Nasdaq Calypso

Multi Sensitivity

Version 18

Revision 1.0

February 2024

Approved

Document History

Revision	Published	Summary of Changes
1.0	February 2024	First revision for version 18.

This function is currently off-catalog and requires a specific license agreement.

The Multi Sensitivity analysis is designed to run a bundle of existing Sensitivity analyses to produce a single, aggregated report.

Additionally, each underlying Sensitivity analysis can be attached to a Hedge Instrument Set that will be used to produce a hedge recommendation.

- Refer to the Calypso Sensitivity documentation for information on configuring and running Sensitivity analyses.
- Refer to Calypso Hedge Recommendation documentation for details on hedge recommendations.

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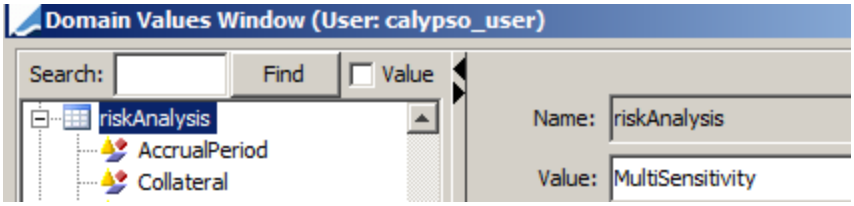
1. Multi Sensitivity

Before you Begin

Make sure that the domains "riskAnalysis" and "riskPresenter" contain the value "MultiSensitivity".



"riskAnalysis" domain

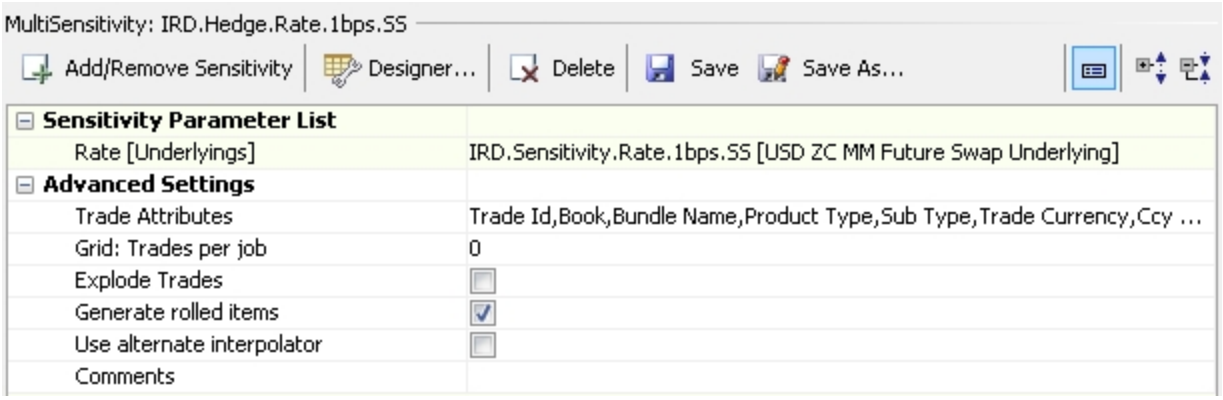
1.1 Supported Sensitivities

The Multi Sensitivity analysis currently supports Sensitivity analyses of the following types:

- Commodity [Underlyings Only]
- Credit
- Credit-Recovery
- Equity
- FX Spot
- FX Curve
- Inflation [Underlyings Only]
- Rate [All Subtypes]
- Volatility/Commodity [Underlying Instruments Only]
- Volatility/Credit [Underlying Instruments Only]
- Volatility/Equity [All Subtypes]
- Volatility/FX [All Subtypes]
- Volatility/Rate [All Subtypes]

1.2 Configuration

The Multi Sensitivity analysis can be configured from **Configuration > Reporting & Risk > Analysis Designer**. Right-click a Multi Sensitivity folder in Analysis Designer, and choose "New Analysis" to add a parameter configuration. You will be prompted to enter a configuration name.



Sample Multi Sensitivity parameters

» Complete the parameters details.

Click **Add/Remove Sensitivity** to add a sensitivity analysis.

▶ See Sensitivity Parameter List for details.

» Specify the Advanced Settings as needed.

- Trade Attributes - Use this field to add more trade attributes to the output. For example, the trade attribute "CounterParty" allows you to slice by trade counterparty in the output.
- Grid: Trades per job - When using a dispatcher, this input controls how many trades should be included in a single dispatcher's job.

  The Calypso API allows defining weights for the products in order to assign higher coefficients to some more complex trades. In this case, this input will control the weighted number of trades per job rather than the actual number of trades per job.

  Upon execution, the process will assign trades to the current job until the maximum capacity is reached or exceeded. So the final weighted number of trades in a job can be slightly more than what is defined in the configuration.
- Explode Trades - Controls whether the trades should be exploded into their underlying components prior to running the report. The explode functions is handled by the <Product>RiskExplode API for each product type.
- Generate Rolled items - Controls whether the market data items that do not exist in the pricing environment at the report's valuation date should be simply rolled (False), or generated again (True). By default, they are simply rolled.
- Use alternate interpolator - If you are using spline interpolators for pricing (MonotoneConvex, Spline, LogSpline) that use the whole curve for interpolation, you can select linear interpolators for the risk computations to use only two consecutive points for interpolation.

  Check "Use alternate interpolator" to use the interpolator defined in domain "riskAlternateCurveInterpolator" for interpolation, typically InterpolatorLinear or InterpolatorLogLinear (default value).
- Comments - Free form comment for information purposes.

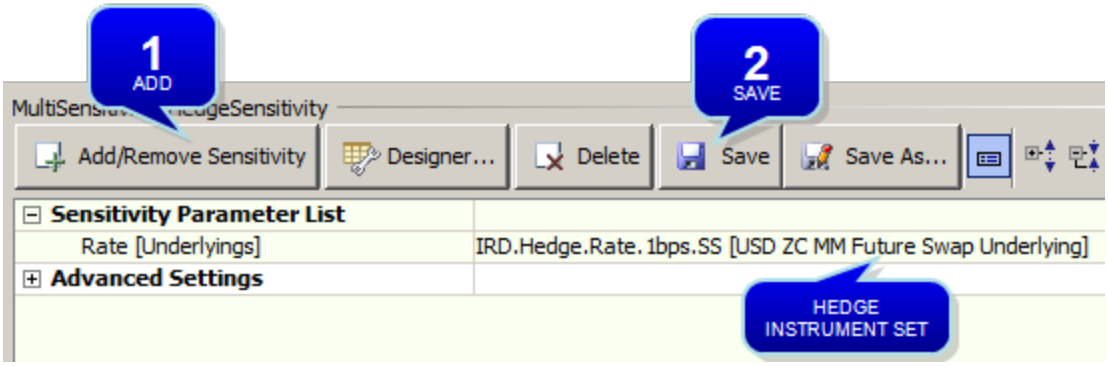
» Click **Save** to save the configuration.

[NOTE: The Advanced Settings set in the Multi Sensitivity parameters override those of the underlying Sensitivity parameters]

1.2.1 Sensitivity Parameter List

The Sensitivity Parameter List is the list of the underlying Sensitivity analyses and Hedge Instruments Sets. This list should have at least one axis defined, and up to nine axes.

It is the user's responsibility to ensure that the underlying analyses are properly configured when running a Multi Sensitivity analysis.



Sample "Sensitivity Parameter List"

Step 1 - Click **Add/Remove Sensitivity** to add Sensitivity parameters.

You will be prompted to select Sensitivity parameters.

[NOTE: You can only select Sensitivity parameters which are supported by Multi Sensitivity]

[NOTE: You can only add Inflation Sensitivity parameters if environment property SHOW_PARRATES_IN_MSA=true]

▶ Please see Supported Sensitivities for details.

If you have selected Sensitivity parameters associated with a hedge instrument set, the hedge instrument set will appear in between brackets, otherwise [None] will appear.

If you want to modify the hedge instrument set associated with the Sensitivity parameters, you can click the hedge instrument set or "[None]", and select a hedge instrument set as needed.

You can click **Designer** to create hedge instrument sets in the Measure Maker window.

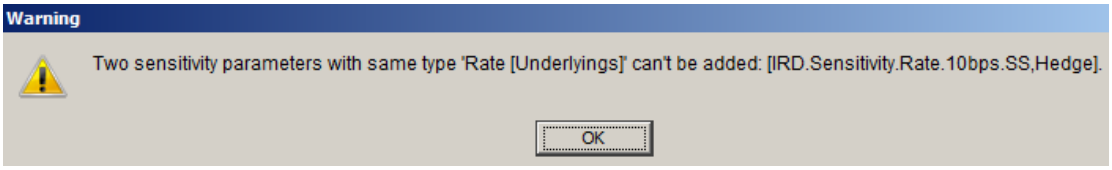
▶ Refer to Calypso Hedge Recommendation documentation for details on hedge recommendations.

Step 2 - Click **Save** to save the Multi Sensitivity parameters.

[NOTE: Please note that two axes of the same Sensitivity type/subtype combination cannot be added]

Example

A Multi Sensitivity with the axis Volatility Rate Points and Volatility Rate Tents is not supported.



1.2.2 Measures

Measures from Underlying Sensitivity

Measures are defined in the underlying Sensitivity configurations. Some measures are not supported in Multi Sensitivity; therefore they will not appear in the Multi Sensitivity Report.

Supported Measures

Sensitivity Type	Measure Name
Credit	creditDELTA creditGAMMA
Credit-Recovery	recoveryDELTA
Equity	equityBetaDELTA equityBetaGAMMA equityDELTA equityGAMMA equityVEGA equityScaledDELTA equityScaledGAMMA equityDaysDELTA equityDiffDelta
FX Spot	fxDELTA fxGAMMA fxDaysDELTA fxDiffDelta

Sensitivity Type	Measure Name
FX Curve	fxCurveDELTA
Rate	rateDELTA rateGAMMA rateBucketsDaysDELTA rateBucketsDiffDelta rateForwardDaysDELTA rateForwardDiffDelta rateTrianglesDaysDELTA rateTrianglesDiffDelta
Inflation	InflationDELTA InflationGAMMA
Equity Volatility	Vega Volga equityDaysVEGA equityDiffVega
FX Volatility	Vega Volga fxDaysVEGA fxDiffVega
Rate Volatility	VegaVolga rateDaysVEGA rateDiffVega
Volatility Commodity	Vega Volga
Volatility Credit	Vega Volga

Underlier Measures

Underlier measures defined in the underlying Sensitivity configurations are not supported in Multi Sensitivity.

Measures not Supported

Sensitivity Type	Custom Measure Name
FX Spot	undFXDelta
Rate	undRateDELTA
Credit	creditDELTA_H
Inflation	undInflationDELTA
FX Curve	undfxCurveDELTA

[NOTE: Custom measures based on unsupported measures are not supported in Multi Sensitivity. Therefore, they will not appear in the Multi Sensitivity report]

See Custom Measures not Supported for details.

Custom Measures

Custom measures are defined in the underlying Sensitivity configurations. Some custom measures are not supported in Multi Sensitivity; therefore they will not appear in the Multi Sensitivity Report.

Please find below the custom measures that are supported in Multi Sensitivity.

Supported Custom Measures

Sensitivity Type	Custom Measure Name
Equity	equityUnitDELTA
Equity	equityUnitGAMMA

Custom Measures not Supported

Sensitivity Type	Custom Measure Name
Rate	rateInstrumentEquivalent
FX Spot	fxSpotDelta
Credit	creditInstrumentEquivalent
Inflation	inflationInstrumentEquivalent
FX Curve	fxInstrumentEquivalent

1.2.3 Verbose

Verbose mode may be needed when trying to analyze issues or to verify detailed information like shift amounts, shift orders, formulas, etc.

Please contact Calypso Product Support for details.

1.3 Hedge Recommendation

While Multi Sensitivity Analysis supports the bundling of multiple Sensitivity configurations, each underlying analysis can be linked to a user-defined Hedge Instrument Set and produce a global hedge recommendation.

Note: only the Sensitivity types and subtypes listed below, and certain associated Risk Factors, are considered hedgeable:

- Equity
- FX Spot
- Rate [All perturbation types, except ParRates]
- Volatility/Equity [Points and Tents only]
- Volatility/FX [Points and Tents only]
- Volatility/Rate [Points, Adjustments, and Tents]

▶ Refer to Calypso Hedge Recommendation documentation for details.

1.4 Output

1.4.1 Attributes

Sensitivity Fields

The fields defined in the Advanced Settings of the Sensitivity parameters are available for display in the Multi Sensitivity analysis.

▶ Refer to the Sensitivity documentation "Advanced Settings" for more details.

Multi Sensitivity Fields

The following fields have been added to the output to provide more information as described below:

- Parameter Set - Displays the name of the Sensitivity Analysis used.
- Parameter Type - Displays the type and subtype of Sensitivity Analysis used.

Bucket	Bucket Size	Shifted Item	Risk Currency	Parameter Set	Parameter Type
3M-6M	3M	USD LIBOR 3M (2286)	USD	Rate.Buckets.1.5bps.ss	Rate[Buckets]
6M-1Y	6M	USD LIBOR 3M (4488)	USD	Rate.Buckets.1.5bps.ss	Rate[Buckets]
0D-1M	1M	USD LIBOR 3M (4488)	USD	Rate.Buckets.1.5bps.ss	Rate[Buckets]
6M-1Y	6M	USD LIBOR 3M (2286)	USD	Rate.Buckets.1.5bps.ss	Rate[Buckets]
1M-3M	2M	USD LIBOR 3M (2286)	USD	Rate.Buckets.1.5bps.ss	Rate[Buckets]
3M-6M	3M	USD LIBOR 3M (4488)	USD	Rate.Buckets.1.5bps.ss	Rate[Buckets]
1M-3M	2M	USD LIBOR 3M (4488)	USD	Rate.Buckets.1.5bps.ss	Rate[Buckets]
0D-1M	1M	USD LIBOR 3M (2286)	USD	Rate.Buckets.1.5bps.ss	Rate[Buckets]
1Y-5Y	4Y	USD LIBOR 3M (4488)	USD	Rate.Buckets.1.5bps.ss	Rate[Buckets]

Sample table view from Multi Sensitivity - Calypso Workstation

1.4.2 Measures

Name / Value Measures

All risk measure names in Multi Sensitivity are aggregated in two columns per risk measure as described below:

- Name of risk measure
- Value of the risk measure

This allows better slicing and dicing capabilities.

equityDELTA	equityDELTA(Base)	equityGAMMA	equityGAMMA(Base)	Underlier Currency	Underlier Name
-113 404 508,95	-113 404 508,95	3 046 578,03	3 046 578,03	USD	Equity.AMZN

Sample table view from Sensitivity – Calypso Workstation

Measures	Values	Underlier Currency	Underlier Name
equityDELTA	-113 404 508,95	USD	Equity.AMZN
equityDELTA(Base)	-113 404 508,95	USD	Equity.AMZN
equityGAMMA	3 046 578,03	USD	Equity.AMZN
equityGAMMA(Base)	3 046 578,03	USD	Equity.AMZN

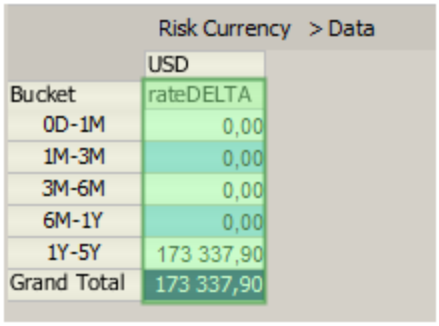
Sample from Multi Sensitivity – Calypso Workstation

Renaming Rate Measures

All risk measures for rates Delta are renamed in Multi Sensitivity.

Risk Measure	Name in Sensitivity	Name in Multi Sensitivity
Rate Buckets	rateDELTA	rateBucketsDELTA
Rate Forward	rateDELTA	rateForwardDELTA
Rate Triangles	rateDELTA	rateTrianglesDELTA

Risk Measure	Name in Sensitivity	Name in Multi Sensitivity
Rate Underlyings	rateDELTA	rateUnderlyingsDELTA



	Risk Currency > Data
	USD
Bucket	rateDELTA
0D-1M	0,00
1M-3M	0,00
3M-6M	0,00
6M-1Y	0,00
1Y-5Y	173 337,90
Grand Total	173 337,90

Sample from Sensitivity – Calypso Workstation

	Risk Currency > Data
	USD
Measures	Values
rateBucketsDELTA	170 828,52
rateForwardDELTA	237 246,81
rateTrianglesDELTA	167 254,17
rateUnderlyingsDELTA	141 271,40
Grand Total	716 600,89

Sample from Multi Sensitivity – Calypso Workstation

Hiding/Viewing Hedge Instruments

By default, only the sensitivities of the portfolio will be seen in Calypso Workstation. The results from hedging instruments are hidden from the output in Calypso Workstation. The sensitivities of the hedging instruments will only serve as inputs for the Hedge Recommendation Window and should not be visible at this stage.

In order to see the hedging trades for debug and or analysis purposes you can set the following environment property:

DISABLE_HIDDEN_FILTERS=true

[NOTE: This is only for testing purposes and MUST NOT BE SET IN PRODUCTION]