Managing Production and Sales of Refurbished Products Under Capacity Limitations

Mayukh Saha, Vaibhav Agrawal
Department of Industrial and Systems Engineering
Indian Institute of Technology Kharagpur
721302, West Bengal, India
maykat1995@gmail.com, vaibhavagrawal.iitkgp@gmail.com,

Dr. Akhilesh Kumar
Department of Industrial and Systems Engineering
Indian Institute of Technology Kharagpur
721302, West Bengal, India
akumar@iem.iitkgp.ac.in

Abstract

With the launch of e-commerce, market has experienced steady surge in consumer durables but it has shortened product life cycle due to rapid changes in features and capabilities. Refurbished items can generate additional revenue for the company while two major drawbacks could be, first, reduced future demand for the newer products and second capacity limitations of the manufacturers. Manufacturers always have inventory holding and sales constraints and additional accumulating inventory of returned product can be difficult to carry over to next periods. This creates a problem of optimal launch of refurbished products to effectively use the capacity limitation without influencing the sales of newly launched products. We propose to formulate an optimization model to find market launch time of refurbished products constrained over profit and capacity by three steps. First an analysis of the time series distribution is done to depict its influence over sales. Secondly, using Bass Diffusion Model as a base form for the sales distribution a convolution of sales curve is presented stating the time and capacity at which the refurbished products needs to be released into the market. Finally, a forecasting method is presented to determine the inventory holding capacity at instantaneous time depending on the market demand.

Keywords
Convolution Analysis, Life cycle, Residence time distribution, Remanufacturing, Forecasting and Optimization

Biographies

Mr. Mayukh Saha is a final year student of the Department of Industrial and Systems Engineering enrolled in its Dual-Degree course (B.Tech and M.Tech) at Indian Institute of Technology, Kharagpur. He has been associated with several projects like forecasting product life cycle curve of personal computers, IPL auction price and match prediction and surveillance system in house to survive adverse conditions. He is a holder of internships from TATA Steel Limited, Alive Home Technologies Pvt. Ltd., Metabot Technologies and Kaizing. He also upholds major position in the Institute by being Department Representative at Career Development Centre, Student body member at Industrial and Systems Engineering Department, Secretary, social and culture-fine arts cup, at Meghnad Saha Hall of Residence and is an active member as a coordinator for International Relations Cell, IIT Kharagpur. He has received honorary achievements for bagging the Gold Medal in Case Study, Flipkart-overnite app hackathon and for securing 28th Maths Olympiad Rank in India.

Mr. Vaibhav Agrawal is a pre-final year student of the Department of Industrial and Systems Engineering enrolled in its Dual-Degree course at Indian Institute of Technology, Kharagpur. He has previously co-authored a conference paper named 'Survival Analysis of Supply Chain Using Bayesian Nonparametric' at 5th International Conference on Business Analytics and Intelligence. Also he has been involved in several other projects like determining time-to-launch of remanufactured products, development of simulation tool to assist cops during criminal chase. He has

worked with the APM Terminals as a part of his internships and completed project on to 'Optimizing terminal operations through integration of Vehicle Booking System'. For the past two years he has been associated with Branding and Relations Cell IIT Kharagpur, institute recognized media and public relation body. During his tenure as Senior Coordinator, he organized the first edition of 'IIT Kharagpur Young Innovators' Program', aimed at fostering research among school students across the nation.

Dr. Akhilesh Kumar is an Assistant Professor in the Department of Industrial & Systems Engineering at Indian Institute of Technology, Kharagpur. He received his Ph.D. degree in Industrial Engineering from Wayne State University (U.S.A.) in 2011. His research interests include application of machine learning, statistical learning, data-mining and optimization techniques to solve real-world problems pertaining to Conditioned-based Maintenance, Logistics and Supply Chain Management. He has publications in the International Journal of Production Economics, European Journal of Operational Research, Expert System with Applications, IEEE. He carried out collaborative research with multi-national companies such as Ford Motor and Delphi Automotive LLP on autonomous diagnostics and prognostics, and reverse logistics respectively. Currently he is a Co-PI from IIT Kharagpur for opportunities for Sustainable Freight Transport 'REINVEST' (R/141842) an EU-India Collaboration project. He has also recently bagged a coveted project from Department of Heavy Industry on "Digital manufacturing and industrial internet of things for enhanced supply chain coordination, quality and maintenance" along with Prof. M. K.Tiwari and Dr. Sri Krishna Kumar in collaboration with Tata Sons.