CHOOSING AN INTERPOLATION METHOD FOR CURVE CONSTRUCTION

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When it comes to derivatives valuation, everything starts with the zero-curve construction. Therefore, choosing a suitable interpolation method is as important as choosing the proper market instrument to build a smooth zero curve.

Interpolation is a statistical strategy for estimating an unknown price or possible yield of an asset using known data. Interpolation is done using other known values in the same order as the unknown value.

Investors and stock analysts often employ interpolated data points to create a line chart. These charts, an essential aspect of technical analysis, enable them to visualize fluctuations in the price of assets.

This document gives a quick overview of how to choose a suitable interpolation method.

1) Hagan Criteria

Hagan and West suggested a set of criteria to compare the interpolations method in a paper published in the WILMOTT magazine in 2006.

The criteria include:

- The shape of the forward curve
- The locality of the interpolation
- The stability of the forward curve

These criteria will be used in this section to check for candidate summit interpolation methods.

Forward Curve Shape

How do the forward rates look in the case of yield curves? The 1m or 3m forward rates are commonly used, but they are nearly identical to the instantaneous rates.

We will want to have positivity and continuity of the forwards. To avoid arbitrage, futures must be positive, and continuity is essential because the pricing of interest-sensitive products is dependent on forwarding rate stability.

According to McCulloch and Kochin [2000], a discontinuous forward curve implies unrealistic expectations about future short-term interest rates or implausible expectations about holding period returns.

As a result, such an interpolation procedure should usually be avoided, particularly when pricing derivatives whose value is based on forwarding values. Although forward smoothness is desired, it should not come at the expense of the other qualities listed above.

Locality

"How local is the interpolation method? Is it possible that if an input is changed, the interpolation function will also change in the immediate vicinity, with minimal or no spill-over elsewhere, or do the changes elsewhere become significant?"

Stability

"Are the forwards not only steady but also continuous? For example, looking for the largest basis point change in the forward curve given a basis point shift (up or down) in one of the inputs can be used to measure the degree of stability".

In order to check the stability, a 1bp bump was applied to each curve instrument one by one, leading to several scenarios equal to the number of tools. Then, the differences in new forward rates between all scenarios and the original ones were calculated, and the one with the greatest difference was retained for the study.

2) Recalibration of Instrument

We believe that a good interpolation candidate has good recalibration properties.

The following steps were taken to quantify the goodness of instrument recalibration.

1. First, build the zero curve with the list of chosen market data points.
2. Choose one market data instrument that evaluates the trade—for example, the 5Y par swap.
3. Take out the chosen market data instrument (5Y swap point) from the curve construction, rebuild the curve, and then re-price the selected market data instrument.
4. Compare the valuation between step 2 and step 3. The smaller the valuation difference in the trade, the better the recalibration property of the chosen interpolation method.

In our next release, learn how the factors Hagan Criteria and Recalibration Instrument are used in the interpolation algorithms for the construction of zero curves using the Bloomberg method Smooth Forward in Summit.

Stay tuned!

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- GreenPoint Summit is a comprehensive platform encompassing new implementations, version and module upgrades, product and application development, test automation, cloud migration, and system maintenance
- Our quantitative services and platforms include Libor Replacement Simulation Tool (LRST), curve creation, recreation and management, model validation and documentation, and creation of challenger models for regulatory compliance.
- Our summit professionals also provide data porting, migration and management as well as cloud services.
- Over the last year we have completed several projects including full system upgrades, Libor/RFR migration, replacement of valuation frameworks, and custom code creation and testing for large global banks and insurers.

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Sanjay Sharma, PhD

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Sanjay provides strategic and tactical guidance to GreenPoint senior management and serves as client ombudsman. His career in the financial services industry spans three decades during which he has held investment banking and C-level risk management positions at Royal Bank of Canada (RBC) Goldman Sachs, Merrill Lynch, Citigroup, Moody's, and Natixis. Sanjay is the author of "Risk Transparency" (Risk Books, 2013), Data Privacy and GDPR Handbook (Wiley, 2019), and co-author of "The Fundamental Review of Trading Book (or FRTB) - Impact and Implementation" (Risk Books, 2018).

Sanjay was the Founding Director of the RBC/Hass Fellowship Program at the University of California at Berkeley and has served as an advisor and a member of the Board of Directors of UPS Capital (a Division of UPS). He has also served on the Global Board of Directors for Professional Risk International Association (PRMIA).

Sanjay holds a PhD in Finance and International Business from New York University and an MBA from the Wharton School of Business and has undergraduate degrees in Physics and Marine Engineering. As well as being a regular speaker at conferences, Sanjay actively teaches postgraduate level courses in business and quantitative finance at EDHEC (NICE, France), Fordham, and Columbia Universities.

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