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 dynamic programming model for 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 condition of lecturers in the Nigerian universities thereby averting frequent strikes and disruption of academic calendars. The frequent and incessant strikes delay students and impacts negatively to their feature; hence, anything that could be done to stabilize the university education in Nigeria will contribute immensely to the economic growth and stability of the country. To achieve this, we applied dynamic programming and developed an optimal decision policy which was applied 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. Applying the optimal decision policy, we obtained (1, 1, 1, 1, 1, 1, 2, 2, 0, 0) which optimizes the academic staff's earning with a promotion to level 08 instead of remaining at bar with many steps. If this policy is implemented, a professor at the bar will grow to level 08 and will therefore earn up to at least double of his/her 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 to be happy and discharge their duties with commitments and thereby addressing the perennial strikes in the Nigerian universities.

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

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1 Introduction

Academic Staff Union of the Nigerian Universities (ASUU) is a trade union formed in 1978 as an offshoot of Association of University Teachers (AUT) which has earlier been in existence. The purpose was not only to protect the interest of her members and influence government policies but the interest of the entire educational system in Nigeria. It offers valuable suggestions on other issues of national interest. ASUU and government are always on the opposing side because of its radical nature and intolerance to injustice from the government. For this reason, the Nigerian government sees her as an enemy that must be crushed as all cost. 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 counting, neglected their welfare, relegated them to begging, and pay no attention to everything ASUU stands for and these resulted to so many strikes by the union. According to [1], ASUU embarked on 16 strikes in 23 years, Federal government and lecturers disagree over 13-year MOU. The incessant strikes were not good for the

Nigerian education system. But the strikes have impacted both positively and negatively to the university system in Nigeria. The positive side of it was the establishment of university autonomy, TETFund, Needs Assessment Intervention Fund, Consolidated University Academics Salary Structure, etc. on the other hand, the negative side include; loss of academic calendars, delay on students' graduation, loss of confidence in the system, massive drift of students to foreign universities, creation of gap in manpower development, system decay, brain drain, etc. In order to bring sanity into the university system and to halt strikes, the government had agreement with the union in the year 2009. The agreement contains the funding of the Federal universities, separate salary structure (Consolidated University Academic Salary Structure II (CONUASS II)) to be reviewed (renegotiated) 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, whatever applies to the Federal universities trickles down to the State owned universities.

Adequate commensurable remuneration for the work offered by the academic staff union of the Nigerian universities have been a problem and has lingered over a long period of time. The remuneration for academic staff was very poor compared to their counterparts and what obtains in other parts of the world. For this reason, the Academic Staff Union of Nigerian Universities (ASUU) was in the forefront to remedy the situation to avert brain drain and better condition of service for her members. ASUU is a very powerful trade union known for struggle to better the lots of Nigerians. In a bid to solve the problem which resulted into several strikes, [2] came up with the implementation of 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, 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 21st October, 2009. The new salary structure, known as Consolidated University Academic Salary Structure II (CONUASS II), is presented in Table1 of 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) effective 1st January 2007 (FGN Circular No. SWC/S/04/S.302/1, dated 18th January, 2007).

(ii) The Consolidated Peculiar University Academic Allowances (CONPUAA), exclusively for university teaching staff and derived from allowances not adequately reflected or not consolidated in CONUASS.

(iii). Rent as approved by the FGN effective 1st January 2007 (FGN Circular No. SWC/S/04/S.302/1, dated 18th January 2007).

3. The effective date for the implementation of the CONUASS II is 1st July, 2009.

4. All inquiries arising from this circular should be directed to the Chairman, National Salaries, Incomes and Wages Commission".

CONUASS has levels 01 to 07 with 13 steps. The level 01 is the least grade for new entrants into the academic cadre, Graduate Assistants, with the last steps of 6, Assistant lecturer and lecturer II have levels 02 & 03 with step 8 as the last steps, Lecturer I has a level of 04 with 9 steps as the last step. The senior lecturer's cadre, level 05, has the longest step of 13, while professorial cadre 06 – 07 has step 10 as their last steps. The level 07 is the highest level in the academics 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 earning of a professor is as a result of the cumulative of salary scale from 01 to 06 plus his/her current level. This is an optimality problem; hence, we want to determine the optimal salary structure for academic staff to solve the lingering and incessant strikes in the universities by the academic staff union (ASUU). This problem is within the domain of dynamic programming, where the levels are the stages and the steps are the states. The problem involves a recursive relationship and the salary structure at each stage is dependent on the salary structure at another stage (level) but in the end produces an optimal salary for the academic

staff. So, the problem has both optimal structure and overlapping sub-solution and therefore can be modelled using Dynamic programming (DP). Though the ASUU demand are numerous, ranging from the revitalization of the Nigerian universities, rejection of IPPIS (Integrated Payroll and Personnel Information System) which eroded the university autonomy that ASUU fought hard to achieve, to static salary that made even polytechnic and colleges of education chief lecturer's salary placed ahead of university professors' salary; it becomes worrisome to any sound mind on the condition of university academic staff. There is urgent needed to salvage the system. It was observed that the government is averse to re-negotiation of the 2009 agreement which was long overdue. And the crucial aspect of the agreement which government always avoid is the welfare area of the agreement which has to do with the salaries, allowance packages and their periodic reviews, so if the packages are enhanced, it will reverse the ugly trend in the Nigerian university system.

But since the agreement, government has refused to renegotiate or reviewed the agreement. The union members are the least payed compared to their counterparts not only in Africa but in Nigerian higher institutions as well. Members can no longer cope with the economic hardship inflicted on them by this neglect. The last straw that breaks the camel's back was the eight (8) months strike embarked upon by the academic staff union on February 2022 to October 2022 where government refused to pay them on the ground of 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 her members to death due to the union members' inability to cater for their health and other family needs. Many of the younger ones left the country in search of better opportunities abroad. There was massive brain drain that left the Nigerian universities worse than ever. We seek to help both the government and ASUU to devise a means of finding a lasting solution and bring sanity into the Nigerian Universities 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.

Dynamic programming is a mathematical optimization technique that is adapted to modelling some complex problem that may be difficult to model using other optimization techniques. It breaks the entire problem into stages to arrive at optimal solution. It makes use of optimality, that is, a situation where the current solution is linked to the previous events. This is achieved through recursive relationship and backward pass to arrive at optimal decision. Dynamic programming (DP) model divides a set of problem into different stages with its decision variables and has an independent decision though the stages are not independent of one another but link one sub-optimal stage to another sub-optimal stage using 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 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, especially in those areas where most of other non-linear and linear optimization cannot be applies. It is mostly used to provide solution and models for those problems that cannot fit into known distribution 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" but in general it maintains a unique feature, which is principally anchored in optimality, [3]. Though dynamic programming has many advantages but one of its greatest shortcomings is the restriction imposes on its applications to large problems, which is the characteristics of real life problems. This restriction is known as the "curse of dimensionality". The curse of dimensionality occurs when the complexity of the problem increases rapidly as a result of little increasing in the number of inputs, [4]. A major advantage of dynamic programming over other non-linear programming techniques is that the computing time is only linearly dependent on the number of stage variables, but unfortunately, size still precludes the use of dynamic programming in the solution of realistic large-scale problems, [5]. For instance, in this current problem on the application of DP to CONUASS, the resulting cost matrix becomes problematic in finding it solution because of its large dimension. But the researchers believe that with adequate software coding, the problem can be solved with ease.

Before a problem can qualify for DP modelling, it must have optimal substructure and overlapping sub-problems. Dynamic programming is used when the sub-problem is not independent. Therefore, Dynamic programming solves each sub-problem just once and store the result in a table so that it can be repeatedly retrieved and used if the need be. So,

if a problem does not have optimal substructure, there is no basis for defining a recursive algorithm to find the optimal solutions and if a problem does not have overlapping sub-problems, we do not use dynamic programming. A critical look into the problem under study shows that it falls under the purview of Dynamic programming.

1.1 Components of Dynamic programming

1. Stages: the problem can be divided into several sub-problems (levels) which are called stages.

2. States: each stage has several states (decision variables) associated with it.

3. Decision: at each stage, there can be multiple choices out of which one of the best decisions should be taken (stage decision).

4. Optimal policy: it is a rule which determines the decision at each stage; if it is globally optimal, it is known as Bellman's principle of optimality.

5. Given the current state, the optimal choices for each of the remaining states do not depend on the previous states or decisions.

6. There exists recursive relationship that identifies the optimal decisions for stage j, given that stage j-1 has already been solved.

7. Optimal decision at the future stage is independent of the optimal decision at the previous stage.

8. The final stage must be solved by itself.

1.2 Aim and Objectives

The aim of this paper is on solution to ASUU strike and Consolidated University Academic Salary Structure II (CONUASS II) in the Nigerian Universities using 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 obtain the optimal decision policy for the entire problem and determine the best policy that would optimize salary structure for the overall interest of the academic staff union members.

To organize this work in a comprehensible manner for better understanding, we devoted section one to introduction and background of the study, section two to literature review, section three to materials and methods, section four to data presentation and analysis, section five to discussions which includes summary, and recommendations.

2 Literature Review

In this section, we review some related works done by other researchers in this area, though there is no direct work done on solution to ASUU strike and Consolidated University Academic Salary Structure II (CONUASS II) in the Nigerian Universities using optimization method but there are some related works on the application of Dynamic programming.

These researchers [6], trace the development of non-serial dynamic programming from the basic theory underlying dynamic programming to the latest applications of non-serial dynamic programming. They observed that most dynamic programming processes can be grouped into four categories: (a) serial processes, (b) non-serial processes, (c) Markov processes and (d) fuzzy processes. The principle of optimality can then be applied directly to serial multistage decision processes if the sufficiency conditions are satisfied. On the other hand, non-serial structure is a structure where at least one stage in the system receives inputs from more than one stage or sends outputs to more than one stage. Again [7], observed that dynamic programming is conceptually a powerful computational technique that can solve nonlinear stochastic control problems involving constraints in the state and control variables. However, it has not been generally used in solving large scale problems because of the large high-speed memory and excessive computational time requirements. And these researchers [8], developed an algorithm for a discrete discounted cost dynamic programming problem which the author was of the opinion that it can be obtained from the complementary slackness theorem of linear programming. The author observed that the policy improvement procedure for solving such a problem coincides with the Simplex method solution to a linear program. But [9] observed that dynamic programming has been proposed as an effective method of solving

combinatorial problems of a sequential nature. It is considered to be computationally advantageous to use dynamic programming since the concept can provide convergence to an optimum solution without a total enumeration. In the development of dynamic programming recursion formulae, the problem is decomposed 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. The curse of dimensionality basically means that the error increases with the increase in the number of features.

Also [4] observed that in Nigeria's maritime sector, container operators, shippers and terminal operators are faced with challenges emanating from low investment in container yard facilities and multimodal transport infrastructures despite the terminal concession reforms. Therefore, it has become critical to employ cost effective optimization models to reduce cargo container dwell times and ships' waiting times at the port. They developed and applied Dynamic programming model for optimal allocation of laden shipping containers to Nigerian seaports. In another related research, [3] opined that careful and pre-planning before embarking on educational venture is rare, and that is why poor academic performance is at alarming rate in the Nigerian universities today. Many people apply the rule of thumb in academic planning and execution. Though we know that if a person devotes more time to studies, there is likelihood that the person will perform better than he/she would perform if no such efforts are applied but this is not always the case as assimilation and retention capacities vary from one individual to another. They developed and applied Dynamic programming for Students' Academic Planning and Performance in the Universities. But [11] observed that over the last three decades, policing has gone through a period of significant change and innovation in Nigeria. In a relatively short historical time frame, the police have reconsidered their fundamental mission, the nature of core strategies of policing, and the character of their relationships with the communities they serve. These changes and innovations grew out of concern that policing tactics did not produce significant impact on crime and disorder. There is now growing consensus that the police can control crime when they are focused on identifiable risks, such as crime hot spots, and when they use a range of tactics to address these ongoing problems. They developed and applied Dynamic programming model for optimal allocation of crime preventing patrol team. Furthermore, these researchers [12], demonstrated various applications of dynamic programming in real life scenarios. Such applications include archaeological findings, where they observed that it may be required to arrange in sequence a number of archaeological sites on the basis of the various types of pottery found there. The authors also demonstrated the application in rehearsal scheduling, where it may be required to order the pieces to be played at an orchestra rehearsal so as to minimize the total man-hours spent by the players. Also, [13] observed that many writers on dynamic programming bemoan the lack of practical applications of the technique. But the increasingly powerful computing facilities now available mean that the solution of many hitherto intractable problems is becoming a reality. The author worked on an aspect of the finance of British local government. The dynamic program used in the paper is presented as a financial control model, and their optimization in every time period allows the user to incorporate new information as it becomes available. And [14] used dynamic programming approach to design a transformer. The researcher observed that while dynamic programming might be an intellectually appealing way of formulating problems, people believe that it is not useful for solving them. The author concluded that dynamic programming can be used in electrical engineer to handle some of the task which appeared to be both time-consuming and exceedingly boring. He obtained the optimal design policy using dynamic programming. On the other hand, [15] observed that dynamic programming makes use of the concept 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 with regard to the state resulting from the first decision. They used dynamic programming to determine the optimal course allocation in the Nigerian Universities. Finally, [16] used multi-objective dynamic programming to improve their design and operational strategies. The researchers aimed at adapting Dynamic programming-based metaheuristic to solve Optimization problem and to apply it to the multi-objective unit commitment problem (MO-UCP). They were of the opinion that their model overcomes the poor performance of standard evolutionary operators on such a heavily-constrained problem. The benefit of using such a

representation is that it helps the authors to design evolutionary operators which keep most of the constraints satisfied at all times.

3 Materials and Methods

Our focus is on solution to ASUU strike and Consolidated University Academic Salary Structure II (CONUASS II) in the Nigerian Universities using optimization method. We can observe that the present status (level) of professors depend on their past level (status). So this relationship between the present and past status are recursive. In other words, the future status (level) depend on today's status (level).

3.1 Method of Data collection

The data for this paper is a secondary data collected from the publication of the National Salaries, Incomes and Wedges Commission with circular No. SWC/S/04/S.100/II/403 of December 8, 2009. The data was on the Consolidated University Academic Staff Salary Structure II (CONUASS II) and the data is still in use today since 2009.

3.2 Method of Data Analysis

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

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

Where $f(S_n, x_n)$ is the optimization function that assign steps (states) to levels (cadres); $R_n(x)$ is the function that assigning values to steps (states); $f_{n+1}*$ is the optimal function from the previous stage, it is the basis for recursive relationship that links the previous stage to the current stage, this is from where optimality is derived; S_n is the stage variable; x_n is the state variables. Our dynamic programming model will consider the long steps without further promotion at professorship cadre (level) as one level (CONUASS 08) and the last level in the academic career. This was born out of the need to accommodate the steps in the professorial cadre.

3.3 Optimal Decision Policy

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 can state the optimal decision policy as follows:

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

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

……. …….

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

$S_n = (n - k_{n-1})$; $x_n* = k_n$ for (stage) level "n" (2)

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

4 Data Presentation and Analysis

4.1 Data Presentation

In Table1, we present the 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.

In table2, we present the raw data from Table1 in a Dynamic programming format and introduce 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 Table2 using the Dynamic programming model stated in equation (1) and Optimal decision policy presented in equation (2) 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

Thus for the optimal solution, we apply the optimal decision policy in equation (2) starting from the last iteration Table "For n = 1" to the first iteration Table "For n = 10" and arrived at:

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

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

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

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

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

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

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

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

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

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

Please see Appendix.

5 Discussions and Recommendations

5.1 Discussion

From the analysis, we obtained an interesting result. In the first case, we observed the last two levels were inadmissible, that is, step 09 and 10 cannot apply and hence, zeros. This means that the terminal level should be level 08. On a careful observation again, we see that the last two levels following levels 09 and 10 have values "2" each. These levels should be the last promotional levels for professorial cadres. Instead of remaining at 07 with many steps, it is better to promote them to level 08. This new terminal promotion will increase the annual salaries of associate professors and professors by at least twice of what they currently earn on this static CONUASS II salary structure. Then the other levels with values "1" will have their salaries adjusted with the 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 of his/her 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 of: (1, 1, 1, 1, 1, 1, 2, 2, 0, 0). This measure can cushion the effect of brain drain due to financial difficulties on the academic staff and restore normalcy in the Nigerian University System.

5.2 Summary

In this paper, we applied dynamic programming model for 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 will help to enhance the living condition of lecturers in the Nigerian universities thereby averting frequent strikes and disruption of academic activities. The frequent and incessant strikes delay students and impact negatively to their feature; hence, anything that could be done to stabilize the university education in Nigeria will contribute immensely to the economic growth and stability of the country. To achieve this, we applied dynamic programming, and developed the optimal decision policy which was applied 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 in the other levels' salaries accordingly. Applying the optimal decision policy in equation (2), we obtained (1, 1, 1, 1, 1, 1, 2, 2, 0, 0) which optimizes the academic staffs' earning with a promotion to level 08 instead of remaining at bar with many steps. This is to say that even if the government find it difficult to do salary review as she ought to 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. 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 in the Nigerian public university system thereby halting incessant ASUU strikes.

2. More research should be carried out to find an algorithm and codes that could solve large class of dynamic programming problems, as this is a problem to the application of dynamic programming.

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