Judges' Commentary: The Frank Giordano Award for 2014

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Introduction

For the third year, the MCM is designating a paper with the Frank Giordano Award. This designation goes to a paper that demonstrates a very good example of the modeling process. Having worked on the contest since its inception, Frank Giordano served as Contest Director for 20 years. As Frank says,

> It was my pleasure to work with talented and dedicated professionals to provide opportunities for students to realize their mathematical creativity and whet their appetites to learn additional mathematics. The enormous amount of positive feedback I have received from participants and faculty over the years indicates that the contest has made a huge impact on the lives of students and faculty, and also has had an impact on the mathematics curriculum and supporting laboratories worldwide. Thanks to all who have made this a rewarding and pleasant experience!

The Frank Giordano Award for 2014 goes to a team from **Huazhong University of Science and Technology**, School of Mathematics and Statistics, in Wuhan, Hubei, China. This solution paper was in the top group, receiving the designation of Outstanding, and was characterized by

- a high-quality application of the complete modeling process, with clear justifications and examples of how the models could be applied to the coaching data, including an extension of the first two models to a third that gave better results;

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- a careful analysis of the parameters and demonstrated sensitivity analysis;
- originality and creativity in the modeling effort to solve the problem as given and to extend the process to selecting the top U.S. presidents; and
- clear and concise writing, making it a pleasure to read.

The Coach Problem

Sports Illustrated, a magazine for sports enthusiasts, is looking for the "best all-time college coach," male or female, for the previous century. Build a mathematical model to choose the best college coach or coaches (past or present) from among either male or female coaches in such sports as college hockey or field hockey, football, baseball or softball, basketball, or soccer. Does it make a difference which time line horizon that you use in your analysis, that is, does coaching in 1913 differ from coaching in 2013? Clearly articulate your metrics for assessment. Discuss how your model can be applied in general across both genders and all possible sports. Present your model's top 5 coaches in each of 3 different sports.

In addition to the MCM format and requirements, prepare a 1–2-page article for *Sports Illustrated* that explains your results and includes a nontechnical explanation of your mathematical model that sports fans will understand.

Solution by the Team

Executive Summary Sheet and *Sports Illustrated* Article

The team's summary was well done and gave the reader a good idea of what to expect. It contained the appropriate specifics with regard to techniques used and comparison of techniques and was both concise and thorough.

Despite a few grammatical errors, the team's article, written in an appropriate nontechnical manner, served as an informative and inviting overview of the issues involved in selecting the top coaches. The decision to highlight John Wooden as a way to clarify the process was excellent.

Assumptions

The assumptions made were very general and somewhat generic. The paper would have been stronger if assumptions were made that applied directly to the models used.

The Models and Methods

The metrics were clearly articulated, with details on how the values associated with each metric were to be determined. The team's explanations included examples, so that the reader could see precisely how coaches' scores were determined. Very few other papers were as thorough in their explanations. The methods used were the Analytical Hierarchy Process (AHP) and Fuzzy Synthetic Evaluation (FSE). After applying each method and comparing the results, they discussed the subjectivity of the AHP method versus the objectivity of the FSE method. To aggregate the results from both methods, they adopted a linear weighted model, Aggregation Model (AM).

Testing Their Models

The primary focus in testing their model was men's college basketball. After determining the top coaches for each method (AHP, FSE, and AM), the team also computed "hit scores" for each by comparing their results to published ratings. They also commented on how, in all their models, the top five positions were less controversial than the top 10.

Extending and Testing Their Models

The team began by applying their model to women's basketball, which has both male and female coaches. After computing the AM scores for these coaches, they determined the top 10 in this field and found their results largely agreed with published rankings. Thus, they concluded that gender was not an issue in their method for determining top coaches.

The team next considered the time factor. Considering that the NCAA basketball tournament did not begin until 1939, then grew from 8 to 16 teams in 1951, and to 32 teams in 1975, 48 teams in 1980, and 64 teams in 1985, the team assigned different weights to each of these periods in their analysis. In applying this factor to each of their three models, they found that the top-10 lists changed their ordering somewhat, but the overall "hit scores" did not change significantly. In their analyses of these results, the team highlighted selected coaches whose positions had changed and explained why that happened. This was a very good example of what distinguished their paper from others.

Finally, the team extended their AM model to football, first listing the metrics that would be different for football versus basketball (for example, bowl games instead of tournaments). Although data for the football coaches were not shown, results for the top five football coaches were given. The team also listed results for the top five hockey coaches, but no change in metrics nor coach data were given. The paper would have been stronger had it been more thorough in application of the AM model to hockey and had it shown the data for football, hockey, and women's basketball coaches.

Sensitivity Analysis

In applying sensitivity analysis, the team demonstrated that their AM model performed better than either their AHP or FSE model alone. Their use of graphs and examples lent clarity and credibility to their analysis. This again distinguished their paper from others.

Extending Their Model Beyond Sports

As an exploration in applying their model more broadly, this team developed metrics to determine the top U.S. presidents. After taking personal qualities, presidential achievements, and leadership qualities into account, they ranked the top 10 presidents. This was what an MCM judge would see as a value-added feature, because it showed that the team was embracing the concept of mathematical modeling, recognizing that the same model can often be applied to very different circumstances.

Recognizing Limitations of the Model

Recognizing the limitations of a model is an important last step in the completion of the modeling process. The team commented on the subjectivity of their weight assignments.

References and Bibliography

The list of references was thorough, and it was very good to see specific documentation of where those references were used in the paper.

Conclusion

The careful exposition in the development and application of the mathematical models, together with the extensions and sensitivity analysis, made this paper one that the judges felt was worthy of the Outstanding designation. The team is to be congratulated on their thoroughness, their clarity, and using the mathematics they knew to create and justify their models. Their presentation made this a very enjoyable and understandable read.

About the Author

Marie Vanisko is a Mathematics Professor Emerita from Carroll College in Helena, Montana, where she taught for more than 30 years. She was also a Visiting Professor at the U.S. Military Academy at West Point and taught for five years at California State University, Stanislaus. She chairs the Board of Directors at the Montana Learning Center on Canyon Ferry Lake and serves on the Engineering Advisory Board at Carroll College. She has been a judge for the MCM for 19 years and for the HiMCM for 10 years.