OPTIMIZING HUB ALLOCATION FOR ENHANCED CONNECTIVITY IN UZBEKISTAN AIRWAYS: A BINARY INTEGER PROGRAMMING APPROACH

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Annotation. *In response to the need for operational optimization within the aviation industry, this study focuses on enhancing the hub allocation system of Uzbekistan Airways, the national carrier of the Republic of Uzbekistan. The research employs Binary Integer Programming to construct an algebraic model aimed at determining the optimal hub locations to effectively connect 11 local airports with 15 key CIS cities. The decision variables in the model indicate the selection of specific locations as hubs, with the objective of minimizing the total number of hubs while ensuring coverage for all target cities within a 1800-mile radius. Comprehensive data collection was undertaken, sourcing information from Uzbekistan Airways' official website, international aviation bodies such as IATA and ICAO, online distance tools, and interviews with industry insiders. The findings suggest that optimal connectivity can be achieved with minimal hubs, specifically through the strategic use of Tashkent and Nukus, which cover all 15 CIS destinations efficiently. Sensitivity analysis revealed that the feasibility of the model is sensitive to the distance threshold, with adjustments to the threshold and coverage requirements influencing hub selection. Implementing this optimal hub system could significantly reduce operational costs and improve passenger experience by streamlining connections across the CIS region.*

Key words*: Binary Integer Programming Operational Research Business Optimization Hub Allocation Strategy*

Аннотация. *Авиация саноатида операцияларни оптималлаштириш зарурати жавобида, ушбу тадқиқот Ўзбекистон Республикасининг миллий ташувчиси бўлган "Uzbekistan Airways" АЖ хаблар тизимини яхшилашга қаратилган. Тадқиқот 11 та маҳаллий аэропортлар ва 15 та асосий МДҲ шаҳарлари ўртасида самарали уланишни таъминлаш учун оптимал хаб жойларини аниқлашга қаратилган алгебраик моделни яратиш учун иккилик бутун сонли дастурлашдан фойдаланади. Моделдаги қарор ўзгарувчилари махсус жойлар хаб сифатида танланганлигини кўрсатади, мақсад эса барча кўзда тутилган шаҳарларни 1800 миль радиусда қамраб олишни таъминлаш орқали хаблар умумий сонини минималлаштиришдир. Маълумотлар тўплаш ишлари кенг кўламда олиб борилди, бу Uzbekistan Airways расмий веб-сайтидан, IATA ва ICAO каби халқаро авиация органларидан, онлайн масофа ҳисоблаш воситаларидан ва соҳадаги инсайдерлар билан суҳбатлардан маълумотларни ўз ичига олади. Натижалар оптимал алоқани минимал хаблар орқали, хусусан, Тошкент ва Нукусни стратегик ишлатиш орқали таъминлаш мумкинлигини кўрсатади, бу шаҳарлар МДҲнинг барча 15 та шаҳарини самарали қоплайди. Сезгирлик таҳлили моделнинг амал қилиш имконияти масофа чегарасига сезгир эканлигини кўрсатди, чеклов ва қамров талабларининг тузатилиши хаб танловига таъсир қилади. Ушбу оптимал хаб тизимини амалга ошириш операцион харажатларни сезиларли даражада камайтириши ва МДҲ бўйлаб алоқаларни соддалаштириш орқали йўловчилар тажрибасини яхшилаши мумкин.*

Калит сўзлари: *Иккилик бутун сонли дастурлаш, Операцион тадқиқотлар, Бизнес оптималлаштириш, Хаб жойлаштириш стратегияси*

Аннотация. *В ответ на потребность в оптимизации операций в авиационной индустрии, данное исследование сосредотачивается на улучшении системы распределения хабов АО Uzbekistan Airways, национального перевозчика Республики Узбекистан. Исследование использует бинарное целочисленное программирование для создания алгебраической модели, направленной на определение оптимальных местоположений хабов для эффективного соединения 11 местных аэропортов с 15 ключевыми городами СНГ. Переменные решения в модели указывают на выбор конкретных мест в качестве хабов, с целью минимизации общего числа хабов при обеспечении покрытия всех целевых городов в радиусе 1800 миль. Для сбора данных было проведено всестороннее исследование, включая программирование, операционные исследования, для расчета базовой стратегии распределения хабов отрасли. Результаты показывают, что оптимальная связность может быть достигнута с минимальным количеством хабов, в частности, через стратегическое использование Ташкента и Нукуса, которые эффективно охватывают все 15 городов СНГ. Аналогичные стратегии можно применить в отношении аэропортов по всей стране.*

Ключевые слова: *Бинарное целочисленное программирование, Операционные исследования, Оптимизация бизнеса, Стратегия распределения хабов*

Introduction.

Operational Research is the field that involves the application of advanced analytical methods and mathematical techniques in order to enable organizations to make better and more informed decisions and reach their goals [1]. Through its subset Business Optimization, many businesses can improve their efficiency, productivity and profitability through better allocation of resources, creating relevant schedules, establishing better routes and much more. One of the fields that might benefit from extensive appliance of principles operational research and business optimization is Aviation Industry.

Airlines usually tend to optimize flight schedules that minimize delays, maximize aircraft utilization, and improve passenger experience or crew and fleet allocation, revenue management, cost minimization or route optimization [2]. However, one another useful implication of Operational Research for airline companies is hub allocation to cover all of the needed destinations with minimums hubs used to improve connectivity thus optimizing fuel consumption and increasing passenger experience. This can be achieved through using Binary Integer Programming and finding minimum number of hubs needed to cover all intended destinations.

The following report includes Operational Research problem of Uzbekistan Airways, a national and flag carrier of Republic of Uzbekistan, that intends to cover all its' CIS destinations with minimum number of hubs used. Potential hubs for Uzbekistan Airways can be 11 domestic International-level airports that are located within Republic of Uzbekistan. Currently, establishing good hub-and-spoke model is a good commercial opportunity for Uzbekistan Airways, due to

geopolitical tensions between Russia and Ukraine that led to various sanctions towards Russian carriers restricted air travel opportunities for travelers to/from Russian Federation.

Problem Statement

Uzbekistan Airways seeks to optimize its hub allocation system to efficiently connect flights between 11 local airports, which are considered potential hubs (Tashkent, Samarkand, Bukhara, Navoi, Urgench, Karshi, Namangan, Andijan, Fergana, Termez, and Nukus) and various CIS cities (Moscow, St. Petersburg, Kazan, Sochi, Ekaterinburg, Novosibirsk, Irkutsk, Samara, Krasnoyarsk, Almaty, Astana, Bishkek, Dushanbe, Baku, and Tbilisi). The goal is to determine the minimum number of hub locations that can adequately cover all cities, where a city is considered 'covered' if it is within a specific distance threshold of at least one hub.

Considering that minimal distance that all fifteen CIS destinations are covered at least by one hub is 1750 miles and that Uzbekistan Airways fleet that mostly operates to CIS A320 and A320 neo are capable of flying up to 3700 miles, Optimal distance threshold where all aforementioned destination cities are covered by at least one hub is considered as 1800 miles. Therefore, Mile limit is 1800 miles.

Objective:

Develop a binary integer programming model to determine the optimal allocation of hub locations for Uzbekistan Airways that minimizes the total number of hubs while ensuring adequate coverage for all cities within the specified distance threshold.

Sensitivity Analysis: Investigate how hub allocation is sensitive to mile limit changes.

Alter Objective: Change the requirement for all destination cities from being covered by one hub to two hubs.

Literature Review

In the following Literature Review theoretical knowledge and expertise required to formulate problem statement, as well as relevant operational research method to build algebraic model is shown. A Background information related to selected company would be provided as well. Moreover, sufficient review of available literature would be done in order to obtain input data to reflect decision variables and constraints of real-world case.

To build algebraic model and reflect it in Excel, Integer Programming, specifically Binary Integer Programming method is used. Integer Programming (IP) is a mathematical optimization technique that focuses on optimizing a given objective function subject to a set of linear constraints, where the decision variables are required to be integers [3]. While, Binary Integer Programming (BIP) is a specific case where the decision variables can only take binary values (0 or 1), representing the presence or absence of a particular element in the solution. This kind of programming is suitable for airline hub allocation problem in operational research [1]. The airline hub allocation problem is an example that deals with determining the minimum number of hubs to cover all intended destinations in order to improve flight connectivity between various destinations through hubs, at the same time using minimum number of hubs minimizes costs particularly, fuel consumption as well as airport costs.

In the context of Binary Integer Programming, the airline hub allocation problem can be formulated with binary decision variables denoting whether a specific location is chosen as a hub (1) or not (0) [4]. The objective function would quantify the desired outcome, such as minimizing total operational costs or maximizing network efficiency. Consequently, the constraints in the model would

be requirements that each airport of a given destination city must be connected to a hub, and through using minimum number of hubs to establish connection to all intended destination cities [4].

Uzbekistan Airways is National Air Carrier and Flag Carrier of Republic of Uzbekistan that is founded in 28 January 1992, and inherited its' starting infrastructure from USSR main carrier Aeroflot (now the largest carrier in Russian Federation) [5]. At the current moment Uzbekistan Airways is largest air carrier in Uzbekistan and one of the largest carriers in Central Asian and CIS region with 36 aircrafts in their fleet and 22 more being in order that operates to around 70 destinations around the world [5]. Apart from operating in CIS region, Uzbekistan Airways has flights to Middle East, Europe, East and South-East Asia, United States and many more charter flights according to demand and seasonality [2].

Data Collection

Data has been collected through using both primary and secondary sources as well as several data sources were utilized to ensure accuracy and reliability:

- Official website of Uzbekistan Airways, www.uzairways.com , necessary information, such as the airline's current route network, hub locations, flight frequencies, and aircraft types, was extracted from the official website of Uzbekistan Airways. This data served as a foundation for understanding the operational context and constraints faced by the airline.

- Several official sources of international regulatory bodies and associations like IATA and ICAO, www.iata.org , www.icao.int have been used as well in order to gain more understanding of hub-and-spoke model that airlines use in order to boost their connectivity [6]. These sites provided insights into industry trends, competitive landscape, and other factors that could potentially influence the hub allocation process.

- Distance calculating online tools like https://www.distancefromto.net/ helped to compute the distances between potential hub locations and destinations and to construct distance matrix between hub and destination cities. These tools enabled the accurate estimation of travel distances, which played a crucial role in formulating the objective function and constraints for the binary integer programming model.

- Direct interview with an insider from Uzbekistan Airways, who is the head of Airline Cooperation Division. To gain a deeper understanding of Uzbekistan Airways operations, preferences, and decision-making processes, a direct interview was conducted with an insider from the company. This primary source of information offered valuable context and expert perspectives that enriched the analysis. Specifically, the latest information about flights and destinations have been obtained.

- Personal experience and knowledge: As a former employee of Uzbekistan Airways, personal experience and background knowledge of the company's inner processes and the way work and business organized and established has been helpful for the project.

Model Formulation

In the following section algebraic / mathematical model of the case will be illustrated before all variables and constraints can be entered to Microsoft Excel Spreadsheet. The model is illustrated in the form of system of linear equations and binary integer programming method is applied.

1. Decision variables:

As it is indicated in the Problem Statement part, Uzbekistan Airways operates from eleven local hubs namely Tashkent, Samarkand, Bukhara, Navoi, Urgench, Karshi, Namangan, Andijan, Fergana, Termez, and Nukus and they are indicated as Decision variables.

Let $x_1, x_2, ..., x_{11}$ be binary variables, where:

$x_1 = 1$ if a hub is Tashkent, and $x_1 = 0$ otherwise.

$x_2 = 1$ if a hub is Samarkand, and $x_2 = 0$ otherwise.

$x_3 = 1$ if a hub is Bukhara, and $x_3 = 0$ otherwise.

$x_4 = 1$ if a hub is Navoi, and $x_4 = 0$ otherwise.

$x_5 = 1$ if a hub is Urgench, and $x_5 = 0$ otherwise.

$x_6 = 1$ if a hub is Karshi, and $x_6 = 0$ otherwise.

$x_7 = 1$ if a hub is Namangan, and $x_7 = 0$ otherwise.

$x_8 = 1$ if a hub is Andijan, and $x_8 = 0$ otherwise.

$x_9 = 1$ if a hub is Fergana, and $x_9 = 0$ otherwise.

$x_{10} = 1$ if a hub is Termez, and $x_{10} = 0$ otherwise.

$x_{11} = 1$ if a hub is Nukus, and $x_{11} = 0$ otherwise.

2. Parameters:

Selected miles that determine hub, threshold is indicated as 1800 miles and illustrated with letter T. Destination cities that do lie within 1800 miles will be indicated as 1, and those which do not will be 0.

b_{ij} is a binary variable, where $b_{ij} = 1$ if the distance between hub city j and destination city i is within the threshold T, and $b_{ij} = 0$ otherwise.

3. Constraints:

Each destination city (i) must be covered by at least one hub within the specified distance threshold T:

For each destination city i, the following constraint must be satisfied:

$x_1 * b_{i1} + x_2 * b_{i2} + x_3 * b_{i3} + x_4 * b_{i4} + x_5 * b_{i5} + x_6 * b_{i6} + x_7 * b_{i7} + x_8 * b_{i8} + x_9 * b_{i9} + x_{10} * b_{i10} + x_{11} * b_{i11} \geq 1$, for each destination city i (from Moscow to Tbilisi)

$x_j \in \{0, 1\}$ for $j = 1$ to 11.

Above formula is applied repeatedly for the rest fourteen cities.

4. Objective function:

Minimize the number of used hubs:

$Z = x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 + x_{10} + x_{11}$

Table I: Distance Matrix

Uzbekistan Airways hub locations with distances																				
Input Data																				
Distance Threshold / Mile limit	1800																			
Distance Matrix - Distance from each potential hub to destination city, given in miles																				
Hubs/Destination	Moscow	St.Petersburg	Ekaterinburg	Novosibirsk	Kazan	Krasnoyarsk	Rostov	Ufa	Sochi	Samara	Almaty	Astana	Bishkek	Baku	Dushanbe	Tbilisi	Minsk	Irkutsk		
Tashkent	1735.39	2089.78	1140.26	1132.29	1351.33	1465.02	1508.92	1109.42	1507.92	1208.97	412.41	688.88	290.91	1016.64	192.58	1263.36	2091.7	1797.28		
Samarkand	1699.66	2069.38	1194.59	1291.53	1346.12	1635.81	1413.88	1128.5	1386.97	1188.47	593.61	813.51	472.65	868.83	163.38	1128.09	2032.63	1978.58		
Andijan	1869.67	2215.51	1226.26	1099.85	1472.82	1404.6	1663.22	1219.61	1665.6	1339.2	296.69	720.2	188.44	1172.38	239.16	1420.96	2234.56	1699.35		
Fergana	1872.05	2221.22	1242.48	1133.07	1479.69	1439.42	1654.18	1229.72	1651.39	1342.95	331.27	745.54	223.5	1152.13	204.61	1403.57	2233.15	1734.01		
Namangan	1838.09	2185.04	1201.32	1097.22	1442.77	1408.61	1630.17	1191.01	1633.11	1308.01	311.72	703.74	197.24	1141.82	228.15	1389.29	2202.12	1712.55		
Bukhara	1645.76	2021.69	1191.97	1355.02	1309.67	1708.6	1334.07	1107.04	1297.13	1145.39	689.24	857.23	567.65	771.55	247.37	1033.97	1966.65	2064.97		
Navoi	1660.83	2033.04	1177.37	1309.7	1314.01	1659.91	1366.42	1102.61	1337.25	1153.57	634.56	819.71	512.99	818.62	210.08	1077.84	1989.56	2012.03		
Termez	1879.72	2254.38	1390.2	1433.41	1537.23	1757.28	1559.47	1323.99	1507.64	1376.07	658.17	985.85	548.33	962.5	123.32	1234.66	2199.84	2060.9		
Karshi	1740.4	2114.96	1264.5	1370.93	1399.09	1712.62	1429.04	1189.85	1387.59	1236.99	654.57	893.97	535.48	854.19	162.2	1120.78	2062.83	2047.8		
Nukus	1343.04	1724.8	994.33	1360.78	1033.82	1742.74	1024.87	865.89	1005.11	860.37	876.68	819.91	759.84	525.54	551.53	760.06	1655.13	2158.85		
Urgench	1424.82	1806.28	1055.59	1372.85	1112.12	1749.04	1100.3	936.75	1070.77	940.01	837.18	838.61	717.71	568.82	477.37	816.89	1735.86	2150.47		

Table II: Binary Relationship between Hubs and Destination Cities

Cities covered by given mile limit																				
1 if city is within 1800 mile range; 0 if city is outside of range																				
Hubs/Destination	Moscow	St.Petersburg	Ekaterinburg	Novosibirsk	Kazan	Krasnoyarsk	Rostov	Ufa	Sochi	Samara	Almaty	Astana	Bishkek	Baku	Dushanbe	Tbilisi	Minsk	Irkutsk
Tashkent	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Samarkand	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Andijan	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Fergana	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Namangan	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Bukhara	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Navoi	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Termez	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Karshi	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Nukus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Urgench	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

Table III: Decision Variables / Constraints and Objective.

| Decision Variables: Used as Hubs | | |

Table IV: Sensitivity Analysis
Input: Mile Limit
Min: 1500 miles
Max: 2000 miles
Increment: 100 miles
Output: Total Hubs / Decision Variables

One-way analysis for Solver model in Solution worksheet													
Mile limit (cell B3) values along side, output cell(s) along top													Data for chart
	Tashkent	Samarkand	Andijan	Fergana	B41	Bukhara	navoi	Termez	Karshi	Nukus	Urgench	Total_hubs	Tashkent
1500	Not feasible												Not feasible
1550	Not feasible												Not feasible
1600	Not feasible												Not feasible
1650	Not feasible												Not feasible
1700	Not feasible												Not feasible
1750	0	0	1	0	0	0	0	0	0	1	0	2	0
1800	1	0	0	0	0	0	0	0	0	1	0	2	1
1850	1	0	0	0	0	0	0	0	0	1	0	2	1
1900	1	0	0	0	0	0	0	0	0	1	0	2	1
1950	1	0	0	0	0	0	0	0	0	1	0	2	1
2000	1	0	0	0	0	0	0	0	0	1	0	2	1

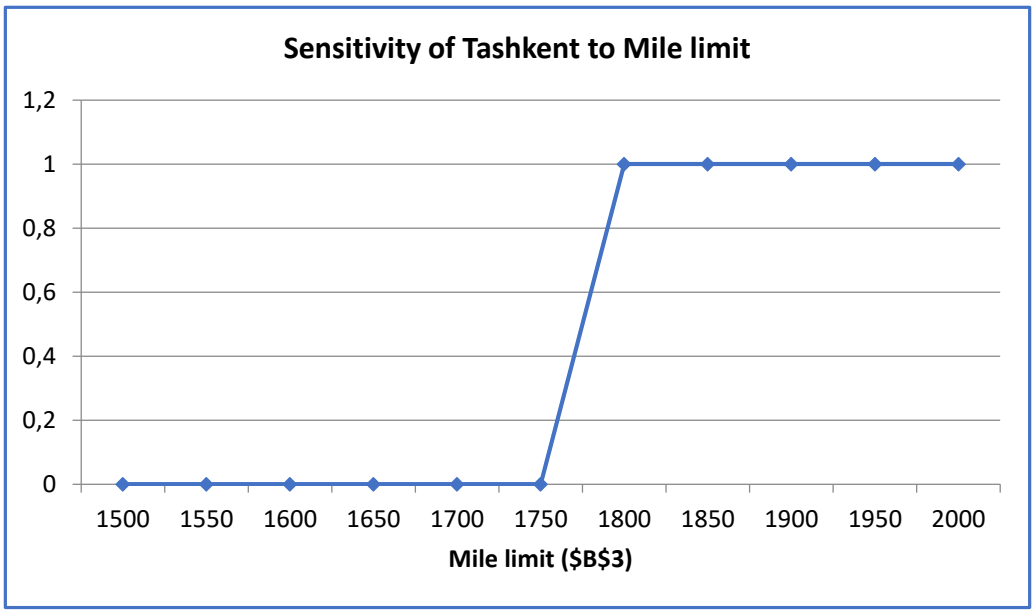

Table V: Sensitivity Analysis II

Changes in:

Miles limit from 1800 to 1900

Constraints: Each city should be covered by at least two Hubs

Distance Threshold / Mile limit	1900

Cities covered by given mile limit

1 if city is within 1800 mile range; 0 if city is outside of range

Hubs/Destination	Moscow	St. Peetersburg	Ekaterinburg	Novosibirsk	Kazan	Krasnoyarsk	Rostov	Ufa	Sochi	Samara	Almaty	Astana	Bishkek	Baku	Dushanbe	Tbilisi	Minsk	Irkutsk
Tashkent	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Samarkand	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Andijan	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Fergana	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Namangan	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Bukhara	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Navoi	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Termez	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Karshi	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Nukus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Urgench	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

Decision Variables: Used as Hubs

Tashkent	1
Samarkand	0
Andijan	1
Fergana	0
Namangan	0
Bukhara	0
Navoi	0
Termez	0
Karshi	0
Nukus	1
Urgench	1

Constraints

Destination	Moscow	St. Peetersburg	Ekaterinburg	Novosibirsk	Kazan	Krasnoyarsk	Rostov	Ufa	Sochi	Samara	Almaty	Astana	Bishkek	Baku	Dushanbe	Tbilisi	Minsk	Irkutsk
Hubs covered by	4	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	2
	>=	>=	>=	>=	>=	>=	>=	>=	>=	>=	>=	>=	>=	>=	>=	>=	>=	>=
Required	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Objective to Minimize

Total number of hubs	4

Analysis and Evaluation of Outcomes:

Original Solution

According to solution proposed by Solver, with total number of two hubs Uzbekistan Airways can cover fifteen CIS destinations. These two cities that can be potential hubs and create effective flight connectivity to Uzbekistan Airways are Tashkent, the capital and Nukus the capital of Karakalpakstan in Uzbekistan. From the calculations it can be seen that majority of destination cities that have connection with Tashkent and Nukus overlap if mile limit is set to 1800 miles. This situation occurred due to that Tashkent cannot be hub for St. Petersburg as the distance between cities is 2089 miles, meanwhile Nukus cannot be hub for Irkutsk as the distance between cities is 2158 miles.

Therefore both hubs to some extent complete each other and allow Uzbekistan Airways to establish good connectivity to those destinations where one hub cannot cover, it can be completed through operating via another hub. Another advantage of having Tashkent and Nukus as hubs, cities are located at different parts of Uzbekistan and can connect surround local cities with CIS destinations.

Sensitivity Analysis

Sensitivity Analysis has shown that if mile limit drops below 1750 miles, solution is not feasible. At the point of 1750 miles, surprisingly Andijan becomes suggested hub alongside with Nukus. And only if mile limit increase to 1800 Tashkent becomes viable hub alongside with Nukus.

In the real-life conditions sometimes change, therefore another objective has been tried by changing requirement of each destination city being covered by at least two hubs. The first attempt where mile limit has not been changed did not bring any result as Solver could not find solution. But after increasing mile limit to 1900, four hubs were suggested by Solver, these are Nukus, Urgench, Andijan and Tashkent.

Conclusion and Recommendations

Conclusion

Based on the analysis and evaluation of the binary integer programming model, the following conclusions and recommendations can be made for Uzbekistan Airways:

Tashkent and Nukus are identified as the optimal hub locations for Uzbekistan Airways, which can cover all fifteen CIS destinations with a mile limit of 1800. This enables efficient flight connectivity and comprehensive coverage of both local and international destinations. Moreover, Tashkent and Nukus are strategically located in different parts of Uzbekistan, which allows for better connectivity with local cities and the ability to reach various CIS destinations where one hub may not be sufficient.

The model shows that the solution is sensitive to the mile limit. As the mile limit drops below 1750 miles, the solution becomes infeasible. However, at 1750 miles, Andijan and Nukus emerge as potential hubs. It is only when the mile limit is set to 1800 miles that Tashkent becomes a viable hub alongside Nukus.

Recommendations:

Uzbekistan Airways should focus on Tashkent and Nukus as the primary hubs for efficient flight connectivity and coverage of CIS destinations within the 1800-mile limit. They need to regularly monitor and assess the mile limit, as it plays a crucial role in determining hub viability. Adjustments in the mile limit may lead to alternative hub options or additional hubs for increased redundancy and connectivity.

If the requirement for each destination city to be covered by at least two hubs is introduced the company needs to consider the possibility of increasing the mile limit to 1900 miles. This will provide a more robust network and increase the resilience of the airline's operations. Company also needs to constantly evaluate and update the model to incorporate changes in the airline's fleet, routes, and demand patterns, ensuring that the hub allocation system remains optimized and aligned with Uzbekistan Airways' strategic objectives.

By implementing these recommendations, Uzbekistan Airways can establish a well-connected and efficient hub allocation system, providing seamless connectivity for passengers while optimizing resources and minimizing operational costs.

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