

ZIA CORPORATION

Serving the fixed-income securities dealer

Zia Fixed Income Calculations Library

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Introduction

The Zia Bond Calculation Library (**Library**) is a comprehensive set of financial functions designed to provide a simplified method of computing bonds and other fixed income instruments. The listing below indicates the types of securities for which calculations are described in this manual. The computations included in the library provide computer professionals the capability of performing complex investment calculations.

The **Library** groups security instruments into the following general categories.

Security Code

Municipal, Corporate, Agency bonds	0
U. S. Government bonds	1
Municipal Notes	2
Actual 360 Notes	3
Actual 365 Notes	4
Treasury Bills, discount securities	5
Stepped coupon bonds	6
Annual Coupons on a semi-annual basis	7
Medium-Term Notes	8

Description Of Securities

The library supports the below listed securities:

- Periodic coupons
- Stepped coupons
- Zero coupons
- Odd first coupon
- Odd first and Odd last coupons
- Interest at maturity securities
- Discounted securities

Note: Bonds which pay interest (coupons) periodically may be paid; Annually, Semi-annually, Quarterly, or Monthly.

Computations are based on industry standard day count basis:

- 30/360
- Actual/Actual
- Actual/360
- Actual/365

Price/Yield computations available are:

- Price to Maturity (all securities)
- Price to Call (all securities)
- Price to Lower - Call or Maturity (all securities, except discounted)
- Yield to Maturity (all securities)
- Yield to Call (all securities)
- Yield to Lower - Call or Maturity (all securities, except discounted)

Data Formats

Numbers

All variables, except for dates, are numbers using a floating decimal point to define the position of the decimal point in the number. The decimal point is not necessary for numbers without a fractional part.

Dates

Dates are string variables, which must be less than 12 characters in length :

- **Month** One or two numeric characters, not to exceed “12” for December.
- **Day** One or two numeric characters, not to exceed “31”. If the day is from the first to the ninth (only one digit), enter a leading zero to fill in the first digit.
- **Year** Four numeric characters, the century and year, less than “3000”. or Two digits, the last two digits of the year. When the century digits are not entered, library assumes the date is a valid date between January 1, 1970 and December 31, 2069.

Date Format	“Example”	Date
mddy	“10100”	Jan. 1, 2000
mmddy	“102010”	Oct. 20, 2010
mddyyyy	“1012000”	Jan. 1, 2000
mmddyyyy	“06011962”	June. 1, 1962

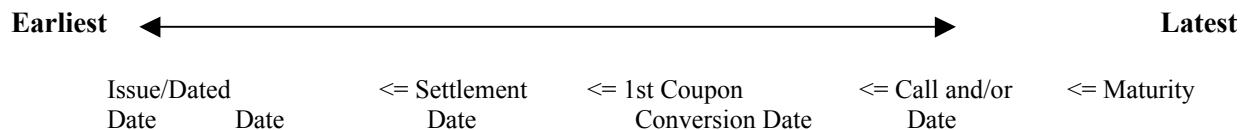
Month, day and year can be separated by any combination of dashes, slashes, commas, periods or spaces. For example, the following list is some commonly formatted dates for January 1st, 2000:

Separator:	“m dd yy”	or	“m dd yyyy”
slash	“1/01/00”	or	“1/01/2000”
dash	“1-01-00”	or	“1-01-2000”
space	“1 01 00”	or	“1 01 2000”
comma	“1,01,00”	or	“1,01,2000”
period	“1.01.00”	or	“1.01.2000”

Remember, when entering a date without a century, the library assumes a valid date between January 1, 1970 and December 31, 2069. If you want to use a date not in this range, include the century. January 1, 2070 may be entered as 1012070.

In order to provide consistency for date calculations, some guidelines must be followed when passing dates. These are:

- The library will not accept dates which do not exist on an actual calendar. Incorrect dates are treated as NULL.
- The library will not perform a security calculation without a settlement date.
- Dates are compared to each other before any calculation is performed. Dates, if necessary for a calculation, must be in the following order:



The presence of NULL string for a date is an indication that you do not want to use that date in a calculation. For example, an Issue/Dated date of NULL will not be used when computing accrued interest.

Prices

All prices are expressed in terms of Dollar Price (dollar per \$100.00 par value).

Accrued Interest

Accrued Interest is computed per thousand. You must compute the dollar amount, by multiplying the Accrued Interest factor by the par amount of the security.

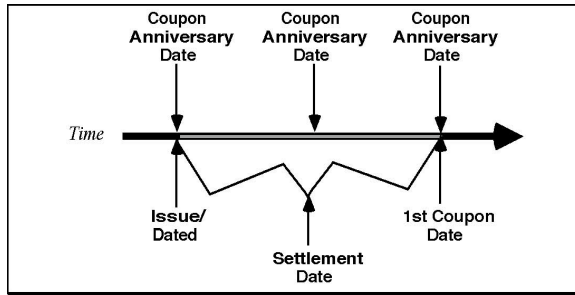
Include Odd Coupon

Some bonds are issued with an “odd first coupon”. This is a bond for which there is more (or less) than one normal coupon period from issue date to the date of the first coupon payment. For example, a semi-annual coupon is considered to be “short” if the first period is less than six months, and “long” if more than a six month period. Traditionally, when settlement occurs during the odd period (before the first coupon payment), an odd coupon amount has been included in the invoice extension of accrued interest but not in the price and yield calculations. The library will included the odd coupon period when computing price and yield, as well as, the accrued interest.

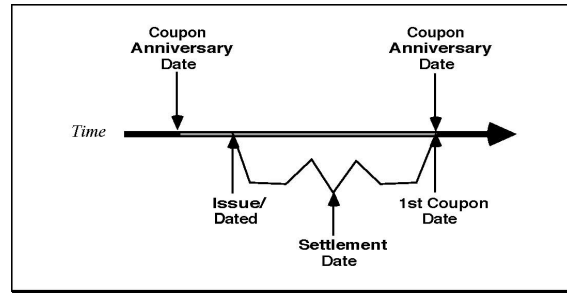
The library will consider the odd coupon for price and yield whenever the settlement date is prior to the 1st coupon date. If the odd coupon is not to be considered, set the Fist Coupon date to NULL. This method allows the correct accrued interest to be computed form the issue/dated date but does not include the odd period in the price or yield calculation.

Note: If the Settlement date is passed the first Coupon you should also set the Issue/Dated Date to NULL. This allows the correct accrued interest to be computed from the previous coupon date.

The following two graphics illustrate the long and short coupon periods:



Odd Long Coupon Period



Odd Short Coupon Period

Odd coupon bonds are issued regularly by the U. S. Treasury and other Federal Agencies. These issuers consider the odd period when computing price and yield as well as when extending the accrued interest. For municipal securities, as required by M. S. R. B., the odd period should not be considered when computing price and yield but should be when calculating the accrued interest. Corporate's presently follow the accepted practice of municipals, however, a trend is starting whereby the Treasury method will be used.

MUNI Switch

The **MUNI** switch controls the method of calculation for all securities which use a 30/360 day count basis (Security Codes 0, 2, 6 and 7). When **MUNI** is set to *true*, Municipal Securities Rule-making Board (M. S. R. B.) rules are in effect for the day count basis and computes the days to next coupon anniversary by subtracting the accrued days from the days in the coupon period. When **MUNI** is set to *false*, the Security Industry Association (S. I. A.) standards method is used. This method computes the days to next coupon anniversary by counting the number of days from Settlement Date to the next coupon date (according to the 30/360 day count basis). Consider the following bond calculations:

Agency Bond	MUNI == FALSE
Settlement Date	03-01-1985
Coupon	10.000%
Maturity Date	01-31-1999
Price	100.000
Yield	9.994

Municipal Bond	MUNI == TRUE
Settlement Date	03-01-1985
Coupon	10.000%
Maturity Date	01-31-1999
Price	100.000
Yield	9.998

The .004% difference in yield is caused by using the M. S. R. B. rule G-33 method to count days from settlement date to next coupon anniversary (149) and the S. I. A. standards method (150).

This switch also controls the number of decimal places of price results in Security Codes 0, 2, 3, 4, 6, 7, and 8. Prices are rounded to 6 places in the **FED** and truncated to 3 places in **MUNI**. Security Code 1 and 5 prices are calculated to 6 and 7 decimal places respectively.

Library Function Call Definitions

Zia **LIBRARY** functions are defined in this section by function name. Included in the definition is the purpose of the function and it's computed results followed by a definition of variables.

DG_BT() **Basic Fixed Income Call**

Function call to the basic fixed income library. This function call passes a pointer to a previously defined variable structure (**DG_Var**) and returns an integer value (error status). It calculates the lower of Price given yield or Yield given price. The following variables are updated before returning to the caller:

- Accrued Interest factor (per thousand)
- Basis "to call" or "to maturity"
- Price/Yield to Maturity date
- Price/Yield to Call date
- Current Yield

Optional library modules may be linked with this library function which enable this function call to also compute:

- Equivalent Yield
- After-Tax-Yield
- Before-Tax-Price
- Duration
- Modified Duration
- Convexity
- Difference in price at yield plus 1 Basis Point
- Difference in price at yield minus 1 Basis Point

DG_Var	Structure Definition
AcrdInt	Accrued Interest factor (per 1000) for use in computing invoice amounts. (Accrued Interest factor X Par Amount = Accrued Interest in Dollars)
ATYield	After-Tax Yield given the entered or calculated price in conjunction with an income tax rate and/or capital gain rate.
Basis	This variable defines the basis of calculation. Basis indicates whether Price or Yield was computed "to call" or "to maturity" date.
BtxPrc	After-tax-yield to price. The Before-Tax-Price given the entered or calculated yield and the income tax and/or capital gain rate.
CallDt1[12]	The Call Date using the standard date format (Refer to General Entries section).
CallDt2[12]	The Call Date using the standard date format (Refer to General Entries section).
CallPrc1	Call Price or Put price (dollar price) of a security.
CallPrc2	Call Price or Put price (dollar price) of a security.

DG_Var	Structure Definition
---------------	-----------------------------

ConvCpn	The Conversion (second) Coupon rate, as a percentage, applies to Code 6 securities.										
ConvDt[12]	The Conversion Date, using the standard date format, determines when the Conversion Coupon rate is applied to a Code 6 security.										
Convexity	Convexity measures duration's "rate of change" for a change in yield.										
Coupon	Coupon rate, as a percentage, on a bond, the interest rate on a note.										
CpnsYr	Frequency of "Coupon payments per Year" for Security Codes 0, 1, 6-8										
	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Annual coupons</td> </tr> <tr> <td>2</td> <td>Semi-annual coupons</td> </tr> <tr> <td>4</td> <td>Quarterly coupons</td> </tr> <tr> <td>12</td> <td>Monthly coupons</td> </tr> </tbody> </table>	Value	Meaning	1	Annual coupons	2	Semi-annual coupons	4	Quarterly coupons	12	Monthly coupons
Value	Meaning										
1	Annual coupons										
2	Semi-annual coupons										
4	Quarterly coupons										
12	Monthly coupons										
CurYld	The Current Yield for a security is the ratio of the annual dollar amount of interest paid on a security to the market price, as a percentage.										
Dur_Mod	The Modified Duration of a coupon security (Security Codes 0, 1, 6, 7 and 8.). i. e., Duration divided by (one plus the yield divided by the periods per year).										
Duration	Duration is a measure of the timing of the cash flows for a coupon security. (Security Codes 0, 1, 6, 7 and 8.)										
EqvYld	The yield passed or calculated is converted to an Equivalent Yield as a percentage.										
FcDt[12]	The First Coupon Date, using the standard date format. The First Coupon Date is used to determine if an "odd" coupon period applies to Code 0, 1, 6, 7, and 8 securities when computing price/yield										
GainRt	Capital Gains Rate, as a percentage, to be used in all after-tax calculations.										
IssDt[12]	Issue Date or Dated Date. An Issue Date is required for Security Codes 2, 3 and 4. The Dated Date is used to calculate accrued coupon interest in Codes 0, 1, 6, 7, and 8.										
MatDt[12]	Maturity Date, of a security using the standard date format.										
Minus1BP	Calculates the difference in price, between the entered or calculated price and the dollar price at the yield Minus 1 Basis Point.										
Muni	MUNI switch. Refer to the "variables used as switches" section.										
Plus1BP	Calculates the difference in price, between the entered or calculated price and the dollar price at the yield Plus 1 Basis Point.										
Price	Dollar Price of a security or zero to calculate the Price of a security.										

Sc Security Code determines the formula and day count basis used in all calculations. Refer to Appendix D for a more complete list of securities and their day count basis.

Type of Security	Interest Pays	Day[†] Count	Security Code
Municipal, Corporate, Agency bonds	Periodic	30/360	0
U. S. Government bonds	Periodic	ACT/ACT	1
30/360, Municipal Notes	At Maturity	30/360	2
Actual 360 Notes	At Maturity	ACT/360	3
Actual 365 Notes	At Maturity	ACT/365	4
Treasury Bills, discount securities	Discount	ACT/360	5
Stepped coupon bonds	Periodic	30/360	6
Annual Coupons on a semi- annual yield basis	Periodic	30/360	7
Medium-Term Notes	Periodic	30/360	8

[†]The Calendar method used to count the number of days between two dates.

30/360 - 30 days in each month; 360 days per year

ACT/ACT - Actual days in each month; Actual days per year

ACT/365 - Actual days in each month; 365 days per year

ACT/360 - Actual days in each month; 360 days per year

SetDt[12] Settlement Date, using the standard date format, required for all security calculations. Refer to the General Entries section.

TaxRt Income tax rate, as a percentage, to be used in all after-tax calculations.

ToCall1 Dollar Price or Yield of a security computed to call date 1.

ToCall2 Dollar Price or Yield of a security computed to call date 2.

ToMat Dollar Price or Yield of a security computed to the maturity date.

Yield Yield of a security or zero to calculate the Yield of a security.

Fixed Income Securities

The **DG_BT** function call calculates Dollar Price and Yield for security codes 0 through 8. This function call passes a pointer to a previously defined variable structure (**DG_Var**) and returns an integer value (error status). Refer to Appendix C for the include file and structure definition.

Calling Syntax: int DG_BT(struct *DG_Var)

The variable structure **DG_Var** contains the variables necessary to satisfy all the security codes. Securities without a call or put option can be computed to maturity by setting the call price and call date to zero. But, you do not have to supply the variables that are not applicable to a security. For example, if you are performing a calculation for a municipal bond (security code 0), you do not have to assign values to **ConvDt** or **ConvCpn**.

DG_Var Description	Variable Type	Variable Name	Input/ Output	Comments
Security Code:	short int	Sc	i	All securities
MUNI switch:	short int	Muni	i	Coupon Securities
Coupons per/year:	short int	PrdsYr	i	Coupon Securities
Basis:	short int	Basis		
Issue/Dated Date:	char	IssDt[12]	i	Codes 2, 3, 4 & odd 1st coupons
Settlement Date:	char	SetDt [12]	i	All securities
First Coupon Date:	char	FcDt[12]	i	Odd 1st coupons
Call Date 1:	char	CallDt1[12]	i	All securities, except code 5
Call Date 2:	char	CallDt2[12]	i	All securities, except code 5
Conversion Date:	char	ConvDt[12]	i	Code 6
Maturity Date:	char	MatDt[12]	i	All securities, except call only
Coupon Rate:	double	Coupon	i	All securities, except zero coupons
Conversion Rate:	double	ConvCpn	i	Code 6
Call Price 1:	double	CallPrc1	i	All securities, except code 5
Call Price 2:	double	CallPrc2	i	All securities, except code 5
Price:	double	Price	i/o	All securities
Yield:	double	Yield	i/o	All securities
Price or Yield to Maturity:	double	ToMat	o	All securities, except code 5
Price or Yield to Call 1:	double	ToCall1	o	All securities
Price or Yield to Call 2:	double	ToCall2	o	All securities
Accrued Interest:	double	AcrdInt	o	All securities

Current Yield:	double	CurYld	o	All securities
Current Yield:	double	CurYld	o	All securities
Equivalent Yield:	double	EqvYld	o	Optional
Capital Gain Rate:	double	GainRt	i	All securities
Income Tax Rate:	double	TaxRt	i	All securities
After Tax Yield:	double	ATYield	o	Optional
Before Tax Price:	double	BtxPrc	o	Optional
Duration:	double	Duration	o	Optional
Modified Duration:	double	Dur_Mod	o	Optional
Convexity:	double	Convexity	o	Optional
Plus 1 basis point:	double	Plus1BP	o	Optional
Minus 1 basis point:	double	Minus1BP	o	Optional

Compute price by specifying a value for **Yield** and a zero (0) **Price**. If the security has a call option, then **Price** will be the lower of “price to call” or “price to maturity”. **ToMat** and **ToCall** will contain the appropriate prices.

Compute yield by specifying a value for **Price** and a zero (0) **Yield**. If the security has a call option, then **Yield** will be the lower of “yield to call” or “yield to maturity”. **ToMat** and **ToCall** will contain the appropriate yields.

Basis indicates which is the lowest Price/Yield result that was computed; “to call date1”, “to call date2” or “to maturity” date by returning one of the values below:

<u>Value</u>	<u>Meaning</u>
0	Yield to Maturity Date is lower
1	Yield to Call Date1 is lower
2	Yield to Call Date2 is lower
3	Price to Maturity Date is lower
4	Price to Call Date1 is lower
5	Price to Call Date2 is lower

Once you have assigned the input variables their appropriate values, call the library using **DG_BT**. One function call to Zia library computes all the output variables.

If an error is discovered the function returns a non-zero value indicating the cause. The input variables are not affected, but the results are set to zero. Refer to Appendix A for a complete list of errors. A zero is returned when the calculation is successful. All Price/Yield calculations use the “direct pricing” method and therefore compute the actual yield even if the bond is priced at par. Note that you have to test for corporate bonds priced at par, if you do not want direct pricing.

The library can be linked such that the following results will not be included:

- Equivalent Yield
- After-Tax-Yield and Before-Tax-Price
- Duration and Modified Duration
- Convexity and Yield \pm 1 Basis Point

Security Codes 0 through 8

This section describes Fixed Income Security instruments as they pertain to Zia LIBRARY. Also included are any particular features of the security that are considered to be unique or differentiate it from the others. Security Code 0 explains will detail all the calculations performed while the other security descriptions will only detail how they differ from code 0.

Security Code 0

Security Code 0 calculates Municipal, Corporate, and Federal Agency Bonds as well as any security which pays periodic interest on a 30/360 (30 day month/360 day year) calendar. Refer to Appendix D for a more complete list of securities, and the day count basis.

OTHER COUPON FREQUENCIES

Most domestic bonds are issued to pay coupon interest semi-annually. However, some pay coupons on a monthly, quarterly or annual basis. Set **CpnsYr** to 1, 4 or 12 to calculate using the appropriate coupon frequency. Refer to Code 7 for another method of computing coupon bonds.

EQUIVALENT YIELD

The result **EqvYld** is provided for comparison to securities which pay interest on a different frequency. The yield is converted to the compounding frequencies as listed below:

<u>Coupons per year</u>	<u>EqvYld result</u>
1	Annual Semi-Annual
2	Semi-Annual Annual
4	Quarterly Semi-Annual
12	Monthly Semi-Annual

CALLABLE BONDS

For Bonds with a call option, you must enter a call price and call date using the **CallPrc** and **CallDt**. If you want to force the price/yield calculation “to call”, assign a NULL to **MatDt**.

YIELD TO INVESTOR

Computing a bond to the call date can also be used to calculate “yield to the investor” for a bond currently held. To calculate the yield to investor, treat the bond as if it were called. Setup the calculation just as you would for a normal calculation except substitute the values for the following variables:

<u>Variable</u>	<u>Definition</u>
SetDt	Purchase date
CallPrc	Market price
CallDt	Settlement date
Price	Purchase price

This setup will compute the yield from the purchase date to the current settlement date at the market price.

BOND EXTENSIONS

After a price or yield calculation, securities must be extended. Extended means computing the dollar amount of Principal, Accrued Interest and Net amount.

To calculate a bond extension, perform a price or yield calculation in the normal way. The library function computes the accrued interest “factor” (**AcrdInt**) per thousand. You must

calculate the actual accrued interest by multiplying the **AcrdInt** by the actual par amount of the bonds.

Note: When specifying an Issue/Dated Date, the accrued interest will be computed from that date except when the settlement date is later than the 1st coupon date or if you do not specify a 1st coupon date.

ODD COUPONS

The library will consider the odd coupon for Price/Yield and accrued interest calculations whenever the settlement date between the Issue/Dated Date and the 1st coupon date. Refer to “General Entries” section for a detailed discussion.

AFTER-TAX CALCULATIONS

The library has the capability of calculating After-tax yield (**ATYield**) and Before-tax price (**BtxPrc**) for notes as well as bonds. After tax yield calculations cannot be done for Treasury Bills. (See Security Code 5, after-tax calculations)

The library makes no assumptions about a bond’s tax status, both values are computed. Whether or not these calculations apply to a bond is up to the user. For a taxable bond, the after-tax yield is valid and for a non taxable bond the before-tax price is valid. If the tax rates are zero, the after tax calculations will not be performed.

The after-tax calculations are always based on either or both of two different tax rates, the income tax (**TaxRt**) and capital gain (**GainRt**) rates. These rates, like the coupon rate, are percentages. In most cases, Municipal Bonds do not require an income tax rate. Just assign a zero to the income tax rate (**TaxRt**)

Premium bonds and notes, in accordance with convention, are calculated using the tax rate for both the tax on interest and the tax on the capital loss.

ZERO-COUPON BONDS

Zero-Coupon or stripped coupon bonds can be calculated exactly as a normal coupon bond by assigning **Coupon** an interest rate of 0.

DURATION

Duration is a measure of the timing of the cash flows (i.e., the interest payments and the principal repayment) to be received from a given coupon security. The duration of the security is equal to

(a) the sum of the present values of each of the cash flows weighted by the time to receipt of each cash flow divided by (b) the total of the present values of the cash flows. The duration of a bond is used by many investors because it is a convenient way of combining the time elements of security for coupons and term to maturity.

The modified duration (**Dur_Mod**) is the duration (computed as above) divided by (1+ Yield/coupons per year).

The library computes duration for coupon securities (Codes 0, 1, 6, 7, and 8).

Here's some characteristics of Duration:

1. If the bond has coupons the duration of the bond will always be less than the term.
2. If two bonds have the same maturity date, the bond with a larger coupon will have a shorter duration.
3. Generally, there is a positive relationship between term to maturity and duration. (Normally the longer the term to maturity, the longer the duration.)
4. In most cases, the higher the market yield, the lower the duration.
5. Zero or stripped coupon bonds will have a duration equal to the term to maturity.

CONVEXITY

Convexity is a measure of how much a bond's price-yield curve deviates from a straight line. If the yield on a bond increases by one basis point, the price will drop. The price will rise when the yield on a bond decreases by one basis point. But, because of convexity, the two price changes may not be equal in magnitude.

The library computes a close numerical approximation of this quantity.

High convexity is a desirable property for a bond or a portfolio of bonds. Here are some factors which increase convexity:

1. Decreasing coupon, holding yield and maturity constant.
2. Decreasing yield, holding coupon and maturity constant
3. In most cases, increasing maturity, holding coupon and yield constant

Although these factors also apply to increasing the modified duration of a bond, it is not always true that increasing the modified duration increases the convexity.

VALUE OF A BASIS POINT

Plus1BP and **Minus1BP** are two calculations which combine several library functions to obtain the movement of dollar price, assuming that the yield moves 1 basis point.

The yield is always re-computed before performing this calculation. For example, **Plus1BP** is defined as the movement (difference) of dollar price, if the yield moves up 1 basis point. If the computed yield is 9.000% for a dollar price of 90.999, the following result is returned:

<u>Remark</u>	<u>Yield</u>	<u>Price</u>	
Price at	9.000%	90.999	
Price at (Yield + .01%)	9.010%	90.718	
Difference in prices		-0.281 =	Plus1BP

Security Code 1

Security Code 1 calculates Government Bonds as well as any coupon security which pays periodic interest on an Actual (actual days in a month/actual days in a year) calendar. Refer to Appendix D for a more complete list of securities and day count basis.

All of the calculations and options available in Code 0 can also be performed using Code 1. The one exception is that the MUNI switch has no effect on the Price/Yield calculation.

Security Codes 2 through 4

Security Codes 2, 3, and 4 are used to calculate notes paying interest at maturity. Notes may be calculated based on three different day count basis according to the Code entered:

<u>Code</u>	<u>Day Count</u>
2	30/360
3	Actual/360
4	Actual/365

Refer to Appendix D for a more complete list of securities and day count basis.

Entries describing a note are the same as for Security Code 0. The interest rate is entered as the **Coupon** and the issue date as the **IssDt**. The price is calculated to 6 or 3 places depending on the setting of the **MUNI** switch. If **MUNI** is *true* three decimal places are calculated, in accordance with rules for municipal notes. Set **MUNI** to *false* when six decimal places are required.

Security Code 5

Security Code 5 is used to calculate Treasury Bills and other discount instruments, such as banker's acceptances, on an Actual/360 calendar. Refer to Appendix D for a more complete list of securities and the day count basis. Given the price, the discount rate is calculated. Given the discount rate, the price is calculated. The bond equivalent yield is computed as the **EqvYld** result.

DISCOUNT EXTENSIONS

For discounted securities, the **AcrdInt** result is the discount interest per thousand par value.

AFTER-TAX CALCULATIONS

The library has the added capability of performing after-tax calculations for Security Code 5. The basic procedures remain the same as in other Codes, however, the nature of discount securities changes the results obtained for the after-tax functions.

ATYield provides the after-tax discount rate (not yield); that is the effective discount rate after tax considerations.

BtxPrc assumes an after-tax discount rate (not yield), and calculates the before-tax discounted price which would be paid to obtain the entered after-tax discount rate.

Security Code 6

Security Code 6 calculates stepped coupon bonds, as well as any security which has two coupon terms, each with it's own coupon rate, and pays periodic interest on a 30/360 (30 day month/ 360 day year) calendar. Typical examples of stepped coupon instruments are: Growth and Income Securities and Capital Appreciation/Future Income Securities. These instruments function essentially as zero coupon securities for a period of time after issuance, then on a conversion date they begin to pay coupon interest semi-annually.

The library can compute the price and yield of any security which contains two interest rate terms (Stepped coupons). The first coupon rate does not have to be zero. For example, for the first 15 years, a security may have a coupon of 4.5% and then for the next 10 years have a coupon of 9.5%.

Enter the security description just as in Code 0. The additional variables of **ConvDt** and **ConvRt** are required for all Code 6 Calculations. The conversion date must fall on a normal coupon anniversary. It is the date on which the conversion coupon rate takes effect.

Security Code 7

Security Code 7 calculates, on a semi-annual yield basis, any security which pays periodic interest on a 30/360 (30 day month/360 day year) calendar. Internally the library converts all yields to their periodic or semi-annual equivalent where ever necessary.

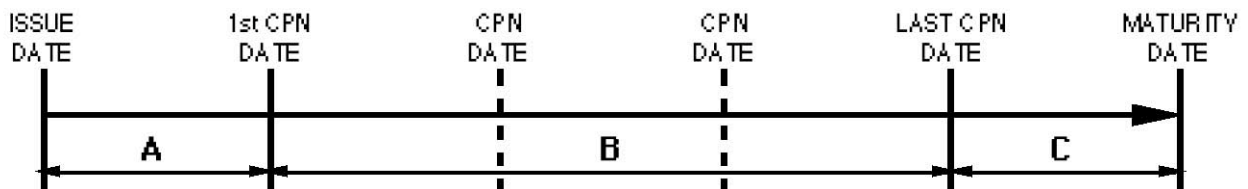
For example, annual coupon bonds can be priced by passing a semi-annual yield to compute dollar price. Conversely, their semi-annual equivalent yield can be computed, by entering a dollar price and computing yield.

Other calculations computed on a semi-annual basis are: Price/Yield to Call Date, Odd First Coupon included in price/yield, After-Tax Yield, Before-Tax Price, Value of ± 1 basis point, and Duration.

Security Code 8

Security Code 8 calculates Medium-Term Notes as well as any security which pays periodic interest on a 30/360 (30 day month/360 day year) calendar. Medium-Term Notes are Corporate or Agency debentures. Interest payments are set at registration and issuers select a specific maturity date for each note within a maturity range. As a result, the first and last interest payment periods may not be one full coupon period, creating a long and short coupon.

The three distinctive parts of a medium term note can be illustrated as follows:



Part A: When the settlement date falls between the Issue date and the 1st coupon date. Enter the Issue date as **IssDt** and the 1st coupon date as **FcDt**.

When the settlement date falls after the 1st coupon date. Enter the previous coupon date

Part B: (previous to the settlement date) as **IssDt** and set **FcDt** to zero.

When the settlement date falls after the Last coupon date. Enter the Last coupon date as

Part C: **IssDt** and set the **FcDt** to zero.

Fixed Income Security Example

An 8.5% Municipal Bond due April 15, 1999 is sold to yield 9%. It is callable on October 15, 1996. at a price of 102.500. Settlement date is June 24, 1987. Calculate price to call and to maturity.

DG Var Description	Variable Name	Input/Output	Value
Security Code:	Sc	i	0
MUNI switch:	Muni	i	1
Coupons per/year:	PrdsYr	i	2
Settlement Date:	SetDt[12]	i	12-07-06
Issue/Dated Date:	IssDt[12]	i	12-01-06
First Coupon Date:	FcDt[12]	i	5-15-07
Coupon Rate:	Coupon	i	5.375
Conversion Date:	ConvDt[12]	i	
Conversion Rate:	ConvCpn	i	
Call Price:	CallPrc	i	101.5
Call Date:	CallDt[12]	i	5-15-11
Maturity Date:	MatDt [12]	i	5-15-24
Income Tax Rate:	TaxRt	i	15
Capital Gain Rate:	GainRt	i	15
Price:	Price	i/	0
		o	98.605
Yield:	Yield	i/	5.5
		o	5.5
Lowest (Call/Mat):	Basis	o	2
Price or Yield to Maturity	ToMat	o	98.605
Price or Yield to Maturity	ToCall	o	100.688
Accrued Interest:	AcrdInt	o	0.895833333
Current Yield:	CurYld	o	5.451
Equivalent Yield:	EqvYld	o	5.576
After Tax Yield:	ATYield	o	4.679
Before Tax Price:	BtxPrc	o	88.997
Duration:	Duration	o	11.446
Modified Duration:	Dur_Mod	o	11.140
Convexity:	Convexity	o	1.659208
Plus 1 basis point:	Plus1BP	o	-0.110127
Minus 1 basis point:	Minus1BP	o	0.110291

Appendix A • Error Conditions

Error #	Description of Error
1.	Invalid Security Code, out of range.
2.	Invalid Periods per year, must be 1, 2, 4 or 12.
3.	Price and Yield both can't be zero.
10.	Issue/Dated Date required.
11.	Settlement Date required.
12.	Conversion Date required.
13.	Maturity Date required.
14.	Call feature or Maturity Date required.
15.	Issue/Dated Date greater than Settlement Date.
16.	Settlement Date greater than Maturity Date.
17.	Conversion Date greater than Maturity Date.
18.	Settlement Date greater than Call Date - call only.
19.	Conversion Date greater than Call Date - Call only.
21.	Invalid Function Code.
22.	Divide by 0.

Appendix B • Security Codes

U. S. Treasury Issues	Calendar	Pricing/Interest Classification	Code
Certificates of Indebtedness	actual*	at maturity	4
U. S. Treasury Bills	actual/360	discount	5
U. S. Treasury Tax-Anticipation Bills (TABs)	actual/360	discount	5
U. S. Treasury Bonds	actual	periodic	1
U. S. Treasury Notes	actual	periodic	1
STRIP Coupons	actual	periodic	1
STRIP Bonds	actual	periodic	1
Federal Agency Issues			
Banks for Cooperatives(Co-op's) Debentures	30/360	at maturity	2
Commodity Credit Corp. (CCC)	30/360	periodic	0†
Export-Import Bank (Ex-Im) PC's	30/360	periodic	0†
Farmers Home Administration (FHDA) Insured Notes	actual	periodic	1
Federal Home Loan Bank (FHLB) Bonds	30/360	periodic	0†
Federal Home Loan Bank Consolidated Notes	actual/360	discount	5
Federal Housing Administration (FHA) Debentures	30/360	periodic	0†
Federal Intermediate Credit Bank Notes and (FICB) Debentures	30/360	at maturity	2
Federal Land Bank (FLB) Bonds	30/360	periodic	0†
Federal National Mortgage Association (FNMA) Debentures	30/360	periodic	0†
FNMA Short-Term Notes	actual/360	discount	5
General National Mortgage Association (GNMA) Bonds and PC's	30/360	periodic	0†
General Services Administration PC's	30/360	periodic	0†
Inter-American Development Bank Bonds	30/360	periodic	0†
Merchant Marine Bonds	30/360	periodic	0†
New Communities Act Debentures	30/360	periodic	0†
(U. S.) Postal Service Bonds	30/360	periodic	0†
Small Business Administration Debentures	30/360	periodic	0†
Student Loan Marketing Association (SLMA) Bonds	30/360	periodic	0†
Tennessee Valley Authority Bonds	30/360	periodic	0†
TVA Notes	actual/360	discount	5

*Actual/actual

†MUNI Switch *FALSE*

State and Local Issues	Calendar	Pricing/Interest Classification	Code
Bonds			
Assessment Supported	30/360	periodic	0
Municipal Zero	30/360	periodic	0
Revenue Supported	30/360	periodic	0
Special & Tax Supported	30/360	periodic	0
Stepped Coupons	30/360	periodic	6
Convertible Zero Coupons	30/360	periodic	6
Notes			
Assessment Supported	30/360	at maturity	2
	actual/360		3
	actual/365		4
Revenue Supported	30/360	at maturity	2
	actual/360		3
	actual/365		4
Special Supported	30/360	at maturity	2
	actual/360		3
	actual/365		4
Tax Supported	30/360	at maturity	2
	actual/360		3
	actual/365		4
Warrants			
Assessment Supported	30/360	at maturity	2
Revenue Supported	30/360	at maturity	2
Special & Tax Supported	30/360	at maturity	2
Other Securities			
Asian Development Bank Bonds and Notes	30/360	periodic	0
Banker's Acceptances	actual/360	discount	5
Certificates of Deposit (CD'S)	30/360	periodic	0
	actual/360	at maturity	3
	actual/360	discount	5
Commercial Paper (C/P)	actual/360	at maturity	3
	actual/360	discount	5
Corporate Bonds	30/360	periodic	0
Foreign Bonds	actual	periodic	1
Medium-Term Notes	30/360	periodic	8
Private Export Funding Corp Secured Note (Single Maturity)	30/360	periodic	0
Pen Central Transportation Certificates (Gov't Guaranteed)	30/360	periodic	0
Repurchase Agreements (Repos)	actual/360	at maturity	3
Student Loan Marketing Assn Notes	actual/360	discount	5