

The World Cup Football Revisited

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In 1982, Peter Walley performed an experiment to test the consistency of (possibly imprecise) probability assessments related to the results of the matches of the World Cup of Football [4]. The experiment was later repeated by Quaeghebeur et al. in 2014 [2] introducing a number of novelties, the most important of which was that the use of sets of desirable gambles.

Here we report on the results of a similar experiment held in November 2022 on the occasion of the 2022 Fifa World Cup in Qatar.¹ Since we found the assessment of sets of desirable gambles to be harder for non-experts, we used a similar setting to [4], in that participants were required to assess lower and upper probabilities for the three possible outcomes of all matches. The predictions for each match were compared pairwise and a bet between two players was activated when their corresponding intervals were disjoint. If for instance for an outcome A Player 1 states the probability interval $[\underline{p}_1, \bar{p}_1]$ and Player 2 states $[\underline{p}_2, \bar{p}_2]$ with $\bar{p}_1 < \underline{p}_2$, then the bet is made for

$$\text{BET} = \text{DISTANCE} \times \text{MIDPOINT} = (\underline{p}_2 - \bar{p}_1) \cdot \left(\frac{\underline{p}_2 + \bar{p}_1}{2} \right),$$

and the amount of points BET goes from Player 1 to Player 2 or viceversa depending on whether event A happens or not.

Competition details The competition had 50 participants, over 2000 predictions, and more than 10000 bets were activated. Rankings were updated daily and participants were allowed to place their prediction until one hour before the match started. Predictions were allowed to be precise or imprecise, and participants were not forced to bet on all matches. To boost participation, prizes of 50, 40 and 30 euros were given to the top three players at the end of the competition, points were doubled in the final stage, and tripled for the final match. There were participants of different ages and training; a few of them had previous knowledge of imprecise probabilities, but the majority had none.

Strategical analysis In addition to the comparison of the performance of the participants with precise and imprecise assessments, we also analysed the outcome for hypothetical players adhering to, among others, one of these strategies: (i) giving probability 1 to the most plausible/least plausible result according to *BetandWin*'s betting odds; (ii) using the probabilities (P(Win),P(Draw),P(Loss)) derived from these betting odds; (iii) applying a distortion model on the previous estimation. Betting on the most plausible outcome and using a pari-mutuel model turned out to produce the best results.

Inconsistencies and Dutch books We also analysed the inconsistencies in the assessments in a number of ways: (i) violations of the notions of avoiding sure loss and coherence from Walley [4], that can easily be checked using results from [1] for probability intervals; (ii) inconsistencies in terms of the extension of (Brier's) scoring rule to imprecise probabilities from [3], that is not equivalent to Walley's coherence; and (iii) the possibility of building a Dutch book against a player, showing that for this game it can be done even under coherence by considering dominated intervals. In all cases, we analysed if there are significant differences between groups of participants according to gender, training, and previous knowledge of imprecise probabilities. The latter group performed better even if violations of coherence were more frequent than expected.

References

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¹More details can be found on the website of the competition, <https://worldcupcompetition2022eng.blogspot.com/>.