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APPLICATION OF DYNAMIC PROGRAMMING FOR STUDENTS FINANCIAL PLANNING

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1. Introduction

According to Walker (2005), financial planning means a process of framing financial policies in relation to procurement, investment and administration of funds. Having a proper way of handling finances has always been a norm to society because financial planning is not just about handling money concurrently but includes predicting future income, assets values and withdrawal plans (Voigt & Benson, 2022). Every person's goals vary from each other following personal objectives and purposes meaning that each needs a suitable setting to satisfy each need. Malaysian Reserve reveals that 50% of Malaysian having difficulties in raising RM1,000 during emergencies and only 40% elders are ready for retirement. To only start managing finances during this age will be too late thus this study proposed a financial planning for students. It is to support Malaysians in ensuring a better outcome by exposing young people to a well-behaved plan of managing finances.

In this case, students' financial planning is solved using Dynamic Programming (DP) method as this method shows a level of effectiveness in solving a complex problem. This is due to DP characteristics of solving one main problem by breaking it into smaller subproblems. It helps researchers to solve only one step of the proposed model to obtain a whole series of decisions.

2. Methodology

Students' financial planning is construct by modelling the conceptual framework and mathematical model as shown in Figure 1. The figure shows the DP structure of allowance allocation made by students annually, T in a tree diagram. T is allocated into four quarters (three months allocation in each quarter): Quarter 1 (A_1), Quarter 2 (A_2), Quarter 3 (A_3), and Quarter 4 (A_4). Then, the allocation in each quarter is distributed into 12 types of attributes involved in expenses (Danes et al., 1999), which is Food (V_{i1}), Rent (V_{i2}), Utilities (electric, water, gas, phone credit, Wi-Fi) (V_{i3}), Transportation (V_{i4}), Donation (V_{i5}), Beauty products/Shopping (V_{i6}), Sports and Entertainment (V_{i7}), Student materials (V_{i8}), Health and Supplement (V_{i9}), Electronic gadgets (V_{i10}), Investment/Savings (V_{i11}), and Emergency funds (V_{i12}). The allocation is subtracted to the attributes mentioned in expenses ($Y_{ij} - V_{ij}$) and the result of subtraction will get the balance (H_{ij}). Since there are 12 attributes and each attribute will have the balance (H_{ij}), it will be added balance of every attribute to get the total balance per quarter, (B_i). The fourth balance in quarter 4, will be used as extra savings for student since the model use for maximizing the student's balance.

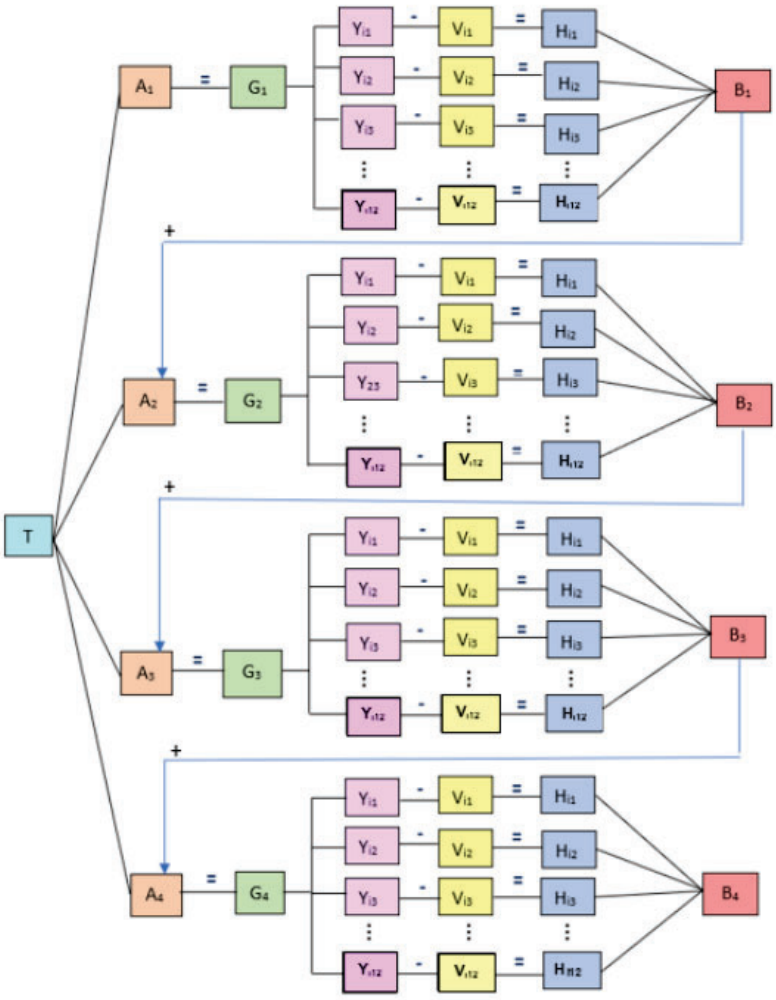

Figure 1: Framework of Dynamic Programming for students' financial planning.

Where,

Indices

i	index for quarter,	i: 1,2,3,4
j	index for attributes,	j: 1,2,3,...,12

Parameters

T	total allowance received by a student annually		
A_i	allocation of the budget for quarter i,	i: 1,2,3,4	
Y_{ij}	allocation of the budget for quarter i for activity j,	i: 1,2,3,4	j: 1,2,3,...,12
V_{ij}	spending of the budget for quarter i for activity j,	i: 1,2,3,4	j: 1,2,3,...,12
G_i	given of the budget for quarter i,	i: 1,2,3,4	
∂	proposed execution based on DP model		
μ	maximum spending percentage of lower bound fixed by DP model		
ω	minimum budget allocation of lower bound that is allowed by DP model		
γ	proposed limit maximum for spending activity		

Decision Variable

B_i	total balance of student allocation for quarter i, i: 1,2,3,4

These formulation for objective function and formulation for constraints are based on Wan Abdul Aziz (2019).

The maximize balance student allocation, B_i can be written as shown in equation (1).

$$Maximize\ B_i = \begin{cases} \sum_{i=1}^{4}\sum_{j=1}^{12}(Y_{ij} - V_{ij}) & ,i = 1 \\ A_i + \sum_{i=2}^{4}\sum_{j=1}^{12}(Y_{(i-1)j} - V_{(i-1)j}) & ,i = 2,3,4\ \ j = 1,2,3,\ldots,12 \end{cases} \quad (1)$$

Subject to:

$$\sum_{i=1}^{4}\sum_{j=1}^{12} Y_{ij} \leq 1 \quad ,i = 1,2,3,4\ \ j = 1,2,3,\ldots,12 \quad (2)$$
$$\partial \leq \sum_{i=1}^{4}\sum_{j=1}^{12} V_{ij} \leq 1\ for\ ,i = 1,2,3,4\ \ j = 1,2,3,\ldots,12 \quad (3)$$
$$V_{ij} \leq Y_{ij}\ \ ,i = 1,2,3,4\ \ j = 1,2,3,\ldots,12 \quad (4)$$
$$B_1 = \sum_{i=1}^{4}\sum_{j=1}^{12}(Y_{ij} - V_{ij}) \geq 0, i = 1,2,3,4\ \ j = 1,2,3,\ldots,12 \quad (5)$$
$$V_{ij} \leq \mu_{ij}\ \ ,i = 1,2,3,4\ \ j = 1,2,3,\ldots,12 \quad (6)$$
$$V_{ij} \geq \omega_{ij}\ \ ,i = 1,2,3,4\ \ j = 1,2,3,\ldots,12 \quad (7)$$

3. Results

Based on Table 1, Student 1 has become the ideal example to be chosen as the best model with the highest final balance proportion of 2.72.

Table 1: Balance allowance of students.

Parameter \ Student	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6
Balance Quarter 1	0.68	0.63	0.40	0.36	0.35	0.54
Balance Quarter 2	1.36	1.25	0.81	0.72	0.69	1.08
Balance Quarter 3	2.04	1.88	1.21	1.08	1.04	1.61
Balance Quarter 4	2.72	2.50	1.62	1.44	1.38	2.15

Validation of model using sensitivity analysis have be made based on execution of three cases by varying parameters. Based on Table 2, an execution for Case 1 when μ is decreased by 0.1 and ω is increased by 0.05. It is observed that Student 1 still has the highest proportion value of 1.40 for balance in Quarter 4 indicates that Student 1 is the best model among six students. For Case 2, an execution of setting a fixed value for $\mu = \omega$ with a proportion value of 0.07, resulting in all six students with the same balance in every quarter. This means that all students will share the same value of balance even though every student allocates and spends differently for each activity. For Case 3, the value of μ is increased by 0.1 and ω decreased by 0.05, resulting in Student 1 with the highest proportion value of balance of 2.72 which means Student 1 is still the best model among all six students even though the parameters vary.

Table 2: Balance from (μ) and (ω).

Parameter \ Student	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6
Case 1						
Balance Quarter 1	0.35	0.21	0.13	0.21	0.09	0.30
Balance Quarter 2	0.70	0.42	0.26	0.42	0.18	0.60
Balance Quarter 3	1.05	0.63	0.39	0.63	0.27	0.90
Balance Quarter 4	1.40	0.84	0.52	0.84	0.36	1.20
Case 2						
Balance Quarter 1	0.16	0.16	0.16	0.16	0.16	0.16
Balance Quarter 2	0.32	0.32	0.32	0.32	0.32	0.32
Balance Quarter 3	0.48	0.48	0.48	0.48	0.48	0.48
Balance Quarter 4	0.64	0.64	0.64	0.64	0.64	0.64
Case 3						
Balance Quarter 1	0.68	0.63	0.40	0.36	0.35	0.54
Balance Quarter 2	1.36	1.25	0.81	0.72	0.69	1.08
Balance Quarter 3	2.04	1.88	1.21	1.08	1.04	1.61
Balance Quarter 4	2.72	2.50	1.62	1.44	1.38	2.15

The data obtained is subjected to formulation of constraints from (1) to (7). It is to ensure that maximization of balance following the objective of the DP model is achieved. For the

sensitivity analysis in Excel Solver based on Table 1, Student 1 achieved to have the highest value of proportion in Quarter 4 and even when the parameters were changed with conditions in Case 1, Case 2 and Case 3, Student 1 still managed to achieve a high value of proportion in Quarter 4 compared to the other five students. This means that the DP model do not budge even if parameters is changed resulting to the DP model to be valid.

4. Conclusion

This paper proposes a quarterly financial student planning. The student financial planning framework were presented. The general objective of this study is to assist students financial in managing the allocated financial by proper financial plan so that the students enable to have balance for their savings.

Based on the preliminary result of survey obtained, following findings have been observed:
a) Students spend their allowances are not based on a proper manner since more than 60% respondents with allowance allocation and spending over 100% which defies equation (2).
b) Although some students used up to their budget, this does not mean they utilize their allowances efficiently.

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