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# Timetabling the major English cricket fixtures

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Every year the England and Wales Cricket Board (ECB) has to timetable all the major cricket fixtures in England (plus a few in Wales, Scotland, Ireland and the Netherlands), apart from those international matches which are timetabled by the International Cricket Council. This is a major undertaking which currently involves 21 clubs (mostly representing counties) playing about 420 matches in three overlapping competitions, as well as another 70 or so matches involving women's teams, touring teams, 'A' teams, Under 19 teams and university teams. Some of these matches will require four days, others only a single day or just an evening.

Over the years the structure of the competitions has changed substantially, with no one year being exactly like the last, with the speed of change increasing in recent years. This is likely to continue as the competitive environment changes, as marketers and broadcasters continue to try to maximise their commercial returns and as the cricket authorities continue to strive to produce competitions and formats which best serve the interest of the sport.

The ECB has several stakeholders to consider when timetabling the fixtures, including clubs, spectators, administrators, sponsors, broadcasters and the England national team. It is impossible to give all of these exactly what they want, so the problem inevitably involves compromise, with the aim of giving a good enough outcome for all stakeholders.

For the past 19 years this has been achieved using a semi-automated computer system which has always been successful in producing timetables that are at least satisfactory for everyone. Recently the use of the system has been extended to undertake "what if" exercises for different structures that the ECB are considering. Without such help it could be dangerous for the ECB to decide upon significant changes, since there would always be the danger of unexpected negative consequences, or even of the problem becoming infeasible. All runs are

made by myself, the system creator, rather than by the ECB themselves, as the levels of complexity are so high.

The first stage of the process is to ask the stakeholders what their constraints and preferences are, following which some quick preliminary analysis is undertaken leading to conversations between me and the ECB. For example, in 2010 there was one particular day on which more than half of the clubs in a division wanted a home match, which is clearly impossible, so discussions had to be undertaken before deciding who was going to be disappointed. In addition, there are usually points of clarification to be discussed concerning the precise meaning of the clubs' requests and decisions to be made as to their relative importance. While the main focus is on the 420 matches in the main three competitions, the requirements of the other 70 matches need also to be considered.

The timetabling problem for the matches in the three main competitions is set up as an optimisation model with large numbers of objectives and constraints, derived from a wide variety of stakeholder requirements and preferences. The solution procedure has changed slightly over the years, but has always been some kind of metaheuristic approach. The current method involves a variety of simulated annealing which uses a modified acceptance criterion depending on the effect not only of the overall change in cost but also the change in the individual subcosts, since this is a multi-objective problem.

However, before the whole timetable can be produced, the first stage is to produce matches for TV that satisfy the broadcasters, since they are the most powerful people involved. When doing this it is important to bear in mind the effect of the televised matches on the overall pattern of remaining matches; this effect can be quite substantial, especially for the home/away balance of the 4-day competition. Thus preliminary analysis is essential before selecting possible TV matches, including a series of "what if" runs of the model, so as to ensure that a good schedule can still be produced for the other stakeholders.

When the TV matches have been agreed, the rest of the timetable is addressed. However, this also cannot be a completely automatic process; interaction between user and computer is necessary for a really good solution to be produced. This is mainly because the weightings for the objectives have to be determined to some extent by trial and error; since the nature of the problem changes from year to year, it is never absolutely obvious which will be the hardest criteria to satisfy.

The proposed timetable is given to the ECB, who usually make some requests for minor changes, and further runs are made to try to accommodate these if possible. Then the timetable is passed on to the clubs, and again there will be a few requests for changes, some of which may be reasonable and others not, and of the reasonable ones some will be achievable but others not. Eventually, the modified timetable is accepted and published, and while one or two stakeholders may end up not entirely satisfied with what they have been given, the overall satisfaction levels are high.