OR NEWSLETTER

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GUEST EDITORIAL
OR Contributions to Forestry — A University of Canterbury Perspective

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This largely autobiographical note provides an historical account of some of my teaching and research involvement with operations research at the School of Forestry, University of Canterbury over the last 26 years. It has eventuated for two main reasons: (1) a request from Hans Daellenbach some time ago for a personal view on the practical impact of OR on forest management in New Zealand; and (2) Prof. David Ryan's Area Profile: Operations Research in the August 1996 Newsletter. It is a dreadful admission I have to make that it took an apparent lacuna in that account's historical overview to spur me into writing this.

Professor Ryan's historical profile states: The Forest Research Institute and more recently [my emphasis] Auckland and Canterbury Universities have been involved in the development of Operations Research models covering most areas of forestry from harvest planning to logging operations to timber milling.

With all due respect to his sources of information, the University of Canterbury, thanks to collaboration of its OR staff and students with those in the School of Forestry, was involved in OR research well before the FRI. Why do I know this? Because up to the end of 1969, I was a research scientist at FRI before moving to the University of Canterbury and I am unaware there was any OR done at FRI by the time I left, except for a few hesitant steps by myself that came to nothing really. The School of Forestry opened its doors in 1970 and later that year I attended an OR short course run by Hans Daellenbach and John George. Hans and John introduced the participants, who included two forest industry people as well as myself, to OR techniques and not a few applications of a forestry nature. I was enthralled by OR's relevance to forestry problems, and vowed to include a major section on OR in my teaching right from the very first forestry student intake. What struck me most significantly about what Hans offered, however, was not just the power of mathematical modelling, but the need for a systems approach to problem solving. If the application of

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Send submissions (in electronic Word or WordPerfect form, with minimum formatting) to the editor.

optimisation techniques was not embraced enthusiastically by all forestry students, then at least they could not avoid being imbued if not indoctrinated in the need for systems analysis by the time they graduated and were released into the workforce.

Thus, more emphasis in teaching at the School of Forestry has been given to holistic approaches to problem solving than to the nature of various individual modelling techniques per se. Borrowing from Fred Baird the analogy of the golfer, its a question of knowing when to use the right club in the right place. In the early seventies, the OR staff at Canterbury provided special teaching inputs of OR theory to underpin my teaching of applications, but gradually over the years, the taking of special basic OR courses available to students of all faculties was made compulsory for first or second year undergraduate forestry students in preparation for substantial inputs on applications during years 3 and 4. To answer partly the question posed by Hans, then, Canterbury forestry graduates have taken away the concept of systems and knowledge of the potential to use OR in the forest sector, and I believe that philosophy has been much more valuable than detailed knowledge of individual modelling techniques. That is not to say that modelling was ignored, as will be seen later.

The first example of undergraduate forestry student applications of OR occurred in 1973, when one of thatyears class devised an optimal solution to scheduling reforestation of harvested areas using LPGOGO (an educational Fortran LP code in H. Daellenbach and E. Bell: User's Guide to LP) for a management case study . There was a real limitation on the size of model he was able to apply. Thus the following year, another undergraduate familiarised himself with the ALPS package on the Burroughs and, with the help of Dr Bill Davis of the Computer Centre, produced a harvest scheduling LP model for his undergraduate dissertation. The NZ forest industry was at that time using desk calculator simulation to plan its wood supply from individual forests or within regions, while FRI was still obsessed with stand rather than forest level analyses, and so not in need of harvest scheduling models concerned with resource allocation. In fact, the first LP applied to wood supply scheduling in the NZ forest industry, called C-Plan, was actually devised by John Hammons, a Kaingaroa forester, not a FRI researcher, and was implemented for a few years in the late seventies and early eighties by one of our graduates, Peter Hill.

FRI researchers in the late seventies were investigating the single stem bucking problem using DP, and developed two systems called MARVL and AVIS, the first of which was applied to PROD for single stands. Their stand level analysis consisted of accumulating volumes of open-market log types, thus precluding consideration of forest level allocations. Oscar Garcia, with his IFS (Interactive Forest Simulator) in 1981 and FOLPI (Forest Oriented linear Programming Interpreter) in 1984, did provide later for a forest and regional level harvest planning capability.

If we return to 1975 at the University of Canterbury, a major opportunity to utilise OR methodology arose when I was asked to develop systems for management planning and control of pine plantations in Fiji. It should be remembered that forest research done by FRI up until 1987 did not cost the NZ forest industry real money, which left university researchers starved of funding from the industry for research on industrial practical problems. Why pay us to do research when FRI provided such support free? The Fiji project started off with my devising the outline of an integrated system for data collection, information processing and retrieval, production forecasting, other forms of modelling, planning and control. From 1975 to 1986, three or more students a year from Canterbury spent their long vacations in Fiji training local staff in successive additions to individual parts of that whole system, and conducted research that included much monitoring of the accuracy of the then existing modelling constituents, together with success in operating the system as a whole. Hans, who has continued to stress over the years the need to consider successful implementation methods, can take heart from the emphasis given to the importance of monitoring and control functions in this planning, and the special realisation it has conferred on the 40 or so students who were involved in projects in Fiji .

By 1979 School of Forestry students, Fijian staff and I had gathered sufficient data and checked equation components sufficiently to develop a linear programming model for scheduling harvests. Kees de Kluyver and I joined forces to offer a case study for a graduate OR class, which included such names well known in OR circles in New Zealand as Fred Baird, Michael Boon, John Buchanan, Gary Eng, John Griffin, Tom Moore, and others. The results of our case study were published in the NZOR journal (de Kluyver et al., 1980). As a direct outcome of this most enjoyable class, Gary Eng undertook thesis research towards an M.Sc. in tree bucking which included consideration of the multiple as well as the single stem problem (Eng, 1982; Eng and Whyte, 1982; Eng and Daellenbach, 1985, and Eng et al., 1986). Gary was later seconded from DSIR in the mid-1980s to provide OR support (largely in system design) for FRI's Conversion Planning Task Force, as apparently that skill was then lacking at FRI. Fred Baird transferred the topic for his PhD research into modelling the NZ forest sector (Whyte et al. 1981; Baird, 1982; Whyte and Baird, 1983, and Baird and Whyte, 1987). In late 1984, of course, Fred transferred his allegiance to fisheries, but

Hans and I still hold copies of the first 6 chapters of his thesis draft and there is still an opportunity for him to complete his degree as an even more mature student this time! Nick Winter teamed up with John George and successfully completed a M.Sc. thesis in 1983 on modelling resource allocations for the Canterbury region, while Trevor Eton and John George looked at forest planning on the West Coast. Grant Read, Don McNickle and Bruce Lamar have also been associated with forestry research projects.

Hans, Kees and I had a paper published in 1981 on the combined use of MODP and MOLP to rationalise harvest scheduling of a mix of log products. One of the major difficulties with this, with Fred Baird's sector modelling, with Lance Broad's MILP to utilisation planning, with the regional analysis of Steve Johnson (1989) [see Johnson & Whyte, 1990 and 1992], and with Gary Eng's decomposition approach to log bucking, was a consequence of the limited capabilities of computer hardware at the time. Computers of today, of course, allow us to solve such problems with comparative ease and offer the added dimension of spreadsheet formulations on which industrial managers increasingly rely and with which they are sympathetic, thus making it easier for OR practitioners to explain the intent and mechanics of optimisation. Examples of this spreadsheet approach are to be found in PhD theses by Villanueva (1992) on integrated yield forecasting and harvest scheduling, Sicad (1993) on plywood modelling for log supply, log peeling, veneer laying up and product marketing, Ogweno (1995) on hierarchical modelling and integration of tactical and operational harvest scheduling, and multiple objective planning of plantation development by Aruan (1996). There have also been masters theses, too numerous to list here, with a major OR emphasis.

One of the spin-offs for a university research supervisor is the availability of data collected by students andsupporting agencies in the industry which can be used in ways other than to meet just students needs for their thesis research. I have been fortunate in acquiring large data sets in this way; they are, moreover, relatively clean, because of inbuilt checking procedures I incorporated in the data collection components and my insistence that research students always get to grips with data validation of their information source. I am most grateful to many students and staff of other organisations for these collections of valuable data. They have led to research publications not only in the field of applied OR (included here in the Bibliography), but in various other areas of forestry, such as design and assessment of mensuration and inventory systems, analysing responses to silvicultural practices like amelioration of sites at time of establishment, fertilisation, thinning and pruning, harvesting, and manufacturing, marketing and distribution of forest products (but not listed here). The examples with a core of OR modelling in them listed in the bibliography below do not represent a complete set, but should be sufficient for illustrative purposes.

But really, publications in all my fields of research have been strongly influenced by the total systems approach that Hans instilled me with all those years ago, and so it is hard to decide where to draw the line on what is and is not OR. The breadth of my research interests that OR led me into, also made it logical to extend my interests into forest sector modelling and in trying to convince senior forestry professionals, politicians and the public that there have been well-established multiple objective modelling capabilities for 30 years to cope with true forms of multiple use forestry (e.g. Whyte & Daellenbach, 1987: Whyte, 1995; Whyte, 1996a and b). The view widely held by politicians and the public, mainly as a result of misleading campaigns by the environmental lobby and also the predilection of forest planners in New Zealand to use predominant rather than true multiple use techniques as the means of representing participatory involvement in land use decisions, namely that indigenous forest is for preservation and plantations are for commercial wood harvesting, is far too simplistic and patently wrong. Consider, for example, the stupidity of the 1987 separation of NZ forests in this way, and the hugely escalating damage in native forests brought about by largely uncontrolled increases in possum numbers as a consequence of the ideology that native forests can look after themselves using ecological purity as the only active mechanism. Again, the obsession of a few organisations with the 1991 NZ Forest Accord, when its too narrow focus has been superseded by the broader considerations of the Resource Management Act of 1991, by the outputs of principle from the 1992 Rio Summit and by the 1995 Montreal Process of monitoring standards for environmental performance to which our government is a signatory, needs comprehensive review. More recently, we have read about arguments over the sale of cutting rights for the Bay of Plenty plantation forests, which actually serve many more purposes than just wood production - to give but one example, there have been more visitors and recreational users over any given period to one 5 000 ha plantation in this sale, namely Whakarewarewa, than to all the 6.2 million ha of native forest throughout New Zealand. What is the point in arguing whether the selling price was fair or not, when you use inappropriate valuation methodology? If only we could open the eyes of the politicians, various lobbyists, the media and the general public to a holistic systems approach to problem solving, our physical and other resources would be far less endangered. So Hans and all of us OR practitioners should still have a

mission, a challenge and a market out there to open peoples eyes to the need for a holistic set of practical realities, together with a recognition of the further need to compromise and effect trade-offs when making decisions. Given the confrontational approach prevalent throughout our society, this may be a tall order, despite our choice of MMP as the form of elected government.

In conclusion, I hope that Newsletter readers will agree that OR is being employed in NZ forestry, at least by some forestry professionals if not politicians, and that the University of Canterbury has pioneered the use of OR in forestry since the early 70s, well before FRI. But, the main inference that OR practitioners should draw is the need for and opportunities to intensify their efforts to promote OR in forestry still more: characterising the system holistically and choosing the correct questions to address within the real problems to be solved, before jumping in with our favourite optimisation models should be our approach, if my own 26 years of experience with OR has taught me anything.

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PUBLISHING SCIENTIFIC PAPERS ON THE INTERNET

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Publishing of scientific papers in the traditional hard copy journal form is technology of the past. As pointed out in the March Editorial of the OR Newsletter this mode is unwieldy, notoriously slow, and fraught by real or perceived favouritism of belonging to one of the in-groups associated with various journals. Publishing on the Internet through dedicated Websites or bulletin boards is one promising way of the future. There are obviously some problems associated with this an approach, such as how to separate the chaff from the corn, or how to have an effective reviewing process.

I see the following major problems with the current journal publishing process:

1. It takes forever to get reviews, and another eternity to see a paper actually published. A journal can take a year to reject a (sometimes good) paper and then you start afresh.

2. Reviewers are overloaded with all sorts of work, and reviews are among their least rewarded activities.

3. Anonymous reviews imply reviewers do not really have to be careful. Sometimes they even have an interest to stump a paper that conflicts with their own work. Combined with (2), the result may often be a sham.

4. Editors do not have the ability to really shape their journal. They are constrained to select from the set of papers submitted to them. Even if they solicit papers actively, many of them consider themselves bound by the decisions of reviewers. Academically, this has justification, but the results may not be desirable. (I once submitted a paper to a top journal although I thought it was not a good fit. I did it at the explicit request of the area editor who said he would like to branch in the direction my paper belonged to. I made sure he saw the paper first, and he actually indicated he liked it. The reviewers thought differently about branching. The paper was therefore rejected.)

These problems are known to all of us, and I'm sure others could add more to the list. They can be solved partially or completely with Internet publishing provided it is done right. Of course, simply putting a paper on Internet is not formally different from writing a working paper, but it is

much more accessible, and that can make a huge difference if we change our system to suit the new technical realities. Here are the ideas:

1. Working papers should be published within interest areas, i.e., on bulletin boards. There is no formal need to belong to a university/research institute to do so.

2. Anybody is encouraged to publish a review or critique of any paper that is on the board, provided the review is signed. There is no reason to be ashamed of a good review.

3. Universities (i.e., we ourselves, with other hats on) should consider the possibility to count such reviewing as part of the academic duties of faculty members. Since reviews will be signed, they can be assessed by promotion committees, etc. If we do that, then reviewers will come forward by themselves!

4. Editors, whose real job is to archive good papers, will surf the network and select papers they like. If these papers have good reviews attached, they are publishable as is. Or some journals may be based on editorial decisions. Otherwise, reviews may be solicited in the normal way, with the consent of the author. (Such consent is necessary because it will preempt publication by other journals — see Problem [1] above.)

5. Authors may still choose to ask editors to consider their work. Their job will be especially easy if someone bothered to review their work (favourably). They will also have the right to refuse publication in journals that do not attract them.

6. Revisions will be done in the usual way by authors responding to comments that they accept. So, revised papers may be put on the net often. I also anticipate lively discussions between reviewers and authors — this will be really worthwhile! Some of the best journals have discussions incorporated within them, but they are a minority.

7. A paper nobody reviews is a non-entity in a way, but at least it is done by closing our ears rather than by shutting the author's mouth. Free speech does not imply everybody has to listen.

All these ideas need more work yet, but I think they can help solve the problems listed. I look forward to hear your comments, suggestions, and ways to fine-tune this process.

THE 32ND ANNUAL CONFERENCE

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The conference showed once again that OR is alive and well in New Zealand. A sparkling array of personalities and papers paraded before us over the two days. NZ is well served by OR over a wide range of areas in which we have particular expertise, and many of the papers reflected this. All the old favourites were there — electricity scheduling, airline scheduling, vehicle routing, to mention just a few. A wide variety to tempt even the most jaded OR appetite.

As has often been the case in the past, it was up to our invited speakers to widen our horizons by describing the work going on overseas. Clay Whybark's talk on Evolving OR and Graham Mills' summary of the Australian OR scene both — in different ways — showed the wide range of issues which will face future OR practitioners.

New issues and new methods are becoming apparent on the local scene too. I particularly enjoyed Kerry Mayes' talk on Drama Theory. It is not often we get Hamlet at an OR conference. Maybe one day someone will give a talk entitled 'A Comedy of Errors'. Will new OR graduates be required to take English Literature as a prerequisite? (That would give a badly needed boost to their level of literacy, the editor)

The Young Practitioners' papers were, as usual, the highlight of the conference. The incredible effort put into these projects amazes me. The quality of research, the clarity of thinking, and the high standard of presentation are all aspects of which the participants can be proud. May they go to even greater heights in later years. Praise must also go to the University staff for their excellent guidance, and to those industries who have had the foresight and enthusiasm to sponsor these projects.

The theoretical papers were also very interesting. Much original work is going on here, and it good to see it presented at conference. It is perhaps unfair to pick out favourites, but Andy Philpott's presentation (with D. Ryan and G. Zakeri) on 'Inexact Cuts in Benders' Decomposition' and N. Zhu and K. Broughan on 'Reducing the Number of Variables in Integer Programming' struck me as particularly outstanding.

With the next conference being in Australia, our Aussie colleagues will have to look to their laurels to come anywhere near our conference standard. A superbly well organised conference, thanks to the hard work of the Management Department at Canterbury.

BRANCH GOSSIP COLUMN

Massey Mutterings

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Mahyar Amouzegar is on overseas leave for two months, visiting UCLA's Optimization and Communications Lab as a Research Engineer (and conveniently missing the annual grade massaging exercise). He has also presented an Invited Paper at the INFORMS Conference in Atlanta, "On Test Problem Construction for Linear Bilevel Programming Problems" (joint work with K. Moshirvaziri).

Mark Bebbington (with David Vere-Jones) was awarded a substantial grant from the latest Marsden Fund round, for work on stochastic modelling of earthquake processes.

Our on-going seminar "OR Fan Club" seminar series has had several PhD student presentations (in both fait accompli and feedback modes), plus special talks from visitors: Madda Lena Nonato (University of Pisa), who discussed polyhedral aspects of airline scheduling problems; and Jose Ventura (Penn State U), whose topic was "A Lagrangian method for scheduling mixed-model assembly lines for a JIT production system".

Symonds Street Stories - Auckland

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Professor Michael Rothkopf (School of Business and RUTCOR, Rutgers University) visited the University of Auckland on November 5 (is there some ominous symbolism in the US Election being held on Guy Fawkes Day?). He encouraged faculty to submit applied OR papers to Interfaces (of which he is Editor-in-Chief).

Mike gave a seminar providing an overview of Bidding Theory and a potpourri of new results in this field. He noted the lack of realism in numerous models which fail to capture the dynamism of the marketplace. For instance, the auction method attributed to Vickrey (the co-winner of the 1996 Nobel Prize winner in Economics) where the best bidder wins but is awarded the amount of the best losing bid is rarely used in practice, as few auctionsare single isolated events.

One must take into account how competitors will respond (in subsequent auctions) to revealed information. In addition, third parties may end up capturing a good deal of the revealed economic rent (the difference between the best two bids). Mike discussed a refinement of the (English) oral auction in which the amount of revealed information (bidders dropping out) is limited by selecting (e.g., at random) a pair of bidders who bid until one drops out and is replaced by another bidder, etc.

Bid evaluation problems in which bidders are free to bid on any combination of multiple items for sale (e.g., in oil exploration, cutting rights, or teaching papers!), can give rise to very difficult combinatorial optimisation problems. Mike presented several solutions, including the "political" one — generating a heuristic solution and specifying a fixed time for the bidders to come up with a better one (outsourcing the optimisation!).

The August 1996 issue OR/MS Today devotes a dozen pages to the (under-represented?!) topic of affirmative action and Mike's talk continued the debate by demonstrating that cost and efficiency is not always sacrificed when subsidies are given to some players (he prudently avoided discussing issues of "fairness").

We wished Mike well on his vacation, lamenting that he was unable to visit Wellington and consult to several beleaguered competitive bidders domiciled in some debugged chambers and seeking to minimise revealed information.

Mainland News

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Our major highlight since the last newsletter was, of course, the ORSNZ Annual conference which was attended by approximately 75 participants. It was a busy time for the branch members, and we thank all those who attended and participated in the conference. In typical Canterbury style, even the sun and the snow we ordered arrived on time!

In November we were privileged to have a two-day visit by Professor Peter Checkland from the University of Lancaster — yes 'the' Peter Checkland. He obviously needs no introduction. He gave two seminars - the first explaining Soft Systems Methodology (SSM) and a second outlining his experiences with SSM in developing an information system for a hospital. Both seminars were very enlightening and explained just how SSM is used in a real world context. The seminars attracted many people from around campus indicating the how SSM integrates OR and other disciplines.

In other news, the Department of Management has recently appointed Dr Andrew Tobias from the University of Birmingham to a senior lectureship position in Operations Management. He is a long standing member of the UK Operational Research Society and visited the Department for several months in 1994.

Wellington Branch News

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Our Management Group has a new staff member. Michelle Baron joined our staff in July of this year. She came to New Zealand from California's San Francisco Bay Area in the United States, after completing a PhD in the Department of Industrial Engineering and Engineering Management at Stanford University. Below is a brief summary of her PhD research.

Title: Managing the Tradeoff Between Productivity and Safety: Risk Management Strategies for Critical Engineering Systems. The research is intended to provide decision support in the design and evaluation of alternative risk management strategies for critical operations. In particular, the research focuses on safety-critical systems such as offshore oil platforms, space systems, chemical processing facilities, and nuclear power plants. In such systems, there is often a real or perceived conflict between the operational objectives of productivity and safety. This is particularly evident in the short-term and under tight resource constraints. In failing to adequately recognise and manage potential trade-offs, it may be difficult to give the more abstract notion of safety a high priority at the expense of the more obvious and immediate goals of high production and reduced operating costs.

The research uses a dynamic systems analysis approach to adapt management strategies to the specific characteristics of the physical system. Combining probabilistic risk analysis (PRA) and dynamic stochastic models, we compute expected risk, production, and cost patterns over the life of the system as functions of strategic options and operating policies. System safety and productivity are optimally balanced using decision analysis. The methodology has been applied to the management of planned and unplanned outages in nuclear power plants.

DEPARTMENT OF ENGINEERING SCIENCE UNIVERSITY OF AUCKLAND: *YEAR FOUR PROJECT ABSTRACTS*

Final year students completing a BE in Engineering Science at the University of Auckland must carry out a project. This project, which is worth 3 papers, represents approximately 20% of the final year's mark. It involves modelling some practical situation, writing a report of about 40 pages, and giving an oral presentation. Approximately half the class choose projects associated with Operations Research problems. The following abstracts give brief descriptions of this year's OR projects and the students who conducted them.

The MORO System: Maintenance operations rostering optimisation *by N. Lupis*

Cadbury Confectionery Ltd in Dunedin currently operate a manual rostering program, based on employees working two-week intervals of the same shift, and rotating back to the same pattern after a period of six weeks. Using a new computer-based optimization technique, Cadbury's can give its employees the chance to indicate their preferences for each of the shift times for a four week period. This project aims to design a model that incorporates these preferences, as well as other constraints thus enabling the development of a roster that caters to the satisfaction of as many employees as possible. The model has shown that this type of computer-based scheduling system is a useful tool, offering several advantages over the current manual technique. With further development the model could lead to better solutions, giving employees greater satisfaction and enhancing the standard of their work.

A dynamic programming engine for determining customs staffing requirements at Auckland Airport by R. Rawles

New Zealand Customs have the responsibility of protecting the country's borders. To do this, Customs staff are required to 'process' travellers coming into and going out of the country. Rostering these staff throughout each day creates a problem. This problem at Auckland International Airport is currently being solved using an heuristic technique. This solution produces a roster which satisfies Customs' policy with regard to processing passengers within a specified time constraint, but it does not guarantee to find an optimal, least cost solution. This project investigated solving the staffing problem by using a dynamic programming approach which produces a near optimal work requirement solution. The solution procedure initially finds passenger processing flows throughout the day. It then calculates the management quality policy 'target-points', refines them, and using these refined target points as bounds to find a staffing solution. Solutions vary depending on the number of open booths, and have costs associated with them accordingly. The best solution is chosen so that the cost is minimised. Finally the required number of open booths throughout the day is found for the combined problem of both arriving and departing passengers. This code along with the rostering code will be incorporated and used by Customs Management at the airport.

Optimizing year-four project allocations for the Engineering Science Department of the University of Auckland by T. Scott

In this report the solution of the problem of assigning students to Year Four projects in Engineering Science is described. The main objectives of this project were to formulate and implement an integer programming model to optimise the allocation. The method used is essentially a two stage process. Firstly all the possible subsets of student/project pairings are generated for each Staff member using preferential bids for projects. A Set Partitioning Optimisation Model is formulated and solved to produce an optimal allocation of students to projects. The resulting allocations are then compared with manual allocations.

Optimising component packaging at Fisher & Paykel by E. Boysen

This project is concerned with developing a method of optimally packing washing machine components into a selection of boxes. The aim is to minimise the total volume of boxes used while satisfying the required demand for components. The problem is modelled as a multi-bin packing problem and is solved using the CPLEX optimisation program which uses a branch and bound algorithm. Results show this model is well suited for a problem of this size, calculates a reduction in volume and box utilisation, and has the potential to solve large problems.

Stochastic modelling for fuel filling in the LAX-SYD sector by Lok Yan Lin

Air New Zealand would like to minimise their expenditure on aviation fuel. The fuel required on a given sector depends on the flight plan, the passengers and freight loaded, and on the weather. Fuel can be loaded in several stages before takeoff, each having increasing fixed cost. The aim of this project was to develop some pilot models for computing optimal fuel filling strategies using decision analysis in a spreadsheet program.

Rostering at the Sheraton by R. Thomson (Joint winner Cecil Segedin Prize)

The aim of this project is to create a data management system to provide high quality rosters for staff at the Sheraton, Auckland. The rosters will be created for a seven day period taking into account the staffs' preferences, requests and any existing commitments. This will be performed while ensuring that they are utilised effectively across the entire organisation. A system has been developed that takes into account the staffs' history, and finds the best allocation of work for these employees to meet the staffing requirements. Some of the aspects that are desirable in the rosters include:

- Periods of 4 or 5 consecutive days on followed by 2 or 3 consecutive days off.
- A variation in department, and hence in skill requirement.
- Regularity in start times throughout the week.

When the seven day model was extended to account for the staffing requirements on the eighth day, a 12% reduction in the cost per day was achieved. This is because the roster is better constructed to deal with the transition into the next week. This shows that the staffing requirements in the future affect the rostering of today.

Inventory planning problem for Hes Brothers Co (NZ) Ltd
by M. Somervell

Hes Brothers Co (NZ) Ltd is an importing company that is interested in reducing its inventory costs. The main problem with this is that the demand is unknown until after they have purchased the inventory. This project looks at what the model for this problem is and at how it could be solved using stochastic dynamic programming. Two methods for stochastic dynamic programming were looked at, a normal stochastic dynamic program which solved all of the variables at the same time, and a method that first divided up the budget and then found the best solution based on that budget division. Neither of these methods could be used to solve to optimality as they require too much computing power. However, the division of the budget method can be used in conjunction with the purchasing managers experience to help reduce the inventory costs to the company.

Deleting redundant cuts in stochastic Benders' decomposition
by J. Remenyi

Stochastic Benders' decomposition is a technique for computing the solution to linear programs that may be divided into a series of almost independent sub problems the solutions of which give direction to the solution of a master problem which provides parameters the sub problems must satisfy. After many constraints or cuts have been added the master problems become slow to solve. Many of the constraints added will be redundant and can be removed. The aim of this project is to determine whether the effort of seeking and removing these additional constraints will lead to an overall improvement and if so to determine when and how in the solution process this should be done, as well as quantifying the result that can be expected should this procedure be carried out. After implementing and refining a procedure to carry out this task it was found that with the sample information given we could solve the problem in 60% of the time it would have previously taken, as well as being able to predict circumstances where it is advisable to use this procedure. In addition a quick method of deleting redundant constraints from the second to last stage was shown.

Real time load allocation in hydro-electric generation
by N. Bartlett

Hydro-electric power is created by the conversion of potential energy of water into electricity through the operation of turbines. These turbines make up parts of generation units which are committed by power utilities to meet demand, forming a schedule called a pre-dispatch. However demand is uncertain and the local station operators are left to meet the uncertainty in demand as it arises by allocating the load instantaneously. This project investigates the determination of a method called Demand Allocation in Real Time (DART) which aims to optimise the real time allocation of load to meet demand at an instant in time, while complying with conditions laid out in the pre-dispatch. The intention is to optimise allocation in a way that minimises the use of water resource over the entire system given a set of committed units. DART is not designed to work on its own. It is intended that it will be implemented with a new pre-dispatch generation model which will provide end conditions for DART to work to. DART in turn provides a new set of conditions from which the pre-dispatch is to be re-calculated.

Minimising changeover costs on a single machine at Carter Holt Harvey Tissue Ltd *by M. McLauchlan*

In this project an algorithm is implemented to minimise the changeover cost on a single machine. This model gives a good solution to the problem of minimising the changeover costs for Carter Holt Harvey Tissue machines. The emphasis on changeover costs can be lightened if a production schedule is produced from a simple inventory model that does not allow any 'stock-outs' for any of the products. For this type of inventory model the production schedule incurs a higher loss of production in terms of changeover due to more frequent inventory replenishments but inventory costs are lowered substantially. The overall cost for this type of inventory model is lower.

Analytic description of tree stem geometry *by T. Allsopp*

Curves were fitted to measure tree stem geometry data. The fitted curves were used to generate corrected setsof data as input for an existing software package that determined the optimal cutting schemes. The solutions for the original measured data and the generated data were compared in terms of sweep, wobble, length and value. A hypothetical tree stem was generated with a known amount of error and the error in the fitted curve was calculated. It was found that

smoothing the data resulted in more valuable logs becoming feasible and thus the solutions gave, on average, a higher value, and that the value per unit length of every test tree stem had less error than the error introduced. The same technique was applied to log geometry data and the fitted curves were used to transform the co-ordinates describing the log geometry and the positions of features on the log such that the logs were straight lines in the transformed co-ordinate system. These transformed co-ordinates were used as input to existing software for determining the optimal cutting pattern for the breakdown of logs into boards in order to estimate the value recoverable using saws capable of cutting around swept logs. It was found that this transformation resulted in solutions yielding higher value boards and an overall increase in the amount of each log used.

Cost efficiency energy consumption at New Zealand Aluminium Smelter *by A.Tonks*

New Zealand Aluminium Smelter located at Tiwai Point near Invercargill produces aluminium by reducing alumina electrolytically. The smelter uses an available energy block during a calendar month, which is paid for at the end of the month. Differences against a monthly target incur high costs. This report proposes and describes a solution approach to minimise the deviation from the target energy consumption and thereby maximise the cost efficiency. Numerical results on data obtained from the smelter show that the approach is indeed valid.

Roster planning for B747-200 flight engineers at Air New Zealand *by G. Jones*

Air New Zealand publishes a new timetable of flights on a six monthly basis. From the timetable of flights, Air New Zealand logistics staff construct tours of duty (TODs) for the crew who must fly them. These tours of duty are then assigned to individual crew in a rostering process. In order to check the efficiency and practicality of a set of tours of duty logistics staff estimate the number crew required to fly a set of tours of duty. At present the estimation of crew requirements for covering a set of TODs in a roster period is based on experience and good judgement. This project describes the development of a roster planning tool for Air New Zealand's logistics staff. Its purpose is to take a set of generated TODs for a 28 day period and give the minimum number of crew required to fly the duties. This project concentrates on the development of this tool for B747-200 flight engineers but the approach can be extended to other crew groups. The project seeks to solve the roster construction problem through an automated approach involving dynamic column generation. Solving to optimality is a two stage process. Firstly an optimal solution of TOD allocation to crew is generated. Secondly the optimal solution is forced integer using constraint branching. The model is set up so as to minimise the number of crew needed to cover all of the work. A successful operation of the model involved a total allocation of 187 trips to a maximum of 68 crew. The optimal solution found that only 66 crew were required to cover all of the work.

Construction of a daily schedule of duties for locomotive engineers *by A. Ng*

This project develops a set-partitioning model and solution procedure to construct a schedule of driver duties for Tranz Metro engineers for each day of the week so that all tasks are completed at minimal cost by the available staff. The number of driver shifts and the total paid hours including overtime hours are minimized.

Construction of a cyclic roster for locomotive engineers at Tranz Rail *by A. Bell-Booth (Joint winner Cecil Segedin Prize)*

This report describes the problem regarding the construction of fortnightly cyclic rosters for engineers at Tranz Rail. This roster satisfies the employment contract and rostering constraints. This report will also introduce a method of solution for this construction. The method uses a three stage approach. Firstly a large number of legal lines of work are generated for the first half of the fortnight. Using these lines of work a Generalised Set Partitioning optimisation model is formulated and solved to produce an optimal subroster over these individual weeks. The third stage involves executing the first two stages for the second half of the fortnight to find a second optimal subroster. This second subroster fits within the restrictions of the previously solved subroster. By linking the solutions of the subrosters a fortnightly cyclic roster is built. This third stage can be executed iteratively so that once the second week is solved it takes the place of the first week and so a new second week is generated. The resulting rosters are then analysed and compared with a manual solution. Possible improvements and extensions are discussed.

DEPARTMENT OF MANAGEMENT UNIVERSITY OF CANTERBURY M.COM./B.SC.(HONS)
Project Abstracts

These practical projects represent the equivalent of one out of six papers.

Fire station locational analysis
by Oliver Spinks and Simon Oliver

The New Zealand Fire Service is constantly making both tactical and strategic changes to improve the quality of service they provide. This study concentrated on one fire station in Christchurch for which relocation is being considered. The analysis used a GIS package and data display tool for finding the locations minimizing travel times in the demongraphic area to be covered now and for projected trends twenty years in the future, meeting Government service standards as to response times.

Labour rostering for the Lyttelton Port Company
by Andrew Gormley and Adam Tankersley

Uncertainties about ship arrivals create problems in rostering labour for container operations. The size of the problem was determined and a number of possible strategies investigated. The cost in terms of increased wages and overtime incurred due to imperfect information about ship arrival times and cargo volume was determined. The possibility of using a spreadsheet based system to computerise the rostering process was also considered, but was found to offer only limited advantages over the current hand method using A2 sheets.

A spare parts ordering system for CWF Hamilton Jet Limited *by Jason Lyftogt, Peter Simpson and Duane Smith*

Like many expanding companies, Hamilton Jet faces a difficult problem of allocating manufacturing capacity between production of new jet units, and spares provisioning. An Inventory Manager, written in EXCEL, forecasts the demand for spares and allows the user to choose between various suggested optimal replenishment quantities and reorder points for alternative provisioning strategies.

OBITUARY: STEFAN VAJDA 1901-95

Stefan Vajda came to England as a refugee in 1939. He obtained a visa to England through his friend and philosopher Karl Popper, who had offered him a job in New Zealand. In fact, he never came to NZ. After a period of internment on the Isle of Man, he became involved in mathematical research for the Admiralty in 1944 and became one of the leaders in the new field of operational research. After the war, he took over as the head of the mathematics group, developing contacts with such people as David Cox and Henry Daniels, statisticians in Cambridge. Martin Beale agreed to join the Admiralty and together with Stefan became interested in the newly developed technique of LP, which became the subject of Stefan's first book, published in 1956. Stefan worked for the Admiralty until 1965, and at the age of 63 became the first professor of OR at the University of Birmingham.

Stefan produced 15 books on subjects ranging from manpower planning to mathematical games, as well a publishing many scientific papers on actuarial sciences, statistics, and OR topics. He was a Fellow of the Royal Statistical Society, a Companion of the OR Society, and an Honorary Member of the Institute of Actuaries.

(Adapted from John Bather's comments in the Journal of the Royal Statistical Society.)

APORS'97 NEWS

Vicky Mabin,Victoria University of Wellington, PO Box 600, Wellington NZ
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APORS'97 is now just 12 months away! This conference, the 4th Conference of the Association of Asian-Pacific Operational Research Societies, is to be held from November 30 till 4 December 1997 at the soon-to-be-completed World Congress Centre in Melbourne. The deadline for submitting abstracts is also coming up fast: 28 February 1997, so the main purpose of this letter is to invite you all to submit a paper, or register your interest in attending, or being otherwise involved — please read on!

As co-organisers of the conference, ORSNZ has been allocated several special slots for events: we have been invited to present a modest number of tutorials, and we are also organising a number of streams and sessions. We already have a number of streams and sessions planned, but there is still time to add to the list, just! So if you would be interested in finding out more about offering a tutorial or workshop, or organising a stream or session, please contact me as soon as possible.

We also have promised to organise some pre-and post-conference tours for conference participants to visit NZ — if any of you have recommendations on that topic, please let me know.

I can recommend that you visit the APORS'97 web site for more information. You can even register, and submit your paper on line. Or if you prefer, contact me or the APORS secretariat for a brochure. Addresses are at the foot of this letter.

Remember we are not having an ORSNZ conference next year, and travel to Australia may cost about the same as internal travel, so do put in a paper abstract, and plan on attending APORS'97. It'll be a great opportunity to share the best of OR applications and theory from the whole of the Asia-Pacific region and beyond. A rareopportunity for most of us. Remember the dates: 28 February 1997 for paper abstracts, and 30 November - 4 December for the conference itself. I look forward to hearing from you with suggestions, contributions or enquiries, and look forward to seeing you there!

APORS'97 tutorials, streams, invited sessions, and workshops (tentative only)

ORSNZ has been invited to contribute to tutorials, workshops, streams, and sessions. Below is the tentative list of session/stream topics and organisers/presenters (subject to possible changes) that have been suggested by ORSNZ members so far. Papers presented in these sessions will be termed 'invited papers'.

Topic	Organiser(s)/Presenter(s)
Rostering and Scheduling	Andrew Mason (*a.mason@auckland.ac.nz*)
Aircrew Scheduling and Rostering	David Ryan (*d.ryan@auckland.ac.nz*)
Vehicle Routing Heuristics	Les Foulds/John Giffin (*l.foulds@waikato.ac.nz*)
Electricity Sector Modelling	Grant Read (*g.read@mang.canterbury.ac.nz*)
Problem Structuring/Soft Systems Methods	Hans Daellenbach (*h.daellenbach@mang.canterbury.ac.nz*)
OR in Environmental Planning	Gary Eng/Conrad Edwards (*engg@moc.govt.nz*)
MCDM Methodology	John Buchanan (*jtb@mngtgate.mngt.waikato.ac.nz*)
Constraint Management	Vicky Mabin (*vicky.mabin@vuw.ac.nz*)
Systems Dynamics and Simulation	Bob Cavana (*bob.cavana@vuw.ac.nz*)
OR in Sport	John Davies/Stephen Clarke (*john.davies@vuz.ac.nz*)
Machine Scheduling	Ross James (*r.james@mang.canterbury.ac.nz*)

This list is by no means comprehensive. If any ORSNZ member wishes to submit further proposals, please contact Vicky Mabin immediately. Similarly, if you have a suitable paper to fit into one of the above sessions/streams, please approach to organizers promptly.

APORS'97 Web site: http://www.maths.mu.oz.au/~worms/apors/apors.html
Conference e-mail address: apors97@sci.monash.edu.au
My address is: Management Group, Faculty of Commerce and Administration
Victoria University of Wellington, PO Box 600, Wellington NZ
e-mail: vicky.mabin@vuw.ac.nz
Phone (04) 495 5140, Fax (04) 495 5253

LETTERS TO THE EDITOR

OR Library Stocks

At a Management Systems, University of Waikato, staff meeting last week, the few library $'s we have left for 1996 drew the inevitable question of which journals we should continue subscribing to. The International Jl of Production Research has raised its subscription to $1800. Should we keep it. Last year we finally gave the reluctant chop to EJOR: $3000 per year was just TOO much. Now as education $'s get harder to come by, such conversations are probably becoming more common at institutions around the country. My point is these decisions are being made relatively independently.

I remember making the suggestion of a two tiered system of library stocks at an OR in NZ Education forum several years ago. The idea was the second tier would contain a list of journals that we felt should be held somewhere in NZ that didn't come into the first tier: journals that an institution felt they must hold. Second tier holdings would be spread around in proportion to OR/MS EFTS's. Hopefully this would lead to a rationalized stock. Interloan (modified) would do the rest. Well the suggestion at the time went down like the proverbial lead balloon. Our then 'rich' Auckland and Canterbury cousins couldn't see the need. Wellington had the AMD library a stones throw away. We can't help it if you're poor was the impression given. Well the "nouveau pauvre" may just have swelled to the point where the idea might be worth revisiting. How about the library person on our Society's committee assignments asking their librarian to see which of the IAOR journals are held in NZ. Circulating a summarized list would be a simple service, appreciated in its own right. A Newsletter article? If there was support for going further, journals could be priced and a survey to each OR group? (journals we expect to continue subscribing to for the foreseeable future; journals we expect to stop subscribing to; journals we'd like to see stockedin NZ; that sort of thing). Savings, costs (tangible and intangible). This assumes we will be dependent on paper versions for a while yet. Could be a study for an OR student looking for a project: "Rationalizing Library Holdings For OR By OR".

John Scott, University of Waikato
jls@mngtgate.mngt.waikato.ac.nz

PS. What has become of that marvellous AMD OR stock? I'm meaning the library variety of course, but perhaps Hugh or Bruce could do us something for the people version. Perhaps the "class of 1990, where are they now?" Another Newsletter article?

ORSNZ VISTING LECTURER FUND

The Council of The Operational Research Society is pleased to announce the formation of the ORSNZ Visiting Lecturer Fund. This fund will be formed from a proportion of member's subscriptions to assist the travel within New Zealand of internationally recognized OR academics and practitioners who are visiting this country. In special circumstances the Fund might be used to support a visit from Australia. The fund is intended to encourage the interaction of the visitor with all of the regional branches of the Society, and it will be expected that the visitor give lectures at each of these branches.

Grants-in-aid from the fund will be available to a maximum of $500. To apply for such a grant, the host of the visitor in New Zealand should apply in writing to:

The Secretary ORSNZ
Department of Engineering Science, University of Auckland
Private Bag 92019
AUCKLAND

enclosing a curriculum vitae for the visitor, and a proposed itinerary. Applications will be considered by Council at the end of January and at the end of June, for visits occurring in the next twelve months.

SPECIAL ISSUE OF OMEGA ON PERFORMANCE MEASUREMENTS IN ASIA-PACIFIC COUNTRIES

Professors W.W. Cooper, K. Tone, and T. Sueyoshi are the guest editors of a special issue on performance measures in Asia-Pacific countries, devoted to the role and effectiveness aspects of management science in our region, covering DEA and its variants, including multi-method papers. Papers should be submitted in quadruplicate to one of the guest editors by 31 December 1996 and should conform to the normal guidelines. The issue is scheduled to appear in the latter part of 1997.

Prof. W.W. Cooper, Dept. of Mgt Sci & Info. Systems, Graduate School of Business, University of Texas at Austin, CBA 5.202, Austin TX 78712.1175, USA

Prof. Kaoru Tone, Saitama University, Grad. School of Policy Science, Urawa, Saitama, 338, Japan

Prof. Toshiyuki Seuyoshi, Dept. of Industrial Administration, Science University of Tokyo, 2641 Yamazaki, Noda-shi, Chiba-ken 278, Japan

JOURNAL OF APPLIED MATHEMATICS AND DECISION SCIENCES

The Journal of Applied Mathematics and Decision Sciences is a new journal devoted to the practical problems of mathematics, Operations Research, and Statistics. Its primary aim is to rapidly publish carefully refereed papers treating practical problems of Mathematics, Operations Research, and Statistics without compromising mathematical precision. The Journal covers a wide range of applied and theoretical subjects, including: Optimization, and Heuristic Methods; Stochastic Systems; Mathematical Modelling; and Numerical Methods and Analysis. Emphasis will be given to papers that address both the theoretical aspects and the application aspects (including computational). In addition, the Journal will also consider papers dealing with applied mathematical sciences that have a practicalimplication (for example computational techniques in Operations Research or Statistics). Of special interest will be papers dealing with modelling and analysis of systems that are important to New Zealand society.

Topics to be covered include: Theory and application of mathematical programming; heuristic methods in OR; mathematical modelling in geothermal, environmental systems, socio-economic systems, and biological systems; reliability and quality control; stochastic systems; and numerical methods and analysis.

For information on submission and/or subscription please write to:

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Palmerston North, NZ
e-mail: m.amouzegar@massey.ac.nz
You may also get information via our WWW page at:
http://fims-www.massey.ac.nz/maths/jamds/

MANUFACTURING & SERVICE OPERATIONS MANAGEMENT — A NEW JOURNAL

MSOM is a new international research quarterly to be published by INFORMS, dedicated to publishing state-

of-the-art theory and practice articles related to managing all aspects of production of goods and services. Four broad classes of manuscripts are of particular interest: (1) applications of mathematical modelling to operations management in novel and interesting ways; (2) applications of economics, OB, or psychology to operations management; (3) the interface between operations

management and other functional areas; and (4) interpretation of practice from the viewpoint of current theory. Review articles and practice-oriented surveys are also of interest.

The managing editor is:
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A NOTE FROM THE TREASURER

Advertising in the OR Newsletter

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As treasurer of the Operational Research Society, I am keenly aware of the need to supplement the ORSNZ's annual income. To this end, we have always welcomed advertising in the newsletter. In some cases, such as in the September mailing, we have included publicity material provided directly by an outside organisation. (Only members with New Zealand addresses will have received this.) We welcome members' feedback on this means of raising much needed funds to reduce the Society's recent annual deficits.

THIRTY-SECOND ANNUAL GENERAL MEETING

Mikael Ronnqvist, Department of Engineering Science, University of Auckland, Auckland NZ
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The meeting was held on the 29 August 1996 at Canterbury University, Christchurch. The major decisions taken were:

1. New fees: There was a consensus at the meeting to have the fees to the closest five dollars and to keep the current structure (in brackets: proposed early pay discount)

Standard Membership	**$50**	($45)
Student/Retired Member	**$15**	($15)
Corporate Membership	**$160**	($160)
Corporate Sponsorship	**$420**	($420)
Journal Only (Libraries)	**$40**	($40)
Newsletter Only (Libraries)	**$15**	($15)
Conference Proceedings	**$20**	($20) (no entry fee will be charged)

Two related issues were that student members will be able to remain as student members during the first year after finishing their degree, and that overseas members will be charged for the extra cost of mailing.

2. APJOR: There was decided that APJOR will be a voluntary subscription to all members and that the Proceeding from the annual conference will replace APJOR. This will take effect from the financial year 1997/1998.

3. New Officers: The following officers were all elected unopposed:

President	A Philpott
Vice President	D Ryan
Secretary	M Ronnqvist
Treasurer	A Mason
Others:	G Read, B Cavana, V Mabin, D Robb, J Buchanan, J Lermit
Auditor	Paul Rouse

MASTERS RESEARCH OPPORTUNITIES — UNIVERSITY OF AUCKLAND

Dr Andy Philpott and Dr Andrew Mason are currently looking for students to undertake the following three OR Masters research projects in the Department of Engineering Science at Auckland University. It is hoped that the first two of these projects will be supported by GRiF funding to the tune of about $18,000 over 16 months, while the third will get private sponsorship funding. Successful applicants will typically complete 3 papers and a thesis to obtain a Masters degree. They will also be expected to spend 50% of their time working with the commercial partner at their site. Please contact Dr Philpott or Dr Mason at the following addresses if you wish to be considered for either of these projects:

Dr A.B. Philpott
Ph (09) 3737599 x 8394
Fax: (09) 3737468
e-mail: *a.philpott@auckland.ac.nz*

or

Dr A.J. Mason
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Dept of Engineering Science, University of Auckland
Private Bag 92019, Auckland

KiwiTech Sailing Optimisation

The Auckland based company KiwiTech develops hardware and software products for the high end yacht racing, yacht cruising and power boat markets. KiwiTech software and hardware products are marketed worldwide and have been used in all major yacht racing events including the 1995 America's Cup aboard Black Magic and Tag Heuer. Main software products are the RaceTech yacht racing and performance analysis package, the SailTech software package for cruising sailors, and the PowerTech chart plotter for launch owners. Other products include Windows based Weather Fax software and a Yacht Racing Rules Expert System. KiwiTech also produces and resells a range of ruggedised PC equipment and accessories suitable for marine use.

KiwiTech wishes to develop weather routing systems primarily to strengthen its position in the high end yacht racing market. Weather routing software is a key requirement of high end offshore campaigns, such as the Whitbread Round the World Race. This software has not been widely used outside this arena due to high cost, and ease of use problems. KiwiTech see a position for a reasonably priced weather routing package for high to mid range offshore yacht racers such as Whitbread and Admirals' Cup, and a similar optimisation package for superyachts and ocean cruisers. The technology can also be applied to tactical choices for short course round the buoys racing from America's Cup down to club racers.

The desired outcome of this project is to produce a suite of software tools for determining routes for racing and cruising yachts which minimize the time taken for them to sail to a given destination. The scope of the project will include the short-course routing problem, in which the weather and tidal current conditions are assumed to be known, as well as the long-course problem, in which uncertainty in the weather must be accommodated.

There has been quite a large body of research carried out on the weather routing of commercial vessels, but relatively little work has been done for sailing vessels. Some theoretical approaches for accommodating weather uncertainty have been suggested, but these have not been implemented and tested in practice. The current project will focus on the extension and successful implementation of the approaches suggested in the literature into a user-friendly code.

We seek a candidate with a good honours degree in either Engineering, Mathematics or Computer Science, with some experience of optimization and competency in programming in C. Candidates with experience in using C++, in particular Microsoft Foundations Classes on the Win32 platform will be preferred, although such experience is not mandatory. Candidates with an interest in yacht racing will also be preferred, although yachting experience is not considered essential.

Optimizing Telecommunications Technology Decisions

Telecommunications companies are regularly faced with decisions relating to the augmentation of capacity in the lines connecting subscribers to local exchanges. The main decisions to be made determine what technology should be adopted in increasing this capacity. The cable technologies available are wireless, copper cable, or optical fibre, all at different costs. The basic problem is to determine a choice of technology for each node and line which is compatible with its neighbours and which gives the least cost. The desired outcome of this project is to produce a suite of computer programs which use dynamic programming techniques to solve these capital provisioning problems.

A student contemplating this project will enrol for a Masters degree in Engineering Science

and so should therefore have a good honours degree in either Engineering, Mathematics, Computer Science or Operations Research. Some acquaintance with dynamic and stochastic programming is preferred but not essential.

Queueing, Simulation and Rostering

Dr Andrew Mason of the Department of Engineering Science at the University of Auckland is looking for a graduate student to undertake an innovative simulation and optimisation based project as part of a Masters degree in 1997. The research component of this degree will involve developing simulation and/or optimisation systems to enhance an automated queue management system developed by an Auckland-based technology company. This company is a major player in its field, with an installed base that includes well known companies in both New Zealand and Australia. This project will introduce Operations Research technologies to further enhance the intelligence of the queue management system. Sponsorship funding will be available to support an applicant with good programming skills and a solid background in queueing systems, simulation and/or optimisation. The ideal applicant will need to interact with both the company's growing development team and clients in New Zealand and possibly Australia. Please contact Andrew Mason at the address below for further information.

MEETINGS CALENDAR

INFORMS San Diego Spring 1997 Meeting
4 - 7 May 1997
Town and Country Hotel, San Diego CA
General Chair: Fred Raafat, San Diego State University, College of Bus. Adm. San Diego, CA 92182

9Th Informs Applied Probability Section Conference
30 June to 2 July 1997
Cambridge Mariott Hotel, Cambridge, MA
For more information e-mail: ap97@bu.edu

INFORMS Barcelona 1997 International Meeting
7 - 10 July 1997
Barcelona, Spain
Call for papers: title and abstract of no more than 100 words, incl. keywords, plus paper fee of US $75 by 30/11/96
Organizing Chair: Jaime Barcelo, Navarro Reverter 33, Barcelona 08017, Spain
e-mail: BARCELO@EIO.UPC.ES

5Th Int. Conference Of The United Kingdom System Society
7 - 11 July 1997
De Montfort University and The Open University, Milton Keynes
Theme: Systems for sustainability: people, organisations, and environments
Call for papers: Abstract of max. 300 words by 31/7/96 (sorry! Try for a late entry!)
For more details e-mail: uksconf@dmu.ac.uk
or Prof. Ray Ison: r.l.ison@open.ac.uk

Portland Int. Conf. On Management Of Engineering Technology
27 - 31 July 1997
Portland State University, Oregon
Call for papers: Title and 50 word abstract with keywords by 31 August 1996
For more details, see http://www.emp.pdx.edu
or e-mail: picmet@emp.pdx.edu

Iasted Int. Conf. On Applied Modelling and Simulation
27 July - 1 August 1997
Banff (beautiful), Canada
Call for papers: 3 copies of paper (max. 12 double-spaced pages inclusive) by January 13 1997.
Contact: IASTED Secretariat AMS'97, #80, 4500 16th Ave. NW, Calgary, Alberta T3B 0M6, Canada
e-mail: iasted@cadvision.com

INFORMS Dallas Fall 1997 Meeting
26-29 October 1997
Hyatt Regency, Dallas, Texas
Paul Jensen, University of Texas, Dept. of Mech. Eng., 62200, Austin, TX 78712

Int. Conf. on OR and Management Science: Icorms - Icord 1997
25-28 November 1997
Manila Mandarin Hotel, Metro Manila, Philippines
Call for papers: 200 word abstracts by 15/2/1997
Contact: Dr Elvira A. Zamora, College of Bus.Ad., University of the Philippines, Diliman, Quezon City 1101
e-mail: elvira@mnl.sequel.net

APORS'97 — The Fourth Conference of the Association of Asian-Pacific OR Societies within IFORS
Nov 30 - Dec 4 1997
Theme: "Coexistence Between Human, Natural & Technological Resources"
World Congress Centre, Melbourne, Victoria, Australia
Call for papers: Abstract (title, authors, affiliation, address) of max. 150 words due 28/2/1997
For submission information details visit our web site
http://www.maths.mu.oz.au/~worms/apors/apors.html
and record expression of interest and submit abstract directly into our data-base, or contact:
APORS'97, PR Conference Consultants Pty Ltd, PO Box 326, Balwyn, Vic. 3102
(Pam Richards) e-mail: APORS97@sci.monash.edu.au
phone: +61 3 9816 9111, fax: +61 3 9816 9287

INFORMS/CORS Montreal Spring 1998 Meeting
26 - 29 April 1998
Queen Elizabeth Bonaventura Hilton, Montreal, Canada
General Chair: Paul Mireault, École des Hautes Études Commerciales,
5255 Avenue Decelles, Montreal, Quebec
e-mail: Paul.Mireault@HEC.CA

INFORMS Israel International Meeting 1998
28 June - 1 July 1998
Chair: Jacob Hornik, Tel Aviv University, Recanati Grad. School of Mgt., Ramat Aviv 69978, Israel

INFORMS Seattle Fall 1998 Meeting
25-28 October 1998
Seattle, Washington
Chair: Marisa Altchuler, Boeing Computer Services, P.O.Box 24346 M/S 7A TH, Seattle WA 98124-0346

IFORS'99 Beijing
If you want to be on the mailing list e-mail: ifors99@amath11.amt.ac.cn
(Note 11 is eleven)

WHAT IS OPERATIONAL RESEARCH?

Operational Research is the scientific approach to solving management problems. Using observation, data and analysis, the OR practitioner builds up quantitative relationships, called models. Models that take an overall system view help management make informed decisions.

The Secretary
Operational Research Society of New Zealand
PO Box 6544, Wellesley St, Auckland

Please enrol me as a member of the Operational Research Society of New Zealand, at the membership grade indicated below. I enclose the appropriate fees*.

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