



## 2018 IM<sup>2</sup>C Judges Commentary

The IM<sup>2</sup>C judges wish to congratulate all students who participated in IM<sup>2</sup>C 2018. This year's problem posed the decision a patient must make when choosing the most suitable hospital for a particular situation. The task was not only to develop a mathematical model to decide which hospital is the best, but also write a two-page 'user-friendly' memo written for a person without much mathematical expertise or computing ability to use as a guide for choosing a hospital. The first model to be developed was to be based solely on mortality. However, in a second model, students had to choose other factors for selecting a hospital based on well-described information and well-explained assumptions. As in previous contests, the 55 papers representing 30 different countries/regions demonstrated a wide range of creative answers to these problems.

### Characteristics of the better papers

From the 55 papers judged, one was considered to be Outstanding. This was paper [2018064](#) from Radford College, Bruce, Australia. Even though their memo was not the most 'user-friendly' one, the explanation of their model was excellent. In their model, the team made a very interesting distinction between 'process factors' and 'outcome factors'. Also, the arguments the team provided in their choice of factors was well explained, and the information they found on the internet was well incorporated and justified in their work. And this is really an important thing for judging the IM<sup>2</sup>C: if any information or formulae are found anywhere in books or on the internet, it is absolutely necessary to explain why this is relevant and applicable in the modeling process for the given problem. As an example, in paper [2018023](#) the Gini-index is used in the model, and how this index (from economics) is used is very nicely described and explained.

Of course, the first thing that is judged is the one-page summary. This summary should not only summarize the team's approach taken and results reached, but also serve as an invitation to the reader to read the rest of the paper. A good example of a well written summary can be found in paper [2018051](#). Also, the process of building the model (the step-by-step description of how the model is constructed) is a point of great interest and importance. Papers [2018043](#) and [2018004](#) are two papers where this was done very nicely.

Another point of attention might be a bit strange at first sight: the use of really advanced mathematics is not obligatory to making a good model. It is obvious that a model must not be too simple, but some papers showed a very nice, well-developed model without excessive use of advanced mathematical formulae. Similarly, computer programs can be of great assistance, especially in solving the actual problem by applying the model developed. But computer codes are not likely to be read by the judges. Therefore, a good explanation of the logic employed in any computer program constructed should be placed in the actual paper. Team [2018004](#) did this very nicely by putting a self-explanatory flowchart of their algorithm in their paper.

One challenge faced by most teams is that in the second model, several aspects had to be taken into account to measure the quality of the hospital. Typically, each factor was originally available measured in completely different scales. Hence, the use of a proper scaling system to unify the different measurements was essential. An example of how this was done with the aid of the normal distribution can be found in paper [2018032](#). Another challenge was deciding how to weight the various factors that teams decided to consider in their model. A nice aspect in several papers was the use of real data, found on the internet. In paper [2018055](#) real data was implemented nicely in the development of the model. The judges realized it was not possible for all students to get easy access to data concerning diseases, mortality and hospitals in a more general sense. Therefore, we sometimes had to judge descriptions of proposed methods without the actual data being presented.

### **Some shortcomings and advice for future participants**

- The patient-friendliness of the “user memo” was something to which several teams did not pay enough attention. Certainly, paper [2018021](#) did! Some papers showed some kind of summary of all the work done, or a written description of the mathematics used, but this was not the stated objective of the memo. So please take careful notice of what is required in the problem statement.
- An analysis of the strengths and weaknesses of the model is something that should always be present, and unfortunately some teams failed to do this. A model can hardly ever be perfect after five days of work, so some reflection on the work done is an important element of a good paper.
- As said before, the explanation of mathematics used is of great importance, since in modeling the construction and explanation of the model is an essential part of the work. The use of unexplained formulae is seen as a serious weakness in the development of a mathematical model.
- As mentioned in the instruction, the use of computer programs is allowed and often quite appropriate, but the programs cannot be read by the judges. It is advised to describe any computer program used in the paper, and the use of a flowchart might be an efficient way to express the logic used in constructing the algorithm.
- The model should always ‘stay in touch with reality’. Unfortunately, some teams made very sophisticated models that turned out to be quite unusable for the given situation.

Finally, please realize ‘Outstanding’ does not mean ‘Perfect’. This is because writing a perfect paper in five days on a situation as complex as this year’s IM<sup>2</sup>C problem is quite impossible for secondary school students - as it would probably be for graduated mathematicians as well! Therefore, the IM<sup>2</sup>C judges give their compliments to all students who participated in IM<sup>2</sup>C 2018, no matter if their paper was judged as a Successful Participant, Honorable Mention, Meritorious or Outstanding. Well Done!!

### **Team Reference**

- [2018004](#) - Shanghai Experimental School, China (Meritorious)
- [2018021](#) - Beijing Academy, China (Honorable Mention)
- [2018023](#) - Pui Ching Middle School, Macau (SAR) (Honorable Mention)
- [2018032](#) - The Masters School, NY, USA (Meritorious)
- [2018043](#) - Bilingvalne Gymnasium, Slovakia (Honorable Mention)
- [2018051](#) - American School of Dubai, United Arab Emirates (Honorable Mention)
- [2018055](#) - Walnut Grove Secondary, Canada (Honorable Mention)
- [2018064](#) - Radford College, Australia (Outstanding)