

ABSTRACT

A prediction market for H5N1 influenza compared with statistical forecasting model

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Objective

The purpose of this study is to compare the results of an H5N1 influenza prediction market model with a standard statistical model.

Introduction

Prediction markets have been successfully used to forecast future events in other fields.¹⁻⁴ We adapted this method to provide estimates of the likelihood of H5N1 influenza related events.

Methods

Participants were given educational grants of \$100 with which to trade financial contracts whose future values depend on the outcome of selected avian influenza watershed events. These events were on the basis of health-related policy decisions, numbers, and locations of human and animal H5N1 cases. For example, one contract was worth \$1.00 if the total number of H5N1 human cases confirmed by WHO was at least 350 by 1/1/2008. After 1/1/2008, it ceased trading and was replaced by a similar contract with a 7/1/2008 target. Traders bought and sold contracts with one another at prices that depended on their beliefs about the likelihood of the underlying event. The resulting prices can be interpreted as the consensus probabilities of event occurrence.

For each of the contracts based on the total number of human H5N1 cases, we also used a statistical model to assess the performance of our prediction markets. The statistical model used the average number of cases per week since 1/1/2006 to predict the total number of cases on the contract expiration date. Although this statistical model only forecasts the total number of cases, it also possesses the properties of a Poisson distribution, as the parameter of a Poisson process in weekly frequency is the same as the average case count per week in maximum likelihood estimation. Thus, we can estimate the probability of the contract being true, and this probability is directly comparable to the results from the prediction markets.

Statistical models critically depend on reliable and timely data. Thus, to have a more comprehensive comparison of the performance of the prediction markets and the statistical model with different specifications, we also assessed the performance of the statistical model using different lengths of historical data, and compared it with the results of the prediction markets.

Results

In all, we offered 52 pairs of contracts. The most popular contracts were focused on the total number of human cases by a specific date.

Both the prediction markets and the statistical model correctly forecasted the outcomes of the five human-case-number contracts at least a month in advance. At the beginning of the trading period, the prediction markets and the statistical model exhibit some discrepancies in the probability that the specified event would be true. As the time before the target week decreased, the probability estimation of these two methods converged, and the predictive accuracy of both methods increased.

When only current data (past 4 weeks) are used in the statistical model, although the model still successfully predicted the final outcomes, it exhibited volatile predictions of the outcome during the trading period, especially when forecasts are made far in advance. In contrast, the prediction markets provide stable forecasts with considerable accuracy. This suggests that long history of data is needed for a statistical model to forecast reliable H5N1 event outcomes. This is in contrast to prediction markets as a mechanism for aggregating information *per se*.

Conclusion

In summary, prediction markets may provide a flexible and effective way to aggregate both objective and subjective information about H5N1 influenza. The probabilities generated by such a market may help public health officials to plan for the future and coordinate resources. Prediction markets, because of

their reliance on surveillance data to define contracts, will not replace any existing surveillance systems. Instead, we propose our prediction market as a supplement to aggregate expert opinions based on existing surveillance information.

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