On Solution to ASUU Strike and Consolidated University Academic Salary Structure II (CONUASS II) in the Nigerian Universities Using Optimization Method

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Abstract: - In this paper, we applied a dynamic programming model for the optimization of Consolidated University Academic Salary Structure II (CONUASS II) for the overall interest of the academic staff and the Nigerian University System at large; the focus of this research was on the decision policy that would help to enhance the living conditions of lecturers in the Nigerian universities thereby averting frequent strikes and disruption of academic calendars; strikes delay students and affect their features; hence, anything that can stabilize the university education in Nigeria will contribute immensely to the economic growth and stability of the country. For us to achieve these objectives, we applied dynamic programming and developed an optimal decision policy to obtain the best optimal policy needed for the highest-ranking cadre in the academic to achieve optimal remuneration of at least twice their per annum salary with subsequent adjustment in the other cadres' salaries accordingly; the researchers applied the optimal decision policy and obtained (1, 1, 1, 1, 1, 1, 2, 2, 0, 0) that optimizes the academic staff's earnings with a promotion to level 08 instead of remaining at the bar with many steps. If this policy is applied, a professor at the bar will grow to level 08 and will earn up to at least double his annual salary (N13,658,325) instead of the current stagnating salary of (N6,020,163) per annum at

the bar; this will make the lecturers happy and discharge their duties with commitments thereby addressing the perennial strikes in the Nigerian universities.

Key-Words: - ASUU strike, CONUASS II, Disruption of the academic calendar, Mathematical optimization, Dynamic programming, Optimal decision policy.

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1 Introduction

The Academic Staff Union of the Nigerian Universities (ASUU) is a trade union formed in 1978 as an offshoot of the Association of University Teachers (AUT) that had been in existence; the reasons for the establishment of ASUU was not only to protect the interest of its members and influence government policies as a trade union but also the interest of Nigeria's entire educational system. The union offers valuable suggestions on other issues of national interest, but the government is always on the opposing side because of its tolerance of injustice; for this reason, the Nigerian government sees her as an enemy that should be destroyed at all costs. The Nigerian government has demonstrated this by disobeying the MoUs and MoAs it willingly entered into with the union, keeping them at a constant salary for over fourteen years and neglecting their welfare, relegating them to begging, and paying no attention to everything ASUU stands for, these resulted to so many strikes by the union. According to [1], ASUU embarked on 16 strikes in 23 years; the Federal government and lecturers disagreed over a 13-year MOU. The frequent strikes are not in the interest of the Nigerian education system, but strikes have impacted both positively and negatively on the Nigerian university system. The positive side of it was the establishment of the University Autonomy Act, the establishment of the Tertiary Education Fund (TETFund), the Needs Assessment Intervention Fund, the granting of a special salary structure to the academic staff known as "Consolidated University Academics Salary Structure", etc. Again, the negative side is loss of academic calendars, delay in the student's graduation, loss of confidence in the public university system, massive drift of students to foreign universities, creation of gap in human development, educational system decay, brain drain, etc. To bring sanity into the university system and halt strikes, the Federal government of Nigeria had an agreement with the union (ASUU) in 2009. The agreement contains the funding of the Federal universities, a separate salary structure (Consolidated University Academic Salary Structure II (CONUASS II)) to be re-negotiated every three years, Earned Academic Allowance (EAA), University autonomy, etc. The agreement was also adopted and applied by the State universities. Since ASUU is a national body comprising all the academic staff of all public universities in Nigeria, whatever applies to the Federal universities trickles down to the State-owned universities.

The cause of the struggle between ASUU and the government was inadequate and commensurable remuneration for the work offered by the academic staff union of the Nigerian universities compared to their counterparts in Africa and the rest of the world. It has been a problem and has lingered over a long period. The remuneration for academic staff is very poor and the least in the world. For this reason, the Academic Staff Union of Nigerian Universities (ASUU) was at the forefront to remedy the situation to avert brain drain and create better conditions of service for its members. ASUU is a powerful trade union known for its struggle to better the condition of the Nigerian educational system. In order to solve the problem that resulted in several strikes [2], the government implemented a sole salary structure for the federal university academic staff in a circular issued on December 8, 2009. According to the circular:

1."The President and Commander-in-chief of the Armed Forces of the Federal Republic of Nigeria has approved a new salary structure for the Academic Staff of the Federal Universities following the collective agreement between the Federal government of Nigeria and Academic Staff Union of Universities on 21/10/2009. The new salary structure, Consolidated University Academic Salary Structure II (CONUASS II), is presented in Table 1 of the Appendix.

2. CONUASS II is a consolidation of the following components: (i) The consolidated Academic Staff Salary Structure (CONUASS) approved by the Federal Government of Nigeria (FGN) takes effect from 01/01/2007 as presented in the (FGN Circular No. SWC/S/04/S.302/1, 18/01/2007). (ii) The Consolidated Peculiar University Academic Allowances (CONPUAA) is exclusively made for university teaching staff only and derived from allowances not adequately reflected or not consolidated in CONUASS. (iii). Rent as approved by the FGN effective 01/01/2007 (FGN Circular No. SWC/S/04/S.302/1, dated 18/01/ 2007).

3. The effective date for the CONUASS II is 01/07/2009. (4). All inquiries from this circular should be directed to the Chairman, National Salaries, Incomes and Wages Commission".

CONUASS has levels 01 to 07 with 13 steps. Level 01 is the lowest grade for new entrants into the academic cadre, that is, the Graduate Assistants (GA), with the last steps of 6; Assistant lecturer and lecturer II have levels 02 & 03 with step 8 as their highest step, Lecturer I has a level of 04 with the last step of 9. The senior lecturer's cadre, level 05, has the longest step of 13, while professorial cadre 06 & 07 has step 10 as its last step. The associate professors occupy the 06 level; level 07 is the highest in the academic cadres for full professors. At this level, a professor can grow up to step ten and remain there until retirement; this is called the bar level.

In this paper, we want to model the CONUASS II data using Dynamic programming; since the highest salary for a professor is a build-up from level 01 to 07, it means that the current earnings of a professor are a result of the cumulative salary scale from 01 to 06 plus his current level salary; this is an optimality problem; hence, we want to use a dynamic programming method to determine the optimal salary structure for academic staff that will solve the lingering and incessant strikes in Nigerian public universities by the Academic Staff Union (ASUU). The stated problem is within the purview of dynamic programming, where the levels are the stages, and the steps are the states (decision variables). The problem involves a link from one level to another and is established through a recursive relationship. Though one salary structure at each stage is dependent on the salary structure of the previous stage (level), in the end, it produces an optimal salary for the entire academic staff on different levels. So, the problem has both optimal structure and overlapping sub-solution; hence, we use Dynamic programming (DP) as a model.

The ASUU demand is numerous, ranging from the revitalization of the Nigerian universities and rejection of IPPIS (Integrated Payroll and Personnel Information System) that eroded the university autonomy, which ASUU fought hard to achieve, to static and stagnating salary structure that made even Chief lecturers in the polytechnics and colleges of education earn monthly salaries that are more than those of professors in the Nigerian universities. The situation becomes disturbing to any sound mind on the condition of university academic staff, and worse still, the vibrant and experienced academic staff are leaving the Nigerian university system in droves in search of better opportunities abroad. There is an urgent need to salvage the system to stop the brain drain. It is a known truth that the Federal government of Nigeria did not want the re-negotiation of the 2009 agreement that was long overdue. The crucial aspect of the agreement that the government always avoids is the welfare aspect of it, which has to do with the salaries, allowances, and periodic reviews. It is intuitive that if the packages are enhanced, it will reverse the ugly trend in the Nigerian university system.

However, since the agreement, the government has refused to re-negotiate or review the agreement as agreed by the government and the union; members can no longer cope with the economic hardship inflicted by this neglect. The last straw that broke the camel's back was the eight (8) months strike embarked upon by the academic staff union from February 2022 to October 2022, where the government refused to pay them on the grounds of a no-work-no-pay policy, while the government was the one who violated the last Memorandum of Action (MoA) reached with the union. The union lost many of its members to death due to the union members' inability to cater to their health and other family needs. We seek to help the government and ASUU to find a lasting solution and bring sanity into the Nigerian university system. We shall apply an optimization technique to achieve this. The optimization technique that can deal with this problem adequately is the dynamic programming (DP) model because the data satisfies the characteristics of DP.

Dynamic programming is a mathematical optimization technique used in modeling some complex problems that may be difficult to model using other optimization techniques; it belongs to

the non-linear optimization family, but the computation follows a linear order. It breaks the entire problem into stages to arrive at the optimal solution. Dynamic programming uses optimality, a situation where the current solution links with the previous events; this is achieved through recursive relationships and backward pass to arrive at optimal decisions. Dynamic programming model divides a set of problems into different stages and states (decision variables) and has an independent decision in each stage but is dependent from one stage to another. Each sub-optimal stage was linked to another sub-optimal stage through a recursive relationship. One sub-optimal stage forms the basis for the next sub-optimal stage, and at the end, the optimal solution for the entire problem is achieved. It relied on a backward pass approach in attaining optimality, that is, the solution to the problem stats from the last stage and back to the first stage. It has diverse applications and is used to provide solutions and models for those problems that cannot fit into known distributions or any optimization model. Dynamic programming has variant models, depending on the nature of the problem to be solved; that is why it is called "dynamic," in general, it maintains a unique feature, which is principally anchored in optimality [3]. Though dynamic programming has many advantages, one of its shortcomings is the restriction imposed on its applications to large-size problems. This restriction is known as the "curse of dimensionality"; the curse of dimensionality occurs when the complexity of the problem increases rapidly because of a little increase in the number of inputs [4]. Empirically, dynamic programming was used by the author to model transportation and logistics problems and to demonstrate the robustness of dynamic programming [5]. The author noted that due to the decomposed nature of the mathematical model developed to handle transportation and logistics problems, dynamic programming was proposed and found to be suited for such a complex model.

However, not all problems are qualified to be modelled by DP. Hence, a problem can qualify for DP modeling if it has optimal substructure and overlapping sub-problems. Dynamic programming is appropriate when the sub-problem is not independent. Therefore, Dynamic programming solves each sub-problem just once and stores the result in a table for use on demand. So, if a problem does not have an optimal substructure, there is no basis for defining a recursive algorithm to find the optimal solutions; also, if a problem does not have overlapping sub-problems, we do not use dynamic programming.

1.2 Aim and Objectives

This paper aims to find a solution to the ASUU strike and Consolidated University Academic Salary Structure II (CONUASS II) in Nigerian Universities using an optimization method, and the objectives are:

1. To determine subprograms and their respective optimal policies

2. To recursively solve the stage problems and to obtain stage policies

3. To determine the optimal decision policy that optimizes the salary structure for the overall interest of the academic staff union members and Nigeria.

The impact and importance of this paper on Computer Science/Computation Technique is that dynamic programming is an optimization technique that has application in Computer Science with the sole aim of developing an optimal decision procedure (algorithm) that will effectively allocate resources not only for optimal benefit of Computer Scientists as members of academic staff but for the general public. DP model and its computing technique are robust and can handle Computer Science modeling problems.

To organize this work properly, we devoted section one to the introduction, section two to the literature review, section three to materials and methods, section four to data presentation and analysis, and section five to discussions, which includes summary and recommendations.

2 Literature Review

Here, we review some related works done by other researchers in this area; though, there is no direct work done on a solution to the ASUU strike and Consolidated University Academic Salary Structure II (CONUASS II) in the Nigerian Universities using

optimization method yet, there are some related works on the application of Dynamic programming.

Dynamic programming was used to model business sustainability that encompasses the economic (Profits), environmental (Planet), and social (People) [6]. It is a known fact that the objective of sustainability management is to choose the levels of activities that the profits or the costs are maximized or minimized, and the impact of the activities on the environment. To achieve these, the researcher formulated the sustainability management problem as a multiple-objective or goal-programming problem where the level of activity undertaken affects the three facets of sustainability. Then, the researcher expanded the multi-objective programming formulated to a dynamic programming problem to cover the dynamic nature of sustainability management. Again, Dynamic programming (DP) guarantees global optimality through an exhaustive search of all control and state grids. The application of DP in PHEVs consists of finding optimal control sequences to obtain the optimal battery state of charge (SoC) and to minimize fuel consumption [7]. The researchers noted that DP is used to solve the optimal energy management problem of HEVs. Hence, to optimize fuel consumption in PHEVs, the researchers used DP to find the optimal power combination of the power components to meet the power demand of the vehicle; again, some researchers [8] developed an algorithm for a discrete discounted cost dynamic programming problem from the complementary slackness theorem of linear programming. The authors observed that the policy improvement procedure for solving such a problem coincides with the Simplex method solution to a linear program. However, [9] observed that dynamic programming is an effective method of solving combinatorial problems of a sequential nature. It is advantageous to use dynamic programming since the concept can provide convergence to an optimum solution without total enumeration. To develop a DP recursive formula, we divide the problem into stages, which are evaluated independently, given a set of environmental conditions (states). On the complexity of a large class of problems, [10] observed that the curse of dimensionality is the problem caused by the exponential increase in volume associated with adding extra dimensions to Euclidean space.

As stated earlier, dynamic programming is applied in diverse fields such as security. These researchers [11] used DP to track crimes in Nigeria. They developed and applied a dynamic programming model for crime-preventing patrol teams. Furthermore, these researchers [12] demonstrated various applications of dynamic programming in real-life scenarios. Such applications include maritime and voyage scheduling for optimal and effective control of activities, including route scheduling. Also, [13] observed that the restriction to the application of dynamic programming is the curse of dimensionality. In trying to solve this restriction, the researchers used deep learning to solve the problem of the curse of dimensionality. Their proposed method was complex but was able to proffer a solution to the problem. And [14] used multi-objective dynamic programming to solve optimization problems. They believed that their model overcomes the poor performance of standard evolutionary operators on such heavily constrained problems. The researchers' interest was in the serial dynamic programming system where one stage output forms input for the preceding stage, and in the end, the independent decisions from each stage are combined to form the optimal decision for the entire system.

On the other hand, [15] observed that dynamic programming uses the concepts of sub-optimization and the principle of optimality in solving a problem. An optimal policy (or a set of decisions) has the property that whatever the initial state and initial decision are, the remaining decisions must constitute an optimal policy about the state resulting from the first decision. They used dynamic programming to determine the optimal course allocation in Nigerian Universities. Finally, [16] used multi-objective dynamic programming to improve their design and operational strategies. The researchers aimed to adapt DP to solve the Optimization problem and to apply it to the multi-objective unit commitment problem (MO-UCP).

They noted that the benefit of using such a representation is that it helps the authors design evolutionary operators that keep most of the constraints satisfied at all times.

3 Materials and Methods

Here, we focused on solutions to the ASUU strike and Consolidated University Academic Salary Structure II (CONUASS II) in Nigerian Universities using the optimization method. We can observe that the present status (level) of Professors depends on their past status (level). So, this relationship between the current and past status is recursive. In other words, the future status (level) depends on today's status (level). Hence, the solution to the ASUU strike and Consolidated University Academic Salary Structure II in the Nigerian University system adequately fits the dynamic programming problem and should be modeled using dynamic programming.

3.1 Method of Data Collection

The data for this paper is secondary data collected from the publication of the National Salaries, Incomes, and Wedges Commission with circular No. SWC/S/04/S.100/II/403; 12/08/2009. The data was on the Consolidated University Academic Staff Salary Structure II (CONUASS II), which is still in use as of October 2023.

3.2 Method of Data Analysis

We apply the Dynamic programming model in equation (1),

$$f(S_n, x_n) = \max_{x_i}[R_n(x) + f_{n+1} * (S_n - x_n)] \quad (1)$$

Where $f(S_n, x_n)$ is the optimization function of two variables (states and stages); $R_n(x)$ is the function that assigns steps to academics (states); $f_{n+1} *$ is the optimal function from the previous stage; S_n is the stage variables; x_n is the state variables. Our dynamic programming model considers the long steps without promotion at the professorship cadre (level) as one cadre (level) with designation CONUASS 08, which should be the last level in the academic career; this was born out of the need to accommodate the long steps in the Professorial cadre known as the "bar'. At the bar level, there is no promotion until the Professor retires from the university service.

3.3 Optimal Decision Policy

This policy will help us in making an informed decision on the allocation of resources and the determination of the optimal decision variables that optimize the objective function. Therefore, let S_i be the stage variables, i = 1, . . , n ; x_i be the decision (state) variables, and k_i* be the optimal decision variable at each stage, then we state the optimal decision policy as follows:

$S_1 = n_1$; $x_1* = k_1$, ……, for (stage) level "01" (2)

$S_2 = (n_1 - k_1)$; $x_2* = k_2$, ..., for (stage) level "02" (3)

……. …….

$S_{n-1} = (n_{-1} - k_{n-1})$; $x_{n-1}* = k_{n-1}$ for level "n-1" (4)

$S_n = (n - k_{n-1})$; $x_n* = k_n$ for (stage) level "n" (5)

Therefore, if the salary structure is implemented in the order (k_1, k_2, k_3, ……, k_n), professors will earn at least double their present salaries per annum, and academics at other levels (cadres) will get an enhanced/ adjusted salary that will prevent strikes.

4 Data Presentation and Analysis

4.1 Data Presentation

In Table 1, we present the raw (original) data on Consolidated University Academic Salary Structure II (CONUASS II), where 01, …, 07 are the levels and 1, 2, . . . ,10 are the steps, N is the unit of measurement (amount) in naira; see Appendix. Also, Table 2 presents the raw data from Table 1 in a Dynamic programming format and introduces levels 08, 09, and 10 to form a square dynamic programming cost matrix, see Appendix.

4.2 Data Analysis

In this section, we analyse the problem presented in Table 2 using the Dynamic programming model stated in equation (1) and the Optimal decision policy in equations (2) – (5) to arrive at the optimal decision that will help to optimize the lecturers' salary structure. We start with the iteration table coded "For n = 10" down to "For n = 1" from the iteration Tables, see Appendix.

4.3 Optimal Decision Policy

Hence, for the optimal solution, we apply the optimal decision policy in equations (2) – (5) starting from the last iteration Table "For n = 1" to the first iteration Table "For n = 10" and arrived at the following solutions:

$$S_1 = 10, \quad x^*_1 = 1$$

$$S_2 = 10 - 1 = 9, \quad x^*_2 = 1$$

$$S_3 = 9 - 1 = 8, \quad x^*_3 = 1$$

$$S_4 = 8 - 1 = 7, \quad x^*_4 = 1$$

$$S_5 = 7 - 1 = 6, \quad x^*_5 = 1$$

$$S_6 = 6 - 1 = 5, \quad x^*_6 = 1$$

$$S_7 = 5 - 1 = 4, \quad x^*_7 = 2$$

$$S_8 = 4 - 2 = 2, \quad x^*_8 = 2$$

$$S_9 = 2 - 2 = 0, \quad x^*_9 = 0$$

$$S_{10} = 0 - 0 = 0, \quad x^*_{10} = 0$$

See Appendix.

5 Discussions and Recommendations

5.1 Discussion

From the analysis, we obtained some interesting results. In the first case, we observed that the last two levels were in-admissible, i.e., steps 09 and 10 cannot apply and therefore zeros. That means that the terminal level should be level 08. On careful observation again, we see that the last two levels following levels 09 and 10 have values "2" each. These levels should be the final promotional levels for professorial cadres. Instead of remaining at 07 with many steps it is advisable to promote Professors at the bar to level 08. This new terminal promotion will increase the annual salaries of associate professors and full Professors by at least twice their current earnings on this static CONUASS II salary structure. Then, other levels with values "1" will have their salaries adjusted with hope that, they will enjoy salary doubling when they attain the levels of 07 and 08. If this policy is implemented, a professor at the bar will grow to level 08 and will therefore earn up to at least double his annual salary (N13,658,325) instead of the current stagnating salary of (N6,020,163) per annum at the bar. Our discussion so far is depicted by the optimal decision policy: (1, 1, 1, 1, 1, 1, 2, 2, 0, 0). This measure can cushion the effects of brain drain due to financial difficulties on the academic staff and restore normalcy in the Nigerian University System.

One area of hindrance to the application of DP is the "curse of dimensionality"; this restriction made dynamic programming to be applied and used to model small-scale problems. Researchers should do more work in this area to find a simple and workable solution to this lingering problem that restricts dynamic programming applications to small-scale problems.

5.2 Summary

In this paper, we applied a dynamic programming model for the optimization of Consolidated University Academic Salary Structure II (CONUASS II) for the overall interest of the academic staff and the Nigerian University System. Our focus was on the decision policy that would help to enhance the living conditions of lecturers in Nigerian universities, thereby averting frequent strikes and disruption of academic activities. The frequent strikes delay students and negatively impact their features; hence, anything that could stabilize university education in Nigeria will contribute immensely to the economic growth and stability of the country. To achieve these, we applied dynamic programming and developed the optimal decision policy to obtain the best policy needed for the highest-ranking cadre in the academic to achieve optimal remuneration of at least twice their current per annum salary with subsequent adjustment on the other levels' salaries accordingly. We Applied the optimal decision policy in equations (2) – (5), and obtained (1, 1, 1, 1, 1, 1, 2, 2, 0, 0), which optimizes the academic staff's earnings with a promotion to level 08 instead of remaining at the bar with many steps. That is to say that even if the government finds it hard to do a salary review as she ought to do but implement this recommendation, the lecturers will be happy and discharge their duties with commitments, and this will go a long way to addressing the perennial strikes in the Nigerian public universities.

5.3 Recommendations

We recommend from our findings in this paper that:

1. The Federal government of Nigeria should introduce level 08 into the CONUASS II and make necessary adjustments in the salary structures of other levels of academics; this will take care of industrial unrest and ASUU strikes in the Nigerian public university system.

2. We recommend that more research should be done to find an algorithm and codes that could solve a large class of dynamic programming problems, as this is a problem in the application of dynamic programming.

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Appendix

Table1. Consolidated University Academic Salary Structure II (CONUASS II)

	1	2	3	4	5	6	7	8	9	10
CONUASS	N	N	N	N	N	N	N	N	N	N
01	1263377	1300255	1337133	1374011	1410889	1447767				
02	1451071	1494474	1537879	1581284	1624688	1668093	1711497	1754902		
03	1649509	1696671	1743832	1790994	1838156	1885317	1932479	1979640		
04	2079995	2155497	2230998	2306501	2382003	2457504	2533007	2608509	2684010	
05	3091505	3205172	3318838	3432505	3546172	3659839	3773506	3887172	4000839	4114506
06	3768221	3905613	4043005	4180397	4317789	4455181	4592573	4729965	4867357	5004750
07	4580349	4740328	4900308	5060287	5220265	5380245	5540225	5700206	5860184	6020163

Source: National Salaries, incomes and Wages Commission, 2009.

Table 2. Presenting Data in Table1 in Dynamic Programming Format

LEVEL	STEPS (Xi)									
Sn	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0
1	1263377	1300255	1337133	1374011	1410889	1447767	0	0	0	0
2	1451071	1494474	1537879	1581284	1624688	1668093	1711497	1754902	0	0
3	1649509	1696671	1743832	1790994	1838156	1885317	1932479	1979640	0	0
4	2079995	2155497	2230998	2306501	2382003	2457504	2533007	2608509	2684010	0
5	3091505	3205172	3318838	3432505	3546172	3659839	3773506	3887172	4000839	4114506
6	3768221	3905613	4043005	4180397	4317789	4455181	4592573	4729965	4867357	5004750
7	4580349	4740328	4900308	5060287	5220265	5380245	5540225	5700206	5860184	6020163
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0

Iteration Table: For n = 10; we have:

S_{10}	f^*_{10}	X^*_{10}
0	0	0
1	0	1
2	0	2
3	0	3
4	0	4
5	4114506	5
6	5004750	6
7	6020163	7
8	0	8
9	0	9
10	0	10

Iteration Table: For n = 9; $f_9(S_9, x_9) = R_9(x_9) + f_{10}^{*}(S_9 - x_9)$

S9/X9	0	1	2	3	4	5	6	7	8	9	10	f*9	X*9
0	0											0	0
1	0	0										0	0, 1
2	0	0	0									0	0
3	0	0	0	0								0	0, 1, 2
4	0	0	0	0	2684010							2684010	4
5	4114506	0	0	0	2684010	4000839						4114506	0
6	5004750	4114506	0	0	2684010	4000839	4867357					5004750	0
7	6020163	5004750	4114506	0	2684010	4000839	4867357	5860184				6020163	0
8	0	6020163	5004750	4114506	2684010	4000839	4867357	5860184	0			6020163	1
9	0	0	6020163	5004750	6798516	4000839	4867357	5860184	0	0		6798516	4
10	0	0	0	6020163	7688760	8115345	4867357	5860184	0	0	0	8115345	5

Iteration Table: For n = 8; $f_8(S_8, x_8) = R_8(x_8) + f_9^*(S_8 - x_8)$

S8/X8	0	1	2	3	4	5	6	7	8	9	10	f*8	X*8
0	0											0	0
1	0	0										0	0 , 1
2	0	0	1754902									1754902	2
3	0	0	1754902	1979640								1979640	3
4	2684010	0	1754902	1979640	2608509							2684010	0
5	4114506	2684010	1754902	1979640	2608509	3887172						4114506	0
6	5004750	4114506	4438912	1979640	2608509	3887172	4729965					5004750	0
7	6020163	5004750	5869408	4663650	2608509	3887172	4729965	5700206				6020163	0
8	6020163	6020163	6759652	6094146	5292519	2608509	4729965	5700206	0			6759652	2
9	6798516	6020163	7775065	6984390	6723015	6571182	4729965	5700206	0	0		7775065	2
10	8115345	6798516	7775065	7999803	7613259	8001678	7413975	5700206	0	0	0	8115345	0

Iteration Table: For n = 7; $f_7(S_7, x_7) = R_7(x_7) + f_8^*(S_7 - x_7)$

S7/X7	0	1	2	3	4	5	6	7	8	9	10	f*7	X*7
0	0											0	0
1	0	0										0	0, 1
2	1754902	0	1711497									1754902	0
3	1979640	1754902	1711497	1932479								1979640	0
4	2684010	1979640	3466399	1932479	2533007							3466399	2
5	4114506	2684010	3691137	3687381	2533007	3773506						4114506	0
6	5004750	4114506	4395507	3912119	4287909	3773506	4592573					5004750	0
7	6020163	5004750	5826003	4616489	4512647	5528408	4592573	5540225				6020163	0
8	6759652	6020163	6716247	6046985	5217017	5753146	6347475	5540225	0			6759652	0
9	7775065	6759652	7731660	6937229	6647513	6457516	6572213	7295127	0	0		7775065	0
10	8115345	7775065	8471149	7952642	7537757	7888012	7276583	7519865	1754902	0	0	8471149	2

Iteration Table: For n = 2; $f_2(S_2, x_2) = R_2(x_2) + f_3^*(S_2 - x_2)$

S2/X2	0	1	2	3	4	5	6	7	8	9	10	f*2	X*2
0	0											0	0
1	2858656	1300255										2858656	0
2	4232667	4158911	1494474									4232667	0
3	5569800	5532922	4353130	1696671								5569800	0
4	5777073	6870055	5727141	4555327	2155497							6870055	1
5	5986783	7077328	7064274	5929338	5014153	3205172						7077328	1
6	7324702	7287038	7271547	7266471	6388164	6063828	3905613					7324702	0
7	9757560	10529874	7481257	7473744	7725297	7437839	6764269	4740328				10529874	1
8	11094693	11057815	8819176	7683454	7932570	8774972	8138280	7598984	0			11094693	0
9	11295439	12394948	11252034	9021373	8142280	8982245	9475413	8972995	2858656	0		12394948	1
10	11501392	12595694	12589167	11454231	9480199	9191955	9682686	10310128	4232667	2858656	0	12595694	1

Iteration Table: For n = 1; $f_1(S_1, x_1) = R_1(x_1) + f_2^*(S_1 - x_1)$

S1/X1	0	1	2	3	4	5	6	7	8	9	10	f*1	X*1
0	0											0	0
1	2858656	1263377										2858656	0
2	4232667	4122033	1451071									4232667	0
3	5569800	5496044	4309727	1649509								5569800	0
4	6870055	6833177	5683738	4508165	2079995							6870055	0
5	7077328	8133432	7020871	5882176	4938651	3091505						8133432	1
6	7324702	8340705	8321126	7219309	6312662	5950161	3768221					8340705	1
7	10529874	10416207	8528399	8519564	7649795	7324172	6626877	4580349				10529874	0
8	11094693	11793251	8775773	8726837	8950050	8661305	8000888	7439005	0			11793251	1
9	12394948	12358070	11980945	8974211	9157323	9961560	9338021	8813016	2858656	0		12394948	0
10	12595694	13658325	12545764	12179383	9404697	10168833	10638276	10150149	4232667	2858656	0	13658325	1