

Dear Conference Delegate

Welcome to the 37th annual conference of the Operations Research Society of South Africa, which this year incorporates the 2nd conference on OR Practice in Africa (ORPA) and an associated ORPA/INFORMS Workshop on OR Education. For these activities, we welcome in particular Dr Eric Soubeiga, Group Chair of Operational Research Practice for Africa (a charity organization registered in the UK), and Professor Jim Cochran as organizing chair for the Workshop on OR Education. We also acknowledge the financial support of the Institute for Operations Research and the Management Sciences (INFORMS), the International Federation of Operational Research Societies (IFORS) and the Association of European Operational Research Societies (EURO), who have provided support for travel and/or accommodation expenses for presenters at the education workshop and for some delegates from elsewhere in Africa.

Plenary keynote addresses will be given by Eric Soubeiga and Jim Cochran, and also by the Statistician-General of the Republic of South Africa (Mr Pali Lehohla), and by Professor Arabinda Tripathy from India. Professor Tripathy has visited South Africa before, in connection with his interests in the field of OR for Development, and we pleased to welcome him back.

We do, however, equally welcome all other delegates from within South Africa and beyond our borders. Without your valued inputs and participation we would not have a conference at all. The programme contains a rich mix of applications (in developed and developing world contexts) and theory, as we are used to seeing in ORSSA conferences. We trust that you will have a productive few days, exchanging experiences, learning new tools, renewing old acquaintances and making new friends. For those of you from outside of the Western Cape, do take some time also to explore the “fairest Cape in all the world.”

Best wishes

Theo Stewart
Chair, Organizing Committee

—*Internet Use*—

Delegates may access either the “Red” lab (on level 5, two floors up from the lecture venues) or the “Green” lab (on the same level as the lectures). However, access to the Green lab is only possible if there is an assistant on duty, while the lab administrator (Theo Armstrong, who will be able answer questions) is generally available in the Red lab.

You may use any machine in the labs.

Collect a card with a username and password from the conference reception desk; the username will be one of `a-red1001` to `a-red1025`. The password is `secret123`. If you are required to change it, make the password `orssa07`, and note this fact on the card. Please return the card to the reception desk when you are done.

For internet access, a further username and password will be required. In this case the username is `ebe@wf.uct.ac.za` and the password is `ebe2006*1`.

In case of problems, ask for Theo Armstrong, the administrator in the Red lab.

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— Programme at a Glance —

Tuesday 11 September 2007

ORSSA Opening Plenary Session (Menzies 9)	
09:00–10:30	<i>Tea/Coffee (served from Menzies 12)</i>
10:30–11:00	
11:00–13:00	I: Supply Chain Management (Menzies 13) II: Combinatorial Optimization (Menzies 11) III: Threat Evaluation & Weapon Assignment (EM 7)
13:00–14:00	<i>Lunch (served from Menzies 12)</i>
14:00–15:30	IV: General Topics (Menzies 13) V: Manufacturing & Inventory Management (Menzies 11) VI: Threat Evaluation & Weapon Assignment (EM 7)
15:30–16:00	<i>Tea/Coffee (served from Menzies 12)</i>
16:00–17:30	VII: General Topics (Menzies 13) VIII: Finance & Credit Scoring (Menzies 11) IX: Decision Support Systems (EM 7)

Wednesday 12 September 2007

ORPA Opening Plenary Session (Menzies 9)	
09:00–10:30	<i>Tea/Coffee (served from Menzies 12)</i>
10:30–11:00	
11:00–13:00	X: Poverty Alleviation & Humanitarian Logistics (Menzies 9) XI: OR Practice in Africa (Menzies 13) XII: Resource Management & Disease Eradication (Menzies 11)
13:00–14:00	<i>Lunch (served from Menzies 12)</i>
14:00–15:30	XIII: General Topics (Menzies 9) XIV: Banking & Finance (Menzies 13) XV: Location Problems (Menzies 11)
15:30–16:00	<i>Tea/Coffee (served from Menzies 12)</i>
16:00–18:00	Plenary Session, including ORSSA AGM (Menzies 9)
19:00–	<i>Conference Banquet (Rhodes Memorial Restaurant)</i>

Thursday 13 September 2007

09:00–11:00	XVI: MCDA & DEA (Menzies 9) XVII: Applications in the Energy Sector (Menzies 13) XVIII: Production & Scheduling (Menzies 11)
11:00–11:30	<i>Tea/Coffee (served from Menzies 12)</i>
11:30–13:00	Closing Plenary Session (Menzies 9)

—Conference Programme—

Monday 10 September 2007

Arrival & Registration

(16:00–18:00) [Foyer, Menzies Building]

Welcome Function

(18:00) [Glass House, Menzies Building]

Tuesday 11 September 2007

(08:00–09:00)

**Registration [Foyer, Menzies Building]
and Coffee [served from Menzies 12]**

Tuesday 11 September 2007:(09:00–10:30)	
Plenary Session I: ORSSA Conference Opening <i>Chair:</i> Theodor Stewart [<i>Venue:</i> Menzies 9]	
09:00–09:10	Martin West (Deputy Vice-Chancellor, UCT) <i>Welcome</i>
09:10–09:15	Theodor Stewart (ORSSA/ORPA 2007 Conference Chair) <i>Announcements</i>
09:15–09:25	Marthi Harmse (ORSSA President) <i>Presidential Address</i>
09:30–10:30	James Cochran, <i>Ennoblization through mobilization: Establishing a preeminent societal position for operational research</i> (p. 16)

Tea/Coffee (10:30–11:00) [served from Menzies 12]

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11:00–11:30	Emmanuel Oyatoye, <i>Application of a multi-objective linear programming to supply chain management: Production-distribution planning</i> (p. 22)
11:30–12:00	Alejandra Gomez-Padilla, <i>Analysis of a milk supply chain: The case of the Los Altos de Jalisco region in Mexico</i> (p. 19)
12:00–12:30	Ozias Ncube, <i>Impact of diversity management at the work place on the supply chain</i> (p. 38)
12:30–13:00	Johan Janse van Rensburg, <i>Simulation of the Sasol coal value chain in Secunda</i> (p. 71)

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11:30–12:00	Elias Willemse , <i>A metaheuristic approach to the routing of patrolling security guards</i> (p. 45)
12:00–12:30	Carel Anthonissen , <i>A two-tier solver for sequential ordering problems</i> (p. 81)
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15:00–15:30	Philimon Nyamugure , <i>A holistic application approach of capability indices</i> (p. 35)
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15:00–15:30	Racheal Egbelakin & Hezekiah Oladimeji , <i>The effectiveness of operations management in the manufacturing industry</i> (p. 31)

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—*Invited Paper Abstracts*—

Ennoblization through mobilization — Establishing a preeminent societal position for operational research

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Abstract

For several years the discipline of Operational Research (OR) has engaged in much hand-wringing over its place in society. OR has accomplished a great deal and yet still has much more to offer, so what is at issue — is OR too complex for most laypersons to comprehend? Has the worldwide OR community overvalued its potential contribution? Are most prospective users unaware of OR and what it has to offer? In my unbiased and humble opinion, the answers to these three questions are emphatically NO, NO, and YES! Many in our discipline believe these responses imply that OR has a branding problem, but I disagree; I believe OR has an identity problem (yes, these are different!). The community of operational researchers can overcome this identity problem by moving into and inhabiting a noble place in the public's psyche. This can be accomplished by publicly asserting and demonstrating the relevance of OR through the mobilization of its students. In this talk I will discuss how OR scholars and practitioners can mobilize its students by i) invigorating and energizing introductory OR classrooms and ii) applying OR through classroom projects to meaningful and important social problems.

Applying OR to deliver sustainable development in Africa

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Abstract

In this presentation the author gives an overview of ORPA from its origins to its achievements to date. Going forward, the author presents a vision for the development of OR in Africa and highlights both opportunities and challenges ahead.

Lessons from problem structuring methods and their application

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Abstract

Various problem structuring methods are being used under different problem situations. A large number of applications of these methods are also being reported. There is substantial commonality in the approach of all these methods, though the methods themselves are quite different. An effort has been made to identify these similarities and initiatives taken to develop appropriate methodology for each individual problem situation. Some of these applications are discussed. The applications relate to situations in parliament to technology adoption in industry to establishment of a new academic institution.

— *Contributed Paper Abstracts* —

Analysis of a milk supply chain — The case of the Los Altos de Jalisco region in Mexico

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Abstract

The objective of this talk is to propose more effective commerce conditions in order to increase the rural development. Mexico is not self-sufficient in milk production and is among the higher milk importers. The specific case of the Los Altos de Jalisco region is studied because its characteristics are the most suitable for our study, since we are interested in milk commerce. The milk supply chain of the studied region may be divided into four groups: milk producers, dairy products producers, dairy products sellers and the final market. We study the commercial relations between the first two members of the supply chain: milk producers (MP) and dairy products producers (DPP). The MP are the owners of cattle and sell milk to the DPP. Among the DPP two groups exist: large companies and minor producers. In order to formalize their relations, MP and DPP must specify the conditions of exchange, *i.e.* engage through contracts. The economic decisions made in these contracts affect physical milk flows and *vice versa*. From a purely economic point of view, contracts determine the behaviour of each company by considering its objectives of profitability (benefit maximization). The contractual aspect is also important since it is used to reinforce the links between the company members of a supply chain. We also analyze the contractual forms used and propose a model to describe these relations. The model suggested is analyzed to establish the optimising conditions. The possibility of using other contracts to increase the economic benefit for milk producers, as well as dairy products producers and the supply chain are finally investigated.

The analytic hierarchy process as an evaluative tool for the strategic consolidation of capital base in the Nigerian banking industry

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Abstract

The reformation of the banking industry by the Central bank of Nigeria requiring banks to consolidate their capital base to N25 billion became an operational concern to various managers in the banking industry. It thus became a necessity for the corporate managers of banks to decide on the different alternatives available to them and consider different criteria in order to strategically consolidate. As the Central Bank of Nigeria gears up to enforce recapitalization by banks to a N50 billion level by the end of 2008, this paper employs the Analytic Hierarchy Process (AHP) as an evaluative tool for strategic reconsolidation of capital base by banks.

An analytical framework for monitoring and optimizing bank branch efficiency using data mining techniques

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Abstract

Financial institutions make use of a variety of delivery channels as a means to liaise and service customers. The primary channel utilized by financial institutions as a means to acquire new customers and increase market share is through its branch network. The branch network requires a major investment of capital and massive commitment of ongoing operating expenses and human resources. A branch that operates efficiently offers a multitude of positive possibilities in the form of high customer acquisition and profitability resulting in a favourable return on investment, consequently increasing the financial institution's competitive advantage in an ever increasing competitive market.

This paper reports on the development of an analytical framework that would assist bank executives in optimizing the network of branches. A combination of data mining techniques — Clustering Analysis and Decision Tree Induction — together with the decision support technique, Data Envelopment Analysis (DEA), was utilized to exploit financial and geo-demographic data. The framework was developed and tested in conjunction with one of the major South African banking groups and the outcome proved to be useful, not only for comparing different branches, but also to identify potential new branch units in the market environment.

Application of a multiobjective linear programming model to supply chain management

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Abstract

Traditionally, the departmentalization of an organization along the supply chain has resulted into a pursuit of departmental objective(s) independent of one another. Marketing, distribution/transportation planning, manufacturing, and the purchasing departments operate independently in most organizations, and this has, in turn, led to an aggregated increase in the cost of business activities.

In the face of today's competitive and global markets, as well as constant pressure to reduce the lead time between the placement of an order to replenish inventory through purchasing or producing and the receipt of products into inventory, researchers have shown that supply chain management is the key area to improve upon. In other words, the ultimate success of a firm depends on its managerial ability to synchronize, integrate and coordinate series of its interrelated business processes or intricate network of business activities.

Supply chain management is the panacea to enhance an organization's operational efficiency. This paper presents the application of a multi-objective linear programming model to the supply-chain management of Dunlop Nigeria Plc. (manufacturer of a range of vehicle tyres).

Applying military techniques used in threat evaluation & weapon assignment to resource allocation for emergency response: A literature survey

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Abstract

One of the challenges faced in emergency rescue planning is the allocation of rescue services to various emergency situations within an urban environment. This is a type of resource allocation problem. Another similar resource allocation problem is the weapon target allocation problem. This paper surveys the literature and discusses the general resource allocation problem, together with a mathematical formulation of the problem. A mathematical formulation of the weapon target assignment problem is also presented. The techniques that are used to solve these problems in practice are discussed and the similarities between these problems highlighted. Finally the application of such techniques for emergency rescue planning is discussed, highlighting possible future avenues of research.

Applying a systems analysis framework in a community context

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Abstract

This paper reports on the testing of the Systems Analysis Framework developed as part of a research project conducted by the CSIR and UCT to apply Systems Engineering (supplemented by other Systems Thinking methods) to the National Poverty Alleviation System (NPAS) in a community context. NPAS is a system that we have defined — a system that consists of all the different role players that make a difference to poverty (government, NGOs, CBOs, *etc.*). The aim was to explore whether viewing a particular community as a poverty alleviation “system” may highlight features of the functioning of the community in a way that enhances understanding and co-operation amongst role players and ultimately improves the effectiveness of all the individual efforts being made.

The Kensington community in Cape Town was selected due to their well-defined geographical boundaries, a long history of community activism and long-standing relationships with UCT. The community and other role players were engaged through a series of interviews, leading up to a workshop at which aspects of the framework was tested. From the perspective of outside facilitators coming into a community, the framework provided a very useful way to “fast-track” an interaction. A “fast tracked” approach is not necessarily always desirable, but given limited resources (in this particular project and in the SA developmental context in general) it certainly has its advantages. The fact that there was a constructive, group engagement with the community that led to a consensual view of the priority issue to be addressed and defined steps of a way forward, can therefore be measured as a positive outcome. The issue of the usefulness of the framework to the community in ultimately assisting them to identify and address their priority needs is a question which requires a much longer term interaction. This project has hopefully laid the foundations for such an interaction to be pursued.

Considerations for model output data analysis requirements

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Abstract

Many modellers consider a project finished when the developed model is running. Some modelers do a single simulation run and use this as a basis for making decisions with regards to the system under study. In fact, it can be proven that creation of the model is only a section of the work. These modelers make little effort in analyzing the simulation output data appropriately. When working with large Stochastic Discrete Step Simulation Models one must be especially aware of the post-run data-analysis requirements. This paper discusses Sasol's experience with its 'Coal Value Chain' simulation model. We shall discuss the different requirements of: data types; formats; analyses and result presentations in terms of Model Validation; Analysis of the System/Process and for Management Decision Making purposes.

Decision support for public policy making

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Abstract

This paper presents some results from an ongoing research project on establishing decision support tools for public policy making in South Africa. The main focus is on medium to long term planning issues implementing regional and national policies. The paper aims to present a methodological framework as well as to show the feasibility of the approach through applications to a specific problem encountered by the CSIR as part of a project completed for a South African government department.

Decision support for a wine cellar

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Abstract

The goal of the study is to lend decision support to management at a wine cellar in three areas of expertise, with Wamakersvallei Winery serving as a special case study. This decision support system is to be delivered in the form of Excel spreadsheet models. The three features of the decision support system are first to assist in the scheduling process of assigning grapes from the different suppliers to the different tipping bins by suggesting rapidly and in an automated fashion a possible schedule based on the information currently considered when making such decisions. The second is to assist the viticulturist in the sometimes difficult rescheduling decisions when the agreed upon amount of grapes cannot be delivered to the cellar due to unforeseen technical or operational problems. The third and last feature of the decision support system is to assist in solving a layout problem concerning the floor plan and pipelines for a cellar. This feature should be able to evaluate the current layout of a cellar and therefore also assist in the design of a floor plan for new facilities or the renovation of current facilities.

This paper will give a brief introduction to the South African wine industry and its supply chain, and then report on the progress of the study to date.

A decision support system to optimise the available resources at Kimberley Mines

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Abstract

Underground mining activity at the Kimberley diamond mines has become uneconomical. There are, however, multiple stockpiles of tailings, some dating back many years, which still contain a fair quantity of diamonds. The diamonds may be processed in multiple plants. Current scheduling is done on a spreadsheet. This paper reports on a new decision support system that has been developed to improve decision making in this multiple source and plant problem.

Developing a systems analysis framework for the national poverty alleviation system

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Abstract

The aim of a research project conducted by the CSIR and UCT was to apply methods normally used by scientists and engineers to better understand and evaluate the joint and separate efforts to alleviate poverty in South Africa. In particular, we wanted to apply Systems Engineering (supplemented by other Systems Thinking methods) to the National Poverty Alleviation System (NPAS), since it was apparent that the perceived inability of NPAS to meet its goals was systems-related. The envisaged outcomes were twofold: firstly, to establish a suitable framework for analysis, and secondly, to describe and analyse the system in such a way that stakeholders and decision-makers can engage towards a more effective Poverty Alleviation System.

We started by performing a Systems Engineering related analysis on the National system, and in the process learned more about the analysis methods as well as the problem domain. Before performing more thorough analyses, it was necessary to define our analysis methods more narrowly as well as the parts of the problem we wanted to investigate. We subsequently developed a Systems Analysis Framework to use in further work, and specified two case studies on which to apply this Framework. This paper discusses the development of the Systems Analysis Framework. During its preliminary use and evaluation, the Systems Engineering approach showed promise but we also realised that it would need to be modified and supplemented. SE provides a rigorous approach for designing and improving predominantly technical systems. We needed a flexible methodology to describe as well as design a system with technical, social and economical components. As part of a search for appropriate systems methodologies, the following approaches have been examined: the Unified Systems Hypothesis, Soft Systems Methodology (SSM) and the Multiple Perspectives Approach. The final framework incorporates elements of the Multiple Perspectives Approach and SSM.

The Digital Divide in numbers

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Abstract

“Digital Divide” is a *bon mot* that expresses the rather dramatic inequalities that have appeared — especially since the advent of wide-spread use of the Internet — in respect of access to information via electronic networks and the use of computer technology for a range of purposes. Technological innovation, like any other economic opportunity or disaster, has enormous potential for increasing inequalities of different sorts but especially income disparities. This holds both between and within societies. The talk considers the Digital Divide, first in terms of network economics (including the work of Economides, Madden, Cooper *e.a.*) and secondly in historical terms — referring to other technologies, including rail (*q.v.* Suomi). Mathematical models can gauge the network effect and an attempt will be made to draw conclusions for South Africa and for Africa from these models.

The effectiveness of operations management in the manufacturing industry

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Abstract

The fortunes and hopes of developing economies in as far as rapid growth and improvement in societal welfare and development are concerned, depend largely on the aggregate volume and quality of goods and services produced within the economy. To this extent, the production of goods and services may rightly be described as the soul and life wire of any economy. Hence, the higher the aggregate value of the goods and services produced and the effective usage of factors of production, the healthier the economy. In rendering the economy healthier through efficient production, operations management becomes very important, since operation deals with the production of goods and services that people buy and use everyday.

This paper examines the effectiveness of Operations Management with a particular reference to a pharmaceutical products company in the Nigerian economic sector.

The effects of free primary education in Kenya

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Abstract

It is three years after the the government of Kenya re-introduced free primary (elementary) education. There has been a massive response and it is said that more than one million school going children register at schools every year. This paper uses transitional matrices/stochastic matrices to forecast and estimate the number of children who will have completed primary education over a certain period of time. This will help the government measure performance and plan for secondary school education for the children.

Employment equity through system dynamics

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Abstract

The Employment Equity Act of South Africa requires an employer to analyse its policies, practices, procedures and environment to identify employment barriers and to develop a workforce profile determining whether groups are under-represented. They also must develop a plan that includes annual objectives, affirmative action measures, numerical goals for achieving equitable representation, an annual timetable and internal monitoring and evaluation procedures. This paper discusses how System Dynamics is used in the above analysis and planning at Sasol — one of the largest employers in South Africa.

Financial modelling in project finance — Facilitating the development of African infrastructures

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Abstract

It is widely recognised that Africa’s development is hindered by scarce infrastructure development (*e.g.* World Bank, African Development Bank, UK Commission for Africa, African Union, UN Economic Commission for Africa, *etc.*). After several years of dismal development, Africa seems set for a flurry of new initiatives mainly in energy. One such initiative that has gained increasing recognition in Africa in recent years is Project Finance and other variants such as Public Private Partnerships (PPPs). Project finance transactions bring together various stakeholders with their relevant financial, technical, operational and commercial expertise in order to design, build and operate an infrastructure (*e.g.* an oil pipeline, a road, a hospital, *etc.*). Under this framework, financial modelling plays a key role in the structuring of project finance transactions. The author reviews the main building blocks of financial modelling in project finance and the way in which key project risks are identified, controlled and quantified through the output of the model. The author assesses the major challenges in modelling a project finance transaction with special focus on the importance that a proper model of the transaction has for the successful assessment of the feasibility and “bankability” of the project.

A holistic application approach of capability indices

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Abstract

Process capability is used in engineering design, manufacturing science and quality assurance. It serves as an indicator of the overall capability of the overall manufacturing system. Capability analysis is used in the qualification of processes, acceptance of equipment, approval activities, problem solving activities and many other activities. Capability analysis is the backbone for measuring process ability to produce products that fall within a designed specification. It is also a yardstick for measuring quality improvements. The accuracy of capability indices depend on the proper understanding of the theory behind the indices as well as an understanding of variation. So many different process capability measuring techniques (indices) have been proposed and are being used in industry today. Each one gives a certain portion of the quality picture, leaving out some equally important details about the process. Not one capability index address the quality of a process holistically, and they all have their merits and demerits. The overall quality details of the belt manufacturing process have not yet been fully studied and ignorance of these details results in belts failing to meet quality requirements, resulting in very high costs in terms of reworks, lost confidence, cost opportunities in the market and increase in waste. The aims of this study is to develop and implement a procedure that holistically gives a quality picture of a manufacturing process. The objectives of the study is to come up with a procedure that economically gives a full quality picture of a process by designing an algorithm that combines different capability indices defining process capability holistically. The algorithm will be implemented on an existing belt manufacturing process. The strength and weakness of a process are only exposed by a complete quality study of that process even when it is producing products that meet the specification. The indices must all compliment each other in giving a holistic state of the process. The holistic approach showed that the construction process of the belts is incapable. Possible source of variations includes materials, humans, machines, methods, measurements and other factors.

Humanitarian logistics

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Abstract

The annual number of disasters world-wide has tripled in the last thirty years! Disasters can cause incredible suffering, loss of human lives, damage to infrastructure and economic loss within a very short period of time. Usually it occurs unexpectedly. Because the number of disasters seem to increase, it indicates that humanity needs to be better prepared to handle such situations. But what does better prepared entail? To be well prepared, have efficient early-warning systems in place, people well-equipped to manage disaster situations with models, software and techniques to assist them, surely must have an impact. What suggestions have been made with regards to this problem? Has there been any developments with regards to quantitative techniques and models? This paper gives an overview of research that has been done in the arena of humanitarian security and might form the platform for further research and studies in this area.

A hybrid approach for mathematical programming under randomness and fuzziness

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Abstract

This paper deals with situations where fuzziness and randomness are under one roof in a mathematical programming setting. An approach is described that combines cutting-plane and Monte Carlo simulation in a synergistic way. It consists of first handling fuzziness through alpha-level decomposition and then dealing with randomness through Monte Carlo simulation. A numerical example is included for the sake of illustration. The paper ends with some concluding remarks along with lines for further developments in the field of fuzzy stochastic optimization.

Impact of diversity management at the work place on the supply chain

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Abstract

The work place has always provided workers with different skills, coming from different backgrounds and of all races. Recently many organisations have been compelled to relook at the composition of their workforce and align it to government imperatives using either gender, race or otherwise as a barometer. In some organisations the process has been managed in staggered terms, while in others there were wholesale changes in the profile of the worker. This paper examines the concept of diversity at the work place, how it is managed, and the impact perturbations in the profile of the workforce (for what ever reason) has on the performance of the supply chain.

The importance of target classification for weapon assignment

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Abstract

A typical flight profile that may be encountered by ground base air defence systems may be a missile approaching at high altitude, before entering a terminal dive of 80° targeting the ground based radar installations. Experimental results show that a conventional rule based TEWA is ineffective in assigning such threats, without first classifying the target and its intended flight profile. Such a threat would conventionally be assigned to the SHORAD weapon systems during its approach, as the SHORAD is capable of engaging such targets at high altitude. The incoming threat, targeting the radars, enter a terminal dive into the “silent cone” of the radars and cannot be designated by the radars, making the SHORAD ineffective against the such a flight profile. It is therefore necessary to first identify and classify the threat and its intended flight profile and rather assign them to alternative fire units at an early stage of the engagement. This paper discusses the importance of identifying and classifying such targets and the impact of such classification on the weapon assignment.

Infrastructural facilities and Nigeria's economic growth — An operational research & econometric analytical approach

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Abstract

In this paper we consider the planning and management of infrastructural facilities in urban centers with specific interest in housing and road construction during period 1995–2005. We look at how operations research may assist the government in the provision of these facilities.

The study identifies certain variables such as government expenditure on selected infrastructural facilities and their contribution to overall Gross Domestic Product, which is the national income indicator. It has been observed that adequate infrastructural facilities is a vital ingredient to the economic growth of any economy, but the Nigerian economy is faced with the challenge of its inadequacy. Also, there are various benefits associated with the provision of infrastructural facilities, some of which increase living standards, increase the level of both local and foreign investments and increase the Gross Domestic Product.

Finally, recommendations were made on how to put an end to problems associated with lack of infrastructural facilities by increasing government expenditures on such facilities and facilitating private sector participation in the provision of infrastructural facilities.

Linear algebra and information retrieval

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Abstract

Two methods of information retrieval are considered. In large data sets, such as the World Wide Web, information is typically too disorganized and too large to consider all the information as it is. The data are represented as a vector space model and two methods for reducing the computation time for query matching are discussed. A so-called term-by-document matrix is first set up, in which documents in the data set and the potential search terms are identified beforehand as important specific to the data set. The reduced rank approach, which involved the Singular Value Decomposition (SVD) of a large matrix, is a very costly computation, but yields very effective search results. An alternative approach entails finding a Krylov subspace generated by the query and term-by-document matrix and projecting the query into the subspace — hence requiring no SVD calculations. The computation times and accuracy of the two methods are discussed and compared.

Location of a fueling station

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Abstract

Sasol had a Blue Pump agreement with other companies for many years. This agreement prevented Sasol from constructing their own fueling stations. When this agreement expired in January 2004, Sasol entered the market. In this presentation the best location for new fueling stations are considered. The problem of locating a single new fueling station is discussed. This problem was solved by means of a mathematical programming model. A case study considering a smaller area is presented. The difficult part is to estimate a weight for every transport zone in the Cape metropolitan area. This was modelled on a log-linear method by using a multiplicative model. Different factors affecting the location were identified. These factors (some quantitative and some binary) were used in the model to determine the weight of each zone. A coefficient is then determined for each factor. These coefficients indicate the importance of the factors in the location. The characteristics of current petrol fueling stations were used to estimate the best values for these coefficients.

Location of a nuclear power plant

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Abstract

South Africa's demand for electricity is growing rapidly. There is a crucial need for more energy sources. One of the options is nuclear power. Cape Town already hosts Africa's only nuclear power plant, which has been operating more or less successfully for more than 21 years. During the last ten years, Eskom has conducted a study and identified four suitable alternatives for the location of another nuclear power plant. All four alternatives are situated on the coast, because tons of seawater is used to cool the condensers. These alternatives also have a stable geology and an acceptable population density.

A multi-criteria decision model is presented to aid in the decision on a best location for a proposed new plant. The first step is to derive a set of criteria that impact on the location of a nuclear power plant. These criteria must then be given weights according to their importance. The next step involves information gathering and an analysis of each alternative for each criterion (criterion scores). This is not as straight forward as it may seem, because the problem consists of mixed (*i.e.* quantitative and ordinal) data. A random sampling approach is used to generate the weights and criterion scores that are consistent with the ordinal information. A linear additive utility function may then be adopted to calculate the performance of each alternative. A stochastic dominance approach is applied to determine a final ranking of the alternatives.

Measuring poverty and taking action

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Abstract

In this paper we present ongoing research aiming to introduce the use of multiple criteria decision analysis methodology in the area of indicators construction. More precisely our work concerns the problem of how to measure poverty with particular emphasis on the so-called under-developed countries (especially within the Africa continent). However, our approach is not how to establish a new statistic or a new descriptive model of poverty.

Our setting is problem situations where national or international institutions wish to pursue a policy of poverty reduction and on the one hand want to establish adequate policies for specific target population aiming to precise results (in order to be able to measure the efficiency of the policy), whilst on the other hand being able to establish for each citizen whether (s)he is eligible to access such poverty reduction policies. Our approach therefore is essentially operational and prescriptive.

Under such a perspective we consider the possibility of using multiple criteria decision analysis in order to construct classes of target populations to which associate precise policies and to assess citizens. The use of ordinal and conjoint measurement theory is considered as principal investigation direction.

A metaheuristic approach to the routing of patrolling security guards

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Abstract

The most essential and alluring characteristic of a security estate is the estate's ability to provide 24-hour security to its residents, of which the continual patrolling of roads and paths is vital. The objective of this paper is to address the lack of sufficient patrol route design procedures by presenting a Tabu Search algorithm capable of generating patrolling routes for an estate's security guards. The paper shows that the problem of designing these routes can be formulated as an Arc Routing Problem (ARP), but unlike most ARPs, the objective is not to minimize the total distance travelled; rather to traverse all the arcs as equally and as regularly as possible. The algorithm is illustrated with a real problem instance from an estate in Gauteng, South Africa. The problem instance consists of 64 road intersections (nodes) and 69 road segments. The results are compared with existing routes and schedules, and provide a significant improvement. Finally, the potential to implement an element of unpredictability in route schedules is discussed.

Minimizing the treatment time in Intensity Modulated Radiation Therapy

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Abstract

Radiation therapy has found widespread use in the treatment of malignant cancers and its use has continued to improve with technological advancements. The advent of multileaf collimators as beam shaping devices has allowed for quality treatment deliveries which can be implemented cheaply and faster than the traditional use of conformal blocks as beam shaping devices. However, treatment planning has become more complex, requiring sophisticated algorithms to aid in the treatment planning process. Integer programming models are presented and solved using polynomial time algorithms to find the minimum treatment time in Intensity Modulated Radiation Therapy so as to increase patient throughput in the treatment of cancer at Mpilo hospital in Zimbabwe. Different scenarios which ignore or take set-up times into consideration, are dealt with and results are compared with those of models developed by other researchers. The results suggest that an 18.18% reduction in treatment time can be achieved.

A modified Osman's simulated annealing and tabu search algorithm for the vehicle routing problem

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Abstract

The basic vehicle routing problem is concerned with finding a set of routes for a fleet of vehicles which have to service a specified number of retail outlets from a central depot. A vehicle is allowed a maximum of two trips a day. In our analysis a vehicle delivers and collects empty containers. For the empty containers to be collected on a specified route, the total volume should not exceed the vehicle capacity. Similarly, the total quantity demanded on that route should not exceed the vehicle capacity. Our objective is to design a set of least cost vehicle routes for a given set of customer requirements.

Monitoring the performance of local government via value functions

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Abstract

It is a function of the provincial sphere of government to monitor and support the functioning of local government (municipalities). Within the Western Cape there are 30 municipalities with varying degrees of capacity and widely differing circumstances (in terms of income generated, administrative capacity, leadership, stability, environmental conditions, *etc*). The oversight role of the provincial department responsible for monitoring the performance of the municipalities dictates that there should be relevant information, made available timeously to provincial management. The provincial management team needs to use this information to detect areas of poor performance so that appropriate support can be provided. Judgement needs to be exercised as to which measurable aspects of performance are indicative of (pending) poor performance, and the relative weight that these aspects should carry in categorising the overall performance of the municipality. A value function approach to structuring, measuring, evaluating and integrating measurable aspects of municipal performance was adopted. This model was developed at the same time that a rigorous process for ongoing data collection from municipalities was instituted by the provincial department, as an integral part of a monitoring and evaluation process for municipalities. It is suggested that the development of the value tree and value function model stimulated learning the complexities of municipal monitoring, and that this model will adapt and grow as relevant data begins to flow into the system from municipalities.

Multi-objective modelling for the electricity sector in Uganda

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Abstract

Multi-objective decision support (MODS) is a structured framework for evaluating decision alternatives against multiple, and often conflicting, criteria. Its ability to handle complex trade-offs in a variety of quantitative and qualitative units gives it much potential in the field of electricity planning. This paper uses multi-objective optimization techniques to structure and analyze the electricity sector in Uganda. Some of the critical criteria which come into play include electricity demand and supply levels, capital & operating costs, plant capacity & output, and Environmental costs.

Multi-objective optimization of water distribution systems using evolutionary heuristics

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Abstract

The problem of designing an ‘optimal’ water distribution system (WDS) is complicated by the difficulty of its own definition. Traditionally, researchers have focused primarily on finding least cost solutions — that is, a set of components which satisfy the system demand and pressure requirements — but it has become widely apparent in recent years that this is grossly inadequate for decision-making in water engineering. Real projects involve a trade-off between cost and robustness, bedevilled by a multitude of factors such as uncertain demand, water quality concerns, the need for additional capacity for future growth, and adequate flow of water for fire fighting. This suggests the need for a multiobjective approach. To add to the challenges, the WDS design optimization problem is NP hard and requires highly intensive computation to evaluate each potential solution.

Given these considerations it is easy to understand that traditional optimization techniques have failed to provide solutions to realistically sized problems. This has led to the growth in use of evolutionary heuristics, such as genetic algorithms and other nature-inspired meta-heuristics, which are robust and able to conduct a thorough search of the solution space despite its immense complexity. The problem of WDS optimization will be introduced in this talk, explaining how it may be solved in a multiobjective manner using evolutionary algorithms.

Multi-plant linear programming for the optimisation of the combination of two refineries

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Abstract

In 2003, a need was identified within Sasol to develop a linear program to capture the activities and interactions between its Secunda Refinery (which is not a conventional refinery) operations and Sasref (Natref) in Sasolburg, in which Sasol has a joint share together with Total SA. This presentation outlines the technical aspects of developing a linear program of this magnitude as well as the difficulties encountered (and overcome) and the resultant perceived benefits.

Non-compensatory preferences and value measurement

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Abstract

One of the fundamental axioms underlying the theory of value functions for multicriteria decision analysis is that of continuity of preferences. One of the criticisms raised particularly by the outranking schools concerning the value function approach is precisely this axiom. It is claimed that there are regions of such poor performance in regard to some criteria that no compensation by good performance elsewhere is possible. We examine this criticism from a value measurement perspective, and suggest two modifications to address the causes of seeming non-compensatory preferences. These modifications are inclusion of loss-avoidance criteria and the replacement of additive sums by a min-max approach.

A nonlinear optimization model for optimal order quantities with stochastic demand rate and price change

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Abstract

An inventory problem with stochastic demand rate in each time period of a planning horizon is considered. A model to compute optimal order quantity and delivery points in the planning period is presented. This model can also account for any anticipated price change that may occur from time to time. In addition, the model can be used to compute volume discounts in accordance to the size of the order. A stochastic global optimization algorithm is used to obtain the numerical results.

Optimal allocation of workers to tasks on a production line

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Abstract

In this presentation the problem of determining an optimal assignment of permanent and temporary workers is considered. All the workers can, with varying abilities, complete all of the tasks on a production line. A model is formulated to assist in an optimal assignment of workers considering the daily employment of temporary workers with skills varying from unskilled to skilled. Two models are presented, each having the same two objectives. The first objective is to maximise a production utility function. The second objective is to maximise the improvement in skill levels of the workers by taking into account the learning curves of workers as well as the fact that the workers forget how to perform certain tasks. Both a dynamic assembly line balancing modelling approach as well as a moving worker modules approach is presented and compared. Results are also discussed in terms of a real life case study in the shoe manufacturing environment.

An optimised recursive line of sight algorithm, for application in a system of systems air defence simulation

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Abstract

The generation of Line of Sight (LOS) information consumes significant resources in large scale simulations where spatial interactions between entities need to be modelled accurately. Due to the importance of optimum utilisation of computing resources, a number of LOS algorithms are reported in the literature to compute LOS information efficiently or reduce the impact of LOS queries on the run-time performance of simulations. The unique high accuracy and high performance requirements of a system of systems ground based air defence simulation combined with dynamic system positions and dynamic LOS queries however necessitate a specialised LOS algorithm. This paper briefly discusses some of the existing and recently developed LOS algorithms and techniques. The new optimised recursive LOS algorithm is then discussed and shown to have a performance advantage above existing algorithms due its recursive nature and lowered computational time complexity.

Optimizing a stand-alone photovoltaic power system

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Abstract

The uncontrollable variations in solar energy make the energy output of the sun a random variable. Designing a photovoltaic power system for a particular load requires knowledge of the random variations in energy profile. A method to simulate the behaviour of an autonomous photovoltaic power system consisting of solar cell modules, charge controller, storage battery and load is described here.

OR in West Africa — An investigation into published literature

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Abstract

This is a detective story. The aim of the paper is to investigate the range and content of the literature of Operational Research relating to the developing countries of West Africa. Like all detective stories, the investigation moves from the obvious areas of search to the obscure. The evidence that is found needs to be classified and described, and this paper shows how it can be done. With such knowledge, further research can proceed, using the experiences of success and lessons of difficulties from the past.

Finally, as happens in detective stories, what is not found may be as important as what is found. So the paper draws attention to areas where there does not appear to be significant existing work.

The resulting bibliography of over 200 items is “work in progress.”

P-median processing centre locations for mobile clinic donations in the South African National Blood Service

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Abstract

Blood transfusion services perform three main logistical functions: the collection, processing, and issuing of blood products for use in patients. Every unit of blood donated at fixed or mobile clinic sites is transported to a blood processing centre. Several blood components decay within hours of donation. The sooner the blood is processed after donation, the better. The travel time from a collection point to a processing centre therefore affects the blood product supply and quality.

The chief operating officer of the South African National Blood Service (SANBS) is considering reducing the number of processing centres to establish hubs of excellence. In this paper decision support is provided to the SANBS with respect to these strategic location decisions.

The mathematical treatment of the problem takes the form of a p -median problem, an integer programming formulation of the network location problem to locate p processing centres amongst a number of supply nodes, constituting the candidate locations, so that the total (or average) travel distance for blood unit collection is minimised. Mobile clinic site data is aggregated into deterministic input to the mathematical model, which is solved by using a branch-and-bound algorithm in LINGO.

Pat Rivett — British OR pioneer

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Abstract

Pat Rivett, who died in July 2005, was a key figure in the development of OR in Britain and, to a lesser extent, South Africa. He built up what became the largest OR group in the UK, at the National Coal Board, and later was the founding professor of the first University Department of OR in the UK, at Lancaster. As the first secretary of the Operational Research Society he created a Society with his imprint. After visiting the States in the 50s, he recognised the importance of the international dimension, and played a leading role in the first International Conference in Operational Research, which led to the creation of the International Federation of Operational Research Societies. By using his outstanding communication skills he was able to persuade private and public sector bodies to apply OR. The distinctive nature of OR in Britain, with an emphasis on application and a society with a majority of practitioner members, is perhaps his greatest legacy.

The practical implementation of stochastic multicriteria acceptability analysis

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Abstract

Stochastic multicriteria acceptability analysis (SMAA) is a family of “low preference information” MCDA techniques that inform decision makers about the types of preferences that would lead to the selection of an alternative without demanding that any preference information is directly expressed. Evidence from simulation studies suggests that SMAA might be normatively and descriptively useful, but objections have been raised that since the techniques do not help in preference elicitation they are not “proper” decision aid. Both sides of this debate are examined and work toward a possible resolution is outlined.

Prevention and medication of HIV/AIDS — The case of Botswana

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Abstract

In this paper we developed a mathematical model which allows estimating and projecting the effects of prevention and treatment programs on the total population size, HIV-induced deaths, and life expectancies. Considering only the female population we project the changes of the demographic developments and the situation of HIV/AIDS for Botswana up to 2060. Our mathematical model is used to project the female population development considering their age-structure. Treatment programs are included through selecting a price for medication (or giving it for free). Prevention programs consist of two parts: school/based programs which try to change risky behavior and instantaneous prevention (*e.g.* free condoms) which has only a short-time effect on the infection risk. The main conclusions drawn from our results are that prevention-only programs always yield the fastest decrease in HIV/AIDS prevalence. Adding a medication program reduces the efficiency of the prevention interventions regarding prevalence, but it reduces the number of HIV/induced deaths and increases life expectancies.

Probability of attack of a fixed wing aircraft in a ground based air defence environment

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Abstract

In a Ground Based Air Defence (GBADS) environment, the threat posed by fixed wing enemy aircraft relative to protected assets is assessed by a decision support system known as a Threat Evaluation (TE) system. By considering pertinent attributes of a typical attack, which requires an aircraft to fly a suitable attack technique in order to effectively deliver a weapon, the aircraft are ranked according to threatening behaviour. The classification and identification of these attack attributes contribute significantly to the accuracy of a TE system.

Such a system may comprise of a number of subsystems which provide alternative means to measure threat, should the available information play to their particular strengths. The TE system in this project comprises a suite of flagging models, conventional models and probabilistic models (see the abstracts on pp. 70 & 79).

The probabilistic model comprises a number of components which may be calculated pre-deployment or real-time. Estimation of the principal real-time component, namely the probability of attack (the probability of an observed aircraft attacking a protected asset), is the primary concern of this talk. To this end, observed aircraft kinematics are used to determine future flight envelopes as well as establishing aircraft membership to attack attribute classes.

Additionally, calculations which are performed pre-deployment (analyzing relevant historic aircraft data) and for simulation purposes (aircraft profile generation), will also be discussed.

Production scheduling in a plastics printing company

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Abstract

The scheduling of different printing jobs on a number of different printing machines is considered in this presentation. Printing jobs are specified according to six different characteristics. The setup time between two jobs on the same machine depends on four different factors and the durations of the jobs are determined by three different factors. The problem may be modelled using integer programming. Even for very small instances of this problem the formulation becomes too large to solve in a realistic time. Therefore a heuristic approach is presented in which the problem is repeatedly solved in two parts. The first part assigns jobs to machines and the second part schedules these jobs on the machines. The solution of the first part is thus used to solve the second part. The solution to the second part is then used to refine the formulation of the first part. The first part is then resolved and the new solution used to resolve the second part. This process is repeated until the work is balanced over all the machines.

Real-time weapon assignment in a ground based air defense environment

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Abstract

In a military environment, enemy aircraft may pose a threat to friendly assets and available weapon systems (WSs) in the immediate tactical environment may be used to neutralize these threats. An operator in the Ground Based Air Defence System (GBADS) environment is responsible for optimally allocating the available WSs to engage enemy aircraft in a limited space of time. This allocation problem may become rather complex as the number of WSs and the number of enemy aircraft increase, and is almost impossible for a human to solve (even approximately) without computational aid.

A Threat Evaluation and Weapon Assignment (TEWA) system is a decision support system for the GBADS environment that estimates the threats posed by each enemy aircraft with respect to each asset and then proposes weapon-target pairs to the operator, based in these threats. The WA system uses the TE subsystem output, WS capabilities, flight path prediction models, *etc.* as input to provide the operator with a means to exercise tactical control of WSs in order to fulfil defence engagement operations within an area of responsibility.

This talk follows on the talk of Jaco Roux and Jan van Vuuren (see abstract on p. 79). We present a simple WA system that operates in the GBADS environment. Some subsystems and their workings are also presented, including the WA framework where the WA models reside. The WA problem is a well-known and well documented problem, not just in the military domain. It may be formulated as a non-linear integer programming problem and has been proven to be NP-complete. In this talk the solution space to the WA problem is divided into rules-based and computational based models and will be discussed in some detail.

Repeat-sales modelling for predicting house prices and constructing a housing index

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Abstract

Automated Valuation Modelling (AVM) for predicting property prices has been adopted at some of South Africa's major banks in order to speed up the home loans granting process and save on costs, since it avoids the need for the physical valuation of properties. While a number of modelling approaches are available for predicting property prices, the repeat-sales model lies at the heart of the AVM system developed by the authors. This model also has the advantage that, in addition to the prediction of property prices, it can be used to construct a housing index. The paper will describe the repeat-sales model and show how it can be used for house-price prediction and to construct a housing index. Some of the issues around the construction of housing indices will be discussed, contrasting the index derived from the repeat-sales model with those traditionally used by the major banks.

Robustness analysis based on weight restrictions in data envelopment analysis

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Abstract

Data Envelopment Analysis (DEA) allows total weight flexibility in the selection of input and output weights in order for the Decision Making Unit (DMU) under evaluation to achieve maximum efficiency. One of the drawbacks of this methodology is that DEA can rate a DMU as efficient based on an evaluation over a subset of the inputs and/or outputs only. This imposes the need to incorporate weight restrictions. There are many methods for determining bounds on the weights, but they can be very subjective and preference information for restricting the weights is not always available. We will introduce a new approach which is designed to test the strength and reliability of a DMU's efficiency standing and does not require the use of preference information.

Rural road maintenance in Madagascar

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Abstract

The paper presents a project concerning the assessment of rural road maintenance projects in Madagascar. The problem situation is discussed and a problem formulation has been chosen in order to:

- focus on the service level provided by the maintenance project;
- enhance participation of the local communities in the funding.

An evaluation model based on ordinal measurement is presented and its application to a pilot area study in the Greater Antananarivo Area is discussed.

Scorecard development with Model Builder for Predictive Analytics

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Abstract

There are a number of software packages that have the capabilities to build predictive models. These packages differ vastly in terms of cost, technique, ease of use, the ability to deliver executables and scalability. PIC Solutions evaluated and compared a number of these software packages and ultimately one package stood out above the rest and met all our model building criteria. This product is called Model Builder for Predictive Analytics (MB4PA) and contains an additional scorecard model for development of predictive models using Goal Programming.

Developing predictive models is a challenging process, as it is full of tedious manual tasks besides the growing pressures to meet business objectives and regulatory requirements. MB4PA software reduces the manual process substantially which leads to increased productivity allowing extra time to run through more options ensuring the best predictive model is produced for the client.

A complete set of industry leading modelling technologies are available through MB4PA and address many of the obstacles faced by scorecard developers. Some of the technologies that MB4PA provide are logistic regression, linear regression, neural networks and goal programming. PIC Solutions uses goal programming as the standard scoring solution.

PIC Solutions invested in MB4PA for various other reasons as well, some of the reasons are: iterative parceling inference process, centralized classing system, better model validation capabilities and the ability make changes to the proposed model during meetings.

MB4PA has proven to be industry leading modeling software. It has brought a great deal of efficiency and automation to the development of predictive models within PIC Solutions. Sophisticated technology, enhanced reject inference methods as well as the weights engineering meetings, are only a few advantages mentioned.

Shared resource scheduling where some conflict between the users may be tolerated

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Abstract

Scheduling problems typically do not allow any conflicts or clashes. However, in certain applications, some level of conflict may be tolerated. For example, in a scheduling problem where users of a computer system are in conflict if they require access to one or more of the same data files. Users may find the slowdown incurred for retrieval of data together with, say 5, other users on the system acceptable, but with more than 5 other users unacceptable. In this talk a few scheduling algorithms are presented for situations where some conflict between different users of a shared resource may be tolerated.

A simulation-based evaluation of a fully fledged threat evaluation & weapon assignment system in a ground based air defense environment

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Abstract

Testing and evaluation of a Threat Evaluation and Weapon Assignment (TEWA) system is imperative in order to demonstrate workability of the TEWA system as a whole as well as sub-components thereof. In this paper a framework for the discrete event simulation of a fully fledged TEWA system is presented with the aim of evaluating various TEWA sub-components for different scenarios (asset deployments). This process is two-fold in the sense that threat evaluation sub-components need to monitor and assign a value of threat to all hostile airborne targets with respect to protected assets by means of rule based, deterministic and probabilistic models, and then weapon assignment sub-components need to utilize available weapon systems in a manner so as to best defend the most important assets. Evaluation of these sub-components using discrete event simulation therefore involves the generation of attack profiles and the investigation of the effectiveness of ground based defenses against these airborne threats using TEWA models developed to date. Monte-carlo simulation will then be used to evaluate the performance of the system by measures such as asset preservation and resource utilisation efficiency.

Simulation of the Sasol coal value chain in Secunda

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Abstract

The coal supply from Sasol Mining to Sasol Synfuels in Secunda has a high variation of coal properties, especially the particle size distribution. As a result of this variation in properties of coal supplied to the Sasol Synfuels gasifiers, the pure gas production is not sustainable over the long term. An integrated set of tools was developed to facilitate optimisation of the 'Coal Value Chain'. The focus was on ensuring sustainability of pure gas volume produced by the gasifiers through optimising the supply of available coal qualities. An Arena simulation model of the coal supply operations and its interaction with the Sasol Synfuels coal processing operation forms part of these tools. Operational changes were introduced since the simulation model was built and the changes were made to the existing simulation model to reflect this. Changes were also introduced to the model to reflect the current operations more accurately. These changes and challenges will be discussed in this paper.

Solution methodologies for the classical assignment problem

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Abstract

The classical assignment problem first appeared in the literature in the landmark 1952 paper by Votaw and Orden. A comparison of the efficiencies of a number of exact and heuristic solution procedures for this assignment problem are presented in this paper.

Spaza shop modelling

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Abstract

One of the South African government priorities is to improve the lives of disadvantaged communities. There are a number of partnerships involving non-governmental organizations (NGO), seeking to implement community-based programs aimed at empowerment or poverty alleviation. Such programs involve interfacing with the concerned communities in order to establish what the actual problems underlying those communities are, and the formulation of strategies for sustainable solutions. These processes require *inter alia* a number of decision-aiding tools and systematic methodologies to capture and to analyze stakeholder views. This paper discusses the modelling of supply chains for the Spaza shop system in the Western Cape. The modelling process involves both soft and hard OR techniques. Soft methods, including SODA and SSM, were chosen because of their suitability to understanding the problems faced by spaza shop owners. The use of SODA made it possible to identify and to structure the multiple conflicting aspects of the spaza shops business context. SSM facilitated conceptualization through a model based on rich pictures and root definitions for relevant worldviews. The softer modelling approach is complemented by more conventional computer simulations for investigating strategies for shop owners and NGO support agencies in terms of a variety of performance measurement indicators.

A stochastic programming approach to managing liquid asset portfolios

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Abstract

Liquid assets, such as government bonds, bills, debentures and gold, that are included in liquid asset portfolios are interest rate sensitive, low (credit) risk financial instruments and inherently low return instruments. Maintaining liquid asset portfolios involves a high carry cost and are mandatory by law for most financial institutions. Taking this into account a financial institution's aim is to manage a liquid asset portfolio in an "optimal" way, so that it keeps the minimum allowed liquid assets to comply with regulations, whilst maximizing the portfolio return to cover at least the carry cost.

In recent years stochastic programming has been applied to a wide range of portfolio management problems similar to ours. We developed a multi-stage dynamic stochastic programming model for liquid asset portfolio management. The model allows for portfolio rebalancing decisions over a multi-period horizon, as well as for flexible risk management decisions, such as reinvesting coupons, in intermediate time steps. Proportional transaction costs are also included for purchases and sales of financial instruments.

One of the most important steps in the multi-staged stochastic programming approach is modelling the uncertainty in the evolution of risk factors over time. We model the uncertainty in terms of scenario trees that closely approximate the empirical distributions implied by market data. By using moment matching techniques we construct scenario trees with discrete yield curve outcomes sufficient for the pricing of liquid assets.

In our talk we discuss our formulation and implementation of a multi-stage dynamic stochastic programming model for liquid asset portfolio management that minimizes down-side risk. We also present some preliminary results.

Strip packing and bin packing – Part I

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Abstract

Two dimensional packing problems involve an orthogonal allocation of items, without overlapping, into a well defined region through utilization of minimum resources. These problems may be classified into bin packing and strip packing problems, where the former involves packing items into a minimum number of fixed sized bins, while the latter involves packing items into an open ended bin to minimize the total packing height.

Some new heuristics for strip packing are introduced and tested against known algorithms from the literature.

Strip packing and bin packing – Part II

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Abstract

There are various strategies for bin packing, including heuristics, exact methods, column generation techniques and meta-heuristics. In this talk the two-phase approach will be considered. In two-phase bin packing, items are first packed into a strip forming horizontal levels, which are then relocated to bins.

There exists a variant of bin packing referred to as multiple variable-sized bin packing, where the sizes of bins may vary. The results of an investigation into the feasibility of using two-phase algorithms for variable-sized bins are presented.

A survey of internal service delivery systems in a commercial bank in Kenya

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Abstract

This paper examines several internal delivery systems and their impact on the internal customer. While there exists a variety of systems that are relevant to contract employees during service encounters, this study investigates the gap between expected and actual quality and tries to establish whether there are deliberate systems put in place to support the internal customer in discharging quality services to the external customer.

The SERVQUAL model was adapted to measure the gap in the perceived quality for the internal customer in a large commercial bank in Kenya. The study made use of primary data. The results indicate that, the bank has employed various systems to support the internal customer. However, there are gaps between the expected quality and the rendered quality which the bank needs to address. Implementation of service quality has a number of challenges, which also came out strongly in the report. The major challenges experienced are those touching on change management, organizational factors, people motivation, standardization of procedures and conflict resolution.

This study provides useful insights and guidance for managers to measure and improve internal customer service quality.

A systems approach to indicators of poverty reduction

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Abstract

Complex problems such as poverty, crime or the spread of disease often occur as the result of a number of different interactions. When we intervene in order to improve the situation, we measure our progress against indicators that report on how we have reduced the outcome of the problem (impact indicators). The interactions that give rise to the problem on the one hand increases the complexity of resolving the problem, but on the other hand provides the opportunity to measure and report on the inherent capacity or fitness of the system to continuously resolve the problem. In a number of different fields, management scientists are continuously seeking to improve the organisational interactions that influence the capacity of a given system to perform. They recognise that the problem can be defined as a system, and unlock value by treating it as a system and measuring appropriate systemic elements in order to improve performance. Examples include optimisation of supply chains, organisations, manufacturing and distribution systems and industries as a whole. These approaches have over time enabled them to identify various elements that optimise both the performance of elements within the system and of the system as a whole. This paper explores approaches to the measurement of the inherent capacity of a system to perform. It uses poverty reduction as an example, and develops concepts aimed at shifting the focus from measuring outcome indicators to measuring elements that can sustainably impact the performance of a system over time.

Threat evaluation & weapon assignment decision support

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Abstract

In a military environment an operator is typically required to evaluate the tactical situation in real-time and protect defended assets against enemy threats by assigning available weapon systems to engage enemy craft. Since this environment requires rapid operational planning and decision making under severe stress conditions, the associated responsibilities are usually divided between a number of operators and computerized decision support systems that aid these operators during decision making processes. The aim in this talk is to suggest a framework for threat evaluation and weapon assignment decision support within the context of a ground based air defence system (GBADS). However, much of the contents of the talk may be generalized in an obvious manner to military environments other than a GBADS one.

The Tom Rozwadowski award — An analysis

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Abstract

The Tom Rozwadowski award is the annual award of ORSSA for the best paper published in a specific year. The award has been presented since the early seventies. This paper will endeavour to give an in depth analysis of the award over the years with the aim of showing what OR work has been recognised, from which organisations, by which Operations Researchers, on what topics and what techniques were used in the various papers. The aim is to give a view of OR in South Africa over the last thirty or forty years.

A two-tier solver for sequential ordering problems

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Abstract

The sequential ordering problem is concerned with the arrangement of a number of elements in a sequence that respects a set of precedence constraints and results in the lowest overall cost. Instances of this problem are regularly found in problems such as the routing of a delivery vehicle, the scheduling of jobs on a machine and the preparation of project plans with limited resources. The sequential ordering problem is known to be complex in the sense that as the size of problem instance increases, the best-known time required to find a guaranteed optimal solution increases exponentially.

We propose a new method that attempts to generate an optimal or near optimal solution to instances of the sequential ordering problem within a practically acceptable time period. The method operates by using two interdependent tiers. The first, a so-called population-based tier, maintains knowledge about the solution space through a diverse set of candidate solutions while exploring the solution space. We use genetic algorithms and particle swarm optimisation as population based methods for this tier. The second, a so-called local optimisation tier, performs an exploitative function by optimising the solutions identified in the population-based tier through greedy neighbourhood search methods.

The research objective was to separate the exploitative and exploratory behaviour into the two tiers and to determine whether or not a two-tiered solver could achieve better performance than the two tiers do on their own. The method was implemented and tested on ten benchmark problems that are available from the Travelling Salesperson Library. These problems have sizes of 14 to 100 nodes. We show that some configurations of the two-tiered method consistently performed better than the individual tiers do on their own, but others failed to yield such improvements. In at least one case (TSPLIB case `ft53.1`) the upper bound was improved.

The use of problem structuring methods to unpack current management issues of a selected NGO (SHAWCO)

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Abstract

Some of the major concern around poverty alleviation in South Africa is that of lack of capacity building as well as lack of co-ordination amongst a multitude of anti-poverty role players, which may result in a waste of limited resources. Furthermore, inefficiency in the management and improper administration of poverty alleviation projects by anti-poverty role players will further aggravate the situation. The United Nations has stressed the need for improved capacity building in various anti-poverty agencies in developing countries.

Poverty is a societal problem existing in a social environment composed of people who are complex interacting entities. Societal problems as well as organizational issues such as vulnerability to being poor, management inefficiency and lack of productivity or social improvement exist within the social context. If these issues are adequately understood and analyzed, it might assist in providing solutions to these problems as well as enacting effective poverty alleviation policy and resourceful program implementations.

The Problem Structuring Method (PSM) has been identified as a collection of tools that assist decision makers in solving complex societal problems, and seek to alleviate or improve situations characterized by uncertainty, conflict and complexity. This research aims to contribute to the understanding of poverty alleviation in South Africa by using PSM to unpack management issues and assist a selected health and welfare Non Governmental Organization (NGO) to function more effectively. The study explores issues around the current management structure of the NGO (SHAWCO) by using the knowledge and wisdom of the people within the system to create a better understanding of the organizational structure, and identify inefficiencies and gaps within the system. Strategic Options Development and Analysis (SODA) was utilized to provide the management team of the organisation with a model that created a forum for negotiation, working with individuality and subjectivity as the basis for problem definition and creativity. Drawing on this experience, general comments on the potential benefits of applying PSM for future research and development in poverty alleviation were suggested.

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