

CHAPTER 39

OPERATIONAL RESEARCH

Doctoral Theses

01. AGARWAL (Richie)
Some Modeling Peculiarities in Innovation Diffusion Process of Marketing.
Supervisor : Dr. Ompal Singh
Th 24308

Abstract
(Verified)

Marketing professionals today have to be proficient in many disciplines and in order to communicate, they need a mathematical language. The focus of this work revolves around mathematical modeling framework of the diffusion theory. The objective is to understand and mathematically model the market behavior in terms of sales and adoption behavior of customers, and furthermore to provide brief explanation about the modes and turning points of product life cycle based on sales of the innovation. Different attributes has been explored in diffusion modeling framework to study the real situation of the market such as dynamic market structure, change in adoption rate, time lag in product awareness and adoption that affects growth of an innovation in the market. A methodology has been provided to study different aspect of customer's perception before and after they make their final purchase. Moreover, two stage diffusion process has been discussed under the assumption that there is a time lag between the Product Awareness Process (PAWP) and Product Adoption Process (PADP). Furthermore, the muti-modal curves in product life cycle have been demonstrated with mathematical formulation that exhibits the dual market phenomenon and also, Weibull distribution has been used to prove the multi-modality of PLC analytically. Various statistical softwares, such as SPSS, SAS and programming language R are applied for prediction purpose which is based on the modeling framework. The empirical analysis of all the models has been done on real life sales data sets. Some goodness-of-fit measures such as MSE, Bias, Variance, RMSPE, R² and Adjusted R² have been used in this research work to justify the models. Also, to evaluate the optimal ranking of the models, Distance Based Approach (DBA) and Weighted Criteria Value Approach (WCVA) have been performed by taking the comparison criteria's of all proposed diffusion models collectively.

Contents

1. Introduction 2. Market expansion based diffusion modelling 3. Innovation adoption modelling inculcating dis-adoption and dis – satisfaction attribute 4. Modeling eventual adoption based on awareness process 5. Market segmentation based modelling: An approach to understand multiple modes in diffusion curevs 6. Using weibull distribution for modelling Bi-modal diffusion curves: A naïve framework to study product life cycle

02. AGARWAL (Vernika)
Multi – Criteria Decision Approaches For Sustainable Collaboration in Supply Chain System.
Supervisors : Prof. P. C. Jha and Prof. Kannan Govindan
Th 24174

Abstract
(*Verified*)

Increasing emphasis of the government on reducing e-waste is one of the major driving forces for the electronics industry in India to include reverse logistics (RL) into its working. Effective RL implementation can also provide manufacturing enterprises (MEs) with ways to balance social and ecological sustainability with economic viability. The ME generally prefers to either collaborate or outsource RL to specialized firms known as third party reverse logistics providers(3PRLP). From the 3PRLP perspective, the major strategic challenge is to understand the economic viability of partnership with ME under the already existing RL framework, while not compromising on its sustainable image. Therefore, given these constraints in the reverse network of ME and 3PRLP, the present thesis aims to present a comprehensive framework that allows for the decision makers (DMs) of these firms to work together so as to mutually enhance the overall sustainability of the reverse SC. This leads to the research objectives of the present work: 1) To identify and prioritize the strategies for effective RL in ME business operations by taking into consideration the role of stakeholders; 3) To provide a comprehensive methodology for integrating sustainability issues into the evaluation and selection process of 3PRLP for complete outsourcing or collaborative alliance from the ME's perspective; ; 4) To develop a framework for evaluation and selection of collaborative partners from the 3PRLP's perspective by considering the requirements of the various stakeholders of 3PRLP; 5) To develop integrated optimization models for analyzing the feasibility and practicability of a collaborative network from the MEs as well as 3PRLP's perspectives. 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. Introduction 2.Strategic decision making modelling for the implementation of collaborative reverse logistics 3.Optimizing logistics outsourcing decisions for sustainable reverse logistics configuration 4. Multi attribute evaluation of collaborative partners in reverse supply chain. 5. Fuzzy optimization models for designing collaborative recover network configuration. Conclusion. Limitations and future scope. References.

03. GUPTA (Tanu)
Some Contributions to Design of Accelerated Life Models.
Supervisor : Prof. Preeti Wanti Srivastava
Th 24175

Abstract
(*Not Verified*)

With the advent of highly reliable products due to rapid advancement in design and manufacturing technologies, carrying out life testing experiments at normal operating conditions is a time consuming job and may not result in adequate amount of failure data for assessing reliabilities in stipulated time. To circumvent this problem and help the manufacturers sustain amidst stiff competition in the market reliability engineers have resorted to testing the items under accelerated environmental conditions to induce early failures The thesis consists of seven chapters with Chapter 1 being introductory. Chapter 2 focuses on formulation of optimal time-censored modified ramp-stress ALT plans using Burr type XII distribution. Weighted goal programming approach is used to determine optimal plan. Time-censored ramp-soak stress ALT plan using Burr Type XII life distribution has been determined using variance optimality criterion in chapter 3. Further, bogey testing or zero-failure testing which is used to demonstrate that a product achieves the required reliability at a high confidence level; has been performed incase of triangular cyclic-stress. The optimum plan is obtained using variance optimality criterion such that zero failures occur with reliability at high confidence level using time-censored data. In Chapter 4 an optimum time-censored modified ramp-stress ALT test plan with two stress factors, viz.,switching rate and voltage, has been obtained under Type-I censoring using

D-optimality criterion. Chapter 5 focuses on formulation of optimal modified ramp-stress and optimal triangular cyclic-stress ALT plans with two independent competing causes of failure using D-optimality criterion. Chapter 6 delves upon formulation of optimal partially accelerated life tests (PALTs) under constant-stress and step-stress loadings with two dependent competing causes of failure using tampered failure rate model and D-optimality criterion. Gumbel-Hougaard copula is used to model the dependence between the two failure causes. Chapter 7 discusses future work. The extensive computational work has been carried out using "*Mathematica 10*".

Contents

1. Life testing under different accelerated environment: An Introduction 2. Time Censored modified ramp-stress alt plan: A goal programming approach 3. Optimal alt plans under ramp soak and triangular cyclic stress schemes 4. Optimal modified ramp-stress alt plan with two stress factors. 5. Optimal modified ramp-stress and triangular cyclic-stress alt plans with independent competing risks. 6. Copula based palt plans using tampered failure rate models with dependent competing risks 7. Future scope. Appendix and bibliography.

04. KAUL (Arshia)

Optimal Advertisement Strategies for Product Promotion.

Supervisors : Prof. P. C. Jha and Prof. Mohan Krishnamoorthy

Th 24173

Abstract (Verified)

Catering to the changing needs of the market new products are introduced continuously. The marketing of these products is dependent broadly on three major interrelated players. These are the firms which are either introducing new products or have products in the market currently and want to spread awareness of these products, end customers who may be converted to potential buyers by persuasion through communication by the firm and last is the medium for communication or medium providers who help to create this market. Real life decisions are essentially qualitative in nature which leads to certain subjectivity; converting these judgments into quantifiable figures can decrease this subjectivity. The main focus of research in this thesis is to develop quantitative methods for promotion strategies which take into consideration the multidimensionality, while addressing the limitations in existing available research. These strategies are for creating awareness of the products in the market leading to their purchase. The details of the models proposed under different conditions in the thesis are as follows: 1. Models from different perspectives namely the perspective of the medium (Chapter 2) and from the perspective of the advertising firm (Chapters 3, 4 and 5) have been considered. 2. Placement of advertisements in web medium taking into account pixelated single or multiple banners. 3. Optimal duration of a promotion campaign is determined for an advertising firm when the market size is (a) static (b) dynamic. 4. Placement of advertisements in television channels for a firm advertising their product(s) for (i) a single product (ii) multiple products. 5. Media planning models for advertisement placement when multiple media are available. The models are proposed for (i) single product (ii) multiple products. 6. Real life case studies have been presented to show the application of the models for assisting decision makers.

Contents

1. Introduction 2. Single period advertisement planning models for pixelated web banners 3. Optimal duration of a promotion campaign incorporating effect of mass and segment specific media 4. Multi – objective advertisement allocation optimization models for product promotion in television medium 5. Multi – period optimization models for product promotion under the effects of mass and segment specific media 6. Conclusion. Limitation and future scope of the study. Reference. Appendices. Annexures.

05. MANISHA

Some Optimum Accelerated Degradation Testing Models in Reliability.

Supervisor : Prof. Preeti Wanti Srivastava

Th 24280

Abstract
(Not Verified)

Rapid advancement in technology resulting in high reliability products likely to last for several years has motivated the manufacturers to carry out accelerated tests (ATs) wherein the items are tested at higher than normal operating conditions to induce early failures. ATs categorized into Accelerated Life Tests (ALTs) and Accelerated Degradation Tests (ADTs) can be carried out in fully and partially accelerated environmental conditions. While an ALT deals with hard failures, an ADT focuses on soft failures wherein failure is recorded when a performance characteristic (PC) of a product crosses a pre-specified threshold. ALTs on high reliability items fail to yield enough failures in feasible amount of time which has necessitated using ADTs. Stress loading schemes in ATs can be constant-stress, step-stress, progressive-stress, cyclic-stress, random-stress, or their various combinations. The thesis comprises five Chapters with Chapter 1 being introductory. Chapter 2 focuses on design of optimal modified ramp-stress ADT plan. Chapter 3 is on optimal zero-failure ADT plans with cyclic stresses depicting ramp-soak and triangular cyclic patterns. In Chapter 4, ADTs under constant-stress (CS) and step-stress (SS) loadings with two stress factors comprising main effect as temperature and interaction effect as temperature and voltage have been devised using fractional factorial experiment. Chapter 5 focuses on formulation of optimal SSADT under partially accelerated environmental conditions with one and two PCs. The dependency between the two PCs has been modelled through Frank copula. The degradation paths have been described either by Wiener Process or Gamma Process. Variance optimality criterion has been used to find out optimal values of such experimental variables as number of test specimens, stress change point(s), stress rate(s) etc.. The models proposed have been explained using numerical examples and sensitivity analyses carried out. The extensive computational work has been carried out using "Mathematica 11".

Contents

1. A prelude to optimum accelerated degradation testing models in reliability
2. Optimal modified ramp-stress accelerated degradation test
3. Optimal zero – failure accelerated degradation test under ramp-soak and triangular cyclic – stress schemes
4. Optimal two – stress ADT models under constant – stress and step – stress schemes
5. Optimal design of univariate and bivariate step – stress partially accelerated degradation tests.