

elements



Interest Rates Package - Introduction

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1. Purpose of Document

The purpose of this document is to introduce the ‘Interest Rates’ package in the elements object model. This document will provide sufficient background to the business problem to explain and motivate the subsequent description of the model. It will also give an overview of the model, outlining the ‘mental picture’ that drove the development of the object model, and then summarize the key features of the model, as documented in UML.

The readers of these documents will be:

- Anyone assessing the usefulness of the elements object model for their purpose.
- People preparing to study the associated package in detail.
- Anyone who wants an outline picture of a particular package because it is used in another package.

2. The Business Problems

The following business issues are addressed by this package:

2.1. What are Interest Rates?

Interest Rates are a way of converting a commodity with a value at one date into another value at a different date.

2.2. Methods for Quoting Interest Rates

Interest Rates are quoted in a variety of ways, such as a yield or discount, over some time period. The standard way to represent rates is in terms of an annual rate. The Interest Rate software must support the various ways of quoting rates and provide a mechanism for converting from one form to another.

2.3. Interest Rate Curves

Interest rate curves support a way for interest rates on various dates to be grouped together to form yield curves. A yield curve can be used to calculate rate values for intermediate dates by interpolating between known values or by extrapolating past known data.

2.4. Date Basis for Rate Calculations

Interest rates can be specified with a variety of start and finish dates and using different date bases. For example, a rate could be quoted as Spot + 1 Week, Actual/Actual. This information is also required when calculating yield curves.

2.5. Compounding Methods

There are many types of compounding interest rates. They can be compounded over a variety of time periods (weekly, monthly, quarterly, etc.), a set number of times per year, continuously, etc. The model for interest rates must support the various compounding methods.

3. Overview of the Conceptual Model

This package extends the functionality introduced in the ‘Basic Rates’ package and should be read in conjunction with that package. This package provides a set of classes and interfaces to support the modeling of Interest Rates.

3.1. Interest Rate Structures

As outlined in the Basic Rates Package, Rates (and therefore Interest Rates) are structured objects. An Interest Rate consists of a *buy*, *mid* and *sell* quote. Each of these quotes is composed of smaller rate *pieces*, a base piece and a set of margins that are added to that base

piece (some margins can be negative, e.g. a discount). Associated with each component of the rate can have a quotation method that determines how the quote is stored and displayed and converted to other forms.

3.2. Interest Rate Specifiers

Interest Rate Specifiers are used in conjunction with the Curve classes to generate Interest Rate curves (yield curves). It specifies the quoted currency, the interest rate of the exchange, a date range over which the rate is valid and a period that it applies to as well as other information needed to construct the yield curve. For example, it could specify USD, 1.5% 1-10-2000 to 8-10-2000.

3.3. Interest Rate Quotation Methods

Interest Rates can be quoted in a wide variety of ways – as yields, discounts, 100 – Discount, 100 – Yield, etc. Classes and Interfaces are defined in the package to support the various quotation methods. Associated with a quotation method is the notion of a ‘canonical’ or standard representation. This canonical form is used when one quotation form is being translated into another.

The following table summarizes the quotation methods specified in the package. In all examples, the starting amount is \$90 and the final amount is \$100.

Quotation Method	Description	Example
Discount Factor	Interest is represented as a ratio of the starting amount (a_1) over the final amount (a_2) = a_1 / a_2	= $90/100$ = $0.9000 = 90\%$
Discount Rate	Proportion of final amount that has to be subtracted from the final amount give the initial amount.	= $(100 - 90)/100$ Discount Rate = $0.1000 = 10\%$
100 – Discount Rate	100% less the Discount Rate (as a percent)	Discount Rate = $0.1000 = 10\%$ 100 – Discount Rate = 90%
Yield	Proportion of initial amount (a_1) to be added to initial amount to arrive at final amount (a_2)	= $(100 - 90) / 90$ = 0.111111 Yield = 11.1111%
100 – Yield	100% less the yield	Yield = 11.1111% . 100 – Yield = 88.8889%

3.4. Compounding Frequency

Model interfaces and classes are provided to support the various compounding interest rates. The following compounding methods are supported:

- Continuously – the interest is compounded on a continuous basis (i.e. the compounding frequency is infinite). The effective interest rate is equivalent to $\log_e(1 + \text{annual rate})$.
- Discretely – Over fixed periods (DiscreteActualCompoundingFrequency) – weeks, months, quarter or in a set number of times per year (DiscreteLevelCompoundingFrequency). The Actual Compounding Frequency has an associated period that defines the period between compounding times (e.g. weeks, months, etc.) The Level Compounding Frequency as a associated frequency that determines how many times the compounding is done over the interest period (this could be 1 time per year, 2 times per year or 1 time per 2 years, etc.).

3.5. Interest Rate Curves

The Interest Rate Curve classes extend the behavior of the Rate Curve classes defined in the “Basic Rates” package.

4. Use of the Object Model

4.1. Curves

For example, an Interest Rate curve could be constructed from the following interest rates:

USD/CHF

Date	Yearly Rate
Spot + 1W	6.0000
Spot + 1M	6.0010
Spot + 2M	6.0020
Spot + 3M	6.0020