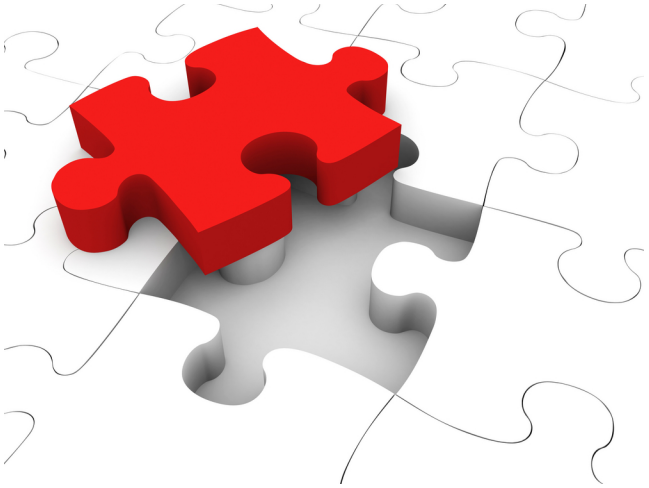
Acuity Derivatives LLC



Classifying Derivatives Contracts

Or herding cats onto carousel seats

February 2012

48 Wall Street, 11th Floor, New York, NY 10004 USA www.acuityderivatives.com

Classification Overview

> *It is always easy to find fault with a classification. There are a hundred ways of arranging any set of objects, and something may almost always be said against the best, and in favour of the worst of them. But the merits of a classification depend on the purposes to which it is instrumental.*
>
> *John Stuart Mill*
> *Auguste Comte and Positivism*

Classification as used here attempts to arrange traded financial derivatives into product classes or groups based on similar or related properties; properties as identified within a defined scheme of taxonomies; and similarity of properties as meaningful within some context.

The motivation for classification here is not much different to classification in biology in that the focus is not so much on the naming of things but on coming up with the best possible ordering of our knowledge base about the properties of the objects being classified such that the ordering gives us the greatest contextual command of the knowledge already acquired about the objects, and also leads us in the most direct way to the acquisition of more.

In plain English and as an example, within the context of classification for risk based P&L attribution policy as an example, we want to think of how to order the properties of financial derivative contracts in such a way that we can group them around the types of risk sensitive behavior they are likely to exhibit and thus how their P&L behavior may be best explained. Additionally, a fundamentally intuitive grouping helps shed light on more risk-sensitive properties that may be applicable within groups.

So,

> **Axiom 1**
> The first step to classification is specifying the properties of the financial derivatives that we want to classify; and using these properties to define the taxonomies most relevant to the context(s) of classification.

Also similar to biological classification, the variety of taxonomies possible will depend greatly on how "rich" derivative contract specifications are; by "rich" we mean how rigorous our descriptions of the financial derivative's properties and their combinations are. We will look at "richness" of specifications in later posts.

Thinking of classification this way introduces a qualification on who should be doing it.

Axiom 2
An extensive knowledge of the fundamental properties of financial derivatives across many processing contexts is necessary for making a good classification of them.

Unlike biological classification however, we opt for non-hierarchical taxonomies. By this we mean that the taxonomies are not assumed related to each other. Simple reason for not constraining our classification framework this way is there is no unifying evolutionary theory of financial derivatives contract terms (at least none that I know of). The emergence, combination and recombination of the terms in a financial derivative have no Darwinian Tree of Life equivalent.

Derivative Properties

Classification may be based on structural or behavioral properties of the financial derivative – the post titled "the contract before the chicken and the egg" on our web site introduces our use of these terms.

The commonality of financial products especially financial derivatives may best be understood through shared behavior (as opposed to shared structure); this for a couple of reasons.

- Structurally different financial derivatives may exhibit similar behavior within some context of observation – indeed they are sometimes explicitly structured to do so.

  (*E.g. create the same risk profile in different ways: Motivational phrases for doing so spring to mind – "A rose by any other name", "Give a dog a bad name and hang him", "You say utility, I say regulatory arbitrage").*

- Behavior (as used here) is forward looking –the fact that a triggered knock-in barrier European option becomes for (almost) all intents and purposes a vanilla European option has more relevance in its future analyses than what it was (though there remain many reasons to retain the knowledge that it started life as a knock-in barrier European option).

Focusing on behavior introduce some complications that our classification framework should handle.

Axiom 3
This introduces the notion that a classification requires **derivation** based on a product's behavioral properties and a set of contextual rules; as opposed to being simply assigned exogenously to properties and context.

Axiom 4
This also introduces the notion that classifications can be **dynamic** and may change over the life of a product; and so suggests a classification framework that supports re-sampling.

Instrument vs. Underlying

The behavioral properties of a financial derivative product will derive from the specific collection of contract terms and contractual commitments; and from the nature of the underlying observable quantity or quantities.

Or more simply: the behavior will derive from properties of the instrument structure (e.g. a Constant Maturity feature on an OTC swap will produce certain behavioral traits); and the behavior will also derive from properties of the underlying observable(s) (e.g. a Constant Maturity Swap leg that resets on a reference Interest Rate swap spread behaves somewhat differently from a Constant Maturity Credit Default Swap leg that resets on a reference credit spread).

Axiom 5
The classification scheme should draw taxonomies from the two behavioral property dimensions: Instrument and Underlying.

Paul Wilmott's[1] things to look out for in exotic contracts offer superb insights into fundamental pricing properties.

[1] Paul Wilmott – Frequently Asked Questions in Quantitative Finance 2nd Edition

Examples of properties from the underlying observable(s) include:

	Descriptions
Underlying Asset Class	The asset class of the underlying observable
Credit	Credit underlying
Rates	Rates underlying
Equity	Equity underlying
FX	FX underlying
Mortgages	Mortgages underlying
Commodities	Commodities underlying
Longevity	Longevity/Mortality underlying
Hybrid	A combination of two or more of these
Number of Independent Underlying Factors	How many independent underlying observables
> 0	A number greater than 0
Order of non-linearity	If the underlying is non-linear or a function of a non-linear function e.g. Option on an Option
0,1,....,n	A number >= 0 (0 means this derivative has a linear payoff - no optionality)
Tradeable Underlying	Whether the underlying observable is a directly traded quantity for which there is a market
Directly Tradeable	A traded market exists
Not Directly Tradeable	No traded market exists
Price Process Type	What type of process the underlying observable(s) are modeled or assumed to follow over time
Deterministic	Non-random function of time
Stochastic	Random with time but with a known probability distribution
Stochastic with undiscoverable probabilities	Random with time and with no known probaility distribution - think's Martians Invading
	The type of process that parameters in the underlying observable's price process are supposed to follow. These parameters include volatility, correlation, mean reversion, jump size, "cost of carry" parameters (e.g. interest rates, dividend yield, default probabilities, mortality rates,
Process-Parameters Process Type	inflation, funding, storage costs)
Constant	Assumed constant - e.g. vol in Black-Scholes
Deterministic	Non-random function of time
Stochastic	Random with time but with a known probability distribution
Events material to Underlying	The types of market events that are material to this underlying observable
Credit Event	A credit event - like bankruptcy, failure to pay, or non-standard ones like Interest Shortfall
Merger Announcement	A corporate action - merger
De-merger Announcement	A corporate action - de-merger
Dividend Announcement	A corporate action - dividend announcement
...	Others
Rate Reset	A reset of an index rate

Examples of properties from the collection of contract terms include:

	Descriptions
Linearity of Payoff Function	The linearity of the payoff function describing the contract's payoff
Linear	A linear payoff - e.g. that of futures
Non-Linear	A non-linear payoff - typically with optionality or other discontinuity
Non-Linear with Free boundary	A non-linear payoff - typically optionality but with embedded decisions e.g. american exercise, co
Time Dependency of Payoff	Whether the payoff has time dependency - where certain events are only possible within certain time periods i.e. some time periods are more equal than others (heterogenous time)
Homogenous Time	No special periods of time
Heterogenous Time	Special periods of time - e.g. ability to exercise only within periods as in Bermudan Options
Path Dependency of Payoff	Whether the payoff has path dependency - and the payoff is a function not just of a final value of the underlying observable but also of the path it has taken
Non-Path Dependent	Final value only
Path Dependent	Path dependent
Process-Parameters Process Type	The type of process that parameters in the payoff function are supposed to follow. These parameters include prepayment, recovery rates, mortality rates
Constant	Assumed constant
Deterministic	Non-random function of time
Stochastic	Random with time but with a known probability distribution
Events material to Payoff function	The types of market events that are material to the payoff function
Credit Event	A credit event - like bankruptcy, failure to pay, or non-standard ones like Interest Shortfall
Merger Announcement	A corporate action - merger
De-merger Announcement	A corporate action - de-merger
Dividend Announcement	A corporate action - dividend announcement
...	Others
Rate Reset	A reset of an index rate
Events/Notices Required	The types of events or notices required to be delivered
Credit Event Notice	Notice of a credit event - like bankruptcy, failure to pay, or non-standard ones like Interest Shortfa
Exercise Notice	Notice of an option exercise
...	Others
Notice of Physical Settlement	Notice of Physical Settlement

Taxonomies and Classification into these

With properties thus specified for the derivative contracts to be classified, the focus shifts to defining a set of taxonomies that are relevant to the context of classification and using the properties to define rules for bucketing into these taxonomies.

So if the context were risk factor analysis where the goal is to group the derivatives products on the basis of what risk factors would apply to them.

The taxonomies may be defined simply as the risk factors themselves e.g.

Credit Spread Delta products
Credit Spread Gamma products
Credit Basis products
Equity Volga products
…

Each of these taxonomies may then be set up with rules that rely on the properties defined for the derivatives contracts.

Credit Spread Delta product:
Includes all derivative contracts where the underlying observable's asset class includes Credit.

Credit Spread Gamma product:
Includes all derivatives contracts where the underlying observable's asset class includes credit AND that underlying observable has a process that is modeled or assumed to be Stochastic.

Credit Spread Basis product:
Includes all derivative contracts where the underlying observable's asset class includes Credit AND the underlying observable is not directly traded.

…

Classification (within this context) then reduces to using these rules to bucket the products into the taxonomies.

It is worth noting that this approach supports re-sampling and derivatives with dynamic behavior in that re-submitting the derivative contracts to this process of examining their behavioral properties and bucketing into taxonomies will re-classify evolved contracts based on the forward looking behavior they possess at that point.

Why is Classification important?

Cross-asset resource sharing is a key 2012 strategic priority for many banks both due to cost rationalization and also a growing business need to form consistent cross-asset views on many trading and operational processes e.g. regulatory compliance, pricing, risk management and margining, P&L explain, cash management, collateral optimization and secured funding.

Classification is fundamental to sharing resources and processes across groups of products by offering insights into commonality of usage and processing.

An additional benefit is the competitive advantage that comes from the operational insights gained about similarities across products classified within the same groups.

Context

We have talked about contexts in which one may want to classify derivative products; and for which one would want to generate multiple taxonomies to support.

Below are some examples of these:

- Market risk analysis
- Risk-based P&L explain analysis (risk factor and unexplained P&L threshold analysis)
- Computational provisioning
- Technology strategy and roadmap definition
- Calibration review
- Price testing and variance threshold analysis,
- Model/method usage policy and validation,
- Operational risk threshold analysis,
- Liquidity and market performance review,
- Netting/hedging strategy

Summary

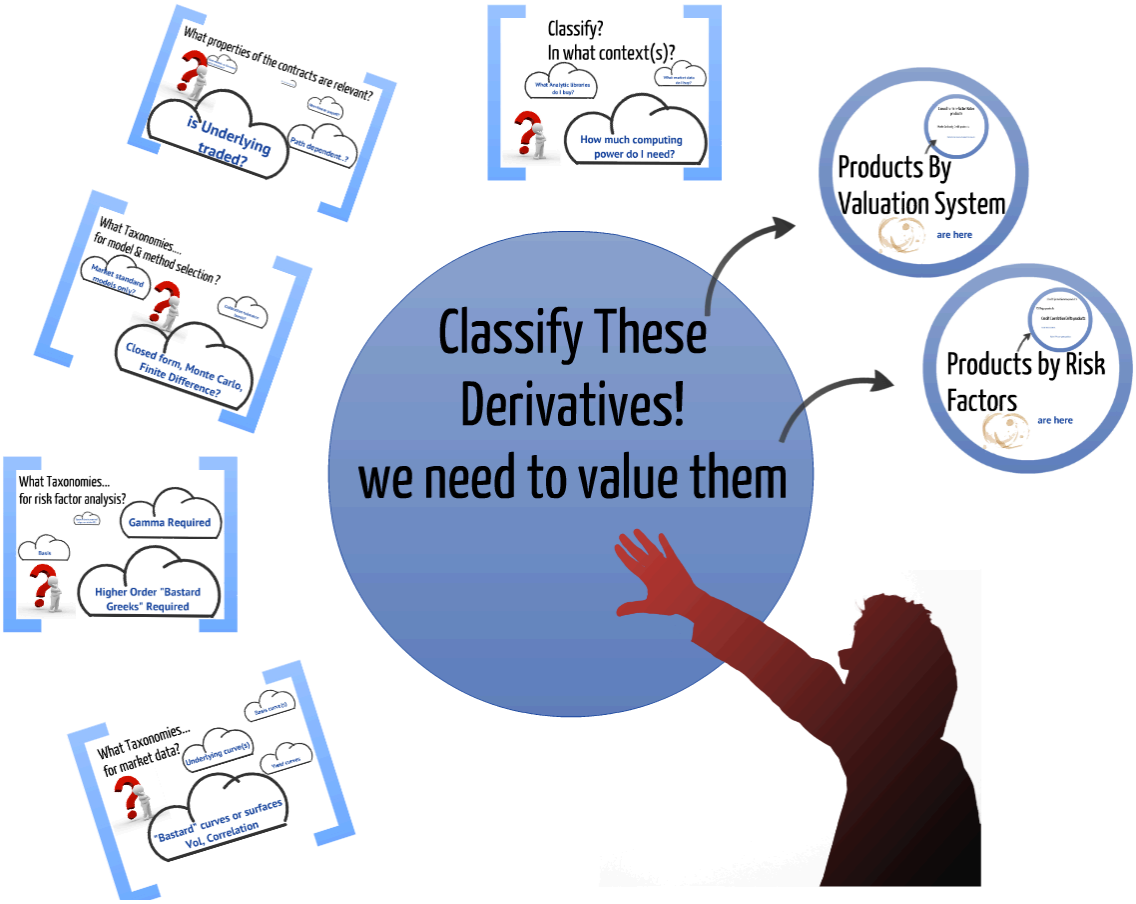
Axiom 1
The first step to classification is specifying the properties of the financial derivatives that we want to classify; and using these properties to define the taxonomies most relevant to the context(s) of classification.

Axiom 2
An extensive knowledge of the fundamental properties of financial derivatives across many processing contexts is necessary for making a good classification of them.

Axiom 3
Contract behavior introduces the notion that a classification requires **derivation** based on a product's behavioral properties and a set of contextual rules; as opposed to being simply assigned exogenously to properties and context.

Axiom 4
Contract behavior introduces the notion that classifications can be **dynamic** and may change over the life of a product; and so suggests a classification framework that supports re-sampling.

Axiom 5
The classification scheme should draw taxonomies from the two behavioral property dimensions: Instrument and Underlying.


What properties of the contracts are relevant?
Is Underlying traded?
Classify?
In what context(s)?
How much computing power do I need?
Products By Valuation System
are here
What Taxonomies... for model & method selection?
Closed form, Monte Carlo, Finite Difference?
Classify These Derivatives! we need to value them
Products by Risk Factors
are here
What Taxonomies... for risk factor analysis?
Gamma Required
Higher Order "Bastard Greeks" Required
What Taxonomies... for market data?
"Bastard" curves or surfaces Vol, Correlation