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Most Profitable Currency Exchange for ASEAN Countries Using Dijkstra's Algorithm

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Abstract. On regular basis, most people directly exchange their currency for another in the money changers or banks for business or traveling purposes. However, the indirect conversion approaches are not yet much developed by previous studies for the exchange rate, especially using shortest path algorithms. While Dijkstra's algorithm is a very well-known approach to solve the shortest path problems. In this paper, the most profitable path is determined using this algorithm. Indonesian Rupiah was considered as an initial node, the positive weights are denoted as distance among currencies. Additionally, these weights are calculated using the ratio between initial and target currencies. By applying initial node and weight values, the proposed Dijkstra graph was constructed for investigating the best currency exchange among ASEAN countries. Results showed Dijkstra's algorithm able to produce the best path for some selected conversion values such as IDR→BND→MYR→PHP→MMK→KHR, VND→SGD→MYR→PHP→KHR, KHR→BND →MYR→THB→PHP and LAK→SGD→MYR→PHP with maximum profit if compared with direct conversion approach. For future business, traveling, or studying abroad, this proposed approach is very helpful in the risk management of currency fluctuations.

Keywords: Dijkstra's Algorithm, Best Currency Exchange, Weighted Graph, Directional Graph, ASEAN Currency

1 Introduction

Dijkstra's Algorithm has been widely implemented to investigate and determine the shortest route or path in any problem domains such as tourism, products delivery, transportation, traveling salesman systems, and others [1-9]. Additionally, this path problem was inspired by a natural question on graphs, which may represent networks of various kinds. The optimum paths minimize the sum of 'weights' associated with its edges. These 'weights may represent amounts like distance or lengths, and then, the problem becomes a question of finding the shortest way to travel from one point to another. This interpretation justifies the name given to the general problem [3].

Interestingly, some previous works have been introduced this algorithm in investigating the best currency exchange path using a directed graph. This graph was established and considered using a ratio between initial currency and target currency. Motivated by previous works [10, 11], we are interested to propose the best currency exchange path for ASEAN Countries using the different ratios using Dijkstra's Algorithm. In this proposed path, we consider weight values among two vertexes using a ratio of a weaker currency and a stronger currency.

In this paper, we also compare between direct conversion approach with the indirect conversion approach, namely Dijkstra's Algorithm. The best currency exchange will be derived by using some stages such as data preparation, node, and edge preparation, graph preparation, computational best currency exchange, and result validation.

2 The Basic Concepts and Methodology

2.1 Dijkstra's Algorithm and Its Implementation on Currency Exchange Rate

a. Graph Concept
   A basic graph reveals a relation between vertexes (set) and edges (set). In other words, a graph (G) consists of two components or sets namely vertex (V) and edge (E) [3].
b. Dijkstra's Algorithm
   An algorithm is defined as a set of rules or instructions for problem-solving purposes logically and systematically. Dijkstra's Algorithm is one of the frequently used approaches in investigating the shortest path of any problem domain. Besides, this algorithm is also easy to be applied for simple vertexes and uncomplicated networks or circuits. [4]. Dijkstra's algorithm works based on the queuing theory with a priority queue. So only the node that has the highest priority will be searched. In determining the priority node, this algorithm compares each value (weight) of the node that is at one level. Furthermore, the value (weight) of each node is stored to be compared with the value that will be found from the newly discovered route, and so on until we obtain the expected node. Graphically, a simple Dijkstra graph is illustrated in Figure 1.

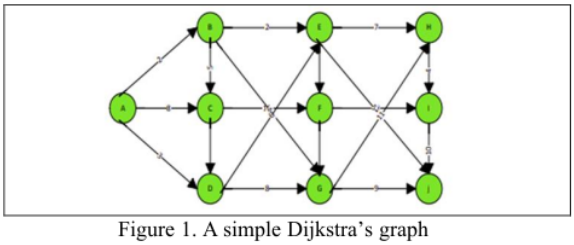

Figure 1. A simple Dijkstra's graph

Dijkstra's Algorithm steps [12]:

1. Set all points distance to infinity except for the starting point set distance to 0.
2. Set all points, including starting point as a non-visited node.
3. Set the non-visited node with the smallest current distance as the current node "C."
4. For each neighbor "N" of your current node: add the current distance of "C" with the weight of the edge connecting "C" – "N." If it's smaller than the current distance of "N," set it as the new current distance of "N."
5. Mark the current node "C" as visited.
6. Repeat the step above from step 3 until the destination point is visited.

c. Currency Exchange Using Dijkstra's Algorithm
The exchange rate is the price of one unit of foreign currency in the local currency or it can also be said that the price of the local currency is against foreign currencies. For example, the exchange rate of the Rupiah against the US Dollar (USD) is the price of one US Dollar (USD) in Rupiah (IDR), or it can also be interpreted as the price of one Rupiah against one USD. In this case, Dijkstra's Algorithm is applied to determine the best currency exchange.

2.2 Methodology

a. Data Preparation
The currencies of Southeast Asia countries are collected from 17/8/2020 – 18/10/2020 [13].
b. Initial Node and Visited Node Preparations
In this paper, we state IDR (Indonesian Rupiah) as an initial node. While Cambodian Riel (KHR) is denoted as the target node.
c. Graph Preparation
   1. List of currencies based on weakest to strongest values accordingly.
   2. Based on Step 1, calculate weight values based on a ratio of initial currency and target currency.
   3. Based on Step 2, provide a directed graph for currency exchange for Southeast Asia Countries.

d. Proposed most profitable path (present value of currency) based on Dijkstra's algorithm and steps are:
   1. Calculate all weight values based on distance or other ratios of currencies. The smallest weight value will be denoted as an initial vertex (node) and edge.
   2. Repeat step 1, but the next (departure) vertex is considered using the smallest weight of currency as chosen in Step 1.
   3. The weight value (from Step 1) is multiplied by the initial currency and the next currency which has the smallest weight. Moreover, we will compare maximum weight values at another edge, respectively. Repeat Steps 1 and 2 for getting the expected vertex.
   4. Iteration will be terminated at the expected vertex (objective node).
   5. Based on Steps 1-4, the most profitable path in currency exchange will be obtained.

3 Determining Most Profitable Path Using Dijkstra's Algorithm

In this section, we demonstrate how can graphs be used to model currency markets? At a very high level, we will assign currencies to different vertices, and let the edge weight represent the exchange rate. A simple example is presented in Figure 2: in this market, we can convert 1 GBP to 1.27 USD, 1 USD to 1.43 AUD, etc. [14].

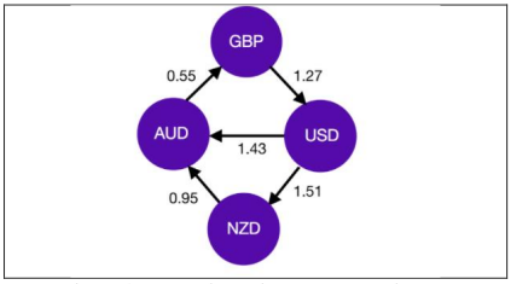

Figure 2. Example exchange rate graph

To determine the exchange rate between two currencies that do not share an edge, we simply find a path between the two currency vertices and walk along with it, multiplying by each successive edge weight (exchange rate). If there are multiple possible paths, choose the path that has the greatest weight product, which corresponds to the most profitable rate.

In this paper, we are concerned to discuss Dijkstra's algorithm and its implementation on determining the most profitable path of exchange rate among Indonesian Rupiah (IDR) and other countries in Southeast Asia. By following steps

given in Sub-Section 2.1, the process on how to obtain the best currency exchange path between IDR and others using this algorithm can be detailed as follows:

Step 1: Provide exchange rate information among countries. In this case, we collected online exchange rates data on August 17, 2020 [13] from all Southeast Asia countries as presented in Table 1.

Edge	Converted Weight	Edge	Converted Weight
(IDR, SGD)	0.000093	(THB, MMK)	43.6200
(IDR, BND)	0.000093	(PHP, MMK)	27.9410
(SGD, BND)	0.9993	(PHP, LAK)	187.2400
(BND, SGD)	1.0007	(PHP, KHR)	84.2690
(SGD, MYR)	3.0583	(MMK, LAK)	6.7013
(BND, MYR)	3.0605	(MMK, VND)	17.0210
(MYR, THB)	7.4458	(MMK, KHR)	3.0160
(SGD, THB)	22.7710	(KHR, LAK)	2.2219
(MYR, MMK)	324.7800	(KHR, VND)	5.6436
(MYR, PHP)	11.6240	(LAK, VND)	2.5400
(THB, PHP)	1.5612	(THB, KHR)	131.5600

Table 1 shows weight values are calculated using a ratio between strong and weak currencies between two countries. For example, a converted weight is 0.000093 between IDR and SGD currencies. In this example, SGD has a stronger currency than IDR in the market. Other weights values are also derived using the same procedure.

Step 2: Based on Table 1, we provide a directed graph with IDR as the initial node in Figure 3.

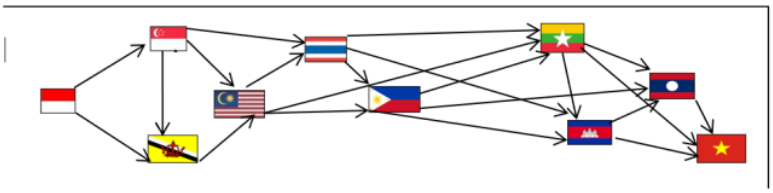

Figure 3. A directed graph of currencies from Southeast Asia Countries

Step 3: Based on a directed graph in Figure 3, determine the weight value for each edge as presented in Figure 4. For example, we want to convert 1 million (IDR) to other currencies in Southeast Asia countries.

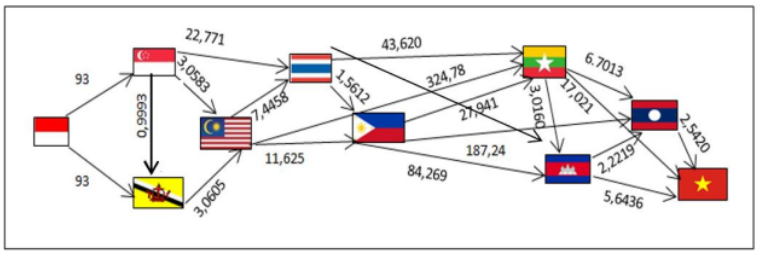

Figure 4. A directed graph with weighted edges

Step 4: Based on Figure 4, determine the most profitable path in converting 1 million (IDR) to any currencies as presented in Figure 5. In this case, IDR is an initial node.

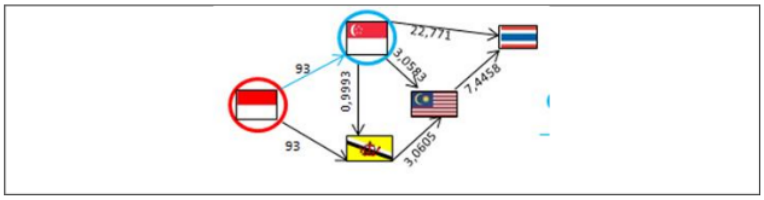

Figure 5. Selected edge at Iteration-1

Figure 5 shows the weight values are the same between edge (IDR, SGD) and edge (IDR, BND). Therefore, we need to decide on a new initial node whether SGD or BND.

Step 5: Apply Iteration-2 until Iteration-7 in achieving the most profitable path using Dijkstra's algorithm. Finally, we obtain the best path for converting 1 million (IDR) to any currencies with maximum profit as presented in Figure 6. Additionally, alliteration results are also detailed in Table 2.

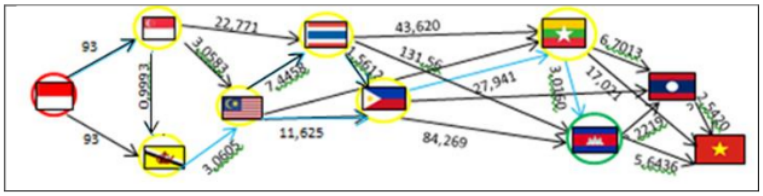

Figure 6. The most profitable path for converting 1 million IDR (Iteration-7)

Table 2. Dijkstra's iterations in determining the most profitable path

IDR	SGD	BND	MYR	THB	PHP	MMK	KHR	LAK	VND
0	93*	93	∞	∞	∞	∞	∞	∞	∞
0	93	93*	284.42	2117.70	∞	∞	∞	∞	∞
0	93	93	284.62	∞	∞	∞	∞	∞	∞
0	93	93	284.62	2119.27	3308.78	92440.99	∞	∞	∞
0	93	93	284.62	2119.27	3308.78	92442.64	278811.42	∞	∞
0	93	93	284.62	2119.27	3308.78	92450.78	278827.84	619539.54	∞
0	93	93	284.62	2119.27	3308.78	92450.78	278831.33	619539.91	157...

Based on Tabel 2, we obtain the most profitable path is IDR→BND→MYR→PHP→MMK→KHR. In this path, 1 million IDR is converted into 278,831.3314 KHR. Moreover, the comparison value between the direct conversion approach and Dijkstra's algorithm is also presented in Table 4.

Table 4. Comparison direct conversion approach and Dijkstra's algorithm

	Direct conversion	Dijkstra's algorithm	Difference
Present value	278,000 KHR	278,831.3314 KHR	821.3314*
Future value	276,800 KHR	298,398.8565 KHR	21,598.8565*

Table 4 indicates that Dijkstra's algorithm can provide better conversion values (present and future) if compared with the direct conversion approach. This table shows that if we want to convert 1 million IDR to KHR, then it will be earned an amount of 821.3314 KHR as a profit. This proposed idea can be enhanced for another currency. Moreover, another graphs of conversion values for VND to KHR, KHR to THB and LAK to PHP are also illustrated in Figures 7-9, respectively.

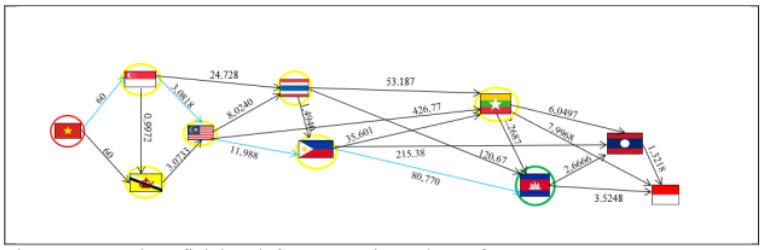

Figure 7. Most beneficial path for conversion values of VND to KHR

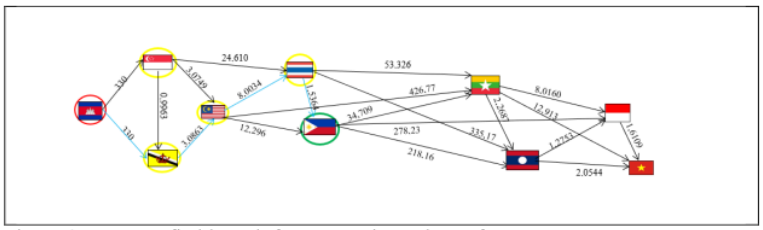

Figure 8. Most profitable path for conversion values of KHR to THB

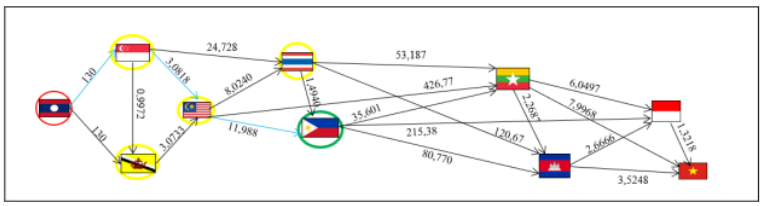

Figure 9. Most beneficial path for conversion values of LAK to PHP

From Figure 7, if someone is interested to convert her/his VND to KHR then we will suggest considering the best path (VND→SGD→MYR→PHP→KHR). While the most beneficial path is KHR→BND →MYR→THB→PHP for conversion values from KHR to PHP in Figure 8. Based on Figure 9, we obtain the best path LAK→SGD→MYR→PHP for conversion currency of LAK to PHP with graph approach.

4 Conclusion

In this paper, we already implemented Dijkstra's algorithm in investigating the most profitable path for currency exchange of ASEAN countries. This proposed path is considered in enhancing Dijkstra's implementation. It can be highlighted that weight values are very important to be considered as distance replacement. In this paper, we proposed the values of the weight based on a ratio of weaker (initial node) and stronger (next node) currencies. Therefore, the distance between an initial node and target nodes is represented by these values in determining the most profitable path. Based on our perspective, this algorithm is one of the indirect conversion approaches in currency exchange. This approach is the best currency exchange for many purposes such as future business, traveling, etc.

Reference

1. Ma, Y., Chang, D., Wang, H and Tang, M: Optimal Shipping Path Algorithm Design for Coastal Port. Procedia Comp. Sci. **162**, 375–382 (2019).
2. Wei, K., Gao, Y., Zhang, W and S. Lin, S.: A modified Dijkstra's algorithm for solving the problem of finding the maximum load path. Proceeding IEEE 2nd ICICT. 10-13 (2019).
3. Akram, M., Habib, A and Alcantud, J.C.R.: An Optimization Study Based on Dijkstra Algorithm for a Network with Picture Trapezoidal Fuzzy Number, Neural Comp. & App. **33**, 1329-1342 (2021).
4. Alam, Md. A., Faruq, Md. O.: Finding Shortest Path for Road Network Using Dijkstra's Algorithm. Bangladesh J. Multi. Sci. Research. **1**, 41-45 (2019).
5. Anshori, Y., Joefrie, Y. Nadyanti, Y.: Implementasi Algoritma Dijkstra dalam Pembuatan Aplikasi Pesona Palu, Scientico: Compt. Sci. and Inf. Journal. **1**, 25-31 (2018).

6. Cantona, A., Fauziah., Winarsih.: Implementasi Algoritma Dijkstra Pada Pencarian Rute Terpendek ke Museum di Jakarta. J. Tek. dan Man. Inf. **6**, 27-34 (2020).
7. Lestari, S., Ardiansyah., Giovani, A. P., Dwijayanti.: Dijkstra Algorithm Implementation in Determining Shortest Route to Mosque in Residential Citra Indah City, J. Pilar Nusa Mandiri. **16**, 65-70 (2020).
8. Darmawan, T. S.: Comparison of Dijkstra and Floyd-Warshall Algorithm to Determine the Best Route of Train. Int. J. Inf. for Develop. **7**, 8-13 (2018).
9. Bozyiğit A., Alankuş G and Nasiboğlu, E.: Public transport route planning: Modified dijkstra's algorithm. Proceeding on Compt. Sci. and Eng. (UBMK), 502-505 (2017).
10. Melissa, Y.: Dijkstra's Algorithm, Lecture note. Massachusetts Institute of Technology. Regexstr, (2014).
11. Sedgewick, R.: Algorithms (4th edition) in Java, Chapter 21, (2011).
12. Rachmawati, D. and Gustin, L.: Analysis of Dijkstra's Algorithm and A*Algorithm in shortest path problem. J. Phys. **1566**, 012061 (2020).
13. www.ValutaFx.com
14. https://reasonabledeviations.com/2019/03/02/currency-arbitrage-graphs/

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