Underwriting Report: Assumptions and Methodologies

**Assumptions**

*Unique Identification of Hurricanes*

* Assumption: Each hurricane has a unique name and year pairing.
* Rationale: Ensures clarity in mapping specific hurricane events to locations without duplicates.

*Estimated 2024 Total Insured Value (TIV)*

* Assumption: Projected TIV for 2024 uses the 2021 TIV with an inflation adjustment of 17.83%.
* Rationale: This provides a reasonable estimate of future values, reflecting recent inflation trends.

*Proximity Risk Assessment*

* Assumption: Hurricanes within 1 degree of a location pose similar risk.
* Rationale: This simplifies the proximity analysis and reflects the likelihood of impact based on geographic closeness.

*Stable Hurricane Frequency Over Time*

* Assumption: Hurricane frequency remains relatively constant year over year.
* Rationale: This facilitates straightforward risk assessment without needing year-specific frequency adjustments.

**Mathematical Methods and Important Formula Explanations**

*Unique Hurricane Names/Years*

* Formula: =UNIQUE(VSTACK(Hurricane1[Name & Year], Hurricane2[Name & Year]),FALSE,FALSE)
* Explanation: Combines data from both hurricane datasets (Hurricane1 and Hurricane2) and uses UNIQUE to return only distinct hurricane name/year combinations. VSTACK merges both datasets into a single list, while FALSE arguments ensure no duplicates appear.

*Unique Hurricane IDs*

* Formula: =IFERROR(XLOOKUP($F3, Hurricane1[Name & Year], Hurricane1[SID]), XLOOKUP($F3, Hurricane2[Name & Year], Hurricane2[SID]))
* Explanation: This formula uses XLOOKUP to find the hurricane ID (SID) that corresponds to a name/year combination in either Hurricane1 or Hurricane2. IFERROR prevents errors if the lookup fails in the first dataset, switching to the second dataset.

*Hurricane Proximity Check*

* Formula: see presentation → “Collection Method”
* Explanation: This formula checks if a hurricane passes within 1 degree of a specific location. It uses FILTER to return latitude/longitude values for hurricanes within the 1-degree range and COUNT to see if any hurricanes satisfy these proximity conditions.

*Max Wind Speed Within 1-Degree Area*

* Formula:

=MAX(

MAX(FILTER(Hurricane1[WMO\_WIND kts],(Hurricane1[SID] = $D2) \* (Hurricane1[Latitude] >= $B2 - 1) \* (Hurricane1[Latitude] <= $B2 + 1) \* (Hurricane1[Longitude] >= $C2 - 1) \* (Hurricane1[Longitude] <= $C2 + 1),0)),

MAX(FILTER(Hurricane2[wind\_speed],(Hurricane2[SID] = $E2) \* (Hurricane2[Latitude] >= $B2 - 1) \* (Hurricane2[Latitude] <= $B2 + 1) \* (Hurricane2[Longitude] >= $C2 - 1) \* (Hurricane2[Longitude] <= $C2 + 1),0)))

* Explanation: This finds the maximum wind speed within a 1-degree range for each location. It filters each dataset to include only wind speeds that meet the latitude/longitude criteria, then takes the maximum from both hurricane datasets.

*Closest Distance Calculation Using Haversine Formula*

* Formula:

=MIN(

IF((Hurricane1[SID] = $D2), getDistances($B2, $C2, Hurricane1[Latitude], Hurricane1[Longitude]), 999999),

IF((Hurricane2[SID] = $E2), getDistances($B2, $C2, Hurricane2[Latitude], Hurricane2[Longitude]), 999999)

)

* Explanation: Uses the getDistances VBA function with the Haversine formula to compute the closest distance between each hurricane and the location. The Haversine formula accounts for earth’s curvature, yielding more precise distances necessary for geographic risk assessment.

*HaversineDist VBA Module*

* Purpose: The getDistances function calculates the shortest distance (in kilometers) between a given location and multiple points (representing hurricanes) using the Haversine formula. This function is critical for accurately determining proximity by accounting for the earth’s curvature.
* How It Works:
* Parameters:
  + latitude1, longitude1: The latitude and longitude of the location in question.
  + latitude2, longitude2: Ranges that contain the latitudes and longitudes of hurricane points.
* Constants:
  + earth\_radius: Set to 6371 km, representing Earth’s radius.
  + deg2rad: Converts degrees to radians using π/180\pi / 180π/180 for trigonometric calculations.
* Calculation:
  + Initialization: minDistance is set to a large number initially to ensure that any calculated distance will be smaller.
  + Loop Through Coordinates: For each point in latitude2 and longitude2, the function:
    - Converts the latitude and longitude values from degrees to radians.
    - Computes dLat and dLon, the differences in latitude and longitude.
    - Applies the Haversine formula:
      * Calculates a as sin⁡(dLat/2)^2 + cos⁡(latitude1) \* cos⁡(latitude2) \* sin⁡(dLon/2)^2
      * Computes c = 2atan(^2)(sqrt(a), sqrt(1−a)).
      * Distance d is then calculated as earth\_radius \* c.
  + Update Minimum Distance: If the calculated distance d is less than minDistance, it updates minDistance.
* Output:
  + After looping through all hurricane points, the function returns minDistance, the shortest distance between the location and any hurricane point.

*Other Relevant Functions*

* While we cannot cover all formulas used in the Excel file, some key functions are:
  1. VLOOKUP and XLOOKUP:
     + These functions retrieve specific data from tables based on a lookup value. VLOOKUP requires the value to be in the first column of the range, whereas XLOOKUP is more flexible, allowing lookups in any column.
  2. SUMPRODUCT:
     + Combines arrays to compute weighted averages or other multi-factor calculations. Here, it’s used to calculate weighted loss ratios by multiplying each value by its corresponding weight and summing the results.
  3. AVERAGEIF and COUNTIF:
     + AVERAGEIF computes the average of cells that meet certain criteria, useful for finding the average loss cost or loss ratio per year. COUNTIF tallies cells based on specified conditions, such as counting hurricanes by year.