Operations Research in Insurance & Revenue Management Research Paper

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***Abstract*- There are various techniques of operations research that can be used for effective revenue management and in insurance. The transportation, advertising e-commerce and hospitality sector are few areas where revenue management using operations research techniques is applied and showed positive results. Also, the paper describes how operations research can be used for insurance products.**

INTRODUCTION

Revenue management is selling "the right product to the right customer at the right time to the right price". It can be described as the use of analytics, which helps predict the behaviour of customers, so that the availability and price of the product can be optimised in order to maximise the revenue. Essentially, it is about matching supply and demand and successful revenue management involves understanding how customers think and what their perceptions of value are. Also this paper lays a special emphasis on use of OR in Airline Industry and Finance Industry.There are a few necessary conditions to employ revenue management strategy which includes-

- Different customers must be willing to pay different prices for the same service or commodity;
- The business must have the ability to predict the changing levels of demand ahead of time;
- At a given time, a fixed amount of resources is only available to be sold;
- It should be a perishable inventory, i.e. after a certain point, the resources can no longer be sold.

RESEARCH METHODOLOGY

The research has been done using secondary data from various sources that includes:

- Published Research Papers
- Books
- Newspapers
- Articles
- OR Experts

RESEARCH OBJECTIVE

- To understand the concept of revenue management and be able to apply the revenue management concept in the business using various operational research techniques like linear programming and fuzzy problem and understand their pricing mechanism.
- Also, how the operations research can be used for insurance products.
- This paper also hypothesis that OR proves to directly or indirectly affect the business working and its employees which further affects its profits.

Phases in solving business problems

- Judgement Phase – It involves determination of objectives and problem raised and finding the cause of problem.
- Research Phase- This phase involves finding and proper OR technique to solve the problem as well as development of hypothesis.
- Action Phase- it involves Remedial Actions and putting thoughts to work that is implement the OR techniques and finding a solution to the problem,

SCOPE OF OR

- Airline Industry
- Retailing
- Restaurant
- Insurance
- Purchasing
- Logistics and shipping

- Investing…

METHODOLOGY

- Formulating the problem – It involves scanning the environment, establishing relationships and premises. Also understanding the problem is a part of this step.
- Deriving the solutions- Various models are used to simulate the models, perform them mathematically and derive at the solution.
- Testing the models and solutions – The solution derived in previous steps in worked out in various scenarios before actually applying in the real-world problem.
- Establishing Controls over the solution – The solution derived from the models remain constant and good as long as the variables (independent and dependent) are not changed.
- Implementing the solution - Solution so obtained should be translated into operating procedure to make it easily understandable and applied by the concerned persons. In this step the strategists communicate the solution to operations managers and the responsibility gets transferred to the operations department.

CHARACTERISTICS OF GOOD MODEL

1. Assumptions should be simple and few.
2. Least Variables.
3. It should be able to assimilate the system environmental changes without change in its framework.
4. Easy to construct.

COMMON OR TECHNIQUES

- Allocations Models
- Simplex Models
- LPP
- Assignment Models
- Replacement theory
- Simulations
- Networking Theory

LITERATURE REVIEW

Revenue Management and E-Commerce
-E. Andrew Boyd
-Ioana C. Bilegan

We follow the historical backdrop of revenue management with an end goal to represent a successful online business model of dynamic, automatic sales. Our talk starts with a short diagram of electronic dissemination as rehearsed in the aircraft business, stressing the basic job of focal reservation and revenue management systems. Strategies for controlling the closeout of stock are then presented alongside related procedures for advancement and forecasting. Research contributions and zones of significant research potential are given unique consideration. We close by taking a look at how revenue management is rehearsed outside of the airline business, its relationship to dynamic pricing, and its future. As we can also see how OR can be used by e – commerce companies for various purposes like transportation and shipping.

Re-Solving Stochastic Programming Models for Airline Revenue Management
- Lijian Chen
- Tito Homem-de-Mello

We study some mathematical programming formulations for the origin-destination model in airline revenue management. Specifically, we devote our focus around the traditional probabilistic model proposed in the paper. The methodology we study comprises of understanding an arrangement of two-organize stochastic projects with straightforward plan of action, which can be seen as a guess to a multistage stochastic programming detailing to the seat allotment issue. Our hypothetical outcomes show that the proposed guess is strong, as in illuminating increasingly progressive two-organize projects can never decline the normal income acquired with the comparing allotment approach.

Risk in Revenue Management and Dynamic Pricing
Yuri Levin, Jeff McGill, Mikhail Nediak

The research paper talks about how risk is an important attribute to be taken into consideration for revenue management and then derives a model for the same. The traditional revenue management optimization models for transportation and accommodation are risk neutral. This works for certain industries where managers use law of large numbers to ensure that long-term average revenues will be maximized as long as good risk-neutral strategies are employed. But this may not be the case

for all. Therefore, a dynamic pricing model incorporating risk is formulated.

The model is represented as a stochastic optimal control problem in continuous time over the fixed planning horizon. We assume that demand for the product follows a nonhomogeneous Poisson process(random) in which the demand rate is price sensitive, where prices are drawn from an arbitrary but finite predetermined set. We formulate a dynamic pricing model incorporating risk, which we analyse as a problem of optimal control. Risk is introduced to the model by augmenting the expected revenue objective with a penalty term for the probability that total revenues fall below a desired level of revenue—a loss-probability risk measure. Risk is added as a constraint. This is solved as an LPP where we get desired optimal values.

The paper presents a new dynamic pricing model that permits control of both expected revenues and the risk that total revenues will fall below a desired minimum. This model would help decision makers in a number of emerging application areas for revenue management to seek pricing policies that balances maximization of expected revenues against risk of poor performance. This model falls within a general class of continuous-time optimal control problems, demonstrates the existence of optimal solutions under reasonable assumptions, provides optimality conditions, and explores some of the structural properties of solutions.

Dynamic Bid Prices in Revenue Management
Daniel Adelman

This research paper talks about how the bid price can be formulated into a linear program which can further be helpful in revenue management. The bid-price controls are a powerful and influential solution concept in revenue management. For example, major airlines have used bid-price control policies for deciding when to open and close customer fare classes for sale. The basic idea of bid-price control is to accept the request if the revenue earned exceeds the value of the resources consumed as measured by bid prices.

Typically, the bid prices are computed as optimal dual prices, i.e., marginal resource values, of a simple deterministic linear program. While the system under control is dynamic, to date there only exist models for computing static bid prices, which do not change as a function of time. One purpose of this paper is to derive and explore a tractable model for computing a time trajectory of bid prices all at once within a single model. In implementation this model may still be re-solved over time, and this turns out to be a good strategy. The second purpose of this paper is to further formalize the connection between bid-price control in revenue management and dynamic programming. However, the linear program itself has never been derived directly from the dynamic program.

Models of the Spiral-Down Effect in Revenue Management
William L. Cooper
Tito Homem
Anton J. Kleywegt

The spiral-down effect occurs when incorrect assumptions about customer behaviour cause high-fare ticket sales, protection levels, and revenues to systematically decrease over time. If an airline decides the number of seats to protect for sale at a high fare based on past high-fare sales, while neglecting the fact that availability of low-fare tickets will reduce high-fare sales, then high-fare sales decreases, resulting in lower future estimates of high-fare demand. This subsequently leads to yields that are lower protection levels for high-fare tickets, greater availability of low-fare tickets, and even lower high-fare ticket sales. This pattern continues, resulting in a so-called spiral down. This research paper develops a mathematical framework to analyse the process by which airlines forecast demand and optimize booking controls over a sequence of flights.

Within the framework, there are conditions under which spiral down occurs. A framework for analysing the dynamics of forecasting and optimization in revenue management is introduced. The results in this paper illustrate how an error in such a model can lead to a systematic deterioration of the controls if the model is updated and used repeatedly. Such systematic deterioration is different in nature, and potentially of greater concern, than the suboptimality of solutions obtained if a model with error is used only once.

Restaurant Revenue Management
Dimtris Bertsimas
Romy Shoida

This research paper develops two classes of optimization models to maximize revenue in a restaurant that may violate the first-come-first-serve (FCFS) rule. In the first class of models, methods like integer programming, stochastic programming, and approximate dynamic programming are used to decide dynamically when, if at all, to seat an incoming party during the day of operation of a restaurant that does not accept reservations. The second class of models addresses reservations. It proposes a two-step procedure: Using a stochastic gradient algorithm to decide prior how many reservations to accept for a future time and then use approximate dynamic programming methods to decide dynamically when, if at all, to seat an incoming party during the day of operation.

Not only two basic models, Integer Programming Model and The Simulation is developed but also extensions to basic models: A Stochastic Integer Programming Model, Approximate Dynamic Programming Model and Comparison Models are developed.

The DSAR Model (Dynamic Seat Allocation with Reservations) serves a larger percentage of both reservation and walk-in customers than the FCFS (First Come First Serve) models. The average wait for walkin customers is lowest using the DSAR. The DSAR outperforms the FCFS model. It again has the best percentage seated for both the reservation and walk-in customers. It also has the highest average waiting time for reservation parties and the lowest average waiting time for walk-in parties. Thus, the DSAR produces more revenue and serves more customers as compared to FCFS for both low and high demands. The results also imply that the DSAR has a higher revenue impact with higher demand.

The conclusions derived from the research includes: For models without reservations, optimization-based strategies outperform FCFS-based strategies for all low and medium load factors and significantly for high load factors. Somewhat surprisingly, optimization-based strategies do not adversely affect the service quality. If we increase the sophistication in the models, it results in higher revenue without sacrificing waiting time. The performance of the ADP model represents the best trade-off between maximizing revenue and maintaining low average waiting time and run time. Also, the reservation models proposed results in a significant improvement relative to the FCFS models for both low and high demand levels. The RB and DSAR models result in both higher revenue and lower customer attrition. Overall, it can be said that optimization-based models have a role to play in restaurant revenue management.

An Operations-Research Study of Sales Response to Advertising

M. L. Vidale,

H. B. Wolfe

The paper assessed the results of studies for major industrial concerns on the sales response to advertising. It is very important to assess as advertising is one of the important and expensive as well as the demanding factor facilitating sales thus it becomes important to get the result about it.

The OR model suggested to conduct this is based on three parameters-

1) Sales decay constant-

It is a concept that states without promotional activities the sales tend to decline under relative constant market and economic conditions. This has been graphically derived using the OR.

2) Saturation level-

OR and Actuarial Science has derived and concluded that advertising campaigns should be considerably shorter, thus they will be more effective. In simpler words, Long campaigns have less effect on consumer behaviour.

3) Response was constant-

This describes the sale behaviour of the product. It is mathematically defined as sales generated per dollar spent on advertising. OR has proven that it is very low for new customers as it takes a lot of efforts and money to acquire new customers.

• OR is also used in – allocation of advertising budget; to measure the impact of advertising.

When carefully designed advertising can provide reliable and reproducible sales figures. OR Techniques here is not so accurate as the sales response to advertising differ from product to product so can't be very sure about results. Although the existence of OR in Advertising is very less, it is probably true that designing advertisements and making prior expectation about consumer behaviour can be solved quantitively using OR.

Applications of Operations Research in the Air Transport Industry
Cynthia Barnhart
Peter Belobaba
Amedeo R. Odoni

This research paper provides a review of the role of operations research in the development of airline revenue management (RM) models. Revenue management is the practice of determining the number of seats on each flight to be made available at each fare level, limiting low-fare seats and protecting seats for later-booking, higher-fare passengers. Given that the operating cost of a scheduled flight departure in a large part fixed in the very short run, the goal of revenue management is to fill each flight with the maximum possible revenue to maximize its operating profit. Airline RM systems have over the past 20 years. It was into this "third generation" of RM systems that OR models, began to be integrated.

Historical booking data for the same flight leg and day of the week are combined with actual booking information for each future flight departure to generate a forecast of total demand by booking class for that departure. These forecasts, together with estimates of the revenue value of each booking class, are then fed into an optimization model that calculates the recommended booking limits for the flight departure in question. The demand forecasts and booking limits are reviewed by the RM systems at regular intervals during the flight booking process. Most of the large and medium-sized airlines around the world have implemented third-generation RM systems.

Airlines have been accepting reservations in excess of their aircraft capacity for more than two decades, in an effort to reduce the revenue losses associated with the noshows. The objective of the flight overbooking component of revenue management is to determine the maximum number of bookings to accept for any given future flight departure, trading off the risks and costs from denied boardings against the potential revenue loss from unsold or spoiled seats. The cost-based overbooking model is the current state of the practice at many airlines which explicitly accounts for the actual costs associated with denied boardings and with empty seats. The OR literature contains many additional works on the airline overbooking problem, some of which propose dynamic programming (DP) formulations.

The second major technique of airline revenue management is the determination of the revenue maximizing mix of seats available to each booking (fare) class on each future flight-leg departure. Given the forecast demand for each booking class, expressed in terms of a mean and standard deviation, along with its associated average fare, the expected marginal revenue of each incremental seat on a flight leg can be determined. It is equal to the average fare of the booking class under consideration multiplied by the probability that demand will materialize for that incremental seat. The optimal protection level for a higher-class seat is equal to the number of seats with an expected marginal seat revenue greater than or equal to the average fare in the next lower class.

Network Revenue Management (or Origin-Destination Control) represents a major step beyond the fare class mix capabilities and is currently being pursued by the largest and most advanced airlines in the world. As its name implies, O-D control gives the airline the capability to manage its seat inventory by the revenue value of the passenger's origin-destination itinerary on the airline's network, not simply according to the fare class requested on a single flight leg.

The most obvious next steps in the further enhancement of airline revenue management systems is to integrate the pricing and seat inventory control decisions currently being made with different decision support tools and, at many airlines, in different parts of the organization. The integration of airline pricing and seat inventory decisions with those of the scheduling and fleet assignment functions is therefore considered to be the "ultimate" challenge for airline operations research.

Operational Research Techniques for Revenue Management
1Kashyap M. Gupta, 2Kavita C. Griglani

The research paper tells us how revenue management is different from yield management. Revenue Management is considered to be more logical while Yield Management is more practical based. Revenue Management can also use operation research to get an optimal result. Operational Research is a mathematical approach to help in decision making by understanding the depth of the situation and helping to create a model out of it. Model later helps to find out efficiency in doing a particular task. Linear

Programming is used in revenue management in a packaged drinking water production industry. Since in this industry the main purpose is to minimise the cost and maximise the profit. Software MALTAB (R2009a-32) helps in making the task simpler. Therefore, Paper uses this software to get the optimal result.

Placement of Staff in LIC using Fuzzy Assignment Problems
Trupti A Thakre1, Onkar K Chaudhari2 , Nita R Dhawade3
Placement of right person for a right job is difficult because of uncertainty and imprecise information for recruitment basis in any organisation. However Fuzzy Assignment helps in tackling the situation. This research paper focuses on how placement of staff in LIC using Fuzzy Assignment Problem helps to reach optimal solution. Fuzzy Assignment Problem is converted into crisp one using magnitude ranking technique and later problem is solved by using Hungarian Method and Matrix One Assignment and Direct Method. All the 3 methods give the same solution. The Fuzzy problem result is more relevant in current circumstances due to increase in uncertainty. This is the way in which OR effects the business indirectly.

A linear programming-based method for the network revenue management problem of air cargo
Kuancheng Huanga, Heng Lu
The research paper is on solving the critical operational issue of air cargo operation faced by airlines is control over the sales of their limited cargo space. The study formulates a multi-dimensional dynamic programming model to present a network revenue management problem for air cargo. Later linear programming based model is used to provide the decision support operationally suitable for airlines. It has also introduces a dynamic adjustment factor to alleviate the inaccuracy problem of the static LP models in estimating resource opportunity cost.

Operational Research and Insurance.
- Christoph Haehling von Lanzenauer
- Don D. Wright
The paper assessed the applications of operational research and its impact on major areas of concern to key players in Insurance and risk management that is made with appropriate reference to actuarial science.
Human life right from the beginning is affected by the risk which the author defines as a ubiquitous phenomenon that is faced continuously by individuals as well as organizations and threaten societies and economic systems. Although Risk is a subjective term, the term risk is used to represent the potential of loss which either can be financial, psychological or physical and all three in themselves generate fear and anxiety. So human desires protection from these risks and thus insurance was developed. It is the Operation Research and Actuarial Sciences that made Insurance so advance and become like what it is now.

OR is majorly used in Insurance Industry for:
1) OR by Insured
From the insurance consumer's perspective, the major areas of concern are insurance purchasing and claim decisions. The former area deals with the issues of whether or not insurance coverage should be bought from a professional risk bearer and if so, how the agreement should be structured, while claim decisions deal with the problem of optimal behaviour after a loss has occurred. OR and Actuarial Science collectively helps to model all his/her purchase decisions. (based on utility, least cost).

2) OR by Insurer
The insurer applies the OR to solve the problems from the insurer's perspective have received a great deal of attention both from actuarial science and Operations Research and cover all functional fields from the premium calculation, underwriting, and marketing to reserving, re-insurance and investment. The common element and the backbone in the broad range of issues is the probabilistic assessment of the aggregate losses. OR helps to decide the Premium be charged for the insurance and the amount of claim to be offered. It is also used in risk assessment – evaluating risk, developing risk managing activities and risk sharing (in case of multiple insurers)

3) OR by Other Perspectives
While little work appears to have been done on issues facing independent agents or brokers as well as claim handling agents (e.g. adjusters), lawyers, either representing (insured) victims or the insurer, are used

in the claim settlement process. Their tasks of establishing negligence and/or negotiating settlements involve dealings in the presence of uncertainty and lend themselves to formal analysis. This also involves the Government for supervisory and regulatory responsibilities insurance availability, affordability and equity.

This paper as a whole discussed the role of OR in Insurance with special emphasis on the contribution of Actuarial Sciences in this industry. In reviewing Operations Research and insurance, we first observed that insurance problems should be seen in the wider context of risk management. Furthermore, we believe that such a review cannot take place in isolation but must be carried out by recognizing the role actuarial mathematics has played in dealing with risk. Both disciplines appear to have crossed each other and then create an advanced complex product like Insurance.

Operations Research Improves Sales Force Productivity at IBM.

-Rick Lawrence, Claudia Perlich, Saharon Rosset, Ildar Khabibrakhmanov, Shilpa Mahatma, Sholom Weiss, Matt Callahan, Matt Collins, Alexey Ershov, Shiva Kumar

This paper addressed the problems faced by IBM regarding declining sales and the solutions to boost it. In 2004 to counter the problem, IBM introduced 2 OR-based strategies to increase sales – 1) OnTarget, a strategy that provides a set of analytical models designed to identify new sales opportunities at existing IBM accounts and non-customer companies and 2) MAP – Market Alignment Program, a program which optimally allocates sales resources based on field-validated analytical estimates of future revenue opportunities in operational market segments. After the initial success of these 2 programmes especially MAP; it was deployed at IBM sales and distribution organization as an integral part of its sales model to better achieve targets and utilise the potential market opportunities.

IBM has a large sales force so bringing a change is not easy but once the change is incorporated the positive impact could be huge and could help in sustain in this dynamic and challenging economy.

The first solution, OnTARGET, was developed in response to a request from SWG for a novel, analytics-based approach to help its sales professionals identify companies, referred as whitespace, that had not purchased previously from IBM. This objective was quickly extended to include existing IBM customers, and subsequently to also include models for IBM server offerings. In 2005, the second solution, the Market Alignment Program (MAP), was initiated with S&D to develop a quantitative approach to guide the deployment of IBM sales professionals to customer accounts with higher expected future revenue. In contrast to a conventional approach in which salespeople are largely allocated to accounts with the highest recent revenue, the MAP process recognized the need to develop analytical models to estimate the realistic revenue opportunity at each company, i.e., the amount of a specific product group that IBM could realistically hope to sell to a specific customer.

One of the biggest challenges in any operations research (OR)-based project is mapping the set of high-level business objectives into specific tasks.

OnTARGET and MAP share a common set of four required tasks:

1. Data Model – Internal view of the database of customers and transaction
2. OR Models- Defining a problem and using OR to find a solution
3. Solution Delivery – Execution of solution
4. Quantifying Business Impact – Evaluating the impact

OnTARGET and MAP are examples of operations research solutions that were designed to address specific business challenges in the broad area of sales force productivity. Although they address different underlying issues, these solutions implement a common approach that is generally applicable to a broad class of operational challenges. Both solutions rely on rigorously defined data models that integrate all relevant data into a common database. Choices of the data to be included in the data model are driven both by end-user requirements and the need for relevant inputs to analytical models. Both business problems have a natural mapping to applications of predictive modelling: OnTARGET predicts the probability to purchase, and MAP estimates the realistic revenue opportunity. Delivering the underlying data and the analytic insights directly to decision-makers (sales representatives for

OnTARGET and sales executives for MAP) is crucial to driving business impact. Both solutions have been deployed across multiple geographic regions, with a strong focus on capturing and quantifying the business impact of the initiatives.

The impact of these 2 strategies was huge and the total revenue was increased by at least 700-800 million dollars and with similar anticipations in future years; which denotes the importance of OR in sales. Moreover, OnTarget helped the customers to save 50 weeks per year of productive time thus over 10 million dollars were saved.

Sales forecasting using extreme learning machine with applications in fashion retailing

Zhan- li Sun,

Tsan-Ming Choi,

Kin-Fan,

Yong Yu

This paper addressed the challenge associated with sales forecasting owing to the volatility of demand and using OR techniques to counter it. In the paper, the novel neural network technique called extreme learning machine is suggested to investigate the relationship between sales and factors affecting demand (designs, comfort, economic factors). An effective sale forecasting is required to take plenty of decisions and calculate production and material costing and determine the sales price thus, need to maintain less inventory thus reducing overheads cost.

Usually Sales forecasting is a very complex process due to involvement of external as well as internal factors but lately, many retailers have started using ELM to forecast sales. ELM method is preferred over other methods as in it the input weights and hidden biases are randomly chosen and output weights are analytically determined by using the Moore-Penrose generalised inverse. Not only ELM is faster but is also avoids many difficulties like over tuned problems and local minima.

The forecasting accuracy of an approach is also influenced by the inherent nature of a product and its sales pattern. In this paper, the effect of sales amount fluctuation on the prediction's accuracy of ELM is investigated. The sales amount of fluctuations are measured by the coefficients of variation (cvs). Sales data of three products were studied, each with a different sales feature. The ELM is thus a promising tool in sales forecasting for fashion retailers. Moreover, in our approach, by using the statistical mean value of multiple trials as the final forecasting result, the ELM forecasting result is more stable than the BPNN algorithms. This makes the ELM approach a better choice when employing the practical forecasting of fashion sales, in which the BPNN result can be very unstable. This study also provides a guide for the selection of the important sales forecasting factors such as design factors (size, colour, etc.) and the price factor. Owing to market competition and globalization, sales forecasting plays a more and more prominent role in a decision support system of a commercial enterprise. It is especially true in the fashion business. It is known that ELM not only has a higher generalization performance than the traditional gradient-based learning algorithms but it also avoids many difficulties faced by gradient-based learning methods such as stopping criteria, learning rate, learning epochs, local minima, and the over-turned problem.

Application of activity-based costing to a land transportation company

Adil Baykasglu,

Vahit Kaplanoglu

The research paper discussed the challenges that the companies have to face due to the dynamic and globalised economy. Due to these, the companies are trying to cut their costs i.e. become leaner, responsive, and agile with ever-increasing efficiency and effectiveness.

To retain its competitive status, a company should provide high-quality service/ products in a limited time with the lowest price possible. The cost-cutting has not only affected the manufacturing sector but also the service sectors including transportation and logistics.

Due to this ever-changing economy, the decision-maker now demands modern cost accounting estimations which the traditional techniques can’t be fulfilled so there is need of OR to develop new cost estimation techniques so that the companies know the demand at various price levels so that they could adjust their product and price and at least achieve break-even.

In this paper, an application of ABC – (activity-based costing) method to a land transportation company is presented. In the present ABC model, SIMPROCESS

is used for process modelling and AHP (analytical hierarchy process) methodology is employed to determine cost driver parameters. The writer of this paper has given a detailed explanation of these techniques. The results obtained from the ABC analyses are also compared with the traditional cost accounting practice of the company to see if there is a difference. It is observed that there is a considerable difference between the current cost assignment procedures of the company and the results obtained from ABC. The present traditional cost accounting procedures of the company was not able to properly distribute overheads to its services. The paper makes a useful contribution to the logistics literature by presenting how ABC along with business process modelling can be applied to a land transportation company through a detailed case study.

Revenue Management & Insurance Cycle
J-B Crozet
Relation of OR is deploying a fixed amount of insurance capacity over a period of time. It uses the theory of revenue management, which integrates market conditions and fluctuations in demand into the decision-making process. We use this framework to develop an optimal pricing strategy and demonstrate how it can be a valuable tool to manage the insurance cycle. It helps to determine the use of dynamic pricing strategies, such as the revenue management techniques used by other industries (e.g., airlines, car rentals, internet service providers) in an insurance context.
1. INSURANCE CYCLE APPLICATIONS: We can investigate the optimal pricing strategy for the different stages of the insurance cycle.

2. OPTIMAL CAPACITY STRATEGY: A revenue management framework can be utilized to optimize the insurer's amount of capacity to achieve a target return on equity for its shareholders over the cycle.

3. STRATEGIC MARKETING DECISION: We can also use our revenue management framework to assess the outcome of strategic decisions.

Revenue management framework provides a tool to adapt to fluctuations:
- it can be re-parameterized dynamically in light of the latest information on actual capacity usage and demand expectations; for instance, an insurer could decide to review its strategy and retune its revenue management model on a monthly basis.
An insurer can therefore manage the ups and downs of the cycle by adjusting its capacity charges so that its expected profits are maximized.

An Integrated Approach towards Revenue Management
Roger Maull
Phillip Godsiff
Revenue management is the maximization of revenue by "selling the right seats to the right customer at the right time". While pricing and demand behaviour were important, so was capacity allocation and planning, and all these areas needed to be brought into revenue management.
In attempting to integrate pricing research with capacity allocations, one of the main challenges faced is that OR-based revenue management often assumed demand to be debatable or probabilistic, whilst pricing research tend to model demand as deterministic. Firms need to evaluate their current organizational model to achieve their pricing and revenue management objectives to meet the challenge of constant change sweeping through their industries. It also allows firms to compete with the help of non-price components, capturing different value propositions of different segments. By ensuring that executives from across the organisation is involved in the intricacies of pricing discussions, more opportunities can be discovered and pricing and revenue management strategies could be more creative, allowing for greater revenues to be realised.

Operations Research in Insurance
PATRICK I~ BROCKET
XIAOHUA XIAt
Operations research methods have been applied to the modelling and the solution of numerous problems in insurance and actuarial science. It reviews insurance industry applications of quantitative reasoning techniques, often known as OR methods. A major research direction and practical application approach within OR is mathematical programming. OR focusses on the developed or promising insurance applications of general linear programming, nonlinear programming, integer programming, and five other special mathematical programming

approaches: network optimization, goal programming, dynamic programming, chance-constrained programming, and fuzzy programming. The field of OR is constantly growing, and the applications of OR techniques in the area of insurance are expanding rapidly. The growing field of OR maintains substantial interactions with computer science, applied mathematics, engineering, finance, economics, and behavioural science. Portfolio analysis, which is widely used as an investment and risk management technique in finance, has been used in insurance, not only from the traditional investment perspective but also as an insurance composition design technique. Utility theory, decision analysis, and many other OR and management science methods have found use in the insurance industry. Both OR methodologies and insurance industry research are experiencing rapid theoretical and technical developments. In OR, various new algorithms, new modelling techniques, and even new approaches are being developed very rapidly.

APPLICATIONS OF OR IN BUSINESS DEVELOPMENT

- Product Mix
- Investment Mix
- Agriculture Production
- Deployment of salesmen
- Transportation

LIMITATIONS OF OR

- Highly Technical – OR solutions can't be interpreted by everyone, so only experts can understand theses models thus limited application.
- Specific Decision Making – It doesn't provide solutions to all problems; this only provides solutions to some problems which can be expressed in forms of models.
- Quantative – This often ignores the qualitative factors which can also affect the business performance.
- Modulation – OR involves modulation of problems which might be not possible in all problems or might act adversely in practical situations.

CONCLUSION

Insurance and revenue management depends upon various models or scenarios. The insurance premium amount or monthly instalments amount varies from person to person based on their personal details and KYC data. Therefore, a fixed formula cannot be used in every scenario because there exist constraints. Hence operation research helps in making optimal decisions after considering all the constraints. It helps in building a model as per our convenience too. Operational research is also used by HR Department for recruitment of right employee for right job to improve the overall efficiency of the insurance or any other firm. On the other hand, revenue management in any industry is an important aspect for the company's future growth. In revenue management there is always confusion in decision making regarding what to sell, whom to sell, when to sell and for how much to sell to increase the existing revenue. To predict all these things is difficult as you need to take care of all the vital elements related to it in one roof and compare and get the best possible solution out of it. Operational research makes this possible by formulating models according to your needs using different operational research techniques like linear programming problem, simplex, assignment, transportation etc. Without operation research, decision making becomes difficult especially in insurance and revenue management sector leading to great losses and inefficient utilisation of resource. These sectors are mainly depended on decision making so one bad decision of yours can highly affect the growth or profitability of your firm or company. Therefore, operation research plays an important role in these sectors. OR uses a variety of problem-solving techniques like Simplex, LPP, Networking to find the most viable solutions to practical business problems and solve them most economically. OR could also prove its mettle in Retail industry by helping to ascertain the deployment of salesmen in various region to minimise cost and maximise profit. Also, as we have seen one common thing in the entire paper, that using techniques of OR affects the business directly as well as indirectly and mostly in a good manner. Using the secondary data and discussions from OR Expert this paper comes to conclude the hypothesis of this paper comes out to be true and OR has a great potential in business development.

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