JOURNAL OF ENGINEERING AND MANAGEMENT IN INDUSTRIAL SYSTEM VOL. 6 NO. 2 YEAR2018
e-ISSN 2477-6025
DOI:10.21776/ub.jemis.2018.006.02.3

REVENUE MANAGEMENT MODEL BASED ON CAPACITY SHARING AND OVERBOOKING IN THE AIRLINE

Oki Anita Candra Dewi[1),]Muhammad Faisal Ibrahim[2)]
Logistics Engineering Department, Universitas Internasional Semen Indonesia[1,2)]

Abstract *Aviation industry often faced uncertainty demand and high level of cancellation. Revenue management in the airline is related to demand management policies to classify and estimate the various requests of pricing and capacity control. This study will develop airline revenue management model integrates luggage passengers with air cargo based on the control of air cargo space. The airline must pay attention to customer behavior due to high cancellation and no-show. In this case we deal with the aspect of the overbooking in which one of the ways to reduce the cost of spoilage due to cancellation or no show. Moreover, in this proposed model, we discuss the expected revenue function to maximize the expected revenue from the policies of accept or reject the booking requests between passengers and air cargo by the same airline. This study aims to develop expected revenue in the dynamic programming model in order to maximize the revenue expectations of the policy of accepting and rejecting booking request between passengers with air cargo in the same airline.*

Key Words: *revenue management; customer behavior; aviation industry*

1. Introduction

Revenue Management (RM) usually refers to the airline industry which commonly offers different prices to maximize revenues. Airline has the characteristics of perishable products, namely products which do not have residual value if it passes a certain period which mean airlines will lost the opportunity of revenue if the tickets were not sold until the flight depart. RM is used to anticipate demand uncertainty problems in the future due to excess inventory may not be stored and used in the next period, while a seats and cargo space capacity offered always fixed and the fixed costs is high but marginal costs is low and often an important concern since its application. According to Luo Li and Luo Li & Ji-Hua [1] explains airlines that implementing revenue management increases their revenue from 2% to 8%. RM in theairlinehastwo types: (i) airpassenger RM and (ii) air cargo RM.

Passenger RM discusses the problem of seat capacity control which about the decision to accept or deny a booking request for a particular fare during the bookingperiod [2]. The earliest work of air passenger RM can be traced to Beckmann [3], Thompson [4] and Coughlan [5] which develops overbooking capacity allocation inthe single flight with a differentfare classes and uses static random variables.Lee and Hersh [6] generalized single seat booking to batch booking and the request probability based on Poisson distribution arrival process to represent the demand pattern. According to Karaesman and Van Ryzin [7] describe a model for a single flight with some fare classes and developing capacity allocation models by calculating the limit of booking request to estimates the expected revenue from demand.

Previous research which addresses the existence condition of overbooking can be found in Beckmann [8], Thompson [9] and Coughlan [5] which develops capacity allocation and overbooking for the single

* Corresponding author Email:oki.dewi@uisi.ac.id
Published online at http://Jemis.ub.ac.id

Cite this Article As Dewi, O. (2018). REVENUE MANAGEMENT MODEL BASED ON CAPACITY SHARING AND OVERBOOKING IN THE AIRLINE. *Journal of Engineering and Management in Industrial System, 6*(2), p86-94.
Paper Accepted : Dec 13th, 2018
Paper Published : Dec 31th, 2018

e-ISSN 2477-6025
DOI: 10.21776/ub.jemis.2018.006.02.3

flight with static random variable of booking request. Subramanian et al [10] take into account of overbooking, cancellation, no-show customer and considered the penalty due to overbooking. Overbooking is a policy to sell tickets exceeding the seat capacity. This policy has a risk and could potentially harm for the airline when the number of passengers show-up upon departure is exceeds of seat capacity because the airline must provide certain compensation of overbooking penalty.

In the air passenger RM literature, some papers discussing dynamic seat allocation models for a single flight. Lee and Hersh [6], and Subramanian, et al [10] discussed discrete-time booking period. Fengand Xiao [11] discussed continuous-time booking model. Luo Li and Ji-hua [1] developed a model under competition using continuous time.

The other sources of significant airline operations for revenue are air cargo. Heinitz [12], and Huang and Lu [16] explains an air freight services or air cargo are important to supply chain of global trade. Based on Yamaguchi [14] inform about the largest two economies in the world, U.S. and Japan, more than 30% of internationally traded merchandise using air transportation. According to Boeing [15] describes the air cargo industry grew 5.9% annually over the next two decades. The characteristic of air cargo RM is different from passenger RM in many areas. Huang and Lu [16] explain the fundamental difference is the nature of the product. For the passenger RM, seats are the product in terms of the demand related by the customer and seat capacity.

However, air cargo products are control over the sales of their limited cargo space. Cargo consumes multi dimensional capacity, i.e. weight and volume are two such dimensions [17]. They formulate weight and volume of shipments as stochastic and developed several heuristics and bounds by decomposing the problem into one-dimensional sub-problem for weight and volume. The similar single-leg problem is proposed by Huang and Chang [18] that developed a heuristic to estimates the expected revenue from both weight and volume by sampling a limited number of points in the state space. Han et al [19] developed a bid-price control policy based on a mixed integer programming (IP) model. Hoffmann [20] recently developed an efficient heuristic that exploits the structure of monotone switching curves to reduce the computational load. Zhuang et al [21] proposed a general model and two heuristics that consistently outperform heuristics ignoring consumption uncertainty.

Air cargo RM is specifically discussed by several researchers. Becker and Dill [22], Amaruchkul et al. [17], Becker and Kasilingam [23], Becker and Wald [24], and Kasilingam [28], Bilings et al [26], Slager & Kapteijns [27], Kasilingam [28], Levin et al [29] provided the background to air cargo RM and the complexities of the product which cargo space is so much more complicated. Luo, et al [31] creates two dimensional model (weight and volume) for overbooking issue with the aim of minimizing cost of spoilage and offloading. Haidar and Cakanyildirim [30] continue the research of Luo et al [31] with the aim of maximizing profit.

However, previous paper discuss dynamic programming on airline revenue management but none of models integrates passenger with air cargo that takes into account on two dimensions, namely cargo weight and volume based on the control of air cargo space. In this model, we present a Markov decision process of the free sale passenger and air-cargo booking process for a single flight with the fare classes of both passenger and air-cargo. We specifically discuss the expected revenue function to maximize the expected revenue from the policies of accept or reject the booking requests between passengers and air cargo by the same airline. This study aims to develop expected revenue in the dynamic programming model in order to maximize the revenue expectations of the policy of accepting and rejecting booking request between passengers with air cargo in the same airline.Moreover, in this proposed model, we also deal with the aspect of the overbooking problems on the air passenger RM.

The remainder of this paper is organized as follows. Section 2 provides the model description to propose the model. Section 3 explores the dynamic programming model to

e-ISSN 2477-6025
DOI: 10.21776/ub.jemis.2018.006.02.3

illustrate the integration of passenger and air-cargo RM problem. Finally, summarizes and conclusions are drawn in section 4.

2. Model Description

In this study, we discuss seat and cargo allocation policy model for revenue management problem on single flights in the same airline. This study focuses in the dynamic single-leg revenue management problem on integration of passenger and air cargo with overbooking consideration. The feature of overbooking, cancellation and no-show is incorporated in the problem formulation for only passenger problem. The goal of this problem is to maximize total revenue from both passenger and air cargo. We develop a dynamic programming model on the same airline to optimize seat allocation of passenger considering overbooking as practiced by Subramanian et al [10] and integration of air cargo revenue management considering two-dimension of weight and volume as practiced by Huang and Chang [18].

3.Model Formulation

In this section, we introduce in dynamic programming model for integration of passenger and air cargo on the same airline to compute the maximum expected revenue and determine the optimal policy. There are seat capacity is denoted by *C*. Generally,$r_1 > r_2 > r_3 > \cdots > r_m$ and$R_1 > R_2 > R_3 > \cdots > R_m$. The highest price class called high fare while the lower price is low fare. Each air passenger and air cargo contained m fare class and expressed by i, where $i = 1,2,..,m$. $r_i$is denoted as rate of type i on passenger and R_i is rate of class i on cargo. There are N decision periods or stages, number in reverse chronological order, *n=N, N-1,...,1, 0,* with stage N corresponding to the opening of the flight for reservation either air passenger or air cargo and stage *0* corresponding to its departure.

In this model, cancellation and no-shows occur at class independent rates, which allow us to use a one dimensional state variable. This research develops overbooking only on air passenger cases with corresponding penalties determined by an overbooking penalty function. At each stage, we assume that only one of the following events occurs: (1) an arrival customer of air passenger. The probability of each type is 0.5 and they request for a seat in fare class,r_i; (2) an arrival customer of air cargo and they request for cargo with weight and volume in fare class R_i; (3) a cancellation by a customer of air passenger that currently holding a reservation. Booking requests in each fare class for event (1) and (2) according to time-dependent process. Based on the number of seat and capacity cargo already booked, we must decide whether to accept or reject each request. In addition, passenger who has already booked may cancel at any time on the *n* period. At this time, the passenger is refund an amount for class dependent. The passengers can also be no-shows at the time of departure and the passengers are not refunded anything.

Let P_{in} denote the probability of a request for a seat (air passenger) in fare class i in period n. And K_{in} denote the probability of a request for air cargo in the fare class i in period n. The probability of a cancellation is denoted by $q_n(x)$ that x is the number of reserved seat on air passenger. So, we have the total probability of each stage from the all event that can occur, ex. request seat, request cargo or cancellation is:

$$\sum_{i=1}^{m}(P_{in} + K_{in}) + q_n(x) + P_{0n} + K_{0n} = 1 \tag{1}$$

For all x and $n \geq 1$

Where P_{0n} and K_{0n} represent the probability of no booking request. This model considering of overbooking as denoted by B, that means the additional number of seat offered on the passenger to response to their cancellation and no-shows. So the additional constraint, $x \leq C + B$.

As a function of the state x in period n, $U_n(x)$ denote the maximal expected revenue of operating the air passenger system over period *n to 0*. While losses due to no-show passenger was denoted by $H_n(x)$, is the total

e-ISSN 2477-6025
DOI: 10.21776/ub.jemis.2018.006.02.3

loss of revenue over period n to 0 because of cancellation and no-show.

$$U_n(x) = P_{0n}U_{n-1}(x) + \sum_{i=1}^{m} P_{in} max\{r_i + U_{n-1}(x+1) - [H_{n-1}(x+1) - H_{n-1}(x)], U_{n-1}(x)\} \quad (2)$$

$$H_n(x) = \sum_{i=1}^{m} P_{in}H_{n-1}(x) + q_n(x)\big(Q + H_{n-1}(x-1)\big) \quad (3)$$

Let denote $Y(x)$as the passenger who show-up when the stage 0. This means$x - Y(x))$ is no-show passenger. We have β denote the probability of no-show passenger and will occur only at the time of departure. However, because this model start with no seat booked at stage N and at most one customer arrive and accepted at most one request at each stage it follow at stage n, $x \leq N - n$. It means that the number of reserved seat is less than the stage take place. Because each passenger have a probability of $(1-\beta)$ to show-up when the time of departure, then $Y(x)$ can be expressed by binomial distribution, $(x, 1-\beta)$. If $Y(x) = C + B$ it would appear overbooking penalty and denote by π_i. Let E is the total expected revenue of the passenger, so we have.

$$U_0(x) = E - \pi_i(Y(x) - C) \quad (4)$$

At the stage $n = 0$, the possibility of other loss of revenue that may occur is the penalty of no-show passenger and denoted by d.

$$H_0(x) = (\beta.x.d) \quad (5)$$

According to Huang and Chang [38], they formulate a multi-dimensional dynamic model for the cargo space control problem which weight and volume of various types of shipments are stochastic and calculated concurrently. The weight and volume of shipment type follows a distribution, which can be represented by a random variable. Let $z_n(v,w)$, be a maximum expected revenue based on the accumulated average volume v and the accumulated average weight w at period n and determine the optimal policy as equation bellow.

$$z_n(v,w) = \sum_{i=1}^{m} K_{in} \max\{R_i + z_{n-1}(v+\overline{v_i}, w+\overline{w_i}), z_{n-1}(v,w)\} + K_{0n}z_n(v,w) \quad (6)$$

Let $\overline{v_i}$ as the average volume of type i and v as the accumulated average volume of the accepted bookings. The average weight of type$i$ is denoted by $w_i$and w as the accumulated average weight of the accepted bookings. This equation will stop when $(v+\overline{v_i}) \geq v_k or (w+\overline{w_i}) \geq w_k$ that means if the accumulated volume of the accepted booking plus the occurring customer with volume of type i is more than the capacity of volume in the airline v_k then this customer will rejected as well as the weight constraint.

The focusof this paper is to develop the dynamic single-leg revenue management problem on integration of air cargo and passenger with overbooking consideration. The feature of overbooking, cancellation and no-show is incorporated in the problem formulation for only passenger problem, so the equation of both categories is:

$$V_n(x,v,w) = V_{n-1}(x,v,w) + U_n(x) + z_n(v,w) \quad (7)$$

e-ISSN 2477-6025
DOI: 10.21776/ub.jemis.2018.006.02.3

$$
\begin{aligned}
&V_n(x,v,w) \\
&= V_{n-1}(x,v,w) \\
&+ \Bigg[P_{0n} U_{n-1}(x) \\
&+ \sum_{i=1}^{m} P_{in} max\{r_i + U_{n-1}(x+1) \\
&- [H_{n-1}(x+1) - H_{n-1}(x)], U_{n-1}(x)\} \Bigg] \\
&+ \Bigg[\sum_{i=1}^{m} K_{in} \max\{R_i \\
&+ z_{n-1}(v+\overline{v_i}, w+\overline{w_i}), z_{n-1}(v,w)\} \\
&+ K_{0n} z_n(v,w) \Bigg] \qquad (8)
\end{aligned}
$$

Where $V_n(x,v,w)$ is the sum of total expected revenue for passenger airline with overbooking, cancellation, and no-shows consideration and the total expected revenue of air cargo airline with two-dimension of volume and weight.

4. Numerical Experiment

A numerical experiment was designed to evaluate the proposed model and calculating in every stage and state during the period. Some of the settings of the test problems were based on Amaruchkul et al. [17] and Huang & Chang [18]. The optimal output at stage n will be an input on the next stage$n-1$. It is assumed that there were 60 decision periods within the entire booking process of passenger and air cargo. The airline seat capacity is set by $C = 20$ seat available dan the overbooking seat is $B = 5$ seat. We assume the overbooking limit at least 10 seats for the booking request of fare class 1. The request probability for fare classes of passenger and air cargo are shown in table 1.

The probability of no booking request of passenger is the probability of booking request in air cargo at fare class i, and vice versa for air cargo probabilities. Based on Huang & Chang [18], there are nine cargo dimension categories of cargo shipments with varying weight and volume distributions. In this paper, we conduct three from nine categories because we use airline for passenger. The three cargos dimension categoriesare shown in the table 2.

Table 1: Request probabilities for fare classes of passenger and air cargo

Decision period	1-20	21-40	41-60
Passenger			
Rate class 1	0,3	0,25	0,15
Rate class 2	0,2	0,25	0,35
No booking request	0,5	0,5	0,5
Air Cargo			
Rate class 1	0,125	0,125	0,05
Rate class 2	0,175	0,125	0,15
Rate class 3	0,2	0,25	0,3
No booking request	0,5	0,5	0,5

Table 2: Mean of weight and volume distribution for cargo categories

Cargo Dimension Category	1	2	3
Average weight	80	160	400
Average volume	60	120	300

The fare classes of air cargo and passenger are shown in the table 3. The price rate of the air cargo will be used to calculate the charge of cargo in accordance with their average weight and volume.

Table 3: Fare classes of air cargo and passenger

Decision period	Price	Penalty/ Cancelation
Passenger		
Rate class 1	200	150
Rate class 2	150	75
Air Cargo		
Rate class 1	3	3
Rate class 2	2	1,4
Rate class 3	1	0,5

The capacity of cargo on this airline was set as shown in table 4. We set the maximum capacity each fare classes to define each cargo customer.

Table 4: maximum capacity of air cargo in fare classes i

Capacity	Weight	Volume
Fare Class 1	3000	1000
Fare Class 2	2100	700
Fare Class 3	1500	500

In this model, we conducted two numerical experiments. The experiment 1 we

e-ISSN 2477-6025
DOI: 10.21776/ub.jemis.2018.006.02.3

provide to test the behavior of the model when the policy open all fare classes during the period.

Table 5 illustrates the experiment result of experiment 1, that the stages start at 60 and finish in stage 0. This means stage 0 is the departure time. In the stage 53, probability that occur is air cargo with fare class 2 and type 3. The decision in this stage is rejected the request because the remain capacity of weight and volume in fare class 2 is not enough to comply type 3 of the request. The simulation results of this experiment, there are 4 seats that have not been reserved. Moreover, the capacity of air cargo in the fare class 1 still leaves 1960 of weight and 220 of volume. The total expected revenue achieved from this experiment is $ 6.440.

In the numerical experiment 2, we provide to test the behavior of the model with open the lowest fare classes until the limits run out, then open a fare class that more expensive. The example of running simulation can be seen in this table below.

Table 6 illustrates the experiment result of experiment 2. In the stage 60, probability that occur is air cargo with fare class 1 and type 2. The decision in this stage is rejected the request because the policy to accept the lowest fare classes while the probability of highest fare class was occur (class 1). The simulation results of this experiment, there are 4 seat that have not been reserved. Same with the experiment 1 but , the capacity of air cargo in the fare class 1 still leaves 2280 of weight and 460 of volume, and also the second fare class still have 1380 of weight and 160 of volume that unbooked. The total expected revenue achieved from experiment 2 is $ 4.800.

Table 5. Example result of experiment 1

Event	Passenger / Cargo	Passenger		Kargo		Decision
		request	Class	Class	Type of cargo	
60	0	-	-	1	2	accept
59	0	-	-	2	2	accept
58	0	-	-	3	1	accept
57	1	1	1	-	-	accept
56	1	1	2	-	-	accept
55	0	-	-	1	1	accept
54	0	-	-	3	3	reject
53	0	-	-	2	3	reject
52	0	-	-	2	3	reject
51	0	-	-	3	3	reject
50	0	-	-	2	2	accept
49	1	1	1	-	-	accept
48	0	-	-	1	1	accept
47	1	1	2	-	-	accept
46	0	-	-	3	2	reject
45	0	-	-	2	3	reject
44	0	-	-	1	2	accept

e-ISSN 2477-6025
DOI: 10.21776/ub.jemis.2018.006.02.3

Table 6. Example result of experiment 2

Stage	Passenger / Cargo	Passenger		Kargo		Decision
		request	Class	Class	Type of cargo	
60	0	-	-	1	2	reject
59	0	-	-	2	2	reject
58	0	-	-	3	1	accept
57	1	1	1	-	-	accept
56	1	1	2	-	-	accept
55	0	-	-	1	1	reject
54	0	-	-	3	3	accept
53	0	-	-	2	3	reject
52	0	-	-	2	3	reject
51	0	-	-	3	3	reject
50	0	-	-	2	2	reject
49	1	1	1	-	-	accept
48	0	-	-	1	1	reject
47	1	1	2	-	-	accept
46	0	-	-	3	2	accept
45	0	-	-	2	3	reject
44	0	-	-	1	2	reject

5. Conclusions

We have developed a dynamic seat and cargo allocation model for the same airline considering Overbooking, Cancellations, and No-Shows on the passenger. We have developed a dynamic programming to optimize ticket fares of both cargo and passenger simultaneously and dynamically over the selling horizon. We also have conducted several numerical experiments to examine the proposed model behavior in terms of total expected revenue.

In this study, refund for customers who cancel their reservation is different price when they wanted to buy for an airline ticket. From the numerical experiment, we have compare that open all fare classes in the both passenger dan air cargo booking request is more profitable than open fare classes step by step from lowest fare class. The policy of open the fare classes is very take effect when decide to open all fare classes and step by step open from lowest price. Future research may consider the relevance of refund with the price paid by the customer when he reserved the ticket as well as considering the overbooking of air cargo and extra baggage of the passenger.

Acknowledgments

The authors would like to express their thanks to the referees for their valuable suggestions and comments. This work is

e-ISSN 2477-6025
DOI: 10.21776/ub.jemis.2018.006.02.3

supported by Directorate of Research and Community Service (DRPM) Directorate General Research and Development of the Ministry of Research, Technology and Higher Education of The Republic of Indonesia (Ristek DIKTI) under Grant Junior Lecturer Research (Penelitian Dosen Pemula/PDP) No. 0045/E3/LL/2018

Institute for Research and Community Services- Universitas Internasional Semen Indonesia (UISI)

References

[1] Luo Li & Ji-Hua, P. Dynamic Pricing Model for Airline Revenue Management Under Competition. Systems Engineering - Theory & Practice, Vol 27, 11. 2007.

[2] Dewi, Oki AC., Nurminarsih, Siti., Narulidea, Winda., Rusdiansyah, Ahmad. Revenue Management Model for Integration of Air Cargo and Passenger with Overbooking Consideration. Proceedings of the International Conference of Logistics and Supply Chain Management System. 2016.

[3] Beckmann, Martin J. Decision and Team Problems in Airline Reservations. Econometrica. 1958. p. 134–145.

[4] Thompson, H.R. Statistical Problems in Airline Reservation Control. Operations Research Quarterly.1961. p. 167-185.

[5] Coughlan, J. Airline overbooking in the multi class case. Journal of the Operational Research Society. 50. 1999.

[6] Lee, T. C. & Hersh, M. A Model for dynamic airline seat inventory control with multiple seat bookings. transportation science, 27(3), 1993.p. 252-265.

[7] Karaesmen, I., and Van Ryzin, G. Overbooking with suitable inventory classes. Operation Research, 52, 2004. p. 83-104.

[8] Beckmann, Martin J. Decision and Team Problems in Airline Reservations. Econometrica. 1958. p. 134–145.

[9] Thompson, H.R. Statistical Problems in Airline Reservation Control. Operations Research Quarterly.1961. p. 167-185.

[10] Subramanian, J., Stidham, J. R. & Lauthenbacker, C. J. Airline yield management withoverbooking, cancellation, and no show. transportation science, vol. 33 no. 2. 1999.

[11] Feng, Y. & Xiao, B. Maximizing revenues of perishable assets with a risk factor. Operations Research, 47(2), 1999. p. 337–341.

[12] Heinitz, F., Hirschberger, M., & Werstat, C. The role of road transport in scheduled air cargo networks. Procedia-Social and Behavioral Sciences. 104, 2013. p. 1198-1207.

[13] Huang, Kuancheng & Lu, Heng. A linear programming-based method for the network revenue management problem of air cargo. Transportation Research Procedia 7, 2015. p. 459-473.

[14] Yamaguchi, K., International trade and air cargo: Analysis of US export and air transport policy. Transportation Research Part E 44, 2008. p. 555-575.

[15] Boeing, Boeing 2010-2011 World Air Cargo Forecast.http://www.boeing.com/commercial/cargo/wacf.pdf. Cross, R.G. 1997. Revenue Management: Hard-core Tactics for Market Domination. New York: Broadway Books. 2010.

[16] Huang, Kuancheng & Lu, Heng. A linear programming-based method for the network revenue management problem of air cargo. Transportation Research Procedia 7, 2015. p. 459-473.

[17] Amaruchkul, K., Cooper, W.L. and Gupta, D., Single-leg air-cargo revenue management. Transportation Science 41, 2007. p. 457–469.

[18] Huang, K., Chang, K. An approximate algorithm fot the two-dimensional air cargo revenue management problem. Journal of Air Transport Management, 38, 2010. p. 36-42.

[19] Han, D.L., Tang, L.C., Huang, H.C., A Markov model for single-leg air cargo revenue management under a bid-price policy. European Journal of Operational Research 200, 2010. p. 800-811.

[20] Hoffmann, R., Dynamic capacity control in cargo revenue management - A new heuristic for solving the single-leg problem efficiently. Journal of Revenue and Pricing Management 12, 2013a. p. 46-59.

e-ISSN 2477-6025
DOI: 10.21776/ub.jemis.2018.006.02.3

[21] Zhuang, W., Gumus, M., Zhang, D., A single-resource revenue management problem with random resource consumptions. Journal of the Operational Research Society 63, 2012. p. 1213-1227.
[22] Becker, B., Dill, N., Managing the complexity of air cargo revenue management. Journal of Revenue and Pricing Management 6, 2007. p. 175-187.
[23] Becker, B., Kasilingam, R., Success factors for the implementation of air cargo revenue management solutions. International Journal of Revenue Management 2, 2008. p. 254-271.
[24] Becker, B., Wald, A., Challenges and success factors of air cargo revenue management. Journal of Revenue & Pricing Management 9, 2010. p. 171-184.
[25] Kasilingam, R., Revenue management and air cargo, in “Revenue management: A practical pricing perspective”. In: Yeoman, I. And McMahon-Beattie, U. (Ed.). Palgrave Macmillan, Basingstoke. 2011.
[26] Bilings, J.S., Diener, A.G., Yuen, B.B., Cargo revenue optimization. Journal of Revenue and Pricing Management 2, 2003. p. 69-79.
[27] Slager, B., Kapteijns, L., Implementation of cargo revenue management at KLM. Journal of Revenue and Pricing Management 3, 2004. p. 80-90.
[28] Kasilingam, R.G., Air cargo revenue management: Characteristics and complexities. European Journal of Operational Research 96, 1997. p. 36-44.
[29] Levin, Y., Nediak, M., Topaloglu, H., Cargo capacity management with allotments and spot market demand. Operations Research 60, 2012. p. 351-365.
[30] Haidar. L.M. and Metin Cakanyildirim. Optimal overbooking limits of a two-dimensional cargo problem: a profit maximation approach. Journal of Revenue and Pricing Management. 2011.
[31] Luo, S., Cakanyildirim, M., Kasilingam, R.G., Two-dimensional cargo overbooking models. European Journal of Operational Research 197, 2009. p. 862-883.