UNIVERSITY OF MANNHEIM
Business School

CHAIR OF SERVICE
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Master Thesis Proposal

Air Cargo Revenue Management – State-of-the-Art Models and Practice Applications

Although the air cargo industry has become increasingly important to serve global supply chains, research in revenue management (RM) for cargo shipments lags far behind passenger RM. One reason may be that the selling process is more complicated in the air cargo business. Air cargo capacity is sold either based on long-term contracts or on a short-term basis on the spot market. Though spot market cargo revenue management has some similarities with passenger RM, several complexities prevent a direct application of air passenger RM. First, the capacity state of a single leg in cargo is usually characterized by two dimensions (weight and volume) rather than one (seats) as in passenger RM. Furthermore, the capacity available to cargo is often not known with certainty prior to departure since it may depend, e.g., on the number of passengers (who are prioritized, for a combination carrier) or on weather conditions affecting the maximum take-off weight. Also the exact volume and weight requirement may be not known exactly in advance. Finally, the purchasing decision of cargo customers may be determined by other factors than air passenger choice among alternative offers. For example, while air passengers onboard typically dislike complex routings and stopovers in their itinerary, cargo customers do not care much about how the shipment gets from the origin to the destination as long as it is timely and reliably delivered at an attractive price. Most of the air cargo RM approaches so far have focused on single-leg and network capacity allocation under the independent demand model (with and without overbooking), while choice-based capacity allocation and dynamic pricing have not received much attention yet.

The objectives of the master thesis are to

- review and classify the literature on air cargo RM and discuss differences to airline passenger RM;
- discuss any gaps between theory and practice, in particular between state-of-the-art optimization approaches for air cargo RM and important practice requirements (e.g., based on insights from expert interviews and/or from the practice-oriented literature);
- review relevant empirical studies from the literature that model and estimate demand response or customer choice as a function of different determinant attributes of cargo offerings;
- discuss whether capacity allocation or dynamic pricing is the more suitable RM approach to cargo RM, considering opportunities, challenges, and limitations of moving from capacity allocation to dynamic pricing in the air cargo business;
- select a suitable state-of-the-art cargo RM model and make suggestions on how to extend it to include a) pricing decisions, b) empirical findings on choice-determinant factors, and c) important practice-relevant aspects.

- discuss potential methods to solve the proposed optimization model and choose a suitable one;
- implement and solve the proposed model, e.g. in AMPL, and apply it to a hypothetical case study, e.g. based on reasonable choice model assumptions that are in line with published empirical findings, and using synthetic or perturbed data for markets, flight network, etc.;
- give recommendations, draw conclusions and show future research opportunities.

Requirements

- OPM 781
- Good knowledge in Operations and Revenue Management
- Analytical skills and an ability to transform real-world business problems into Operations Research models

Administrative information for writing a master thesis at the Chair of Service Operations Management can be found here.

Selected Literature Recommendations

Amaruchkul, K., Cooper, W. L., & Gupta, D. (2007). Single-leg air-cargo revenue management. Transportation science, 41(4), 457-469.

Amaruchkul, K. (2020). Customized Dynamic Pricing for Air Cargo Network via Reinforcement Learning. In International Symposium on Integrated Uncertainty in Knowledge Modelling and Decision Making (pp. 213-224). Springer, Cham.

Amaruchkul, K., & Lorchirachoonkul, V. (2011). Air-cargo capacity allocation for multiple freight forwarders. Transportation Research Part E: Logistics and Transportation Review, 47(1), 30-40.

Azadian, F., & Murat, A. (2018). Service location grouping and pricing in transportation: Application in air cargo. European Journal of Operational Research, 267(3), 933-943.

Barz, C., & Gartner, D. (2016). Air cargo network revenue management. Transportation Science, 50(4), 1206-1222.

Becker, B., & Dill, N. (2007). Managing the complexity of air cargo revenue management. Journal of Revenue and Pricing Management, 6(3), 175-187.

Becker, B., & Wald, A. (2010). Challenges and success factors of air cargo revenue management. Journal of Revenue and Pricing Management, 9(1), 171-184.

Billings, J. S., Diener, A. G., & Yuen, B. B. (2003). Cargo revenue optimisation. Journal of Revenue and Pricing Management, 2(1), 69-79.

Boonekamp, T., Gromicho, J., Dullaert, W., & Radstaak, B. (2013). Air cargo revenue management. Masters thesis, Vrije Universiteit, Amsterdam. Link

Dumouchelle, J., Frejinger, E., & Lodi, A. (2024). Reinforcement learning for freight booking control problems. Journal of Revenue and Pricing Management, 1-28.

Feng, B., Li, Y., & Shen, Z. J. M. (2015). Air cargo operations: Literature review and comparison with practices. Transportation Research Part C: Emerging Technologies, 56, 263-280.

Hellermann, R., Huchzermeier, A., & Spinler, S. (2013). Options contracts with overbooking in the air cargo industry. Decision Sciences, 44(2), 297-327.

Hoffmann, R. (2013). Dynamic capacity control in cargo revenue management–A new heuristic for solving the single-leg problem efficiently. Journal of Revenue and Pricing Management, 12(1), 46-59.

Huang, K., & Chang, K. C. (2010). An approximate algorithm for the two-dimensional air cargo revenue management problem. Transportation Research Part E: Logistics and Transportation Review, 46(3), 426-435.

Huang, K., & Lu, H. (2015). A linear programming-based method for the network revenue management problem of air cargo. Transportation Research Procedia, 7, 459-473.

Kasilingam, R. G. (1997). Air cargo revenue management: Characteristics and complexities. European Journal of Operational Research, 96(1), 36-44.

Kasilingam, R. (2011). Revenue management and air cargo. In Revenue Management (pp. 166-179). Palgrave Macmillan, London.

Levina, T., Levin, Y., McGill, J., & Nediak, M. (2011). Network cargo capacity management. Operations Research, 59(4), 1008-1023.

Luo, S., Çakanyıldırım, M., & Kasilingam, R. G. (2009). Two-dimensional cargo overbooking models. European Journal of Operational Research, 197(3), 862-883.

Moussawi-Haidar, L., & Cakanyildirim, M. (2012). Optimal overbooking limits of a two-dimensional cargo problem: A profit maximization approach. Journal of Revenue and Pricing Management, 11(4), 453-476.

Neal, C., & Koo, T. T. (2020). Demand for cargo airships: An analysis of mode choice decision making in the freight transport industry. Journal of Air Transport Management, 83, 101741.

Pak, K., & Dekker, R. (2004). Cargo revenue management: Bid-prices for a 0-1 multi knapsack problem. Working Paper. Link

Park, Y., Choi, J. K., & Zhang, A. (2009). Evaluating competitiveness of air cargo express services. Transportation Research Part E: Logistics and Transportation Review, 45(2), 321-334.

Pfeffer, S. (2015). Revenue Management in der Luftfracht (Doctoral dissertation, Dissertation. Stuttgart: Universität Stuttgart). Link

Popescu, A., Keskinocak, P., Johnson, E., LaDue, M., & Kasilingam, R. (2006). Estimating air-cargo overbooking based on a discrete show-up-rate distribution. Interfaces, 36(3), 248-258.

Previgliano, F., & Vulcano, G. (2022). Managing uncertain capacities for network revenue optimization. Manufacturing & Service Operations Management, 24(2), 1202-1219.

Rizzo, S. G., Lucas, J., Kaoudi, Z., Quiane-Ruiz, J. A., & Chawla, S. (2019). AI-CARGO: A Data-Driven Air-Cargo Revenue Management System. arXiv preprint arXiv:1905.09130.

Slager, B., & Kapteijns, L. (2004). Implementation of cargo revenue management at KLM. Journal of Revenue and Pricing Management, 3(1), 80-90.

Srinivasan, D., Amit, R. K., & Chiang, W. C. (2023). Air cargo revenue management: a state-of-the-art review. International Journal of Revenue Management, 13(3), 144-165.