

Modeling and Modeled Probabilities for the CME Hurricane Index

Introduction

Modeling the CHI is crucial to determining both pricing and basis risk for structures traded and transformed which use the CHI as the underlying index. Currently, we have some variant of modeled support from both AIR and RMS.

CME has two styles of CHI seasonal options, each of which requires model probabilities:

1. aggregate contracts
2. maximum contracts

This paper will consider what these contracts imply about the requirements for modeling and generating model probabilities. Further, it will detail how these probabilities can be obtained.

Contract Requirements

Seasonal Aggregate Contracts

The seasonal aggregate ('agg') contracts have an underlying which is the sum of all landfalling CHI values observed over a hurricane season (June 1 to November 30). As such, the model probability we require is the probability that a given agg CHI value is observed. This requires that we know, on a simulated basis, what model events occur during a simulated year (and then we sum them up).

Seasonal Maximum Contracts

The seasonal maximum ('max') contracts have an underlying which is the maximum of all landfalling CHI values observed over a hurricane season (June 1 to November 30). As such, the model probability we require is the probability that a given max CHI value is observed. This requires that we know, on a simulated basis, what model events occur during a simulated year (and then we take the maximum value).

Model Differences

While both AIR and RMS are catastrophe models and, as such, work in a similar manner, there are significant differences in the underlying way AIR and RMS treat modeled events and aggregation of events.

AIR started life as a company supporting reinsurance contracts. As such, their model had to consider aggregation of events – essentially asking the question of how many events (and of what kind) happen over a simulated year. This allows reinsurance contracts with aggregate or timing-based quantities (2nd event covers etc) to be priced accurately. Consequently, the output from the AIR model is in the form of a table which lists not only the event which occurs but also which of the 10,000 years that AIR simulates that

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event occurs in and when during the simulated year that event occurs. This means that the output from AIR is perfectly suited to calculating quantities on a seasonal basis

To the same extent, RMS models are well suited to the analysis of seasonal and aggregate contracts; the main difference is in the computation. The primary output of an RMS model is a table of modeled events losses to a property insurance portfolio alongside annual frequencies of occurrence for each event (known as an event loss table or ELT). When this is combined with the RMS Miu Platform – RMS’ multi-year simulation platform for the management of ILS portfolios – it is possible to accurately calculate the risk to any ILS or reinsurance structure, including those that provide seasonal or aggregate cover.

Using AIR to Generate Probabilities

AIR have made available, with the release of CATRADER 9.0, a data set which lists the CHI value for each landfall for each storm (storms can have multiple landfalls) in their model. To generate probabilities, the user first needs to take a ‘database format’ output from CATRADER for the portfolio under consideration (to examine the Gulf region, for example, the user sets up a portfolio which just includes 100% market share for the Gulf states, TX to AL). The ‘database format’ output lists, by simulated year and day of the year, which simulates storms made landfall and where. By combining this output with the supplemental CHI dataset, the user can create a set of data which lists, by simulated year and day, the CHI value for each storm’s landfalls.

From this point, generating probabilities is a simple task. To look at agg contracts, the user sums up the CHI values for all landfalls in each year. To calculate the probability that the agg is above, say, 30 the user counts the number of simulated years with an agg of 30 or greater and divides that number by 10,000 (since there are 10,000 years and each year is equally likely). To look at max contracts, the user finds the maximum CHI values of all landfalls in each year. To calculate the probability that the max is above, say, 10 the user counts the number of simulated years with a max of 10 or greater and divides that number by 10,000.

Using RMS to Generate Probabilities

RMS has modeled the CME Hurricane Index using wind field data from the RMS U.S. Hurricane Model,¹ and provides full CHI support to all Miu clients through the characterization service. These prepackaged Index ELTs can be used to calculate risk metrics of financial structures based on the CHI. In order to model such structures, new CME contracts (“classes”) are defined that are based on the CHI ELTs included in Miu. Risk metrics are determined by simulating the index values over the risk period (1,000,000 simulations per contract for risk periods up to five years) and applying the

¹ RMS U.S. Hurricane Model Version 8.0, upgraded in 2003, last updated in 2006

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financial structure (attachment, payout, etc.) that appropriately describes the contract. The results of the modeling can be analyzed and interpreted via Miu's reporting features.

RMS advises RiskLink users that, for two reasons, the informational databases accompanying RiskLink are insufficient to accurately calculate CHI index values. First, the RiskLink parameters are captured when the eye of the storm makes landfall. As CHI values are reported just prior to landfall and parameters are likely to change within hours of landfall, this may lead to significant uncertainty. Moreover, users may need to make multiple assumptions to convert parameters to those needed in the CHI index formula. These assumptions typically lead to biased estimates of the storm parameters, resulting in CHI values that significantly diverge from RMS' view of risk.

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