Newsletter

Operations Research Society of South Africa
Operasionele Navorsingsvereniging van Suid-Afrika

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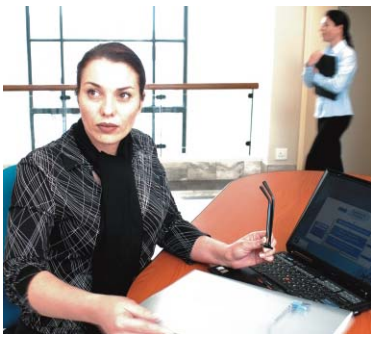

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FROM THE PRESIDENT'S DESK

By Marthi Harmse (marthi.harmse@sasol.com)
ORSSA President

Marthi Harmse

This is the first letter to you from my desk (or rather notebook) for 2006 and for my term as president. Looking country-wide and world-wide, there is a lot going on which I could write about, but much of these proceedings might cause some negative thoughts in some of us. Without introducing a new kind of Operations Research – originating in South Africa it could be referred to as ostriching OR – I would like to focus on the positive side of things.

Many of the issues I would like to ignore were fiercely debated in the forerun to the local elections. Things like poor service delivery. But come to think of it, I believe people like us could make a worthwhile contribution to address issues such as poor service delivery. We could assist local government with their financial planning and better preparation for elections, advise with respect to better water and electricity provision, help design better road, rail and harbour infrastructures, help education institutions to achieve better timetables and better identification of learners at risk, assist small entrepreneurs to be more successful, help people in the tourism industry – including ecotourism – to be more successful, help to improve the sustainability of our natural resources (such as our game parks, mining industry and water and energy management), assist with better organization of events such as the upcoming soccer world cup, help to address unemployment questions, assist our industries and businesses with better decision support systems, help organizations to improve the management of their projects and knowledge, help investors to make better decisions, assist with crime prevention, inform with respect to improved availability of blood where and when needed, assist hospitals to improve the admission of patients, inform with respect to better humanitarian logistics, help to locate and destroy war mines, etc. Right now we are organizing national, African and international conferences, and in doing so, we promote various beautiful regions of our country.

This letter now starts reading like many of the campaigns I have seen recently. Maybe we should forget about ostriching OR and establish yet another political party – we might call it the New Operations Research Party with the motto *Operations Research for Real Change*. Not new because this would be a new type of OR – since its very beginnings OR was about real change. Furthermore, many projects similar to the ones mentioned above were presented at recent and less recent OR conferences and reported on in different OR and OR related journals.

It seems that I could indeed write an optimistic letter at the beginning of this great year lying ahead of us, but without ignoring what is happening around us. Instead of introducing a new kind of OR or establishing a new political party, maybe we could simply raise awareness about ORSSA and what we have to offer?

All the best for the year ahead. ♦

Features

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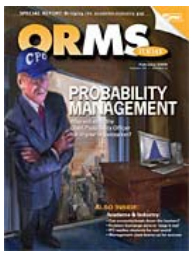

ORMS Today's

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FROM THE EDITOR

Cobus Potgieter

I want to start off by wishing all our members the best for the rest of the year. As Marthi stated we are faced with numerous challenges in this country and it seems that they are growing every year. The power failures we experienced in the Western Cape were somewhat inconvenient, but resulted in new opportunities and innovative ideas. This might be the right way to look at it as operations research practitioners!

In the main article Jan van Vuuren discusses the issue of scheduling spouse-avoiding mixed doubles tounaments. He explains why this is such a difficult task and how mathematics can help solve this problem. This is a beautiful example of a practical problem being solved using mathematics.

An article by Jan Greben was published in the October 2004 edition of the Newsletter regarding predictions on the outcome of the 1994 South African elections. The CSIR was again involved in predictions of the recent local election outcome and the results are discussed in this issue. A paper titled "A model for election night forecasting applied to the 2004 South African elections" by Jan Greben, Chris Elphinstone and Jenny Halloway, describing the election forecasting methodology, is scheduled to appear in Volume 22(1) of ORiON, due out in June 2006.

The book review by Hans Ittmann is a glance at the past of Operations Research. Historic events and the birth of Operations Research is discussed in chronological order to put it into perspective.

The newsletter also includes the names and pictures of the 2006 ORSSA executive committee and is concluded with some general information regarding ORSSA.

Until next time,
Cobus

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CSIR Election Forecast Adds Value To Analysis Of Voting Patterns

Deidre Lotter for CSIR

Accurate forecasting of results and analysis of voting trends by the Council for Scientific and Industrial Research (CSIR) contributed significantly to a raised level of discussion among political commentators during last week's local government elections.

"With 10% of the results available at 02:52 on Thursday morning 2 March 2006, the CSIR team predicted that the ANC's national results would be 66.5%, the DA's 17.2% and the ID's 2.4%," says Dr Jan Greben, project leader of the CSIR team. "The actual numbers reported by the IEC at that time were 62.6%, 22.6% and 3.4% respectively. Hence, our numbers were close to the final results for these parties (65.8%, 16.4% and 2.2%, respectively) at a time when the actual results still differed significantly from the final ones." At the same time, the CSIR predicted a voter turnout of 48.7%, with the final number being 46.8%.

"These forecasts continue our record of accurate prediction of results in the 1999, 2000 and 2004 elections," says Hans Ittmann, media spokesperson for the CSIR team and manager of the CSIR Built Environment's logistics and quantitative methods competence area.

Contracted by the SABC, the CSIR team worked in shifts around the clock from 1 March at the IEC headquarters in Pretoria.

"An exciting new aspect of our work is the development of trend matrices, a type of analysis that has not been available before," explains Greben. The quantitative theory of trend analysis was developed at the CSIR after the 2004 elections, and was presented at the CSIR Research and Innovation Conference in February. This theory makes use of the election results in all 19 000 voting districts to trace the movement of voters between parties in subsequent elections. Such an objective analysis is of great value to political analysts, as Professor Susan Booysen from the University of the Witwatersrand confirmed.

One of the CSIR team's critical predictions concerned the outcome of the election in the Cape Town Metro. "With 44% of the results available, we forecast that the DA would win the election in the municipality, with the ID holding the balance of power," says Ittmann. "Based on our prediction, the SABC put out a news bulletin that was subsequently quoted nationally in both the print and electronic media."

Both Greben and Ittmann emphasise the scientific nature of the CSIR's contribution. "We are not political commentators or analysts; our role is the application of mathematical and statistical tools to enable a more sophisticated forecast and analysis of voting trends and patterns, thus raising the level of political discussion." ♦

Spouse-avoiding Mixed Doubles Tennis Tournaments

By Jan van Vuuren (vuuren@sun.ac.za)

Introduction

A *spouse-avoiding mixed doubles tennis tournament of order n* is an arrangement (called a *resolution*) of tennis matches for n married couples so that they compete in a minimum number of rounds (during which matches occur simultaneously) in such a way that:

1. no player is partnered with or against his/her spouse,
2. each player opposes each other player of the same sex *exactly once*, and
3. each player is partnered with and opposes each player of the opposite sex *exactly once* (see, for example, Wallis [9] or Colbourn & Dinitz [3], Part V, Section 7.11).

If the men and women comprising the married couples are enumerated by means of the indices 0, … , $n-1$ in such a way that man i is married to woman i for all $i = 0, \ldots, n-1$, then a match in the tournament may be denoted as a grid of the form

i	j
k	ℓ

$\leftarrow$ men

$\leftarrow$ women

in which the top row is reserved for the men and the bottom row for the women competing in the match. The double vertical lines represent the net and hence in the match above man i and woman k oppose man j and woman ℓ. To resolve a tournament as described above, $2(n-1)$ copies of the elements of the set $\mathbf{Z}_n = \{0, \ldots, n-1\}$ have to be arranged into $n(n-1)/2$ grids of the form shown above, in such a way that

1. each *unordered* pair of $\mathbf{Z}_n$ occurs exactly once in both the top and bottom rows of the combined grids,
2. each *ordered* pair of $\mathbf{Z}_n$ occurs exactly once on a [NW-SE or NE-SW] diagonal and as a column of the combined grids.

For example, suppose $n = 4$, then a resolution of the spouse-avoiding mixed doubles tennis tournament is shown below.

Match 1	Match 2	Match 3	Match 4	Match 5	Match 6
0 1 / 3 2	2 3 / 1 0	0 2 / 1 3	1 3 / 0 2	0 3 / 2 1	1 2 / 3 0
Round 1		Round 2		Round 3	

These six matches may be scheduled into a minimum of three rounds in which matches may be played simultaneously, as indicated above. Two questions immediately arise concerning the process of automated design of such a tournament:

1. how may the matches to be played in a spouse-avoiding mixed doubles tennis tournament be resolved in a systematic manner?
2. how may the matches be scheduled into the minimum number of rounds in a systematic manner?

The problem of tournament match resolution

In 1972 the director of the Briarcliff Racquet Club in New York conceived the notion of a spouse-avoiding mixed doubles tennis tournament, as described in the introduction. The mathematician AJ Hoffman was a member of this club and was accordingly assigned the task of designing a schedule for such a tournament. He realised that the notion of a Latin square occupies a central role in the construction of spouse-avoiding mixed doubles tennis tournaments. A *Latin square of order n* is an $n \times n$ array containing n distinct symbols, such that each symbol appears (exactly once) in each row and in each column of the array. An example of a Latin square of order 5 containing the symbols in $\mathbf{Z}_5$ is

$$L_1 = \begin{bmatrix} 0 & 4 & 3 & 2 & 1 \\ 2 & 1 & 0 & 4 & 3 \\ 4 & 3 & 2 & 1 & 0 \\ 1 & 0 & 4 & 3 & 2 \\ 3 & 2 & 1 & 0 & 4 \end{bmatrix}.$$

Two Latin squares are said to be *orthogonal* if the superposition of one onto the other is an $n \times n$ array in which all n^2 ordered pairs are different. For example, the Latin square L_1 above and the Latin square

$$L_2 = \begin{bmatrix} 0 & 2 & 4 & 1 & 3 \\ 4 & 1 & 3 & 0 & 2 \\ 3 & 0 & 2 & 4 & 1 \\ 2 & 4 & 1 & 3 & 0 \\ 1 & 3 & 0 & 2 & 4 \end{bmatrix}$$

are orthogonal, because their superposition

$$(L_1, L_2) = \begin{bmatrix} (0,0) & (4,2) & (3,4) & (2,1) & (1,3) \\ (2,4) & (1,1) & (0,3) & (4,0) & (3,2) \\ (4,3) & (3,0) & (2,2) & (1,4) & (0,1) \\ (1,2) & (0,4) & (4,1) & (3,3) & (2,0) \\ (3,1) & (2,3) & (1,0) & (0,2) & (4,4) \end{bmatrix}$$

contains all 25 possible ordered pairs that may be formed from $\mathbf{Z}_5$ (if symbol repetition is allowed in the pairs). The *transpose* of a Latin square is obtained by swapping its rows and columns, and is denoted by means of a "T" superscript. We have, for example, that $L_1^T = L_2$. If a Latin square and its transpose are orthogonal, as is the case with L_1 above, the Latin square is said to be *self-orthogonal*. The following existence results are well known.

Theorem 1. There exist Latin squares of all orders $n \in \mathbf{N}$. ■

Theorem 2. There exists a pair of orthogonal Latin squares of order n for all $n \in \mathbf{N}$, except for $n = 2$ and $n = 6$. ■

Theorem 3. If $n \neq 2 \pmod 4$ and $n \neq 3, 6 \pmod 9$ then there exists a self-orthogonal Latin square of order n. ■

Proving Theorem 1 is a simple matter, using techniques from the mathematical sub-discipline of *group theory* (although the result seems to be folklore, the interested reader is referred to Grimaldi [4], Section 17.2 or to Theorem 1.1 in Laywine & Mullen [6]). However, the proof of Theorem 2 is far from trivial, and the theorem has a long and illustrious history, having started its life (in a more restricted form) as a slightly flawed conjecture by the great Leonhard Euler on a problem involving the placement of 36 officers in a platoon, and was finally proven (in corrected form) by Tarry [8] in 1900. Theorem 3 was proved by Mendelsohn [7] in 1971 and involves the notions of the *prime decomposition* of the order n and the *Kronecker product* between matrices. The theorem is not a characterisation, in the sense that is does *not* claim that self-orthogonal Latin squares of order n, where $n \equiv 2 \pmod 4$ or $n \equiv 3, 6 \pmod 9$ do not exist.

Hoffmann made the link between spouse-avoiding mixed doubles tennis tournaments and self-orthogonal Latin squares in 1973 by proving the following remarkable theorem, in collaboration with Brayton and Coppersmith [2].

Theorem 4. A resolution of a spouse-avoiding mixed doubles tennis tournament of order n exists if and only if a self-orthogonal Latin square of order n exists. ■

If the (upper-diagonal) entry in row i and column j of a self-orthogonal Latin square L of order n is given by ℓ_{ij}, then a match in a spouse-avoiding mixed doubles tennis tournament of order n may be constructed as

i	j
ℓ_{ij}	ℓ_{ji}

← men

← women

Note that, in order to avoid pair repetition in the transposition (L,L^T), pairs of elements of the form (k,k) from $\mathbf{Z}_n$ have to occur on the diagonal of (L,L^T), because L is self-orthogonal. Since each row of L contains each symbol in $\mathbf{Z}_n$ exactly once, each man will team up with each woman exactly once if a match of the structure shown above is formed from each of the $n(n-1)/2$ upper-diagonal entries of L. Furthermore, since each column of L contains each symbol in $\mathbf{Z}_n$ exactly once, each man will oppose each woman exactly once if a match of the structure shown above is formed from each upper-diagonal entry of L. Also, because each ordered pair of $\mathbf{Z}_n$ (in which repetition of elements of $\mathbf{Z}_n$ is allowed) occurs exactly once when L is superimposed onto L^T, it follows that each *un*ordered pair of $\mathbf{Z}_n$ appears exactly once amongst the upper-diagonal entries of L (when repetition of elements from $\mathbf{Z}_n$ is disallowed) and hence the women will oppose each other exactly once if matches are resolved from the upper-diagonal entries of L only. Moreover, spouses will never play in the same match, because diagonal entries of L are avoided. Finally, the men will oppose each other exactly once, because the men are represented by the row and column indices of L, and all upper-diagonal entries are considered.

For example, the female team mates in the game in which man 0 and man 1 oppose each other are woman 4 and woman 2 respectively, because the entry in row 0 and column 1 of (L_1,L_1^T) is (4,2) – or equivalently, because the entries in (row 0, column 1) and (row 1, column 0) of L_1 are 4 and 2 respectively. If we continue in this fashion the matches in a spouse-avoiding mixed doubles tennis tournament of order 5 that correspond to the self-orthogonal Latin square L_1 above, are given by

Match 1	Match 2	Match 3	Match 4	Match 5
0 1 4 2	0 2 3 4	0 3 2 1	0 4 1 3	1 2 0 3
Match 6	**Match 7**	**Match 8**	**Match 9**	**Match 10**
1 3 4 0	1 4 3 2	2 3 1 4	2 4 0 1	3 4 2 0

It follows from Theorem 4 and by the construction method above that the quest to automate the resolution process for matches to be played in a spouse-avoiding mixed doubles tennis tournament is reduced to the question of automating the process of self-orthogonal Latin square construction.

The problem of scheduling matches into the minimum number of rounds

The resolution of matches into the minimum number of rounds that may be played simultaneously is not accommodated in the approach outlined in the previous section. However, Hoffmann also noticed that if a symmetric Latin square S can

be found that is orthogonal to the self-orthogonal Latin square L mentioned in the previous section, then the tournament matches resolved by L may be scheduled into a minimum number of rounds according to the structure of S. Here the adjective *symmetric* means that the Latin square S is its own transpose (*i.e.*, $S = S^T$). For example, consider the symmetric Latin square

$$S_1 = \begin{bmatrix} 0 & 3 & 1 & 4 & 2 \\ 3 & 1 & 4 & 2 & 0 \\ 1 & 4 & 2 & 0 & 3 \\ 4 & 2 & 0 & 3 & 1 \\ 2 & 0 & 3 & 1 & 4 \end{bmatrix}.$$

This Latin square S_1 is orthogonal to the self-orthogonal Latin square L_1 given in the previous section, because all 25 ordered pairs in the superposition

$$(L_1, S_1) = \begin{bmatrix} (0,0) & (4,3) & (3,1) & (2,4) & (1,2) \\ (2,3) & (1,1) & (0,4) & (4,2) & (3,0) \\ (4,1) & (3,4) & (2,2) & (1,0) & (0,3) \\ (1,4) & (0,2) & (4,0) & (3,3) & (2,1) \\ (3,2) & (2,0) & (1,3) & (0,1) & (4,4) \end{bmatrix}$$

are different. The symmetric orthogonal mate S may be used to schedule the matches resolved by L, by requiring the match in which man i and man j are partnered with woman ℓ_{ij} and woman ℓ_{ji} respectively (as dictated by two entries in L) to be played in round s_{ij}, where s_{ij} denotes the entry in row i and column j of S. For example, match 1 in the example where $n = 5$ in the previous section should be scheduled in round 3, because in that match man 0 and man 1 oppose each other, and the entry in row 0 and column 1 of the Latin square S_1 is 3. Continuing in this fashion, the schedule

Round 0: | 1 | 4 | / | 3 | 2 | | 2 | 3 | / | 1 | 4 | Couple 0 has a bye

Round 1: | 0 | 2 | / | 3 | 4 | | 3 | 4 | / | 2 | 0 | Couple 1 has a bye

Round 2: | 0 | 4 | / | 1 | 3 | | 1 | 3 | / | 4 | 0 | Couple 2 has a bye

Round 3: | 0 | 1 | / | 4 | 2 | | 2 | 4 | / | 0 | 1 | Couple 3 has a bye

Round 4: | 0 | 3 | / | 2 | 1 | | 1 | 2 | / | 0 | 3 | Couple 4 has a bye

is obtained. This schedule comprises the minimum number of rounds, because more than two matches per round is clearly impossible (there are only five people of each sex) and hence a schedule with fewer than $10 \div 2 = 5$ rounds does not exist when $n = 5$. The question is therefore, when such a symmetric orthogonal mate S may be found for a self-orthogonal Latin square L of order n. The following theorems answer this question (partially).

Theorem 5. Suppose L is a self-orthogonal Latin square of order $n = p^t \neq 2^1, 3^1$, where p is prime and t is a natural number. Then L possesses a symmetric orthogonal mate S. ■

Theorem 6. Suppose L is a self-orthogonal Latin square of order n, where $\gcd(n, 6) = 1$. Then L possesses a symmetric orthogonal mate S. ■

Theorem 5 (in a slightly different form) is originally due to

Mendelsohn [7]. In Theorem 6 the notation gcd(n, 6) = 1 means that n and 6 have no common factors (except 1), *i.e.* that n does not have a 2 or a 3 in its prime decomposition, and the theorem is due to Wallis [9]. The proofs of both Theorems 5 and 6 are constructive in the sense that they actually provide methods for the construction of L and S – they do not merely establish their existence. However, these methods are based on arithmetic over *Galois fields* and hence fall outside the scope of the current article, but the reader is referred to Jooste [5] for a concise and self-contained explanation of the proofs.

Open questions

The problems of resolving a spouse-avoiding mixed doubles tennis tournament of order n into matches and scheduling these matches into the minimum number of rounds have been solved, by the methods described in Sections 2 and 3, when n is a prime power or when n has no factors (other than 1) in common with 6, *i.e.* for the values n = 4, 5, 7, 8, 9, 11, 13, 16, 17, 19, 23, 25, 29, 31, … (optimal playing schedules for these cases may be found in Jooste [5]). However, for the remaining values, n = 6, 10, 12, 14, 15, 18, 20, 21, 22, 24, …, solutions to these problems seem very hard to obtain in a structured manner. It is known that self-orthogonal Latin squares of orders 2, 3, and 6 do not exist. However, for n = 10, Bose *et al.* [1] were only able to produce (as late as 1960!) two Latin squares (not transposes of each other) that are orthogonal, but it is not known whether a self-orthogonal Latin square of order 10 exists. It is believed that self-orthogonal Latin squares may be constructed by methods from the mathematical sub-discipline of *design theory*, but such constructions will likely be *ad hoc* (for specific values of n) and not a structured approach that is valid for whole classes of values of n.

However, certain advances have been made towards solving the problems of match resolution and match scheduling into rounds for spouse-avoiding mixed doubles tennis tournaments, by relaxing the requirements of the tournament, to something like the following:

1. no player is partnered with or against his/her spouse,
2. each player opposes each other player of the same sex *at least once*, and
3. each player is partnered with and opposes each player of the opposite sex *at least once*.

For such relaxations the playing schedules are, however, not optimal, in the sense that a certain amount of redundancy occurs (such as players being partnered with players with whom they have teamed up before, just to be able to oppose players that they have not encountered before).

The problem of resolving spouse-avoiding mixed doubles tennis tournaments into matches played in the minimum number of rounds therefore seems far from being solved completely, and the outstanding cases of this problem represent a serious challenge to the mathematically inclined operations researcher!

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A snapshot of the output from the computer program written by Jooste [5] to schedule the matches for each round of a spouse-avoiding mixed doubles tennis tournament.

SAS® SOFTWARE FOR FINANCIAL INTELLIGENCE

Going beyond Basel II

Written by André Zitzke - SAS, Risk Product Manager

Financial services companies have always been on the leading edge of technology because technology facilitates processes which, in turn, generate higher revenues. Regardless of the market or whether the value of equities rises or falls, companies that manage their transaction risks well make money. Several changes in the recent past, including the globalisation and deregulation of the financial services industry have brought the industry to new levels of complexity and have caused a geometric rise in the number of transactions and activities. This activity has brought increased attention to the financial services industry by regulatory bodies, which argue that without oversight, the collapse of a single large financial organisation could start a domino effect and wreak havoc on the world economy.

There are really two balancing acts going on at the same time: the balance between the parties that have a common interest (corporation/investor, financial institution/account holder) and the balance between the regulator and the regulated (Local regulator/Local financial services companies, Basel II Committee/European Union financial services companies, U.S. Securities and Exchange Commission/U.S. corporations).

Although various projects to comply with Basel II have been running for a few years now huge pressure is building to have them completed by the looming deadlines. As these projects move forward management is looking at what next? Looking beyond economic capital is the immediate attention grabber while managing risk to create more value has a longer range focus.

Basel II implementations are the first projects for all involved, financial institutions, regulators and vendors alike. This brings its own set of unique challenges. The Basel II documents are guidelines, implementation specifics are formulated by regulators and the financial institutions. Interpretation of the Basel II accord is sometimes lengthy. Once done the implementation starts.

Early experiences are that data integration is still the major challenge as with most IT projects. Investing in an advanced analytical engine that will serve the institution well beyond the current Basel II requirements is the next technology challenge.

Technology is only the enabler in this quest to manage risk as opposed to measuring it. As with many things in life, to skip a step in process can have dire consequences.

Coming to grips with measuring risk using Basel II is presently causing sleepless nights.

Some of the major areas that institutions are looking to technology providers for are:

- A comprehensive risk data model, that facilitates development of a single customer view
- Processing efficiency and scalability, that avoids duplication
- Advanced analytics which extend well beyond the Basel II requirements
- Capabilities to consolidate multiple risk platforms and related environments within the institution including direct access to the ERP systems
- Extensive and flexible reporting capabilities including regulatory templates
- Multi-national RWA estimation capabilities

Specifically in the retail arena being able to understand what drives customers to default assist greatly in adopting and enhancing strategies to attract better customers and to develop better customer fitting products. With flexible technology the same environment will also be able to validate current score cards. Transparency during the whole process is an absolute requirement from Basel II.

What good is the all powerful analytics if the results from all that hard work cannot be consolidated and aggregated for reporting that satisfies regulatory requirements as well as the different internal risk requirements. Reporting templates help to speed up the process of report development in a resource scarce industry. Flexibility in reporting capabilities goes a long way in satisfying unique requirements across the enterprise.

Implementation experience adds the cherry on the top. Learning from past experiences and being able to avoid the pains other similar institutions make the road ahead a lot smoother.

Beyond the technology the technology provider is becoming more and more critical in the decision making process. Providers that have a proven track record in analytics and data management have a clear advantage. Other important criteria are financial stability and growth. The provider must be in it for the long haul. Investment in research and development give a good indication who will keep up to date with continuous changes in this industry. Current customers, big and small, across geographies, give a good indication of the knowledge required to implement these technical projects. Market validation from independent analysts is always helpful to work through the marketing messages.

Financial institutions regulators and vendors are ascending this curve bravely. Riding this curve out to get optimal business value to all stakeholders will score maximum points.

ORSSA Executive 2006













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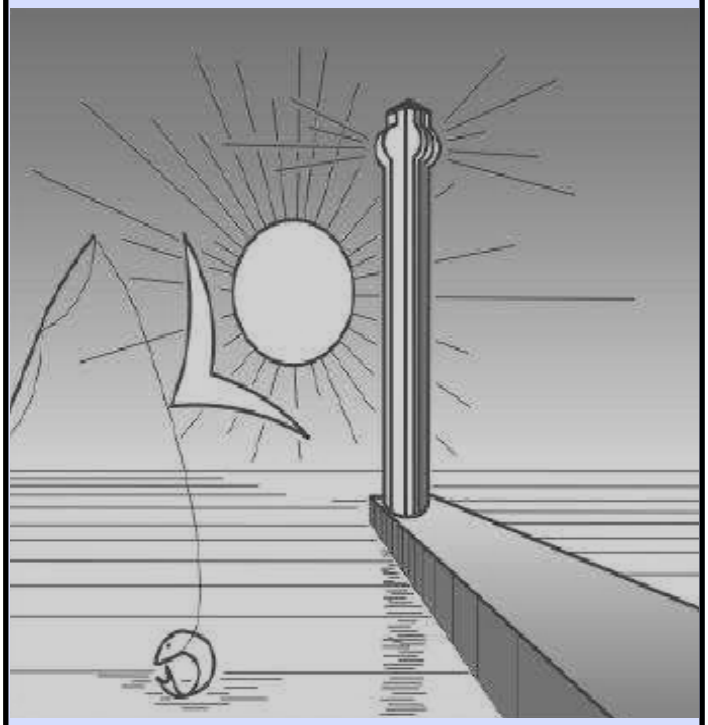

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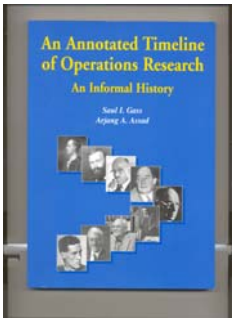
BOOK REVIEW

By Hans Ittmann hittmann@csir.co.za)



***An Annotated Timeline of Operations Research; An Informal History* by Saul I. Gass and Arjang A. Assad, 2005. Kluwer Academic Publishers B.V., New York, USA. pp. 213. ISBN 1-4020-8116-2(pbk), USD 29.95.**

An Annotated Timeline of Operations Research: An Informal History is the latest addition to the growing literature on the history of Operations Research (OR). OR, as a discipline, formally came into existence during World War II. However, the origins of OR can be traced further back. As with all scientific fields, OR has its own "pre-history" dating back to Biblical times and consisting of events, ideas, people and methods that contributed to the field even before its official birth. In this book the authors trace OR's history back to 1564 beginning with *The Book of Games and Chance*. This is followed by short descriptions of important events over the period 1564 to 2004, and why these events are considered important. A number of relevant references are listed with pictures of the authors where applicable. In addition, short biographical sketches with quotes from the authors or others are presented where available. In this regard the title of the book accurately reflects its content.

The annotated timeline is divided into eight periods in separate chapters. The chapters are titled:

- OR precursors from 1564 to 1873 (18 pages);
- OR precursors from 1881 to 1935 (25 pages);
- Birth of OR from 1936 to 1946 (15 pages);
- Expansion of OR from 1947 to 1950 (19 pages);
- Mathematical, algorithmic and professional development of OR from 1951 to 1956 (31 pages);
- International activities, algorithms, applications, and OR texts and monographs from 1957 to 1963 (29 pages);
- Methods, applications and publications from 1964 to 1978 (29 pages), and
- Methods, applications, technology and publications from 1979 to 2004 (33 pages).

The book concludes with a very useful index of acronyms, names, and subjects.

It is impossible to share everything that is contained in this text. Aspects that attracted the attention of the reviewer are, however, highlighted, although other readers may find different events more attractive.

In the preface the definition of OR caught the eye and it is good to be reminded regularly of what OR actually entails. The definition given is: "Mathematical or scientific analysis of the systematic efficiency and performance of manpower, machinery, equipment, and policies used in a governmental, military or commercial operation". OR is therefore not considered a natural science; neither is it a social science. Its distinguishing characteristic is that OR applies its scientific and technological base to resolving problems in which the human element is an active participant. OR is the science of decision-making, the science of choice and thus the science of better! The statement that OR is not a natural science is debatable and for another discussion.

In the first time period covered by the book, the Königsberg bridge problem, which led to the establishment of the theory of graphs by Leonhard Euler, still fascinates. In the city of Königsberg there was a seven-bridge configuration and the question was whether it was possible to cross the seven bridges and return to the starting point in a continuous walk without re-crossing any of the bridges. This work dates back to 1736. Another interesting historical piece describes Lagrange multipliers which originated in 1788.

The facility location problem as we currently understand it was first formulated in 1909. In the 1930s a sixteen-year old Hungarian mathematician analysed the general problem of minimising the distances from the facility to any number of points and proposed a method of solution. He wrote the paper in French and published it in a Japanese mathematical journal. The author was Endre Weiszfeld, later known as Andrew Vazsonyi, after emigrating to the USA. In 2002 Vazsonyi wrote his biography titled *Which door has the Cadillac: Adventures of a Real-Life Mathematician*. The specific problem Vazsonyi worked on is fascinating, as are the peculiarities surrounding him. In this same period Frederick Lanchester developed his differential equations that dealt with the relationship between the concentration of forces and the effective strength of the opposing forces in a battle. The solution of these equations determined the expected results of a combat engagement used in war games. Although not the start of war games, it was possibly the first time that relationships between different forces where presented mathematically.

The period 1936 to 1946 saw the real birth of OR through many military applications. Leontief, the Russian scientist, developed inter-industry economics relationships during 1936 and this prompted Dantzig to develop the general linear programming model. One could say that this was the birth of linear programming, today the most common OR technique.

The travelling salesman problem is credited to Merrill M Flood for popularising this most celebrated combinatorial problem. Flood was exposed to the problem in 1937.

During the same period the research of a number of prominent scientists led to Nobel Prizes. These names include: Leontief, Kantorovich, Blackett (of Blackett circus fame), and Stigler, an economist who first posed the diet problem. The first book on OR titled *Methods of Operations Research* by Morse and Kimball appeared in 1946, but it was classified and was only released as an unclassified text in 1951.

The ten years after the war saw the expansion of OR into industry, as well as the development of many techniques and algorithms, and was a very fertile period for the discipline. Again, a number of OR scientists involved in research during this period ultimately received Nobel Prizes. One that should be highlighted is an entry dated 1953 with the topic the *Shapley Value*. It addresses the possible answer to the important question of finding a fair distribution of payoff in *n*-person games. The *Shapley Value* may be interpreted as the average marginal contribution of each player when the grand coalition forms, averaged over all *n*! ways in which a coalition can be formed, one player at a time. Lloyd Shapley was the joint-recipient of the Nobel Prize for economics in 2005, over fifty years after he published his initial work on this topic. Herb Simon, also a Nobel laureate, who became interested in the study of decisions when he was only nineteen, introduced the notion of bounded rationality and satisficing in 1955.

OR expanded internationally over the period 1957 to 1963 and more formal activities were initiated. For example, the first IFORS Conference was held and it is known that at least one South African delegate, one R.R. Tunesius, attended.

This period also introduces the reader to more familiar names, some whom are still alive, in the OR environment. Some of the techniques and methods that stand out include industrial dynamics, fuzzy set theory, the delphi method and implicit enumeration. The period following includes new techniques or methods, such as Multiple Criteria Decision-Making (1970), Decision Support Systems (1971) and Soft Systems Methodologies (1972).

The recent past described in the book addresses, inter alia, the Analytic Hierarchy Process, simulated annealing, tabu search and supply chain management. There are obviously many more.

Some specific comments:

- There is possibly too much information and one sometimes feels a bit more about a specific issue would have been appropriate.
- The authors are from the USA and might be biased towards OR in the USA.
- Linked to the above, the emphasis throughout is not on OR applications. This is a pity.
- One serious omission is the "inward-looking crisis" OR went through in the seventies. The well-known paper "the future of OR is past" by Ackoff is not mentioned at all.
- In writing history one should probably rather steer clear of recent years. The authors should have terminated their timeline much earlier than the year 2004. It is just too difficult to achieve an historical perspective on recent developments.
- ORSSA has had several women presidents since its inception in 1969, which indicates active involvement. In this annotated timeline there is mention of only two women.

This book should not be read from cover to cover. It lends itself to paging through and reading interesting short snippets that catch the eye. Throughout the book there are many informative pieces that contributes uniquely to the history of OR. Most of what is contained in this journey through time is of great interest.

I not only enjoyed reading about the various events, but learnt a great deal of OR, proving that one is never too old to learn. Most of the book is an easy-read while being well written.

The discipline needs more of these books on the history of OR. This not only preserves the past, but adds to the richness of what we know as *Operations Research*. ♦

ORSSA General Information

What is ORSSA?

The Operations Research Society of South Africa (ORSSA) exists primarily to further the interests of those engaged in, or interested in, Operations Research activities. ORSSA is continually involved in matters which concern operations researchers, such as drawing up guidelines for OR education, presenting short courses and marketing OR. The Society provides information to the public on the nature of OR and on career opportunities in OR.

At national level the Society is managed by the Executive Committee (EC). In the larger centres activities are arranged by five chapters. The EC is elected annually at an Annual General Meeting (AGM) and the chapter managements at their respective AGM's. The chapter chairpersons also serve on the EC.

ORSSA Annual Conference

The 2006 conference will take place at the Sinodale Centre, c.o. Burger and Boshoff streets, Pietermaritzburg, from 3 September 2006 to 6 September 2006 (Exec meeting only on the 3rd).

The Annual ORSSA Conference is a highlight on the Society's calendar of activities. A list of past ORSSA conferences may be accessed via the *Past ORSSA Conferences* button under *Conferences* on the ORSSA website (www.orssa.org.za). The call for papers and general information on the upcoming ORSSA conference may be accessed via the *Upcoming ORSSA Conference* button under *Conferences* on the ORSSA website.

ORSSA Membership Benefits

By becoming a member of ORSSA you will have access to the following benefits:

1. *Receiving the ORSSA Newsletter.* This newsletter appears three times a year with lots of exciting news and information about OR and ORSSA activities, personalities, international news, book reviews, etc. The new-look format of the newsletter not only renders it a professional publication, but it also allows more space for news items!

2. *Receiving ORiON, the official journal of ORSSA.* This journal has appeared annually for the past twenty two years. It is dedicated to our members and you can use it to publish your work, and read what research fellow OR practitioners do, etc.

3. *Participating in the activities of a local ORSSA chapter.* There should be a chapter in your region and the activities of chapters are dependent on the members' participation! Chapters arganise a wide variety of events annually, including colloquiua, short workshops, cocktail parties, dinners and competitions.

4. *Attending the annual national conference at a reduced rate.* The annual ORRSA conference is a highlight on the calendar of ORSSA. During the conference members have the opportunity to present papers on their research, and to make new OR-related acquaintances (end to renew old ones).

5. *Being afforded opportunities to network with professional peers.* This may be achieved via interaction with the Executive, via the chapters or via the newsletter. Through these interactions members can remain up to speed with developments in the local OR community, share experiences and broaden work-related and personal horizons.

6. *Accessing OR-related job opportunities.* The society has in the past (and will in future) assist members in looking for a position in the field of OR. This is done (i) by placing advertisements of job vacancies in the Newsletter, and (ii) by publishing abbrevated CVs of member job seekers in the Newsletter.

7. *Being considered for the Society's annual awards.* There is an annual student competition, with a cash price attached to it, as well as the coveted Tom Rozwadowski medal for the best published material by a member of ORSSA every year.

Hardcopies of Documents in the Archive

An Archive of records is kept up to date by the ORSSA Archivist. To see a list of all documents in the archive, visit the ORSSA website at www.orssa.org.za.

For more information regarding ORSSA, please visit the website at www.orssa.org.za.

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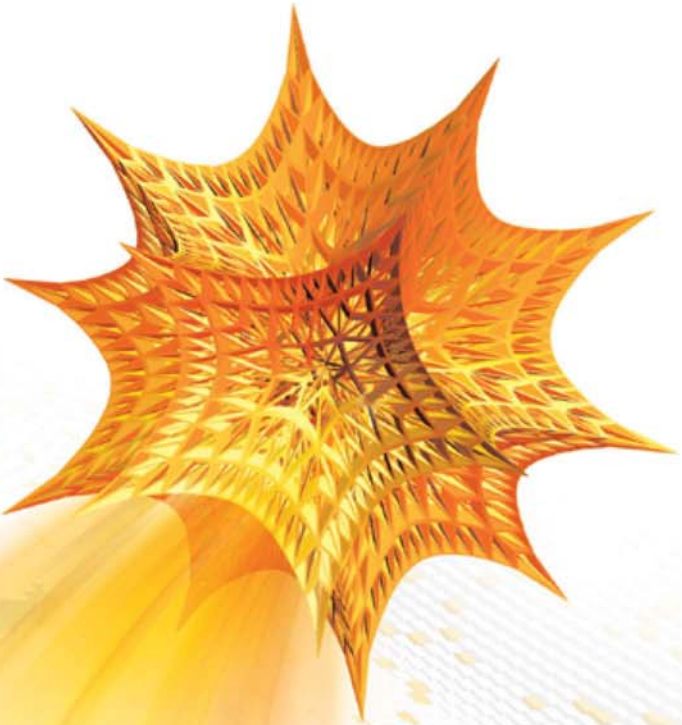

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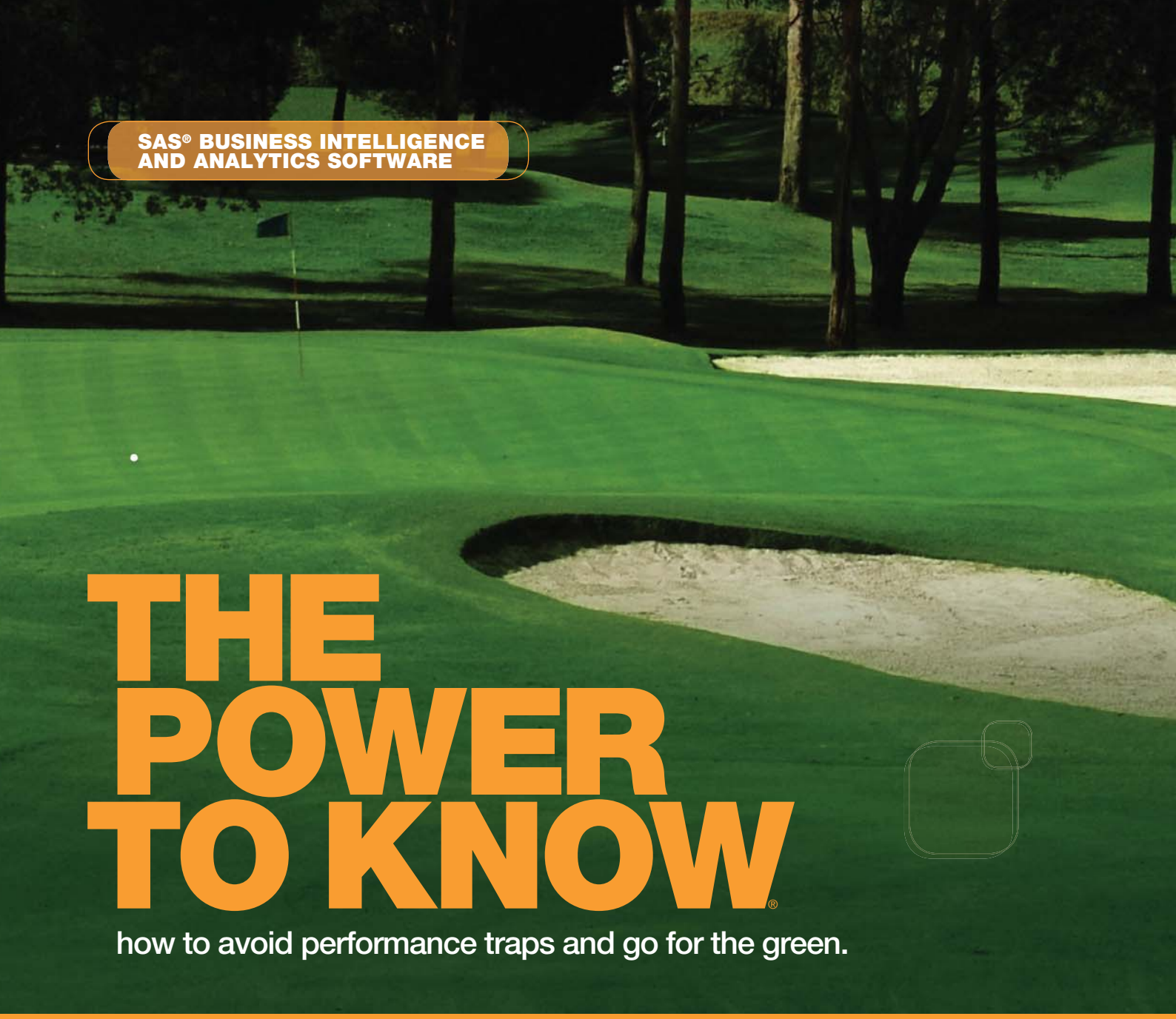

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