2018 ABMC Scoring System Overview

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0   Overview

In previous years, all questions were weighted equally. This resulted in many ties that had to be broken manually. Our new scoring system attempts to resolve this issue. Important changes to the system are as follows:

- Problems do not have a fixed point value; they are calculated from the proportion of contestants who solve the problem.

- An estimation problem on the Accuracy Round reduces the chance of ties to essentially 0.

- All scores are scaled to 50 points for each individual round, 300 points for Team Aggregate, and 160 for the Team Round.

1   Individual Tests

1.1   Problem weighing

Each problem is weighted as follows

$$W = B + 1 - \frac{\alpha}{\alpha_{\mathrm{MAX}}},$$

where B is the baseline, α is the number of contestants to solve a certain problem with α_{MAX} being the largest α within the round. Clearly, $W \in [B, B+1)$, meaning there is at most a difference of 1 in weight between the "easiest" and "hardest" problem. For the Speed Round, $B = 1$ and for the Accuracy Round $B = 3$.

Each score is then scaled such that the highest score has a weight of 50 points within a certain round.

1.2   Tiebreaking

Our system reduces the need for tiebreaking unless two contestants have solved the exact same set of problems. In the unlikely event that two contestants solve the exact same problems on a certain round, their other round's score becomes the tiebreaker.

To ensure that there exists a round in which no two scores are the same, we added an additional *estimation question* where students will try to estimate the answer to a question that is almost impossible to compute exactly.

The problem's weight is calculated by

$$W := \min \left\{ \alpha, \frac{\alpha \beta X}{|X - I|} \right\},$$

where X is the correct answer, I is the contestant's input, α is the maximum weight of the problem, and β is the maximum percent difference of the input to achieve α. Put simply, if a contestant's answer is within β percent of the correct answer, they get α points. If not, their score is determined by the second part of the function. For the 2018 ABMC, we plan to use $\alpha = 1$ and $\beta = 0.01$.

2 Team Scores

2.1 Team Aggregate

The Team Aggregate score takes the sum of the top 3 scores of each round for a given team. Scores are scaled to 300 points.

2.2 Team Round

Like the HMMT Guts Round, the point values for our Team Round are predetermined, starting at 4 points per question on Round 1 and 10 points on Round 7. Round 8 contains an estimation question, whose score is given by the deliberately convoluted function

$$W := \max\left\{0, \left\lceil \min\left\{13 - \frac{|I - X|}{0.1|I|}, 13 - \frac{|I - X|}{0.1|I - 2X|}\right\}\right\rceil\right\},$$

where X is the correct answer and I is the given number. Scores for the entire round are scaled to 160 points.

2.3 Team Total

The Team Total is simply the sum of the Team Aggregate and the Team Round. The maximum Team Total is 460 points.