

CHAPTER 40

OPERATIONAL RESEARCH

Doctoral Theses

01. AAKASH

Modeling the Role of Electronic Word of Mouth in Online markets.

Supervisors : Prof. Anu Gupta Aggarwal and Dr. Abhishek Tandon

Th25427

Abstract
(Verified)

The electronic-word-of-mouth (eWOM) treated as a crucial information source not only by online marketers but also by customers. E-marketers examine eWOM for extracting the valuable information with respect to consumer satisfaction, experiences, and choices. It also supports the marketer in connecting with their customers in terms of time as well as cost effective way. The eWOM act as WOM available online and impact the buying decisions of imitator types of adopters. Many e-commerce websites manage their online review systems for monitoring the market pulse so as to plan important marketing policies related to the quality of product, retailer monitoring, advertising, promotion etc. Thus, eWOM has been a strong online marketing force. This thesis provides an extended e-commerce success model by including criteria such as refund policy, eWOM, valance, helpfulness and personalisation so as to represent new e-commerce world challenges. This research presents a numerical for prioritizing the alternatives of e-commerce websites on the basis of extended e-commerce success model using multiple-criteria-decision-making (MCDM)-based techniques. This research introduces the multi-attribute based advertising budget allocation method to divide the budget into individual websites. This research examines the impact of eWOM, website quality and product satisfaction on the levels of satisfaction and repurchase intentions of prospect customers. This thesis also determines the role of eWOM characteristics such as length, sentiment, readability etc. in predicting the helpfulness and product sales. This research presents a model for predicting hotel guest satisfaction using eWOM, hotel and word based features embedded in textual content of hotel eWOM. Moreover, this study also presents the models for ranking of online reviewers through eWOM posted by them. This research helps the marketers to understand some important characteristics related to eWOM, products/services and reviewers that influence the satisfaction, repurchase intentions, product sales and reviewer rankings opportunity conversion for the marketer.

Contents

1. Introduction 2. Website selection and advertising budget allocation incorporating eWOM 3. Customer satisfaction and repurchase intention: role of website quality, product satisfaction and eWOM 4. Analyzing eWOM characteristics which contribute to eWOM helpfulness and sales 5. Assessment of hotel performance and guest satisfaction through eWOM 6. Segmentation, efficiency and rankings of online review community: the role of eWOM and reviewers characteristics. Conclusions and directions for future research. References.

02. BANSAL (Gunjan)
Analytical Study for New Product Management & Economic Impact of Re Manufacturing.
 Supervisor : Dr. Adarsh Anand
Th 25428

Abstract
(Verified)

New product management deals with three most conflicting matters such that Quality, Time and Cost and the objective is how to optimize the set of relationships in each new product situation so that a valuable product can be developed. The new product process must respond to three unique inputs- the right product quality at the right time and the right cost. The three inputs tend to conflict with each other though there are synergies too. Here, a new product management is studied analytically where innovation of diffusion is combined with a few well know statistical techniques.. This study describes various quality attributes of “software” as a product and identifying the ones which matter the most for calling the product to be qualitative in nature. Also, a business model has been derived that describes customer perceptions and trade-offs to generate promising product in the market using the concept of conjoint analysis and the sales prediction model has been presented. Also, certain demographic parameters of the customers that impact on the usage period of the product and determine the expected usage time of the product are discusses. Further, the success of a product is directly proportional to the satisfaction perceived by the customers. It proposes a modeling framework wherein the impact of customer satisfaction with the first generation of a product is measured and incorporated in the adoption of a subsequent generation of the product. n the supply chain management incorporating the development of the new product is valuable and raises questions regarding forecasted demands of potential consumers and effective designing of product. Re-manufacturing has become one of the most preferred strategies for sustainable development, therefore this study has discussed how to integrate product design and supply chain management along with the reverse logistics activities so that an efficient process is obtained.

Contents

1. Introduction 2. Selection of attributes and new product management 3. Predicting product’s effective usage time by customer 4. Up- graduation of new product based on customer’s satisfaction 5. New product development under re manufacturing 6. Effective new product management using design for Re-manufacturing. Conclusion and scope for future research. References. Annexures.

03. BHATT (Navneet)
Vulnerability Discovery Modelling for Software Systems.
 Supervisor : Dr. Adarsh Anand
Th 25429

Abstract
(Verified)

A better understanding of vulnerabilities and the nature of vulnerability discovery can provide useful insight into software security. An effective means of measuring software security and the likelihood of vulnerability discovery would be a significant aid in increasing that security. One proposed technique for better understanding software security is to model vulnerability discovery. The present work addresses the development of mathematical models for the vulnerability discovery phenomenon and subsequently deals with its related attributes such as-patches and exploits. The proposal starts with linking the vulnerability discovery trend to the attractiveness of a software and further extended to the development of a methodical framework that is capable in generalizing different functional forms of vulnerability discovery models. The vulnerabilities have been further characterized as leading vulnerabilities and additional vulnerabilities, and a related mathematical model has been developed which considers that some vulnerabilities might trigger in the discovery of additional vulnerabilities. Later,

an analytical examination of the developed model has been provided and corresponding numerical illustration provides an informative analysis of the vulnerabilities discovered at subsequent time points. The Vulnerability Discovery Models (VDMs) has been further integrated with the importance of reporters, deployment of patches and the allocation of resources. Lastly, a framework has been discussed that helps in classifying vulnerabilities as exploit-prone or not exploit-prone.

Contents

1. Introduction 2. Software vulnerability discovery modelling: a new paradigm 3. Characterizing and categorizing software vulnerabilities 4. Vulnerability discovery process based on the impact of reporters 5. Resource allocation problem for software vulnerability discovery 6. Exploitability prediction of software prediction for vulnerability discovery 7. Conclusion and scope for future research. Conclusion and scope for future research. References.

04. BHAYANA (Nidhi)
Decision Making Models for Supplier Evaluation and Selection in Sustainable Supply Chain Management.
 Supervisor : Prof. P. C. Jha
Th 25432

Abstract (Verified)

In today's competitive world, technological advancement and market globalization has established the sustainable dimensions in SC environment. To maintain the competitive advantage and increasing awareness, manufacturers has shifted the focus towards socio-ecological aspects while fulfilling their financial targets. Moreover, involvement of major stakeholders' demand to incorporate sustainability at all echelons of SC which further leads to more complexities and challenges in the SC framework. SCs, thus, seeks to develop competitive advantage by integrating in-house activities of a company with external or internal suppliers, SC partners and customers. Hence, it is imperative for electronic sector to determine and implement the significant strategies for the effective implementation of SC. Thus, Indian electronic companies need to integrate all decisions at strategic, tactical and operational level in SC planning process while considering sustainable aspects. The emphasis of the current thesis is to construct models for optimizing significant decisions for sustainable SC and develop theoretical viewpoint for future. The research framework summarizes the following aspects to unknot the way of sustainable SC network problem for an Indian electronic sector: 1) Assessing and analyzing the feasibility of strategic, tactical and operational decisions for sustainable SC network, 2) Inspecting appropriate business operations' strategies for effective SC network by incorporating the expectations of stakeholders, 3) Analyzing the models numerically that will support manufacturer and retailers in managing their SC effectively by incorporating customers' satisfaction level, 4) Integrating and acknowledging sustainable concerns in supplier evaluation process for building strong association among SC partners, 5) Developing optimization models for real-life business scenario particularly for the network of Indian electronic sector. The proposed models can serve as effective decision tools in implementation of collaborative alliance between ME and 3PRLP in the Indian electronics industry.

Contents

1. Introduciton 2. Multi criteria fuzzy optimization models for supplier evaluation and selection decision 3. Multi objective optimization approaches for supplier selection decision in sustainable environment 4. Integrated models for customer driven sustainable supply chain network 5. Integrated MCDM approach for supplier evaluation and establishing their capability differences 6. Conclusion 7. Limitations and future scope. Bibliography. Appendix.

05. DIPIKA
Contributions to Modelling and Stochastic Differential Equation Based Assessment of Software Reliability.
 Supervisor : Dr. Ompal Singh
Th 25424

Abstract
 (Not Verified)

In the 21st century, we seldom see any industry or service organization working without the help of an embedded software system. Such a dependence of mankind on software system has made it necessary to produce highly reliable software and quantify their reliability. This quantification can be done with the help of modeling. Software reliability is defined as the probability of failure free software operation for a specified period of time in a specified environment. In highly complex modern software systems, reliability is the most important factor, since it quantifies software failures during the process of software development and software quality control. Large number of models have been developed to address the problem of software reliability measurement. Due to complexity in testing phase, software firm do not attempt to deliver a complete and perfect product in one development life cycle. Software firms upgrade their offerings by adding new features as compared to previous releases. Software is updated with latest features to make it more flexible, reliable and demandable. A better up-gradation can enhance the reliability and characteristics of the system; but at the same time, a risky up-gradation can cause errors in the system. In software industries, up-gradations are happening in the software at a very brisk speed. Due to very short life of software in the environment of perfect competition market, the successive up gradations are required for its survival. Fault detection-correction are two different and yet important activities for software developers. They both should go hand in hand for a good debugging process. Randomness is the changes. For estimating and predicting reliability of the proposed models, various software packages have been used like SPSS (Statistical Package for the Social Sciences), SAS (Statistical Analysis System) and LINGO solver.

Contents

1. Introduction 2. Multi release software reliability modelling based on change and fault detection correction process 3. Revisiting error generation and stochastic differential equation based software reliability growth models 4. Stochastic differential equation based modelling under different environments 5. Modelling uncertainty through stochastic differential equation and entropy based framework. Conclusion and scope for future research. References.

06. GAUTAM (Prerna)
Strategic Inventory Management of Defective Items.
 Supervisors : Prof. Chandra K. Jaggi and Dr. Aditi Khanna
Th 25430

Abstract
 (Not Verified)

The fundamental aspect of inventory management revolves around product management and customer satisfaction. The process of managing products is categorized into numerous stages implementing all the required activities viz. manufacturing, transporting, pricing, screening, reworking, salvaging, refunding, etc. In any organization, each player has different work objectives and hence performs all its activities accordingly. Talking about product management for any inventory firm, the incurrence of defective items is inevitable. To be precise, the

items that fail to meet the requirements with respect to the quality characteristics are called defective items. The incurrence of defective items can happen at the manufacturer's end or retailer's end due to various reasons like using low-quality raw material, design flaws, poor workmanship, machine shifting from an "in-control" state to an "out-of-control" state, and lack of control over external factors like temperature, humidity, etc. In the case of the retailers, the defectives can be found in the ordered lot due to possible reasons like unavoidable wear and tear during loading, unloading, and transport and accidents resulting in a full or partial defect in the items. These defective items not only hamper profitability for the supply chain players but also ruin customers' trust. Thus, it is pragmatic to integrate the defective items into our respective inventory modeling. Motivated by this, the present thesis develops inventory models for imperfect quality items, taking into account some other pragmatic scenarios like deterioration, trade-credit, carbon-emissions, defect management & product recovery techniques, etc. The developed models have wide application in many manufacturing as well as retail chains like textiles, electronics, furniture, footwear, plastics, chemical and allied industries, etc.

Contents

1. Introduction 2. Literature review 3. Inventory replenishment models for imperfect quality items with varying demand patterns and trade credit 4. Integrated vendor buyer strategies for imperfect production systems with maintenance and warranty policy 5. Analyzing the effect carbon emissions on inventory models with imperfect production systems 6. Defect management and product recovery techniques for a sustainable supply chain 7. Conclusion and directions for future research. List of publications. Bibliography and Appendices.

07. JAIN (Reena)

Supply Chain Policies for Curbing Bullwhip Effect.

Supervisors : Prof. Chandra K. Jaggi and Dr. Mona Verma

Th 25431

Abstract (Not Verified)

The fundamental goal of Supply Chain Management is to monitor the different processes involved in making the product or service available to end consumer. The efficiency of these services is measured in terms of performance measures of supply chain such as customer satisfaction in terms of product fill rate, lead time, response time. One of the important factors responsible for lowering the measure of performance of a supply chain is Bullwhip Effect. Supply chain phenomena of amplification of demand on traversing the information in the form of orders from lower echelon to higher echelon is defined as bullwhip effect. The main causes responsible for bullwhip effect are shortage gaming or rationing, price variation, demand signal processing and order batching. Problem of rationing appears in case of limited capacity constraint where total demand floating in market is higher than total capacity of supplier. The supplier has to allocate his capacity among retailers following some allocation mechanism. In anticipation of curtailment of supply, retailers inflate their demand and as a result bullwhip effect arises. Price variation usually occurs because of quantity discounts, surge pricing, price dependent demand, premium payment scheme. To overcome this, a new algorithm Iterative Proportional Allocation is introduced which promotes truth inducing mechanism and suppresses bullwhip effect. Among the tools to fight with bullwhip effect, coordination between different members of supply chain is treated as best policy. Vendor Managed Inventory under revenue sharing contract and block chain technology plays vital role in improving coordination. Motivated by the aforementioned problems of supply chain responsible for causing bullwhip effect, the present thesis entitled "Supply chain policies for

curbing bullwhip effect” emphasizes on the mathematical modeling for capacity constraint situation to reduce bullwhip effect under different realistic conditions.

Contents

1. Introduction 2. Literature review 3. Exploring bullwhip effect: causes and redress 4. Impact of premium payment policy on bullwhip effect 5. Vendor management inventory and revenue sharing contract under shortage gaming scenario 6. Block chain: pathway to improve performance measure of supply chain 7. Conclusion and recommendation for future research. Bibliography. List of publications.

08. MAHAJAN (Divya)
Integrated Multicriteria Optimization Models for Modular Software Development.
 Supervisors : Prof. Pankaj Gupta and Dr. Mukesh Kumar Mehlawat
Th 25422

Abstract (Verified)

The present thesis discusses various aspects of modular software development (MSD). Various multicriteria optimization models (MCOMs) are discussed to evaluate and select best-fit components. The models are formulated to select the optimal maintenance teams and performance testing tools (PTTs), and consider user satisfaction (USAT) and enhancement in MSD. This thesis comprises six chapters. Chapter 1 is introductory. Chapter 2 presents DEA based nonlinear MCOM to select software components in the presence of optimal redundancy to ensure software reliability. A real-world case study of MSD is discussed to show proposed optimization model's efficiency. Chapter 3 introduces the outsourcing of modules along with the maintenance of the software. It focuses on an integrated MCOM for MSD and its maintenance. The fitness evaluation of software components, vendors, and maintenance teams is conducted using TOPSIS. The proposed optimization model is tested using a case study. Chapter 4 introduces a multi-period MCOM to enhance and establish a software system. The fitness evaluation of module alternatives is conducted using TOPSIS. The development of e-commerce software is considered as a case study. Chapter 5 studies yet another essential feature of MSD, viz., its performance testing. The fitness of a PTT is evaluated based upon many important attributes using TOPSIS. A linear membership function based fuzzy utility approach is used to solve the MCOM. A case study from the domain of ERP is discussed. Chapter 6 extends the MCOM discussed in Chapter 2 for multiple application development. This chapter also deals with USAT and discusses a metric to evaluate USAT and obtain the total USAT score. We use the DEA technique to obtain efficiency scores and present a MCGP framework, which maximizes the USAT score and minimizes the total cost. The suggested MCOM is tested on a case study presuming GPS based tracker in ERP software development.

Contents

1. Introduction 2. Evaluation and selection of software components under optimal redundancy 3. Multicriteria optimization model of development and maintenance of modular software 4. Multi-period optimization of software components and enhancement of modular software 5. Evaluation and selection of performance testing tools in modular software development 6. A hybrid approach for modular software development involving user satisfaction and multiple applications. Bibliography.

09. PANWAR (Saurabh)
Modelling Diffusion Dynamics and Optimizing Time to Market Decision for Products and Services.
 Supervisors : Prof. Ompal Singh and Prof. P.K. Kapur
Th 25423

Abstract
(Not Verified)

Accurate prediction of diffusion parameters and demand function of innovations plays a pivotal role in strategic planning and monitoring marketing decisions. Consequently, modeling new product adoption behavior using suitable and reliable mathematical models is imperative for analysts and business experts. Therefore, the present research seeks to develop analytical models that effectively facilitate the predictive analysis of the diffusion paradigm of single and multigenerational innovations. The work carried out in the thesis proposes novel mathematical models to comprehend and predict the growth behavior of new products and services. Besides, this thesis also investigates the generation substitution and customer attrition behavior simultaneously in the adoption process of service generations. The work undertaken in the thesis also proposes a robust approach to determine the optimal release time policy for software products based on the aspiration of the management team. As the testing resources are finite for every software development project, it is necessary for software developers to know when to deliver the software to its users and when to stop the testing process. In addition, the present research derives the launch time decision for new offerings such as cellular and telecommunication services, which are known as subscribe-to-use (STU) products by evaluating the trade-off between the vital attributes using multi-criteria decision-making. In the present thesis, the empirical analysis has been performed on real-life datasets to exhibit the validity and robustness of all the proposed mathematical models. For the optimization models, numerical analysis has been carried out to illustrate their practical applicability and sensitivity analysis has been performed to assess the dependability of the objective functions and the decision variables on the model parameters. Furthermore, the proposed work also recommends essential managerial insights to assist the managers and policymakers for better decision-making.

Contents

1. Introduction 2. Modeling diffusion of multigenerational innovation while considering change point 3. Understanding the diffusion paradigm of new products in the context of price variation and change point 4. Modeling technology diffusion: a study based on market coverage and advertising efforts 5. Strategic decision making for software time to market and testing termination time 6. Predicting diffusion dynamics and launch time strategy for mobile telecommunication services 7. Conclusion and directions for future research. References.

10. PRIYAMVADA
Inventory Management under Preservation Technology Investment.
 Supervisors : Prof. Chandra K Jaggi and Dr. Aditi Khanna
Th 25425

Abstract
(Not Verified)

Management of the items which are deteriorating in nature is just about the strategies used to reduce the rate of deterioration. Talking about the management of deteriorating items, preservation technology investment is an

essential tool to overcome the loss due to deterioration. Generally, the deterioration rate is considered to be constant, which is not practical if an investment in preservation technology has been made. Because of this, the deterioration rate can be regarded as a decreasing function of the investment in preservation technology. Usually, the holding cost for deteriorating items increases with time, so time-varying holding cost is a more realistic assumption. Moreover, it is also realistic to assume that demand is price-dependent. Since emissions are a significant concern to the atmosphere, additional investment in preservation techniques is an innovative approach to controlling emissions and maintaining environmental performance. While discussing the integrated inventory modelling, several research articles highlighted the equal decision-making power of the supply chain players. Despite its tangent applicability, some practical scenarios demand that either of the two players behave as the leader and the other one as a follower. In the view of these pandemic days, explore an inventory model taking into account different investments - preservation technology, service facility, and awareness strategies for a retailer supplying essential goods (food and grocery items) is a tool to face the challenge imposed by the COVID-19 crisis. Thus, motivated by this, the present thesis develops inventory models for deteriorating items, taking into account some of the investment in preservation technology investment and pragmatic scenarios time-varying holding cost, price, and stock dependent demand, carbon emissions, etc. The developed models have wide application in many manufacturing as well as retail chains like the food industry, packed food items, and allied industries, etc.

Contents

1. Introduction 2. Literature review 3. Optimal inventory policies with dependent demand 4. Sustainable inventory models with preservation strategy 5. Integrated inventory models for an imperfect production systems 6. Inventory management strategies during COVID-19 crisis 7. Conclusion and future research directions. Bibliography. List of publications.

11. SINGHAL (Shakshi)

Diffusion Models and Optimization Problems for New Product Development.

Supervisor : Prof. Ompal Singh

Th 25426

Abstract (Verified)

In today's fiercely competitive market, new product development can be viewed as a road map to profitably growing businesses. Therefore, the precise understanding of innovation adoption and diffusion is requisite for the accurate prediction of future sales and market growth. The process that describes the penetration of innovation among the potential market is commonly known as a diffusion process. A more insightful and state-of-art research vis-à-vis analytical models are needed to analyze new product success at both individuals and market level. Consequently, this thesis aims to create more insights in innovation adoption and diffusion modeling, and the analysis of marketing variables both theoretically and empirically. Building on the differential equation-based analytical models, the present thesis determines a reasonable estimate of future sales for innovations using real-life sales data and case studies. The comprehensive picture of the diffusion process modeled in the proposed work for new products by incorporating phenomena such as distributed time lag in the product awareness and adoption pattern, uncertainty in the adoption and market growth rate, substitution behavior of successive generations could offer new managerial insights for better decision-making. To examine and validate the estimation efficacy and forecasting performance of the proposed models, the empirical analysis using actual sales data of innovations is carried out in the

present thesis. The present study is also driven by the impending influence of innovation and its marketing attributes on consumers, society, managers, and organizations. Therefore, this work also focuses on the evaluation of marketing variables viz. selling price, advertisement expenditure, and warranty period for consumer durables and technological innovation using the optimization techniques. The practical applicability of the optimization models are demonstrated by considering the case of capital-intensive products.

Contents

1. Introduction 2. Predicting innovation adoption using time lag based diffusion 3. Modeling stochastic diffusion process for new products 4. Analyzing optimal pricing decision towards new product success 5. Evaluation marketing variables of technological innovations. Conclusion and future research directions. References and Appendix.

M. Phil Dissertations

12. BANO (Yasmeen)
Study of Multi-Dimensional Diffusion Paradigm and Attrition Process in Marketing
Supervisor : Prof. Ompal Singh
13. BARUA (Dixita)
Decision Making Models for Implementation of Supply Chain Management Paradigms
Supervisor : Dr. Veena Jain
14. OBAID (Amna)
Warehouse Location and Distribution
Supervisor : Dr. Rubina Mittal
15. SHARMA (Ankush)
Accelerated Testing With Multiple Stresses : A Review
Supervisor : Prof. Preeti Wanti Srivastava
16. SIDDIQUI (Farah)
Study on Sustainable Inventory Systems
Supervisor : Dr. Aditi Khanna
17. SWETA (Yadav)
Study on Customer Lifetime Value Models for Online Businesses
Supervisor : Prof. Anu Gupta Aggarwal