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Dynamic Pricing Strategy of Indonesia Air Cargo Carriers in the Domestic Market

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Abstract

Most of air cargo carriers in Indonesia domestic market are using single pricing strategy and not taking booking time into consideration for space pricing. It could be a challenge to optimize cargo space revenue of air cargo carriers. This paper aims to optimize cargo space revenue using dynamic pricing strategy by considering different booking time or sales period. This research conducts empirical analysis on air cargo pricing strategies for Garuda Indonesia on certain significant routes. It concludes that Garuda Indonesia generate more revenues using optimized dynamic pricing strategy than using single pricing strategy. In practice, this paper provides references for air cargo carriers in their decision making of applying the dynamic pricing strategy.

Keywords: Revenue Management; Air Cargo Carrier; Dynamic Pricing; Single Pricing; Sales Period.

1 Introduction

Revenue management is about analyzing the situation to predict the behavior of the customers, which is uncertain, and provide the right amount of products or services for the customers in order to maximize the revenue. The main objective of revenue management is to sell the right products or services to the right customers in the right time (13). In the late 1970s, American airlines has adopted the concept of revenue management, the essence of which was to sell a right number of products to suitable customer segments at the right prices during the right time frames to maximize the sales revenue and increased their revenue by 40% (13). Nowadays, revenue management is widely recognized and utilized. Many companies and industries have adopted revenue management techniques in order to increase their profit, especially in airline industry.

Over the past decade, there has been continuous growth in worldwide air cargo transportation. According to the forecasts of Boeing and Airbus, the growth and contribution of air cargo industry to economic development is expected to more than double within the next 20 years. Air cargo transportation becomes very important for cargos that need short transportation time and high reliability. The application of revenue management become very important for airline in managing rapid growth of air cargo business. Recently, almost all air cargo carriers in Indonesia, specifically domestic market, always make their price according to the shipper types and cargo types. Most of them do not take the booking time into consideration for pricing decision. As such, air cargo carriers in domestic market in Indonesia stuck using single pricing strategy overall sales periods.

The single pricing mode strategy may have the following shortcomings. Firstly, a single pricing mode neglects the fact that potential demands in the air cargo market at different sales periods are not the same. Secondly, this pricing mode ignores that the degrees of demand changes in response to space prices are different at different sales periods. Lastly, the single pricing mode may not match the relationship between booking demands and space supplies on segments with a supply shortage. As such, it is necessary for air cargo transport carriers to apply the innovative pricing strategy for the limited space in the air cargo market. Similar to the air passenger industry, a dynamic pricing mode referring to different booking periods can be utilized to maximize cargo revenues.

This study will analyze about air cargo revenue management in Garuda Indonesia (GA), the Indonesian legacy carrier. Currently, GA adopt single pricing strategy to manage its air cargo revenue. Domestic route has dominant contribution by 70% of total air cargo revenue and unique characteristic of market as well that will be our main discussion. From the market demand side, the rise of ecommerce in Indonesia is supported by Indonesian purchasing power of domestic market and positive economic growth. Those positive condition lead to the increasing of air

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cargo demand. The increasing trend is also captured by Garuda Indonesia management to their cargo revenue target 2019. The revenue target increase 59% from previous year. In other side, Garuda Indonesia has to face efficiency program by using threshold Seat Load Factor (SLF) in passenger market, and the flight with SLF no more than decided threshold will be canceled. The cancel flight policy due to efficiency causes gap between capacity planning and realization for cargo belly capacity that still demand on belly space of passenger aircraft. The capacity for cargo in first quarter 2019 is decreasing by 20%. As such it is necessary for GA to apply an innovative pricing strategy for limited space. Same as air passenger industry, a different booking periods can be utilized to maximize air cargo revenue. This paper aims to optimize cargo space revenue using dynamic pricing strategy by considering different booking time or sales period.

2 Literature Review

Revenue management of air transport mainly focused on four key important points, they are demand forecasting, overbooking level, capacity control, and pricing. The first part reviews many previous studies on the research area of demand forecasting, overbooking level and capacity control in the field of revenue management and the following part explores the recent studies about innovative pricing strategies to further address dynamic condition in air cargo industry.

For the point of air cargo demand forecasting, previous research mainly focused on developing forecast models and main determinant variables in demand forecasting. Such as, the dynamic simulation model is developed for forecasting air cargo demand (14) and the evaluation of forecasting model is conducted to obtain accuracy of air cargo demand forecasting (9). More relevant research studied of other main determinants such as the influence of air freight yield and oil price in future market development of air cargo (10,11).

Overbooking is the practice of intentionally selling more cargo space than the available capacity in order to minimize spoilage cost due to the occurrance of no show (8). However, if the real cargo show up at the flight departure exceeds the available capacity, the offloading cost occur (3). Other research subsequently addressed this dilemma by optimizing the air cargo overbooking level with the objective of minimize the spoilage and offloading costs (15).

For the point of capacity control, most previous research focused on optimizing the selling capacity with objective of maximizing revenue. For example, Amaruchkul and Lorchirachoonkul, studied the optimum allocation of air cargo capacity for multiple freight forwarders by using a discrete Markov chain and dynamic programing method (92). The recent studies of air cargo capacity control is considering two-dimensionality, the weight and volume of cargo, in objective of maximize expected revenue. Some solution methods are proposed to solve the problem, such as heuristics based methods, among which the best one is to separate two-dimension problem into two one-dimension state space (1). In addition, a heuristic algorithm to estimate the expected revenue from weight and volume is developed by Huang and Chang (7). Further research also explored many initiatives regarding capacity allocation, for example determination of total weight and volume capacity to sell through allotment contracts and the decision of accepted spot booking were optimized by Moussawi-haidar and tying mechanism of hot-selling routes and underutilized routes was developed by Feng et al (6,11).

Pricing studies include relationship between price and demand of air cargo, and some matters regarding joint price and quantity optimization. For relationship between price and quantity of demand, many previous research studied the demand function as monotonically descend with the price, for example Xi, Xuefei, & Hua (16). Some air ticket pricing studies assume that the demand depends on the customer arriving process and the buying probability of customers affected by price (12). Regarding the issues of joint price and quantity optimization, dynamic programing models are developed. Such as, Chew et al. proposed a dynamic programming model to jointly determine the price and inventory allocation for a product with two-period lifetime (4). In addition, Cizaire and Belobaba took both the fares and booking limits as decision variables based on a two-period booking time and two fare classes (5). Yoon et al. studied the joint pricing and seat control in air passenger industry with the consideration of cancellation in booking processes and a mark-up policy in pricing strategy under uncertain demands (17).

The above literature about demand forecasting, overbooking level and capacity control mainly considers the determination of space price with prices being fixed rather than being taken as decision variable. This research aims to explore the pricing strategies of air cargo carriers in the competitive market. Therefore, the next section deeply reviews the current research of pricing strategies in air cargo industry.

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The above-mentioned studies mainly focus on the monopolistic market, i.e. only one firm is in the market. Then the demand depends on the pricing of the firm only. While this research focuses on the pricing strategies in the occasion of two carriers in the market, thus a competitive market is considered. But this study does not consider the case that domestic air freight competes with road freight transport. The following part reviews the current pricing studies in the competitive market. Current studies regarding pricing in the competitive market are mainly based on the game theory, such as the game pricing with considering the two price classes between the competition of two airlines. Considering the booking periods in the competitive market, investigated the prices and capacity allocation decisions in the duopoly market over an early discount period and a regular full-fare season.

From the analysis in this part, current studies mainly consider the case of two price classes and seldom consider the case of multi-periods. This research will fill the current research gap by considering more price classes and containing several sales periods in the competitive market for air freight transport industry with considering overbooking level to maximize revenue. As such, this research aims to study the pricing decision with consideration of multi-classes and multi-periods in the competition market. It focuses on the air cargo space pricing strategy over multi-periods in the market under the game between two carriers. In addition, different attributes between potential market demands and degrees of demand changes in response to space prices exist at different sales periods. Therefore, this research develops a pricing model to determine space prices for two carriers at each sales period.

3 Methodology/Materials

3.1 Problem description

This paper studies the dynamic pricing of air cargo space pricing on a certain significant flight route. In this case, the space pricing during the sales process for each carrier is as follows. At the beginning of the sales period, the carrier owns its available space for the market and makes the pricing strategy for different sales periods. At each period, the amount of space booking demand depends on both the potential market demand and the price in this period. The carrier then accepts these requirements and obtain the revenue. Then the amount of available space reduces gradually. If all the available space is sold out before the end of the sales period, the carrier cannot accept new booking demand. On the other hand, if the available space is not sold out by the end of the sales period, the remaining space is wasted without gaining any revenue.

The selling time in the air cargo domestic market is short. Once the price strategy is determined by one air cargo transport carrier, it is hard to adjust. Therefore, air cargo transport carriers need to make the price for each period in advance. Considering the fairness, carriers usually do not allow the price going down as the flight approaches to departure (17). The reason is that if the price changes to a lower one in the later booking stage, the former customers who have booked the space at higher prices may feel unfair. From a long-term perspective, it will lead to carriers' profit reduction.

Therefore, it assumes that carriers adopt the "low-before-high" (LBH) manner for pricing at each period, i.e. the price at the later period is higher than or equals to the price at the former period. Moreover, each period can only have one price class so that the space price is a section function of the sales period.

An air cargo carrier adopts a dynamic pricing strategy to increase the cargo revenue by taking advantage of different potential market demands and different degrees of demand changes in response to space prices at different periods (18). In this situation, an air cargo carrier needs to consider the following issues when implementing the differential pricing strategy.

1. the amount of available spaces that owned by both carriers
2. the pricing strategy of its competitor if the carrier's space pricing strategy is determined
3. the degrees of demand changes in response to space prices of two carriers at each sales period
4. the corresponding revenue after determining the price in each period.

Suppose the two carriers are E_1 and E_2, with their demands at a certain period being affected by both the carrier's price and its competitor's price. In this case, if the price of E_1 in sales period t is p_t^1 and E_2's price in sales period t is p_t^2, then function (1) denotes the booking demand of E_1 in period t when the price of E_1 is p_t^1 and the price of E_2 is p_t^2.

$$D^t_1 = F(p_t^1, p_t^2) \qquad (3.1.)$$

Similarly, function (2) denotes the booking demand of E_2 in period t when the price of E_1 is p_t^1 and the price of E_2 is p_t^2

$$D^t_2 = G(p_t^1, p_t^2) \qquad (3.2.)$$

If the pricing strategy of E_1 is determined, E_2 will determine its own pricing strategy according to E_1's strategy and demand function (2). In turn, it will affect E_1's booking demand and revenue, and vice versa. Therefore, a carrier needs to consider the competitor's corresponding pricing strategy before determining its own pricing strategy. Moreover, since prices at different periods follow the manner of LBH, the price at a former period can determine the lower limit of the price at a latter period. In this case, carriers cannot simply follow the principle of maximizing the revenue of each period to decide their pricing strategies. It is necessary for carriers to consider the constraint relationship of the prices before they decide their pricing strategies.

3.2 Model

This paper focuses on the air cargo pricing in the competitive market including multiple sales periods with two carriers competing on a certain route. The model is constructed with following assumptions:

1. The two carriers provide no difference in transport services. This assumption is based on the fact that customers do not care about transport processes in air cargo industry, such as comfort and transshipment, but care about cargos being transported to the destinations.
2. The booking demands at different periods are independent of each other.
3. The pricing strategy of each carrier follows the manner of LBH. As mentioned above, the manner of LBH considers the fairness for customers who have booked spaces earlier.
4. The booking demand of each carrier at each period is linear relating to both of its own price and its competitor's price. The higher of its own price or the lower of its competitor's price, the fewer demands will be.
5. The situation of "overbooking" and "cancellation of booking" are not taken into consideration.

$T = (1, 2, 3, \ldots, t)$ denotes the set of sales periods. The set of air cargo carriers is $N = (1, 2)$. The decision variables p_t^1 and p_t^2 represent the price at the period t of carrier 1 and carrier

2 respectively. The accepted amount of booking demand of carrier 1 and carrier 2 at the period t are q_t^2 and q_t^2 respectively. The remaining available spaces can be sold at the period t owned by carrier 1 and carrier 2 are represented as W_t^1 and W_t^2. W_1 and W_2 denote the amount of original available spaces owned by carrier 1 and carrier 2. The booking demands of carrier 1 and carrier 2 at the period t as denoted as D_t^1 and D_t^2 respectively. Assume that the booking demand of each carrier at each period is linear relating to both of its own price and its competitor's price. As such, functions (3) and (4) denote the relationship between demands and prices at each period of two carriers respectively, as below.

$$D_t^1 = a_t - b_t * p_t^1 + c_t * p_t^2 \ (b_t \geq c_t) \ \forall \ t \in T \tag{3.3.}$$

$$D^t{}_2 = a_t - b_t * p_t^2 + c_t * p_t^1 \ (b_t \geq c_t) \ \forall \ t \in T \tag{3.4.}$$

a_t, b_t and c_t are parameters. b_t denotes the amount of demand decreasing if a carrier increases the price by one unit. While c_t denotes the amount of demand increasing if the other carrier increases the price by one unit. In each period, $(b_t \geq c_t)$ denotes that the booking demand of each carrier is influenced by its own price more than or equal to its competitor's price. As such, the nonlinear programming pricing strategy model for carrier 1 can be established in the condition that carrier 2's pricing strategy is confirmed.

$$\pi^1 = Max: \ \sum_{t=1}^{T} p_t^1 \times q_t^1 \tag{3.5.}$$

$$S.T.:$$

$$q_t^1 = Min\{D_t^1, \ W_t^1\} \quad \forall \ t \in T \tag{3.6.}$$

$$D_t^1 \geq 0 \quad \forall \ t \in T \tag{3.7.}$$

$$\sum_{t=1}^{T} q_t^1 \leq W^1 \tag{3.8.}$$

$$W_{t+1}^1 = W_t^1 - q_t^1 \quad \forall \ t \in T \tag{3.9}$$

$$p_t^1 \leq p_{t+1}^1 \quad \forall \ t \in T \tag{3.10.}$$

The objective of equation (5) is to maximize the total revenue of carrier 1 in all sales periods. Equation (6) means that the accepted amount of booking demand of carrier 1 at each period can exceed neither the booking demand nor the remaining available space. Equation (7) indicates that the booking demand of carrier 1 at each period cannot be negative. Equation (8) means the total accepted booking demand of carrier 1 in all sales periods cannot exceed its original owned available space. Equation (9) denotes the conversion relationship of each period's remaining space of carrier 1. Equation (10) means the pricing strategy of carrier 1 follows the manner of LBH. Similarly, the nonlinear programming pricing strategy model for carrier 2 can be constructed based on carrier 1's pricing strategy.

The model of this paper focuses on the pricing optimization in the circumstance that optimizing dynamic pricing strategy of one company. In this stage, one carrier's pricing strategy is fixed, the price at each period of the other carrier will be decided

3.3 The algorithm of differential pricing strategy for one Carrier

Suppose that carrier 2's pricing strategy is fixed, then the demand function for carrier 1 at each period can be expressed as below.

$$D_t^1 = a_t' - b_t * p_t^1 \ , \quad (a_t' = a_t + c_t * p_t^2) \tag{3.11.}$$

If the amount of booking demands of carrier 1 exceeds the amount of remaining available space at a certain period, carrier 1 can increase the price of that period to the level of satisfying $D_t^1 = W_t^1$ to improve revenues. It means, for the optimized pricing strategy of carrier 1, the amount of booking demands cannot exceed the amount of remaining available space at each period, for example, $D_t^1 \leq W_t^1$. Therefore, equation (6) can be changed into equation (12).

$$q_t^1 = D_t^1 \quad \forall \ t \in T \tag{3.12.}$$

Then the pricing model of carrier 1 can be change into equation (13)

$$\pi^1 = Max: \ \sum_{t=1}^{T} p_t^1 \times (a_t' - b_t * p_t^1) \tag{3.13.}$$

$$S.T.:$$

$$a_t' - b_t * p_t^1 \geq 0 \quad \forall \ t \in T \tag{3.14.}$$

$$\sum_{t=1}^{T} (a_t' - b_t * p_t^1) \leq W^1 \tag{3.15.}$$

$$p_t^1 \leq p_{t+1}^1 \quad \forall \ t \in T \tag{3.16.}$$

The objective function of equation (13) can be changed into equation (17)

$$\pi^1 = Min: \ \sum_{t=1}^{T} p_t^1 \times (b_t * p_t^1 - a_t') \tag{3.17.}$$

4 Results and Findings

4.1 Data

The case that two carriers in Jakarta, making their space prices on the route of Jakarta-Banjarmasin, Jakarta-Manado, Jakarta-Medan, Jakarta-Pontianak, Jakarta-Makassar are chosen for the empirical analysis. In Jakarta, the air cargo industry operated by two carriers, Garuda Indonesia Group (GA) and Lion Group (JT). For the former one, it has the dominance and takes almost half of the market share. Several other air cargo operating companies cooperate with each other, share the same pricing behavior and form a carrier union, which is referred as the latter one in this paper. The two parties, i.e. GA and JT, have the competitive relationship in practice.

Assume that the time length of the spot market is from 7 days prior to the flight taking off to the departure day. There are 8 sales periods in total if each day is taken as one sales period. Based on nature of business and historical booking trend of air cargo, we assumes that the space booking in air cargo was mostly distributed in the 7 days prior the departure date. As such, the proportion of space booking of each period in the air cargo market can be estimated as the proportion in the Figure 1. Then the distribution of the booking demands in different sales periods can be obtained. These ratios can reflect the distribution of cargo space booking demands at each period in air cargo market. In practice, the average daily freight transport volume of GA carrier on each route, based on average distribution in the recent 1 year as seen in the table 1. Additionally, based on data from Angkasa Pura II, daily air cargo transport volume of JT carrier on that route is also obtained.

Then, with the distribution of cargo space booking demands at each period and the average daily air cargo volumes of the two parties, the booking demands at each period of the two parties can be obtained, as shown in Table 2. These booking demands can reflect the potential market demands in their corresponding periods.

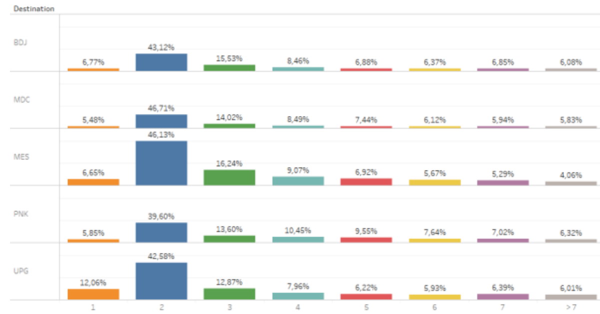

Figure 1: Booking ratios at each period

GA carrier and JT carrier mainly use the belly space of air passenger aircrafts for their air cargo service. From Angkasa Pura II, Indonesia airport authority, it can be found that for one day available capacity as seen in Table 4. Currently, the aircraft used for passenger transportation in Indonesia is mainly Boeing 737-800 NG and 737-900 ER with the loading space of its belly being 3500 kg in total for cargo capacity.

4.2 Result

Define Coefficient using empirical data from both airline Garuda Indonesia (GA) and Lion Group (JT). The data gathered from daily performance with range sample of April 2018 – March 2019. The information about pricing for both airline as seen in the table 1.

After taking the initial prices and the relative cargo transport volume of GA carrier and JT carrier into Eq. (3) and Eq. (4), the parameters a_t , b_t and c_t can be calculated, as shown in Table 6. The model can be finally solved.

Table 1: Booking demand at each period for Garuda Indonesia

Garuda Indonesia

Route	Booking Demand at Each Period (Kg)							
	1	2	3	4	5	6	7	>7
CGK-BDJ	1.026	6.534	2.353	1.282	1.043	965	1.038	921
CGK-MDC	613	4.253	1.497	836	638	523	488	374
CGK-MES	1.789	12.413	4.370	2.441	1.862	1.526	1.423	1.092
CGK-PNK	861	5.825	2.001	1.537	1.405	1.124	1.033	930
CGK-UPG	3.050	10.767	3.254	2.013	1.573	1.500	1.616	1.520

Table 2: Booking demand at each period for Lion Group

Lion Air Group

Route	Booking Demand at Each Period (Kg)							
	1	2	3	4	5	6	7	>7
CGK-BDJ	581	3.699	1.332	726	590	546	588	522
CGK-MDC	398	2.759	971	543	414	339	316	243
CGK-MES	721	4.998	1.760	983	750	614	573	440
CGK-PNK	310	2.102	722	555	507	405	373	335
CGK-UPG	2.097	7.404	2.238	1.384	1.082	1.031	1.111	1.045

Table 3: Available Capacity for Garuda

Route	Available Capacity each day (Kg)
CGK-BDJ	15.000
CGK-MDC	7.000
CGK-MES	24.500
CGK-PNK	14.000
CGK-UPG	23.500

Table 4: Cargo price of Garuda Indonesia

Route	Single Price per kg (IDR)							
	1	2	3	4	5	6	7	>7
CGK-BDJ	19.400	19.400	19.400	19.400	19.400	19.400	19.400	19.400
CGK-MDC	41.800	41.800	41.800	41.800	41.800	41.800	41.800	41.800
CGK-MES	17.000	17.000	17.000	17.000	17.000	17.000	17.000	17.000
CGK-PNK	18.500	18.500	18.500	18.500	18.500	18.500	18.500	18.500
CGK-UPG	28.700	28.700	28.700	28.700	28.700	28.700	28.700	28.700

Table 5: Cargo price of Lion Group

Route	Price Per Kg (IDR)							
	1	2	3	4	5	6	7	>7
CGK-BDJ	19.800	19.800	19.800	19.800	19.800	19.800	19.800	19.800
CGK-MDC	49.470	49.470	49.470	49.470	49.470	49.470	49.470	49.470
CGK-MES	17.460	17.460	17.460	17.460	17.460	17.460	17.460	17.460
CGK-PNK	18.964	18.964	18.964	18.964	18.964	18.964	18.964	18.964
CGK-UPG	34.920	34.920	34.920	34.920	34.920	34.920	34.920	34.920

Table 6: Coefficient a b c

Rout	Coefficient	Coeficient at each Period							
		1	2	3	4	5	6	7	>7
CGK-BDJ	a	8.072.84	51.418.14	18.518.64	10.088.07	8.204.01	7.595.86	8.168.23	7.250.05
	b	0.74	4.72	1.70	0.93	0.75	0.70	0.75	0.67
	c	0.37	2.36	0.85	0.74	0.38	0.35	0.38	0.33
CGK-MDC	a	932.55	6.468.95	2.277.38	1.271.91	970.41	795.12	741.83	569.35
	b	0.02	0.13	0.05	0.03	0.02	0.02	0.01	0.01
	c	0.01	0.06	0.02	0.01	0.01	0.01	0.01	0.01
CGK-MES	a	14.600.31	101.280.07	35.655.50	19.913.51	15.193.11	12.448.69	11.614.39	8.913.88
	b	1.55	10.75	3.78	2.11	1.61	1.32	1.23	0.95
	c	0.77	5.37	1.89	1.06	0.81	0.66	0.62	0.47
CGK-PNK	a	7.987.65	54.070.28	18.569.59	14.2683.54	13.039.68	10.431.74	9.585.19	8.629.40
	b	0.79	5.35	1.84	1.41	1.29	1.03	0.95	0.85
	c	0.40	2.67	0.92	0.71	0.65	0.52	0.47	0.43
CGK-UPG	a	4.197.11	14.818.66	4.479.01	2.770.23	2.164.68	2.063.75	2.223.84	2.091.60
	b	0.10	0.36	0.11	0.07	0.05	0.05	0.05	0.05
	c	0.05	0.18	0.05	0.03	0.3	0.3	0.3	0.3

Table 7: Pricing result under dynamic pricing strategy

Rout	Dynamic Pricing prioe Per Kg (IFR)=p1							
	1	2	3	4	5	6	7	<7
CGK-BDJ	19.420.0236	19.420.0236	19.420.0236	19.420.0236	19.400.0000	19.400.0000	19.400.0000	19.400.0000
CGK-MDC	50.028.5732	50.028.5732	50.028.5724	50.028.5724	50.028.5724	50.028.5724	50.028.5724	41.800.0000
CGK-MES	17.122.0074	17.122.0074	17.122.0074	17.122.0074	17.122.0074	17.000.0000	17.000.0000	17.000.0000
CGK-PNK	18.556.4307	18.556.4307	18.556.4307	18.556.4307	18.556.4307	18.556.4307	18.556.4307	18.500.0000
CGK-UPG	31.390.7439	31.390.7439	31.390.7439	30.818.7415	30.818.7415	28.700.000	28.700.000	28.700.0000

The single pricing mode currently adopted by two carriers is optimized to test whether the dynamic pricing strategy can make more revenue than the single pricing strategy. The pricing results under the single pricing strategy for two carriers are shown in Table 4 and Table 5. The dynamic pricing results achieved for the GA are shown in Table 7. Under this pricing strategy, the total revenue of GA is IDR 2.040.379.402 for the sample 5 routes. It shows the revenue has increased by using the proposed dynamic pricing strategy compared to the revenue IDR 1.933.555.220, gained under the initial pricing strategy. The results indicate that if GA carrier change its initial pricing strategy to the dynamic pricing strategy, revenues can increase by 6%. By generating dynamic pricing strategy which impact the booking demand as one of our decision variable, Table 8 shows the accepted booking demand at each period for the 5 sampe route. It shows that dynamic pricing causes different demand at each period and result suggestion of optimum accepted booking demand at each period. Figure 2 shows revenues of GA carrier at each sales period by using the optimal dynamic pricing strategy and the single pricing strategy. It can be found that 1) sales revenues under the single pricing strategy are lower than the corresponding revenues under the dynamic pricing strategy.; 2) under the dynamic pricing strategy, dynamic pricing strategy match the relationship between booking demands and space supplies on segments with a supply shortage.

5 Conclusion

Based on the competition between two air cargo transport carriers on a certain route in the domestic market in Indonesia, this paper studies the dynamic pricing strategy applied in the decision making over multiple sales periods for limited cargo space/capacity. The pricing strategies of two carriers are optimized with the objective of maximize sales revenues in the whole periods. The empirical analysis studies the case that GA carrier and JT carrier compete on the certain 5 sample significant routes. From the empirical results, the research draws the conclusion that the dynamic pricing strategy can obtain more revenues than the single pricing strategy in the Indonesia air cargo market;

The model in this study is also possible to be applied in other industries, such as liner shipping industry, if the available space is fixed and services cannot be stored in these industries

Table 8: Accepted booking demand

Rout	Accepted Booking Demand (Kg)=q1							
	1	2	3	4	5	6	7	<7
CGK-BDJ	1.011	6.439	2.319	1.263	1.043	965	1.038	921
CGK-MDC	459	3.185	1.121	626	478	391	365	374
CGK-MES	1.600	11.102	3.908	2.183	1.665	1.526	1.423	1.092
CGK-PNK	816	5.523	1.897	1.458	1.332	1.066	979	930
CGK-UPG	2.775	9.797	2.961	1.870	1.461	1.500	1.616	1.520

Table 9: Revenue under dynamic pricing strategy

Rout	Revenue under Dynamic Pricing (IDR)								Total
	1	2	3	4	5	6	7	<7	Revenue
CGK-BDJ	19.633.738	125.052.693	45.038.692	24.534.923	20.225.011	18.725.774	20.136.821	17.873.267	291.220.919
CGK-MDC	22.968.568	159.329.336	56.091.661	31.327.057	23.901.127	19.583.727	18.271.238	15.647.078	347.119.792
CGK-MES	27.401.755	190.081.637	66.917.971	37.373.521	28.514.308	25.936.621	24.198.364	18.571.902	418.996.079
CGK-PNK	15.140.870	102.492.043	35.199.288	27.046.510	24.717.147	19.773.717	18.169.044	17.198.949	259.737.568
CGK-UPG	87.106.545	307.545.344	92.956.985	57.633.429	45.035.168	43.036.198	46.374.588	43.616.788	723.305.044

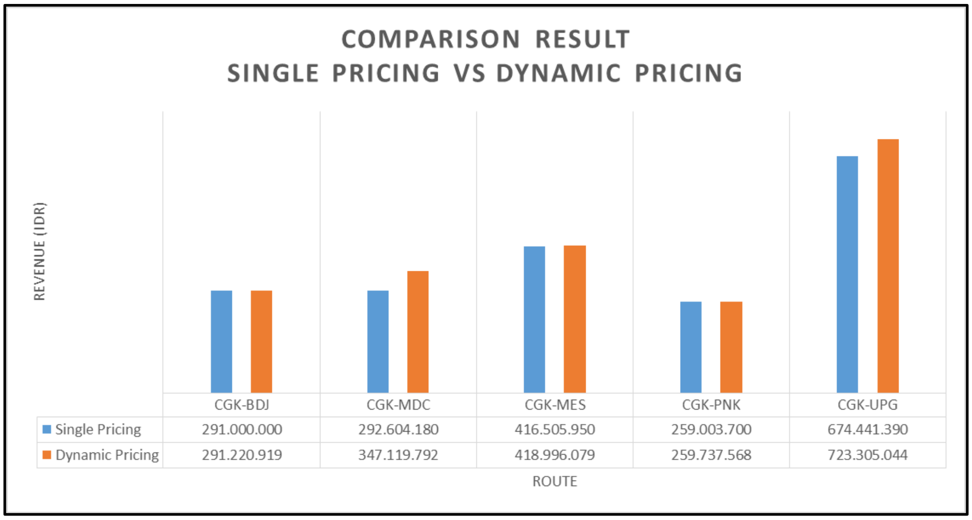

Figure 2: The comparison of GA's revenue carrier at each period under dynamic pricing strategy and single pricing strategy

For similar cases and industries, instead of using one single pricing strategy, operators can utilise the adopted model in this paper and design their differential pricing strategies to obtain more revenues. As any research has the limitation, this research provides ample room for future studies. For example, it would be interesting for future studies to develop pricing optimization models among three or more carriers in the air freight transport industry. In addition, future research can consider the situation of overbooking and cancellation by large forwarders which can impact on the space selling in the spot market.

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