

MOTIVATION / BACKGROUND

- a) Krys Financials has been working in the Investment Banking and Securities Trading community since 1994. This experience has revealed unresolved challenges which concern the Pricing of investment Bonds and the agreed Yield of return.
 - These challenges are often the norm than the exception and have impacted the quality of business among Traders, Central Banks and Finance Ministries.
 - These challenges sometimes raise questions among Accountants and Auditors concerning the validity of gains/losses based on computed yields claimed by Traders.
 - These Bond Pricing challenges can possibly result in millions of dollars of trading errors, losses or gains between trading participants.
 - These challenges can also result in millions of dollars of accounting errors relating to accruals, amortization of premiums and accretion of discounts.
- b) Krys Financials' research has concluded that this problem exist in various Investment Banking and Securities Trading communities across the world.
 - Krys Financials uses this medium to foster the development of a common Bond Pricing solution for various Investment Banking and Securities Trading communities around the world. These communities include Central Banks, Finance Ministries, Dealers/Brokers, Traders, Customer Executives, Accountants, Auditors and other regulators, stakeholders and participants.

c) Intent / Methodology

- This document serves to promote a forum for discussions and presentations among regulators and stakeholders to formalize a common Bond Pricing solution.
- Krys Financials' initial proposal represents a central web-based Bond Pricing solution that addresses these challenges.



TABLE OF CONTENTS

MOT	IVATION / BACKGROUND1
STAN	NDARD BOND PRICING FORMULAS (SBPF) AND ASSUMPTIONS
CHA	LLENGES RELATING TO THE PRICING OF BONDS
a)	The SBPF does not support Bonds issued with Odd Coupons
b)	Common errors relate to the Accrual or Day-count Basis (i.e. 30/360, Act/360, Act/Act, etc.)
c)	Pricing Tools/Software often differ in Price calculations due to Counter/Clockwise Day-count orientation
d)	Pricing anomaly relating to a mixture of Clockwise and Counter-clockwise Day-count orientation4
e)	Pricing anomaly relating to a mixture of Periodic and Daily Coupon/Yield rate5
f)	Pricing Tools/Software often does not price for coupon periods smaller than quarterly
g)	Pricing Tools/Software often does not automatically handle Variable Bonds5
h)	Pricing Tools/Software often does not automatically identify Odd Coupon bonds
i)	Pricing Tools/Software often does not automatically validate weekends and holidays
j)	Banking and Trading communities sometimes have unique/isolated methods of manually pricing bonds
k)	Millions of dollars incorrectly traded and booked due to Price/Yield calculation anomalies7
CALI	L FOR RESOLUTION
REFE	BRENCES



STANDARD BOND PRICING FORMULAS (SBPF) AND ASSUMPTIONS

Bond Price =
$$\frac{C}{(1+y)^{1}} + \frac{C}{(1+y)^{2}} + \dots + \frac{C}{(1+y)^{n}} + \frac{F}{(1+y)^{n}}$$

Bond Price = $C * \frac{\left(1 - \left(\frac{1}{(1+y)^{n}}\right)\right)}{y} + \frac{F}{(1+y)^{n}}$

Where:

F = Face (Par) value at maturity n = number of payment Periods C = Coupon interest payment \rightarrow F * Coupon Rate y = Yield interest Rate 0 < y < 1; n > 0 and is an integer

Coupon, Yield, Face, Price relationships:

Coupon Rate = Yield Rate	\leftrightarrow	Par :	Price = Face
Coupon Rate < Yield Rate	\leftrightarrow	Premium:	Price > Face
Coupon Rate > Yield Rate	\leftrightarrow	Discount:	Price < Face

CHALLENGES RELATING TO THE PRICING OF BONDS

a) The SBPF does not support Bonds issued with Odd Coupons.

- Bonds are often issued with Odd Coupons occurring at the first and/or last periods.
- This breaks the integrity and assumptions of the SBPF:
 - SBPF requires 'n' to be an integer number and not a fraction.
 - 'n' should represent periods of equal length (days, weeks, months or years).
 - Coupon Rate is not equal to Yield Rate \leftrightarrow Par: Price = Face.



- b) Common errors often relate to the Accrual or Day-count Basis (i.e. 30/360, Act/360, 30/365, Act/365, Act/366, Act/Act, etc.).
 - Accrual basis is often based on country and may be difficult to compute manually.
 - Non-USA bonds are often Act/365 or Act/Act depending on the leap year 1-day factor.
 - 30/360 Accrual-Basis calculations are different between USA and Europe.
 - Correct Yields are important to compute the 'spread' between Investor/Liability investments at Act/365 which are linked/matched to Asset investments at 30/360.
- c) Pricing Tools/Software including spreadsheets, business/financial calculators, pricing services and custom-built software often differ in Price computations due to Counter/Clockwise Day-count orientation.
 - 'Price' is the Present value (PV) of Future Cashflows. This implies a Counter Clockwise Day-Count, i.e. in a reverse direction, from future-date to present-date (e.g. from Maturity-date to Last-Coupon or Settlement date).
 - Clockwise and Counter-clockwise Day-counts may differ with the final day-of-theweek derived/counted. This may be due to variations in Accrual basis e.g. 30/360 for USA and Europe differs with the last day of a 31-day month.
 - Consistent Day-count orientation/direction improves the integrity of bond computations, which is similar to maintaining a single unit of measurement.
- d) Pricing anomaly relating to a mixture of Clockwise and Counter-clockwise Daycount orientation.
 - One spreadsheet tool L uses a consistent Counter-clockwise Day-count orientation.
 - Another spreadsheet tool X uses a Clockwise Day-count to compute prices during coupon periods and uses Counter-clockwise otherwise.
 - This inconsistent method of Day-count may present unit of measurement anomalies. This is like mixing feet and inches in one equation as a single unit of measurement.



- e) Pricing anomaly relating to a mixture of Periodic and Daily Coupon/Yield rate used to compute the Dirty-Price and Clean-Price of bonds.
 - Spreadsheet X uses a Periodic Coupon/Yield rate for calculating the Dirty-Price which contains an implicit Periodic Coupon Interest Amount (Full or Accrued).
 - However to independently calculate the Coupon Accrued Interest, a Daily Coupon/Yield rate is employed. This result is then subtracted from the Dirty-Price to arrive at the Clean-Price.
 - This inconsistent method of Coupon/Yield Day-count factor introduces an anomaly resulting from a mixture of different units of measurement, i.e. Periodic vs. Daily Coupon/Yield rate.
- f) Pricing Tools/Software often does not price for coupon periods smaller than quarterly e.g. every 2 months or monthly.
 - This impacts the calculation of Bond Equivalent Yields that may be used to compute the Overall Yield of a portfolio of different investment instruments/securities.
 - The Bond Equivalent Yield of Investor/Liability investments which are usually at shorter coupon/interest periods (e.g. 30-days, on Call, Monthly) is a means of measuring the point to point 'spread' between Assets investments (e.g. bonds), which are usually at longer coupon/interest periods (e.g. 3-months, 6-months, annually).

g) Pricing Tools/Software often does not automatically handle Variable Bonds.

- Variable-Coupon bonds are Priced, Amortized or Accreted to next coupon payment date rather than the standard maturity date.
- Variable-Principal (Amortized) bonds are Priced as a series of multiple Fixed-Principal bonds where each Principal re-payment is treated as a separate bond with its own duration. This may be compared to Amortized Loans depending on the frequency of Principal/Interest re-payment periods.



h) Pricing Tools/Software often does not automatically identify Odd Coupon bonds.

- This often results in practitioners' mistaken use of the SBPF to price the variations of Odd Coupon bonds, which results in incorrect prices.
- Practitioners often lack readily available tools/software to detect the variation of Odd Coupon bonds in order to apply the relevant formulas.
- Practitioners are often unaware of what adjustments to make to the SBPF in order to price Odd Coupon bonds.
- When a bond is in its last coupon it automatically assumes the role of an Odd Coupon bond, hence the SBPF will not apply since the value of 'n' may include fractions.
- Variations of Odd Coupons include Odd First Coupon Long, Odd First Coupon Short,
 Odd Last Coupon Long and Odd Last Coupon Short.
- i) Pricing Tools/Software often does not automatically validate the holidays of the country from which a bond originates.
 - Coupon Interest are often calculated and paid before or after weekends and public holidays.
 - This affects the price of the bond relative to the point of a holiday onwards to the maturity of the bond.
- j) Some Investment Banking and Securities Trading communities have unique/isolated methods of manually pricing bonds without the use of pricing tools/software.
 - It is possible but not feasible to manually price bonds based on the complexity of variables involved. Pricing bonds manually often results in:
 - Little or no detection and adjustments for Odd Coupons
 - Inconsistency in Counter-clockwise Day-count orientation
 - Incorrect treatment of Accrual basis
 - Inconsistency in Coupon/Yield Day-count factor



- k) Millions of dollars incorrectly traded and booked due to Price/Yield calculation differences in Pricing Tools/Software.
 - Consider a Bond Issue at Par with Odd Coupons where it is normal to assume that Coupon Rate = Yield Rate and you have made financial commitments on this basis.
 - In reality Coupon Rate is not equal to Yield Rate hence someone would suffer the consequence of trading errors due to incorrect Yield assumptions.
 - If Trader-1 uses software tool X and Trader-2 uses software tool L to price the same bond with different results then one party may suffer losses due to pricing errors.
 - Accountants and Auditors often use the Yield Rate to test the actual overall booked earnings of a bond. Incorrect Yields will definitely create audit variances.
 - Using an incorrect Yield Rate to book the Amortization of bond Premiums or the Accretion of bond Discounts will definitely misrepresent investment profitability.
 - There is no Fair Exchange of Value, especially when Trading parties are ignorant of computational pricing errors resulting from Pricing Tools/Software.

CALL FOR RESOLUTION

This is a call for members of the Investment Banking and Securities Trading communities to make contributions to resolve these and other fundamental Bond Pricing challenges where possible.

Krys Financials has developed an Application solution that addresses several of the aforementioned challenges. We look forward to meetings, discussions and presentations to promote a feasible solution to these fundamental Bond Pricing challenges.



REFERENCES

- BOND MARKETS ANALYSIS' AND STRATEGIES
 - Frank Fabozzi
- FINANCIAL INSTITUTIONS MARKETS AND MANAGEMENT
 - Professor Charles D'Ambrosio
- INVESTMENTS
 - Zvi Bodie, Alex Kane, Alan Marcus
- CHARTERED FINANCIAL ANALYST (CFA) PROGRAM
 - Association for Investment Management and Research (AIMR)
- ADVANCED BOND CONCEPTS: BOND PRICING
 - http://www.investopedia.com/university/advancedbond/advancedbond2.asp
- TIME VALUE OF MONEY
 - http://en.wikipedia.org/wiki/Time_Value_of_Money
- INTERMEDIATE ACCOUNTING
 - Paul Danos, Eugene Imnoff
- ADVANCED CALCULUS
 - Murray Spiegel
- MICROSOFT OFFICE EXCEL
 - Microsoft Corporation
- IBM LOTUS 1-2-3
 - International Business Machines Corporation (IBM)
- ADVANCED BUSINESS ANALYST CALCULATOR
 - Texas Instruments
- FINANCIAL CALCULATOR
 - Hewlett Packard