RMS® CCRA® Training Program
Tropical Cyclone Modeling Exercise

ANSWER KEY

Learning Objectives:

Assume that you are a catastrophe analyst for a fictitious primary insurer called Coast to Coast Insurance Company that writes properties exposed to Hurricane Wilma. You have been asked to analyze your company's Florida commercial hurricane portfolio and provide a report of the modeled risk as the hurricane is threatening landfall in Florida.

Your goals are to assess Coast to Coast's modeled risk using the stochastic storms IDs provided by RMS prior to landfall, and to calculate and understand the contributors to the uncertainty around modeled mean losses.

Overview

The following workbooks are available to you to complete this exercise:

1. FL Exposure Summary.xls, which contains exposure data profiles for the Coast to Coast portfolio
2. HUWilma_StochasticTracks_EP.xls, which contains:
   - Read Me tab with important background information and instructions
   - Four tabs with stochastic EP (STEP) results for 36, 24, and 12 hours prior to landfall, and at landfall. Each tab has an exposure map with the stochastic storm tracks plotted on it.
   - Storm Info tab with stochastic storm parameter information

Note: You will not need to use the STEP Tool for this exercise. However, if you are interested, information can be created from templates that can be downloaded from the Cat Updates section of www.rms.com after an event and used in the RMS Stochastic EP (STEP) Tool. The STEP tool calculates an *event-specific* loss EP curve for a given analysis using data from the RDM_port table. You can download the Stochastic EP Tool and installation instruction from the client log-in section of RMS Owl.

Portfolio Summary

- Florida Hurricane, all lines of business
- Wind only policies
- 600 accounts covering 1,005 locations
- Total Values: $3,301,973,092
- Total Limits (i.e. Insured Values): $3,295,610,004
- Primary building characteristics are captured
- Secondary characteristics are not captured

Portfolio Analysis Summary

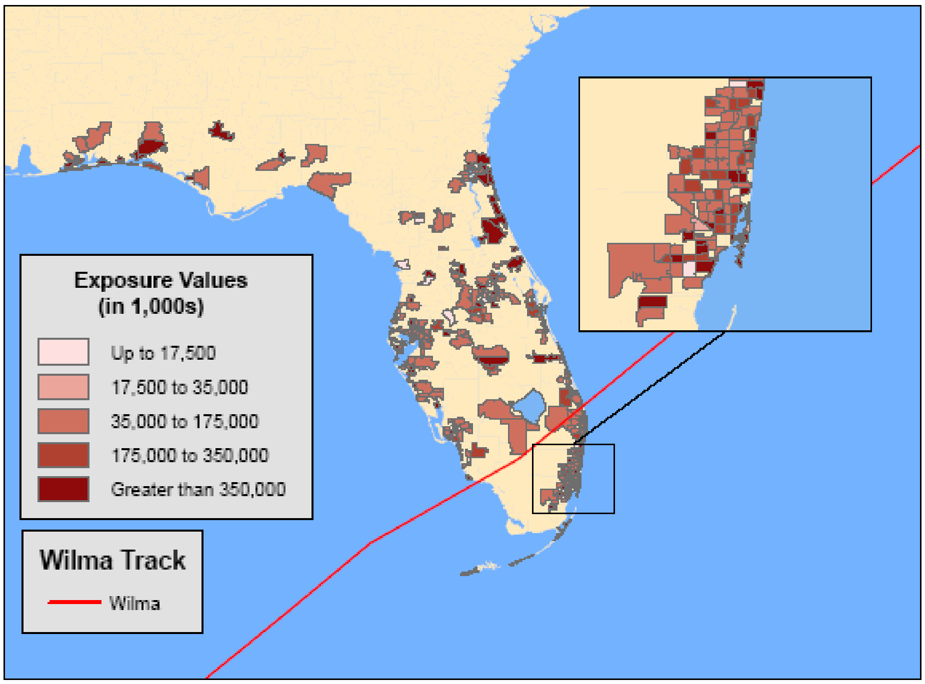
- Distributed U.S. hurricane EP portfolio level analyses
- Wind losses only
- RMS 2011 Stochastic Event Rates
- Analysis 1: Without loss amplification
- Analysis 2: With loss amplification

Background Information on Hurricane Wilma

Hurricane Wilma made landfall on the southwest Florida coast near Cape Romano on October 24, 2005 and was a category three hurricane at the time of landfall. At landfall, Wilma was a very large hurricane with maximum sustained winds of 120 mph (193 km/hr), a central pressure of 950 mb, and an eye diameter of over 70 miles (112 km). Hurricane force winds extended out to around 90 miles (145 km) from the eyewall.

Figure 1 shows the distribution of Coast to Coast's exposure relative to the track of Wilma (shown in red). The inset area shown on the right side of the map is the Miami/Fort Lauderdale region.

Figure 1



Part 1: Wilma Pre-Landfall Analysis

As Hurricane Wilma is approaching the Florida coast, you retrieve the suite of RMS stochastic tracks through the Cat Updates service at 36, 24, and 12 hours before projected landfall. At each point in time (36, 24, and 12 hours) you analyze your portfolio using the Stochastic EP (STEP) Tool templates and assess the potential range of losses at landfall. Use the data provided for each time period in HUWilma_StochasticTracks_EP.xls, to answer the following questions.

1. Refer to the T36 tab of the workbook to compare the mean loss 36 hours before landfall including loss amplification to the same loss excluding loss amplification. Explain why losses including loss amplification are higher than those without.

   ***Answer**: Primary Post-Event Loss Amplification (PLA) quantifies three major components that escalate loss following major catastrophic events: Economic demand surge (EDS), Claims inflation (CI), and Super Cat loss amplification impacts. Of these three, the following two are the most likely contributors to higher loss for Wilma:*

   1. *Economic demand surge (EDS): Increase in the costs of building materials and labor costs as demand exceeds supply. This factor has the biggest overall impact.*

   2. *Claims inflation (CI): Cost inflation due to the difficulties in fully adjusting claims following a catastrophic event.*

2. List two reasons why the events shown on the T36 tab are not classified as Super Cat storms.

   Answer*: Super Cat events are those exposed to significant loss escalation due to both the modeled peril (wind) and non-modeled hurricane related losses (inland flooding, theft, looting, arson, contamination, evacuation failures and systemic economic downturn) in selected urban areas. These events do not qualify because:*

   - *None of the stochastic storms have a correlated component of loss greater than 15% in the dbo_correlation table located in the RMS EVENT INFO database.*
   - *Ground up loss ratio = regional loss / gross regional product. From the third to the last slide of Unit 3, the Miami metro exposure is $273.2. Thus the GU loss ratio for the largest event loss (event ID 447848) = $ 3,885,047/$273.2B = .001422%. This is not large enough to qualify.*
   - *Most of the storm tracks do not pass through Miami metro area.*

3. Look at the stochastic events used to estimate losses 12 hours prior to landfall using the data on the Storm Info tab (Rows 28-32) and the associated map. Compare the following parameters to those for Wilma at landfall stated below.

   - Rmax: ~ 35 miles
   - Central Pressure: 950 mb
   - Location of landfall: Near Cape Romano, FL
   - Category: 3

   Provide an explanation of how the parameter value differences translate to the modeled loss differences.

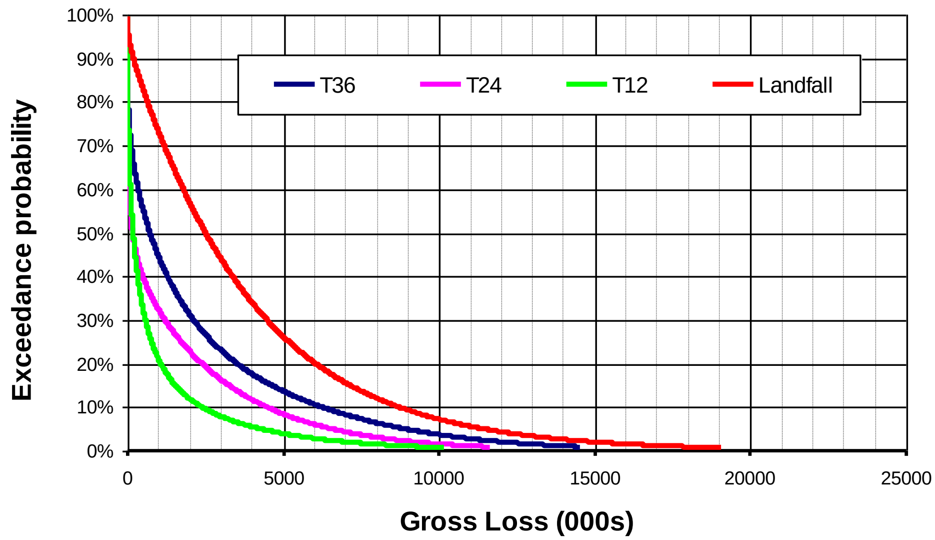
   Answer*: The track of the storm has the largest impact on losses, as can be observed by the variation in the exposed values for each storm track. Note that there is a wide range of loss potential from category 2 storms. For this category of stochastic storm, there is a correlation between Rmax (radius to maximum winds) and modeled loss. As seen in the three category 2 storms in the T12 suite, the wider the Rmax, the larger the loss.*

   Side note: The eye diameter (distance to the eyewall where the maximum wind speeds occur) of hurricane Wilma of 70 miles – or approximately a 35 mile radius - most approximates storm IDs 450691 and 449038.

Part 2: Wilma Post-Landfall Analysis

Assume that Wilma has now made landfall, and RMS has issued a post-landfall suite of tracks, shown in the map on the Landfall tab of the workbook. Analyze the EP curve with loss amplification for these storms along with those of each previous suite of stochastic storms released prior to landfall (shown in Figure 2 below).

Figure 2



4. What is the approximate percentile associated with the modeled mean gross loss with loss amplification for each of the four time periods in the table below?

	Gross Mean Loss	Percentile
T36	*$2,072,776*	*30%*
T24	*$1,371,196*	*28%*
T12	*$853,473*	*23%*
LANDFALL	*$3,681,700*	*37%*

***Answer**: The percentiles shown in the above table are derived by looking up the mean loss on the OEP curve provided in the worksheet and selecting the corresponding EP value. Using the Landfall data as an example, the exceedance probability (or percentile) is approximately 37%. In other words, there is a 37% chance that losses from this portfolio will exceed $3.682M from one of these events.*

5. Using the gross mean loss analysis results and exposure maps provided, list two reasons for the differences between the pre-landfall and landfall values.

   Answer:

   i. Storm track - The landfall stochastic tracks extend just south of Lake Okeechobee, where there is significant exposure, thus on average increasing exposed value to these events than for the pre-landfall events.

   ii. Storm parameters - The predicted central pressure rises for the chosen suite of stochastic storms closer to landfall time, contributing to lower modeled losses. The landfall suite of storms has a dramatic decrease of central pressure, thus increasing losses compared to the previous stochastic storms.

6. What are the 20th and 80th percentile gross losses, for each time period listed in the table below with loss amplification?

	20%	80%	Range of 20% to 80% Gross Losses
T36	*$3,510,672*	*$17,721*	*$3,492,951*
T24	*$2,382,167*	*$213*	*$2,381,954*
T12	*$1,062,752*	*$12,147*	*$1,050,605*
LANDFALL	*$6,034,100*	*$636,112*	*$5,397,988*

   a. Explain what the percentile values mean.

   Answer*: As an example, for T12, the probability of exceeding a loss of $1,062,752 is 20%, and the probability of exceeding a loss of $12,147 is 80%.*

   b. What trend do you see in the range of percentile gross losses? Provide a reason for this trend.

   Answer*: The range of losses decreases for the time periods prior to landfall. If you review the region covered by the stochastic storm tracks through time, you will find that it narrows and is covered by fewer stochastic events as the storm gets closer to making landfall. This decreases the range of possible losses. In addition, the range of central pressure and one-minute wind speeds becomes smaller from T36 to T12. This further reduces the range of possible losses.*

   However, the stochastic storms chosen for landfall show a larger range of loss. This is primarily due to a greater uncertainty in the storm's category at landfall. Both the central pressure and wind speed ranges for the landfall suite are significantly greater than the stochastic storm suites prior to landfall.

Part 3: Contributors to Loss Uncertainty

Initial claims losses for this portfolio are approximately $4.5M. You have been asked to determine why the actual losses are higher than the modeled gross mean loss from the Landfall suite of stochastic storms.

7. At approximately what percentile of the gross loss distribution with loss amplification do the initial claims losses of $4.5M fall?

   ***Answer**: 30th percentile. This is approximated by looking up $4.5M on the summary losses table in the "Landfall" tab of the worksheet and selecting the corresponding "EP" value.*

8. Review the data in the FL Exposure Summary.xls spreadsheet and provide two examples of how exposure data uncertainty might be contributing to the loss uncertainty.

   Answer:

   i. Geocoding resolution: 10% of limits are at ZIP Code resolution. This will be a significant factor in modeled vs. actual loss differences.

   ii. Building floor area is not shown for residential buildings (residential buildings comprise 2.4% limits and values). It is uncertain if floor area was included in the model results, since it is absent from the exposure summary.

   Only a small percent (<1%) of limits are classified with unknown construction and/or occupancy, which will not be a significant contributor to exposure data uncertainty.

9. The stochastic event from the Landfall suite that most closely approximates initial claims losses is ID 448986 with an assigned weight of 0.00708. The tables below show the details for this stochastic event.

EVENTID	EVENTLOSS	EXP	STDDEVI	STDEVC	MDR	CV
448986	$5,319,635	$169,260,575	$2,142,134	$1,755,068	0.031429	0.732607

DESCRIPTION	*RMAX LEFT*	*RMAX RIGHT*	*CP*	*CAT*	*LAT*	*LONG*
FL-SW_Cat4	23.5015	23.5015	934.04	4	25.9	-81.575

   a. Explain why event 448986 was given a lower relative weight than most of the other storms listed in Stochastic Events table on the landfall tab (Rows 16-24).

   ***Answer**: The storm strength, as measured by Central Pressure and Category, is much stronger than that of both the predicted and the measured storm parameters of Wilma at landfall. Wilma made landfall as a Category 3 event with a central pressure of 950 mb.*

   Note: As Wilma made landfall, it was very difficult to predict wind speed as it moved over the Gulf of Mexico. Reduction in sea surface temperature due to the previous passage of hurricanes Katrina and Rita led to predictions of lower wind speeds, however just as Wilma made landfall, it gained energy from a warm sea surface temperatures near shore (see discussion of sea surface temperature impacts on storm tracks in Unit 2).

   b. Provide two potential contributors to parameter uncertainty that would contribute to differences between actual and modeled losses for the suite of stochastic storms.

   ***Answer**: Catastrophe risk analysis parameter uncertainty describes the uncertainty in the actual values that define specific catastrophe risk modeling parameters. This* *type of uncertainty is caused by measurement errors, analytical imprecision and limited sample sizes during the collection and treatment of data.*

i. The final track of Wilma is on the Southern bound of the modeled tracks, which moves it away from most of the portfolio exposure at landfall. Limited historical track precedents can lead to uncertainty in the track prediction.

ii. The measured wind speeds could be different than the actual wind speeds.

Note: Specifically for Wilma, a number of official surface wind observation (ASOS) sites in Miami-Dade and Broward Counties stopped reporting data at their highest noted sustained wind speeds, at 72-74 kt (80-85 mph) It is likely that higher sustained wind speeds occurred at these sites, as subsequent meteorological calculations estimate winds at these locations to have approached 90-95kts (104-110 mph).

10. What trend do you see between the landfall suite of gross mean stochastic event losses with loss amplification and the CV (Rows 27 – 35)? Provide an explanation for this trend.

***Answer**: The CV decreases with increasing AAL. This is due to the fact that the vulnerability uncertainty is less for more severe storms. Thus, the greater the modeled mean loss, the lower the uncertainty. Review Unit 4 of the presentation for more detailed information.*

11. Based on the tables that provide the stochastic event uncertainty distribution parameters, list two ways to arrive at the total <u>event</u> standard deviation for each storm.

***Answer**:*

i. The first method to calculate the total event standard deviation is to add the independent and correlated standard deviations (STDDEVI+ STDDEVC) for that event. Using the gross loss figures for event 448986 as an example:

$STD_{gross} = STDDEVI_{gross} + STDDEVC_{gross} = \$1,901,840 + \$1,563,083 = \$3,464,923$

ii. The second method is multiply the CV by mean event loss. Using the gross loss figures for event 448986 as an example:

$STD_{gross} = CV_{gross}\ X\ \text{mean gross loss} = 0.729902\ X\ 4,747,108 = \$3,464,923$