULTS

On the application of the above-mentioned numerical methods, we have obtained the following novel empirical results which are presented as displayed as shown in Table 1- Table 12

Table 1: Quantifying the effects of decreasing k by 10% on Synthetic Industries using ODE45 numerical method

Example	LGS TIME (WEEKLY)	$S(old)$	$S(new)$	EPD (%)
1	1	0.0300	0.0300	0
2	8	0.2715	0.0512	81.1314
3	15	0.4875	0.0702	85.5934
4	22	0.6813	0.0873	87.1911
5	29	0.8557	0.1026	88.0143
6	36	1.0131	0.1163	88.5181
7	43	1.1553	0.1287	88.8588
8	50	1.2840	0.1399	89.1043
9	57	1.4004	0.1500	89.2886
10	64	1.5056	0.1591	89.4307
11	71	1.6007	0.1674	89.5424
12	78	1.6865	0.1749	89.6313
13	85	1.7640	0.0816	89.7026
14	92	1.8339	0.1878	89.7602
15	99	1.8968	0.1933	89.8068

16	106	1.9535	0.1984	89.8447
17	113	2.0047	0.2030	89.8755
18	120	2.0507	0.2071	89.9007
19	127	2.0921	0.2109	89.9212
20	134	2.1295	0.2143	89.9379
21	141	2.1631	0.2174	89.9515

Table 2: Quantifying the effects of decreasing k by 30% on Synthetic Industries using ODE45 numerical method

Example	LGS TIME (WEEKLY)	$S(old)$	$S(new)$	EPD (%)
1	1	0.0300	0.0300	0
2	8	0.2715	0.1002	63.1030
3	15	0.4875	0.1629	66.5786
4	22	0.6813	0.2192	67.8322
5	29	0.8557	0.2696	68.4885
6	36	1.0131	0.3151	68.8992
7	43	1.1553	0.3560	69.1836
8	50	1.2840	0.3930	69.3922
9	57	1.4004	0.4264	69.5497
10	64	1.5056	0.4566	69.6704
11	71	1.6007	0.4840	69.7632
12	78	1.6865	0.5088	69.8344
13	85	1.7640	0.5312	69.8885
14	92	1.8339	0.5515	69.9293
15	99	1.8968	0.5698	69.9596
16	106	1.9535	0.5864	69.9818
17	113	2.0047	0.6014	69.9978
18	120	2.0507	0.6150	70.0089
19	127	2.0921	0.6273	70.0165
20	134	2.1295	0.6384	70.0213
21	141	2.1631	0.6484	70.0242

Table 3: Quantifying the effects of decreasing k by 50% on Synthetic Industries using the ODE45 numerical method

Example	LGS TIME (WEEKLY)	$S(old)$	$S(new)$	EPD (%)
1	1	0.0300	0.0300	0
2	8	0.2715	0.1491	45.0742
3	15	0.4875	0.2557	47.5603
4	22	0.6813	0.3511	48.4633
5	29	0.8557	0.4369	48.9425

6	36	1.0131	0.5142	49.2476
7	43	1.1553	0.5839	49.4616
8	50	1.2840	0.6469	49.6196
9	57	1.4004	0.7039	49.7377
10	64	1.5056	0.7554	49.8265
11	71	1.6007	0.8021	49.8923
12	78	1.6865	0.8443	49.9403
13	85	1.7640	0.8824	49.9745
14	92	1.8339	0.9170	49.9980
15	99	1.8968	0.9481	50.0137
16	106	1.9535	0.9763	50.0236
17	113	2.0047	1.0017	50.0292
18	120	2.0507	1.0247	50.0320
19	127	2.0921	1.0454	50.0328
20	134	2.1295	1.0640	50.0323
21	141	2.1631	1.0809	50.0309

Table 4: Quantifying the effects of decreasing k by 80% on Synthetic Industries using the ODE45 numerical method

Example	**LGS TIME (WEEKLY)**	$S(old)$	$S(new)$	**EPD (%)**
1	1	0.0300	0.0300	0
2	8	0.2715	0.2226	18.0300
3	15	0.4875	0.3948	19.0265
4	22	0.6813	0.5492	19.3921
5	29	0.8557	0.6881	19.5894
6	36	1.0131	0.8133	19.7172
7	43	1.1553	0.9265	19.8078
8	50	1.2840	1.0288	19.8742
9	57	1.4004	1.1214	19.9226
10	64	1.5056	1.2051	19.9575
11	71	1.6007	1.2808	19.9818
12	78	1.6865	1.3493	19.9982
13	85	1.7640	1.4110	20.0085
14	92	1.8339	1.4668	20.0147
15	99	1.8968	1.5171	20.0179
16	106	1.9535	1.5625	20.0191
17	113	2.0047	1.6033	20.0191
18	120	2.0507	1.6402	20.0183
19	127	2.0921	1.6733	20.0171
20	134	2.1295	1.7032	20.0158

21	141	2.1631	1.7301	20.0144

Table 5: Quantifying the effects of decreasing k by 90% on Synthetic Industries using the ODE45 numerical method

Example	LGS TIME (WEEKLY)	$S(old)$	$S(new)$	EPD (%)
1	1	0.0300	0.0300	0
2	8	0.2715	0.2471	9.0151
3	15	0.4875	0.4411	9.5137
4	22	0.6813	0.6152	9.6971
5	29	0.8557	0.7719	9.7967
6	36	1.0131	0.9132	9.8614
7	43	1.1553	1.0409	9.9073
8	50	1.2840	1.1564	9.9408
9	57	1.4004	1.2608	9.9650
10	64	1.5056	1.3553	9.9822
11	71	1.6007	1.4407	9.9939
12	78	1.6865	1.5179	10.0016
13	85	1.7640	1.5875	10.0063
14	92	1.8339	1.6503	10.0089
15	99	1.8968	1.7069	10.0101
16	106	1.9535	1.7580	10.0104
17	113	2.0047	1.8040	10.0101
18	120	2.0507	1.8454	10.0095
19	127	2.0921	1.8827	10.0088
20	134	2.1295	1.9163	10.0080
21	141	2.1631	1.9466	10.0073

Table 6: Quantifying the effects of decreasing k by 99% on Synthetic Industries using the ODE45 numerical method

Example	LGS TIME (WEEKLY)	$S(old)$	$S(new)$	EPD (%)
1	1	0.0300	0.0300	0
2	8	0.2715	0.2471	9.0151
3	15	0.4875	0.4411	9.5137
4	22	0.6813	0.6152	9.6971
5	29	0.8557	0.7719	9.7967
6	36	1.0131	0.9132	9.8614
7	43	1.1553	1.0409	9.9073
8	50	1.2840	1.1564	9.9408
9	57	1.4004	1.2608	9.9650
10	64	1.5056	1.3553	9.9822
11	71	1.6007	1.4407	9.9939
12	78	1.6865	1.5179	10.0016

13	85	1.7640	1.5875	10.0063
14	92	1.8339	1.6503	10.0089
15	99	1.8968	1.7069	10.0101
16	106	1.9535	1.7580	10.0104
17	113	2.0047	1.8040	10.0101
18	120	2.0507	1.8454	10.0095
19	127	2.0921	1.8827	10.0088
20	134	2.1295	1.9163	10.0080
21	141	2.1631	1.9466	10.0073

Table 7: Quantifying the effects of decreasing k by 105% on Synthetic Industries using the ODE45 numerical method

Example	**LGS TIME (WEEKLY)**	$S(old)$	$S(new)$	**EPI (%)**
1	1	0.0300	0.0300	0
2	8	0.2715	0.2838	4.5076
3	15	0.4875	0.5107	4.7571
4	22	0.6813	0.7143	4.8494
5	29	0.8557	0.8976	4.8997
6	36	1.0131	1.0630	4.9326
7	43	1.1553	1.2126	4.9560
8	50	1.2840	1.3478	4.9729
9	57	1.4004	1.4702	4.9850
10	64	1.5056	1.5808	4.9933
11	71	1.6007	1.6807	4.9989
12	78	1.6865	1.7709	5.0023
13	85	1.7640	1.8523	5.0043
14	92	1.8339	1.9256	5.0053
15	99	1.8968	1.9918	5.0056
16	106	1.9535	2.0513	5.0056
17	113	2.0047	2.1050	5.0053
18	120	2.0507	2.1533	5.0049
19	127	2.0921	2.1968	5.0045
20	134	2.1295	2.2360	5.0041
21	141	2.1631	2.2713	5.0037

Table 8: Quantifying the effects of decreasing k by 120% on Synthetic Industries using the ODE45 numerical method

Example	**LGS TIME (WEEKLY)**	$S(old)$	$S(new)$	**EPI (%)**
1	1	0.0300	0.0300	0
2	8	0.2715	0.3205	19.0305
3	15	0.4875	0.5803	19.0297
4	22	0.6813	0.8135	19.4005
5	29	0.8557	1.0234	19.6044
6	36	1.0131	1.2130	19.7379

7	43	1.1553	1.3844	19.8329
8	50	1.2840	1.5395	19.9007
9	57	1.4004	1.6797	19.9484
10	64	1.5056	1.8064	19.9805
11	71	1.6007	1.9208	20.0014
12	78	1.6865	2.0241	20.0138
13	85	1.7640	2.1172	20.0206
14	92	1.8339	2.2011	20.0236
15	99	1.8968	2.2766	20.0242
16	106	1.9535	2.3447	20.0234
17	113	2.0047	2.4060	20.0219
18	120	2.0507	2.4612	20.0202
19	127	2.0921	2.5109	20.0183
20	134	2.1295	2.5557	20.0164
21	141	2.1631	2.5960	20.0147

Table 9: Quantifying the effects of decreasing k by 30% on Synthetic Industries using the ODE45 numerical method

Example	LGS TIME (WEEKLY)	$S(old)$	$S(new)$	EPI (%)
1	1	0.0300	0.0300	0
2	8	0.2715	0.3450	27.0460
3	15	0.4875	0.6267	28.5457
4	22	0.6813	0.8796	29.1038
5	29	0.8557	1.1074	29.4119
6	36	1.0131	1.3131	29.6139
7	43	1.1553	1.4991	29.7576
8	50	1.2840	1.6674	29.8591
9	57	1.4004	1.8195	29.9300
10	64	1.5056	1.9569	29.9771
11	71	1.6007	2.0810	30.0071
12	78	1.6865	2.1929	30.0245
13	85	1.7640	2.2938	30.0335
14	92	1.8339	2.3847	30.0371
15	99	1.8968	2.4666	30.0374
16	106	1.9535	2.5403	30.0359
17	113	2.0047	2.6067	30.0334
18	120	2.0507	2.6665	30.0305
19	127	2.0921	2.7204	30.0275
20	134	2.1295	2.7688	30.0247
21	141	2.1631	2.8125	30.0221

DISCUSSION OF RESULTS

Table 1 to Table 9 are results of quantifying the effect of decreasing and increasing the amount of synthetic supplied to the synthetic industries, applying the method of ODE 45 numerical simulation, we observed from the prediction S(old) remains the same because the model parameters are fixed at 100% while S(new) varies because of the variation of the amount of synthetics supplied to the industries (Ø).

From Table 1 to Table 9, the biomass of synthetic industries S(new) when the amount of synthetic supplied is varied from 10% to 99% has lost biomass over that of S(old), that is when all the model parameters are fixed at 100% showing evidence of biodiversity lost. When the amount of synthetic supplied is varied from 105% to 130%, the biomass of synthetic industries S(old) lost biomass over S(new) showing evidence of biodiversity gain.

From example 1 to 21, we consistently observed an increase in the population of synthetic industries when Ø is varied from 105% to 130% while decreasing Ø from 10% to 99% decreases the population of synthetic industries.

As we increase the decrease of synthetic supplied from 10% to 130%, the value of the first scenario is less than the value of the second scenario and the second is less than the third scenario, As the percentage increases, there is improved biomass of the population of the synthetic industries.

CONCLUSION

We applied the methods of Ordinary Differential Equation of order 45 (ODE45) to check the estimated proportion depleted (EPD) and estimated proportion increase (EPI) with respect to synthetic industries by decreasing and increasing the amount of synthetic supplied to the industries.

Graphical Simulation

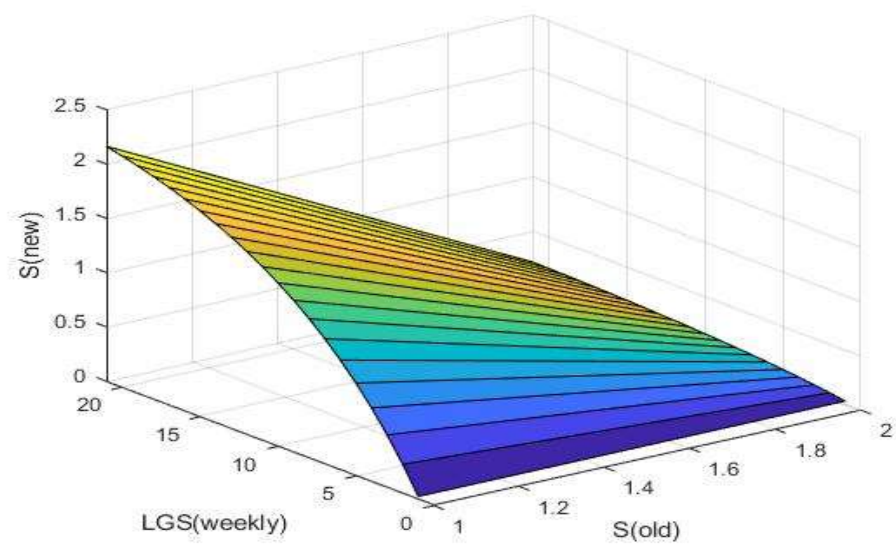


Fig1. Graphical Simulation on the Effect of decreasing Ø by 10% on Synthetic Industries

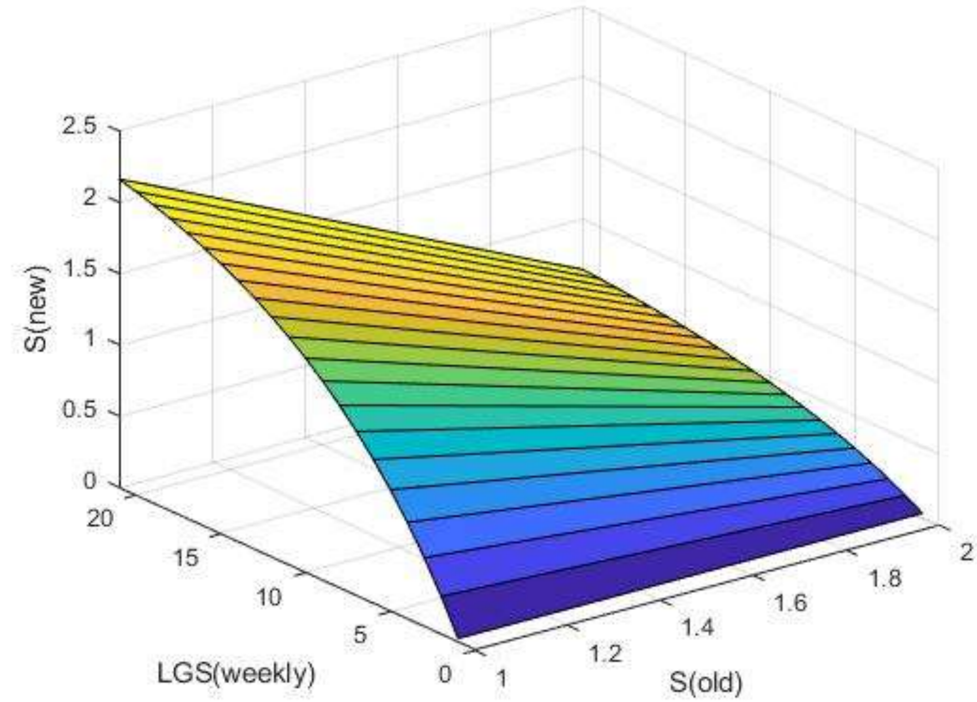
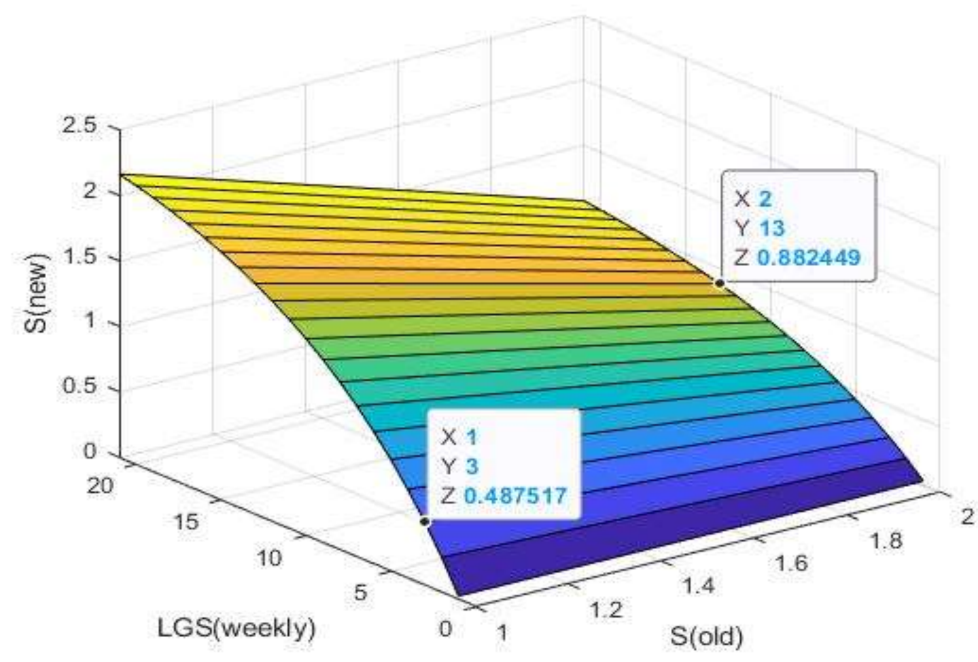


Fig2. Graphical Simulation on the Effect of decreasing Ø by 30% on Synthetic Industries



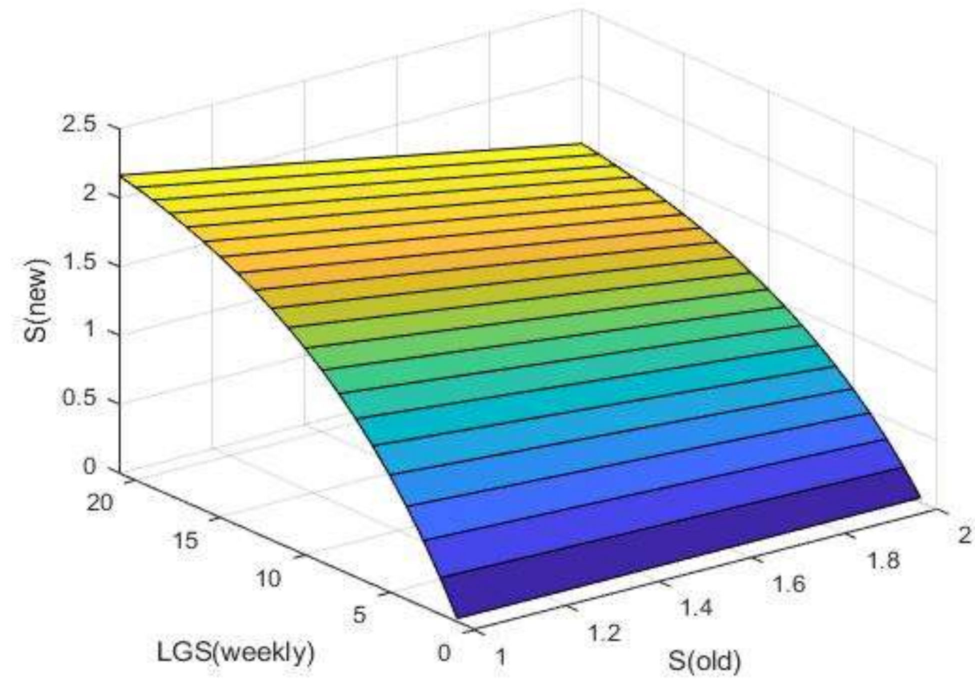


Fig3. Graphical Simulation on the effect of decreasing Ø by 50% on Synthetic Industries

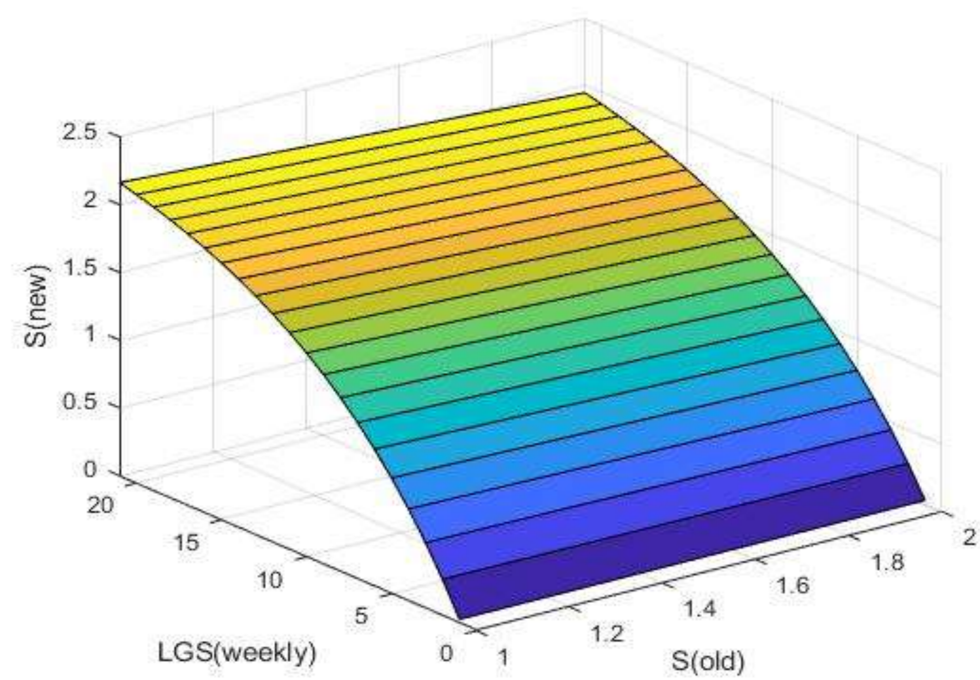


Fig4. Graphical Simulation on the effect of decreasing Ø by 70% on Synthetic Industries

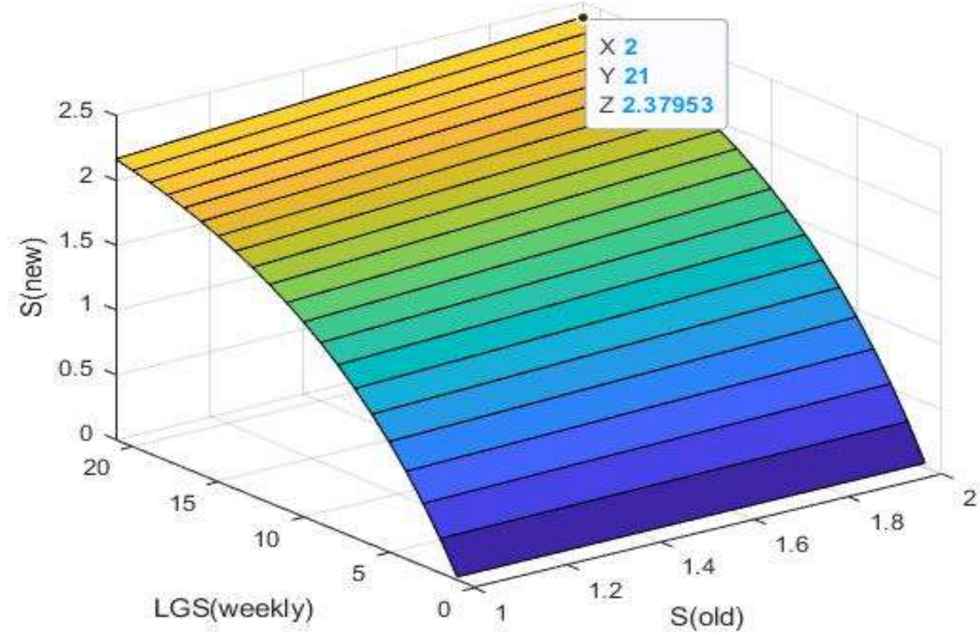


Fig5. Graphical Simulation on the effect of decreasing Ø by 90% on Synthetic Industries

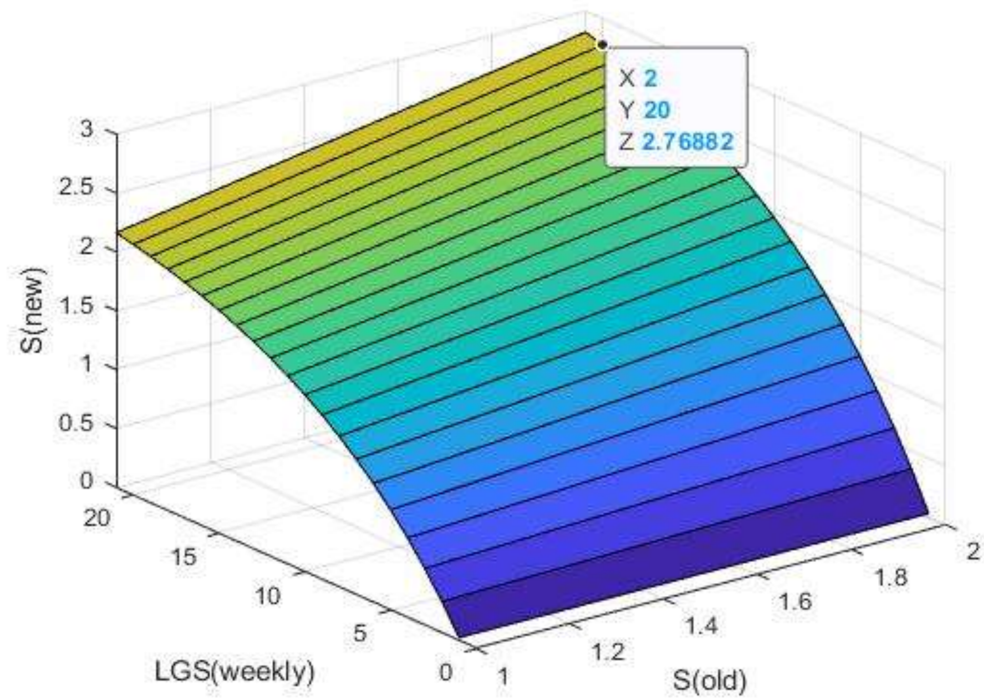


Fig6. Graphical Simulation on the effect of increasing Ø by 110% on Synthetic Industries

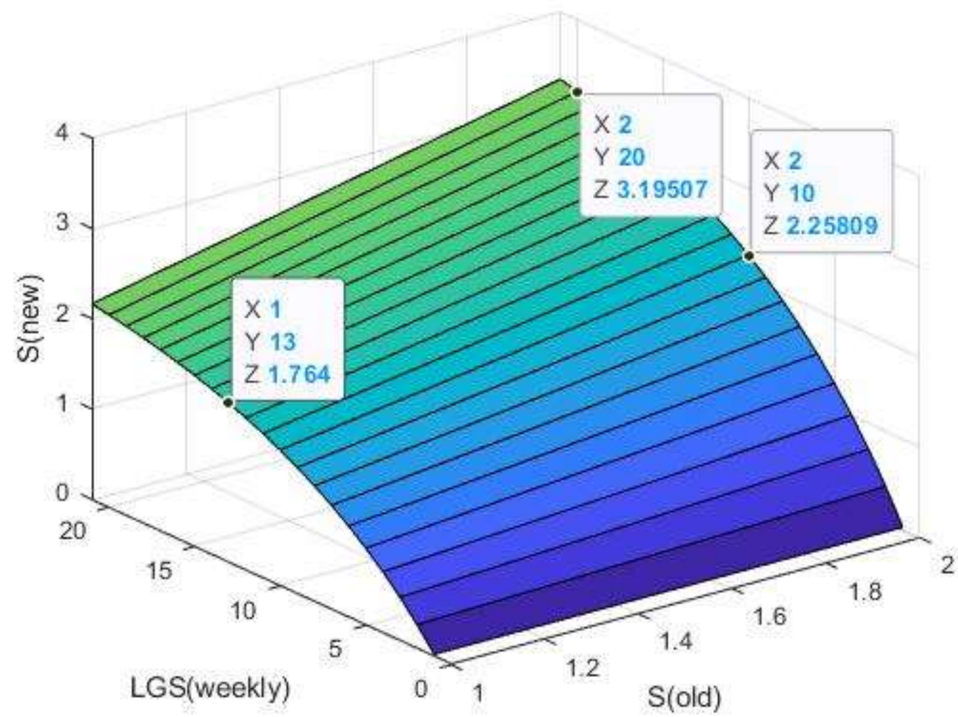


Fig7. Graphical Simulation on the effect of increasing Ø by 130% on Synthetic Industries

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