



BOND_PORT_ANALYSIS_FUNC TECHNICAL REPORT

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Abstract

This Technical Report provides a full line-by-line explanation of the BOND_PORT_ANALYSIS_FUNC function.

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Introduction to the Function

About this Report

This report provides a line-by-line explanation of the BOND_PORT_ANALYSIS_FUNC function algorithm. It is meant to give the reader a detailed explanation of how the function operates and produces its outputs.

About The Function

The BOND_PORT_ANALYSIS_FUNC function possesses an extremely comprehensive and dynamic algorithm to assist its user in bond portfolio management. The function produces a wide selection of outputs and provides information on both the individual bonds in the portfolio, and the overall portfolio. The function allows the user to perform sensitivity analysis on the portfolio by adding and taking away bonds from the portfolio to analyze the overall effect.

The function is dynamic and allows the user the option to input more variables above what is required to further enhance the analysis generated with just the required inputs. The function will also automatically adjust its output matrix to any changes made, whether it be by adding more bonds to the portfolio or adding an optional input.

Setting-Up the Function

Function Variables

Input Variable

Variable Name	Required/Optional	Type	Purpose
VALOR_RNG	Required	Variant	Input Variable
MOODY_RATING_RNG	Required	Variant	Input Variable
SP_RATING_RNG	Required	Variant	Input Variable
INSURANCE_NAME_RNG	Required	Variant	Input Variable
CUSIP_RNG	Required	Variant	Input Variable
ISSUE_NAME_RNG	Required	Variant	Input Variable
BOND_TYPE_RNG	Required	Variant	Input Variable
COUPON_RNG	Required	Variant	Input Variable
FREQUENCY_RNG	Required	Variant	Input Variable
MATURITY_RNG	Required	Variant	Input Variable
CALL_PRICE_RNG	Required	Variant	Input Variable
CALL_DATE_RNG	Required	Variant	Input Variable
PURCHASE_DATE_RNG	Required	Variant	Input Variable
PURCHASE_PRICE_RNG	Required	Variant	Input Variable
PURCHASE_QUANTITY_RNG	Required	Variant	Input Variable
PURCHASE_FEES_RNG	Required	Variant	Input Variable
CURRENT_PRICE_RNG	Required	Variant	Input Variable
MARKET_YIELDS_RNG	Optional	Variant	Input Variable
CREDIT_AGENCIES_RNG	Optional	Variant	Input Variable
PORT_BOND_TYPES_RNG	Optional	Variant	Input Variable
PORT_MATURITIES_RNG	Optional	Variant	Input Variable

PORT_CREDIT_QUALITIES_RNG	Optional	Variant	Input Variable
DELTA_VAL	Optional	Double	100 * Basis Points
REBALANCING_SLACK	Optional	Double	Used in Bond Maturity, Bond Type and Credit Quality. This value creates some "slack" for the rebalancing algorithm (between desired percent and actual percent) to reduce clutter in cases where the difference between the target percent allocation and the current percent allocation is small.
SETTLEMENT	Optional	Date	Date to base bond price/yield/maturity calculations.
GUESS_YIELD	Optional	Variant	Used to solve for YTM.
COUNT_BASIS	Optional	Variant	Used in bond calculation functions in the algorithm.
OUTPUT	Optional	Integer	Defines what output the user wants.

Code Variables

Variable Name	Type	Purpose
h()	Long	Assist in making output dynamic
i	Long	Counter Variable
j	Long	Counter Variable
k	Long	Counter Variable
l	Long	Counter Variable
m	Long	Counter Variable
n	Long	Counter Variable
hh	Long	Counter Variable
ii	Long	Counter Variable
jj	Long	Counter Variable
kk	Long	Counter Variable
ll	Long	Counter Variable
mm	Long	Counter Variable
nn	Long	Counter Variable
NROWS	Long	Holds number of rows for TEMPO_MATRIX
NCOLUMNS	Long	Holds number of columns for TEMPO_MATRIX
Y_VAL	Double	Variable used for Yield and Price Calculations
P_VAL	Double	Variable used for Yield and Price Calculations
S_VAL	Date	Variable used for Yield and Price Calculations
M_VAL	Date	Variable used for Yield and Price Calculations
C_VAL	Double	Variable used for Yield and Price Calculations
F_VAL	Integer	Variable used for Yield and Price Calculations
R_VAL	Double	Variable used for Yield and Price Calculations
B_VAL	Integer	Variable used for Yield and Price Calculations

G_VAL	Double	Variable used for Yield and Price Calculations
NA_STR	String	Reports value "N/A"
NR_INT	Integer	Holds the value for a bond that is not rated
NR_STR	String	Holds Value "NR"
FIND_STR	String	Returns a value that is being searched
LOOK_STR	String	Holds a value that is used to find another value
MULT1_VAL	Constant As Double	Value is 10 to convert 100 prices into \$1000 multiple
MULT2_VAL	Constant As Double	Value is 100 to convert coupon rate to percent
MULT3_VAL	Constant As Double	Value is 1000 to adjust quantity to \$1000 multiple
HEADINGS0_STR	String	Used in Header Line
HEADINGS1_STR	String	Used in Header Line
HEADINGS_ARR()	String	Used in Header Line
TEMPO_VAL	Variant	Holds temporary values
TEMP1_VAL	Variant	Holds temporary values
TEMP2_VAL	Variant	Holds temporary values
DATE1_VAL	Date	Holds date values
DATE2_VAL	Date	Holds date values
TEMPO_MATRIX	Variant	Stores output for Case 0
TEMP1_MATRIX	Variant	Stores output for Case 1
TEMP2_MATRIX	Variant	Stores output for Case 2
TEMP3_MATRIX	Variant	Stores output for Case 3
TEMP4_MATRIX	Variant	Stores output for Case 4
PORT_BOND_TYPES_FLAG	Boolean	Determines if optional value for Bond Types was inputted
PORT_BOND_TYPES_MATRIX	Variant	Store information from Bond Type Input
PORT_MATURITIES_FLAG	Boolean	Determines if optional value for Maturities was inputted
PORT_BOND_MATURITIES_MATRIX	Variant	Store information from Maturities Input
PORT_CREDIT_QUALITIES_FLAG	Boolean	Determines if optional value for Credit Quality was inputted
PORT_CREDIT_QUALITIES_MATRIX	Variant	Stores information from Credit Quality Input
CREDIT_AGENCIES_FLAG	Boolean	Determines if optional value for Credit Agencies was inputted
CREDIT_AGENCIES_MATRIX	Variant	Stores information from Credit Agencies Input
MARKET_YIELDS_FLAG	Boolean	Determines if optional value for Market Yields was inputted
MARKET_YIELDS_MATRIX	Variant	Stores information from Market Yields Input
VALOR_VECTOR	Variant	Holds information for its respective input Range
MOODY_RATING_VECTOR	Variant	Holds information for its respective input Range
SP_RATING_VECTOR	Variant	Holds information for its respective input Range
INSURANCE_NAME_VECTOR	Variant	Holds information for its respective input Range
CUSIP_VECTOR	Variant	Holds information for its respective input Range
ISSUE_NAME_VECTOR	Variant	Holds information for its respective input Range

BOND_TYPE_VECTOR	Variant	Holds information for its respective input Range
COUPON_VECTOR	Variant	Holds information for its respective input Range
FREQUENCY_VECTOR	Variant	Holds information for its respective input Range
MATURITY_VECTOR	Variant	Holds information for its respective input Range
CALL_PRICE_VECTOR	Variant	Holds information for its respective input Range
CALL_DATE_VECTOR	Variant	Holds information for its respective input Range
PURCHASE_DATE_VECTOR	Variant	Holds information for its respective input Range
PURCHASE_PRICE_VECTOR	Variant	Holds information for its respective input Range
PURCHASE_QUANTITY_VECTOR	Variant	Holds information for its respective input Range
PURCHASE_FEES_VECTOR	Variant	Holds information for its respective input Range
CURRENT_PRICE_VECTOR	Variant	Holds information for its respective input Range
COUNT_BASIS_VECTOR	Variant	Holds information for its respective input Range
GUESS_YIELD_VECTOR	Variant	Holds information for its respective input Range
tolerance	Double	Used in optimization for calculating yields
epsilon	Double	Used to help calculate the price of a bond

Error Handling

If any error is triggered during the course of the function the code is sent to line ERROR_LABEL and the function outputs the error number.

Constant Variables

Some variables used in the function are pre-defined before the function begins. These include:

NA_STR is set equal to "N/A"

NR_STR is set equal to "NR"

tolerance is set equal to 10^{-15}

epsilon is set equal to 0.0000001

For the SETTLEMENT variable, if it is set to zero then the date is set to NOW() or today's date. Otherwise it is set to whatever date is specified.

Passing the Inputs

Required Inputs

The code begins by passing all of the function's required inputs into their respective matrix.

The code for passing these required inputs is the same for all variables. Once the input is passed into its respective matrix the code checks the number of rows in that matrix. If there is only one row then the matrix is transposed to have its new number of rows equal to the original number of columns. The data held in the matrix would now be in one column with multiple rows as opposed to multiple columns and one row. If there is more than one row in the original input then nothing is changed.

During this process, the variable `NROWS` is set using the number of rows in `ISSUE_NAME_RNG`. This should intuitively make sense since the `ISSUE_NAME_RNG` holds the names of the bonds held in the portfolio. Therefore, the number of rows in the array will equal the number of securities in the portfolio.

Optional Inputs

Two optional variables are also defined in the process of passing the required inputs. These are the `COUNT_BASIS_VECTOR` and the `GUESS_YIELD_VECTOR`. While, these two inputs are optional for the user, they are still required for the function. This means that if they are not defined in the function inputs, then default values are needed.

Both of the optional inputs follow the same logic for determining if default values are needed. Three if-statements are used in the process.

The first if-statement checks if the input is an array. If it is then the input is set equal to the respective matrix.

The second if-statement, which is imbedded in the first, then performs the same condition check used for the required inputs. If the number of rows is equal to one then the matrix is transposed.

If in the first if-statement the input is not an array then the code jumps to the third if-statement to input default values. For the `COUNT_BASIS` variable if the input is blank and for the `GUESS_YIELD` variable if the input is blank or equal to zero, the code dimensions the respective matrix to equal `NROWS` and then uses a loop to input the default value into each of the rows.

The default values are 0 and 0.5 for the `COUNT_BASIS` and `GUESS_YIELD_VECTOR` respectively.

Dynamic Inputs

One of the unique aspects of the `BOND_PORT_ANALYSIS_FUNC` function is its dynamic capabilities. The output of the function is dependent on three optional input variables: `PORT_MATURITIES_RNG`, `PORT_BOND_TYPES_RNG` and `PORT_CREDIT_QUALITIES_RNG`. The function then uses the index variable h to control the size of the output matrix.

This section of the code begins by re-dimensioning the index variable h to have 4 rows in base zero: $h(0)$, $h(1)$, $h(2)$ and $h(3)$. Next $h(0)$ is set to equal 76. $h(0)$ represents the minimum number of columns that the function will output regardless of the other optional input variables.

The function then checks to see if the optional inputs were inputted by the user. It does this by using the `isArray` function. If the optional input was inputted into the function then it is passed to its respective matrix.

Each of the optional inputs also has a FLAG variable, which identifies whether or not data is present. If data is present then the FLAG is turned on, if not then the FLAG is turned off.

The first optional variable to be passed through these conditions is the `MARKET_YIELDS_RNG`. If data was inputted then the data is passed into the `MARKET_YIELDS_MATRIX` and the `MARKET_YIELDS_FLAG` is activated.

For the next three optional inputs: `PORT_MATURITIES_RNG`, `PORT_BOND_TYPES_RNG` and `PORT_CREDIT_QUALITIES_RNG` the same logic applies but with an added condition.

Since these three variables control the index variable h and thus the output, values need to be assigned to $h(1)$, $h(2)$ and $h(3)$.

If data was inputted into the optional variable then the respective h will be set equal to the number of rows in the corresponding input. If no data was inputted then the respective h will be set to zero. The h values will then represent the added number of columns in each additional section needed as well as the original 76. The table below summarizes the logic.

Optional Variable	h	h value if optional variable is present	h value if optional variable is not present
<code>PORT_MATURITIES_RNG</code>	$h(1)$	Number of rows in <code>PORT_CREDIT_QUALITIES_RNG</code>	0
<code>PORT_BOND_TYPES_RNG*</code>	$h(2)$	Number of rows in <code>PORT_BOND_TYPES_RNG</code>	0
<code>PORT_CREDIT_QUALITIES_RNG</code>	$h(3)$	Number of rows in <code>PORT_CREDIT_QUALITIES_RNG</code>	0

* Specific to this case variable j is set equal to $h(2)$

Finally, the last optional variable checked in the function is the `CREDIT_AGENCIES_RNG`. If information was entered into the function for this variable then the `CREDIT_AGENCIES_FLAG` is turned on and the information is passed into the respective matrix. A loop is used to clean the information using the `Trim` function to remove spaces, and is then placed it back into the matrix in the same way it was before.

The function then checks to see if the last entry in the `CREDIT_AGENCIES_MATRIX` is numeric. If it is then the variable `NR_INT` is set equal to that number in the last row of `CREDIT_AGENCIES_MATRIX`. If it is not numeric or if no data was inputted for `CREDIT_AGENCIES_RNG` then the value of `NR_INT` is set to 8.

The `NR_INT` corresponds to the last Tier in the bond rating- Not Rated. The number that corresponds to this rating is 8. This is why the last row of `CREDIT_AGENCIES_RNG` is used to get the value for `NR_INT` (because it's the lowest rating) and why the default is 8.

Headings Line

Headings Line Part One

The headings line has two main purposes. As one might expect, it loads all of the required headings into the output matrix TEMPO_MATRIX and by doing this also determines the number of columns required in TEMPO_MATRIX.

This section begins by determining if the string HEADINGS0_STR is blank. If it is then the code continues. If it is not then the code jumps to line 1985, which is explained later.

Next NCOLUMNS is set equal to 19. This number represents the maximum number of sections the function can output assuming all the optional variables described above are inputted.

To fully understand how the headings work, it is first important to understand how the output is displayed. This function can generate a maximum of 19 sections. However, within each section there are multiple columns.

At this point the reader might question then why the variable NCOLUMNS is set equal to 19 if 19 represents the sections and not necessarily the number of columns.

The answer is that at this point the function does not know how many columns there will be as this is dependent on how many of the optional variables were inputted and also how many data points are in each optional variable.

To account for this the headings are first loaded in as a string of text into their respective section. For headings that are dependent on the optional variables, conditions are made so that if they are not present the column headings don't get loaded into that section.

Looking back at the code, after NCOLUMNS has been defined HEADINGS_ARR is re-dimensioned to have number of rows equal to NCOLUMNS. At this point each row in HEADINGS_ARR represents a section in the output.

Next a loop proceeds to insert blank spaces into each section and then the filling of each section begins.

Regardless of the optional variables discussed above, sections 1 through 5 and section 19 will always be present. The string of heading's names for each column in the section is loaded into their respective row in HEADINGS_ARR separated by a comma.

The remaining sections are all dependent on the optional variables discussed above. The logic for loading the headings for all the sections is the same.

For this part of the code the variable k is set equal to h(1) or h(2) or h(3) depending on the section being loaded into HEADINGS_ARR. Remember that these h values will equal the number of data points inputted for their respective optional variable.

A loop is then set up from 1 to k. If k = 0 then the loop will not proceed and the headings will be skipped. If k is not zero then the loop will continue.

For the sections that are dependent on the optional variable, the number of columns in each section is dependent on the number of data points passed through in the optional variable.

To create each heading the loop first identifies the value in the optional variable matrix that will be used in the column headings and assigns that value to the variable LOOK_STR. The loop then loops through the relevant sections and attaches the LOOK_STR variable into the column string. The next time through the loop, a new LOOK_STR is used and a new heading is created using that LOOK_STR. All of the headings in a given section are separated using a comma and stored in their respective row in HEADINGS_ARR.

For example:

If in the PORT_BOND_MATURITIES_MATRIX two values existed, 1 and 2, then in section six of the output- VALUE BY MATURITY BRACKET, two columns would be generated:

VALUE BY MATURITY BRACKET: 1 YEARS

VALUE BY MATURITY BRACKET: 2 YEARS

The code would read

```
... LOOK_STR = Format (PORT_BOND_MATURITIES_MATRIX(j, 2), "0.0")
```

```
HEADINGS_ARR(6) = HEADINGS_ARR(6) & "VI) VALUE BY MATURITY BRACKET: " & LOOK_STR & " Years" & "," ...
```

Where LOOK_STR would equal the values 1 and 2; And HEADINGS_ARR(6) would house the two columns separated by a comma.

A summary of all the possible sections is given below:

Section	Name	Dependant on	Number of Columns
I	No Name	Not Dependant	24
II	No Name	Not Dependant	11
III	No Name	Not Dependant	12
IV	No Name	Not Dependant	12
V	No Name	Not Dependant	17
VI	VALUE BY MATURITY BRACKET:	PORT_MATURITIES_FLAG	h(1)
VII	VALUE BY BOND TYPE:	PORT_BOND_TYPES_FLAG	h(2)
VIII	VALUE BY CREDIT QUALITY:	PORT_CREDIT_QUALITIES_FLAG	h(3)
IX	CREDIT QUALITY BY BOND TYPE:	PORT_BOND_TYPES_FLAG	h(2)
X	CREDIT QUALITY BY MATURITY BRACKET:	PORT_MATURITIES_FLAG	h(1)
XI	MODIFIED DURATION BY BOND TYPE:	PORT_BOND_TYPES_FLAG	h(2)
XII	MODIFIED DURATION BY CREDIT QUALITY:	PORT_CREDIT_QUALITIES_FLAG	h(3)
XIII	PRE-TAX YIELD BY BOND TYPE:	PORT_BOND_TYPES_FLAG	h(2)
XIV	AFTER-TAX YIELD BY BOND TYPE:	PORT_BOND_TYPES_FLAG	h(2)
XV	PRE-TAX YIELD BY MATURITY BRACKET:	PORT_MATURITIES_FLAG	h(1)
XVI	AFTER-TAX YIELD BY MATURITY BRACKET:	PORT_MATURITIES_FLAG	h(1)
XVII	PRE-TAX YIELD BY CREDIT QUALITY:	PORT_CREDIT_QUALITIES_FLAG	h(3)
XVIII	AFTER-TAX YIELD BY CREDIT QUALITY:	PORT_CREDIT_QUALITIES_FLAG	h(3)

XIX	No Name	Not Dependant	12
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Headings Line Part Two

Once all of the heading strings are loaded into their respective sections, the next part is to separate them into columns.

To start, HEADINGS0_STR is set equal to blank, and a loop begins to pass the contents of HEADINGS_ARR to HEADINGS0_STR to form one string of all the headings. Once this is complete HEADINGS_ARR is erased.

The code then moves to line 1985. The code that follows would be the code that would have proceeded if HEADINGS0_STR were not blank at the beginning of the function.

NCOLUMNS is then set equal to 0 and a loop begins to determine the actual number of columns that will appear in the output matrix.

It does this by counting the number of commas in the string HEADINGS0_STR. To do this a Do loop is set up which uses the InString function to originally start at position one (indicated by the i variable) and loop for the first comma in the string HEADINGS0_STR. InString returns the number of characters to the comma and is set equal to variable j. Every time the loop loops a tally is added to the NCOLUMNS variable. i is then set equal to j + 1 to start at the next position after the comma, and the loop begins again looking for the next comma in HEADINGS0_STR. This loop continues until no more commas can be found in the string. At this point j will equal 0 leading i to equal 1 and the loop ending.

The next line subtracts 1 from the NCOLUMNS variable. This is because the loop above will always produce a value for NCOLUMNS that has one column more than is needed. This is because in the loop above, even after no more commas are found, a tally is still added to NCOLUMNS before the loop exits.

TEMPO_MATRIX is then re-dimensioned to have 0 to NROWS + 1 number of rows and 1 to NCOLUMNS number of columns.

While the reasoning for the number of columns should be intuitive, the reader might wonder why the number of rows is set in base zero with a plus one. The reason why two more rows are added to NROWS is to account for an additional row for the headings, and an additional row for the Portfolio line, which is discussed in the next section of this report.

The final step in the process is to place all of the headings from HEADINGS0_STR into their appropriate column in the 0th row of TEMPO_MATRIX.

This process is done using a loop similar to the Do loop used to determine the number of columns. This loop however loops from 1 to NCOLUMNS. It uses the same Instring function to perform the same operation of determining the number of characters from a starting position i to a comma. Once the number of characters is found it is stored in variable j. The mid function is then used to return the actual name of the heading being extracted. This is done by starting at the ith position and extracting j-i number of characters from HEADINGS0_STR. This process pulls each heading out of HEADINGS0_STR and places it in its appropriate column.

Once all the headings have been placed. A loop begins that places a blank space in all the remaining cells in the matrix TEMPO_MATRIX. The headings line is then complete.

Setting Up the Initial Portfolio Line

The last row of the function's output shows the user how the overall portfolio performed for most of the criteria in a respective column. This helps the user make decisions for the overall well being of the portfolio and also helps in sensitivity analysis.

This section begins by placing the name "Portfolio" in the last row and first column of the output matrix TEMPO_MATRIX.

Next zeros are placed into certain columns of the portfolio line. These columns include: column 6, 7, 30, 31, 36, 59 and 74.

hh is then set equal to h (0) or 76

ii is set equal to hh+1

jj = hh + h(1) + h(2) + h(3)

A loop is then used to place zeros into every column on the Portfolio line from ii or 77 to jj.

Next nn is set equal to hh + h(1) * 4 + h(2) * 5 + h(3) * 4 +1. The starting point of section 19 of the output. (By default h(0) has 5 sections)

The Portfolio line on column nn is then set equal to zero.

The Giant i Loop

Introduction to the Giant i Loop

This loop will loop from 1 to NROWS, or in other words for all of the data points in the inputs. NROWS also corresponds to the number of rows in the output.

Cleaning the Vector Data

Before the function proceeds, the following Vectors have their data cleaned using the Trim function, which removes any unnecessary spaces from the data. These vectors include:

- VALOR_VECTOR(i, 1)
- CURRENT_PRICE_VECTOR(i, 1)
- MATURITY_VECTOR(i, 1)
- PURCHASE_DATE_VECTOR(i, 1)
- PURCHASE_PRICE_VECTOR(i, 1)
- PURCHASE_QUANTITY_VECTOR(i, 1)
- PURCHASE_FEES_VECTOR(i, 1)
- COUPON_VECTOR(i, 1)
- FREQUENCY_VECTOR(i, 1)
- CALL_PRICE_VECTOR(i, 1)
- CALL_DATE_VECTOR(i, 1)
- MOODY_RATING_VECTOR(i, 1)
- SP_RATING_VECTOR(i, 1)
- INSURANCE_NAME_VECTOR(i, 1)
- CUSIP_VECTOR(i, 1)
- ISSUE_NAME_VECTOR(i, 1)
- BOND_TYPE_VECTOR(i, 1)

General Bond Information

After the data has been cleaned the code checks some conditions in the data it is looping through before continuing. If any of the conditions aren't met, then the code is sent to line 1983 and the next i is triggered. These conditions are:

VALOR_VECTOR, MATURITY_VECTOR, CURRENT_PRICE_VECTOR, PURCHASE_DATE_VECTOR, PURCHASE_PRICE_VECTOR, and PURCHASE_QUANTITY_VECTOR are not blank.

MATURITY_VECTOR, PURCHASE_DATE_VECTOR and PURCHASE_QUANTITY_VECTOR do not equal zero.

The function then starts inputting data from the vectors into their appropriate location in the output matrix TEMPO_MATRIX.

TEMPO_MATRIX(i, 1) is set equal to VALOR_VECTOR(i, 1)

TEMPO_MATRIX(i, 2) is set equal to MOODY_RATING_VECTOR(i, 1)

TEMPO_MATRIX(i, 3) is set equal to SP_RATING_VECTOR(i, 1)

TEMPO_MATRIX(i, 19) is set equal to CDate(MATURITY_VECTOR(i, 1))

The CDATE function changes the string to date format.

To place CURRENT_PRICE_VECTOR into TEMPO_MATRIX(i,61) two if-statements are used.

The first one checks to see if there is a "-" character in the current price. If there isn't then TEMPO_MATRIX(i, 61) is set equal to CURRENT_PRICE_VECTOR(i, 1).

Next there is a check to see if the value in TEMPO_MATRIX is greater than 0. If it is, then the value in TEMPO_MATRIX is converted to a double type variable.

If there is a “-” character in the CURRENT_PRICE_VECTOR value, then TEMPO_MATRIX(i, 61) is set equal to CURRENT_PRICE_VECTOR(i, 1) but no further conditions are tested.

The reasoning behind this has to do with the way bond prices can be formatted. Prices can be entered as a dollar figure and number of 32nds by using a “-” instead of a “.”. For example a price of 101.25 could also be entered as 101-08.101-08, would represent 101 and 08/32 or 101.25. The code above ensures that if the price is not entered in the 32nds format the data is converted to a double variable to hold the decimal points.

Purchase Information

General Price Information Part I

TEMPO_MATRIX(i, 25) is set equal to CDate(PURCHASE_DATE_VECTOR(i, 1))

Again, the CDATE function changes the string to date format.

To place the PURCHASE_PRICE_VECTOR into TEMP_MATRIX(i, 26) the same logic that was applied to the CURRENT_PRICE_VECTOR is used again and for the same reasons.

TEMPO_MATRIX(i, 27) is set equal to CDbI(PURCHASE_QUANTITY_VECTOR(i, 1))

The CDbI function converts the value into a double variable and assumes the number of bonds purchased have a \$1000 par value per bond.

For setting the PURCHASE_FEES_VECTOR equal to TEMPO_MATRIX(i, 27) an if-statement is used. This if-statement checks that the value of PURCHASE_FEES_VECTOR is greater than 0. If it is then TEMPO_MATRIX(i, 28) is set equal to CDbI(PURCHASE_FEES_VECTOR(i, 1)). If not then TEMPO_MATRIX(i, 28) is set equal to zero.

For the purchase fees it is important to note that they should not be re-entered if the fee is already included in the price. Also accrued interest should not be included as a fee.

COUPON_VECTOR and FREQUENCY_VECTOR are passed into their respective columns TEMPO_MATRIX(i,16) and TEMPO_MATRIX(i,17) in the same manner.

Both use an if-statement to check if the value being passed is greater than zero. If it is then the value is first converted to a double variable and then passed into the respective matrix.

If the value is less than zero then the value placed in TEMPO_MATRIX is zero.

CALL_PRICE_VECTOR and CALL_DATE_VECTOR are also passed to their respective matrixes TEMPO_MATRIX (i,23) and TEMPO_MATRIX(i,24) in similar ways.

For CALL_PRICE_VECTOR if the value being passed equals zero and for CALL_DATE_VECTOR if the value being passed is blank then the value placed in TEMPO_MATRIX for each respective column will be a blank space. If not then for CALL_PRICE_VECTOR the value will be converted to a double variable before being placed in TEMPO_MATRIX and for CALL_DATE_VECTOR the value is converted to date format before being placed in TEMPO_MATRIX.

Converting Price Data

The next section of code is responsible for taking the data from the Current Price column and Purchase Price column and converting the prices in those columns into one consistency format.

As discussed earlier in the section, price information can be entered in multiple formats. A further explanation is provided below.

Prices are entered as a percentage of par, which is assumed to be \$1000. For example, if a \$1000 dollar par bond is selling at a discount of \$975 then the price is entered as \$97.50.

The function, however, supports different pricing notations for quoting a bond. A user may input a bond using any of the methods described below:

Dollar Figure notation: Most familiar notation would quote the price like any normal price e.g. \$97.50.

32^{nds} notation: Uses a “-” instead of a “.” E.g. 101-08 is the same as 101 and 8/32 or \$101.25.

The + notation: quoted as 99-10+ indicating to add an additional 1/16.

The 2 notation: quoted as 99-102 with the 2 indicating to add an additional 2/256.

In order to create a list of prices that are all consistent, the function uses the BOND_PRICE_PARSE_LINE to convert all of the possible notations into the Dollar Figure Notation. Converting the prices into this notation is also necessary in order to perform calculations with the prices later in the function.

To do this TEMP0_MATRIX(i,61) which was already set equal to the Current Prices is set equal to TEMP1_VAL. TEMP1_VAL is then sent through the sub BOND_PRICE_PARSE_LINE.

BOND_PRICE_PARSE_LINE returns an output with all the Current Prices now converted to the Dollar Figure Notation. The output with these prices is stored in the variable TEMP2_VAL. The new Adjusted Current Prices in dollar figure notation are then set equal to TEMP0_MATRIX(i,62).

The same process is then done with TEMP_MATRIX(i,26) which was already set equal to the Purchase Prices. These prices are all adjusted into Dollar Figure Notation using the sub BOND_PRICE_PARSE_LINE and the output is set equal to TEMP0_MATRIX(i,29).

TEMP0_MATRIX(i, 32) is then set equal to TEMP0_MATRIX(i, 27).

TEMP0_MATRIX(i, 33) is then set equal to TEMP0_MATRIX(i, 28).

TEMP0_MATRIX(i,74) which is the Market Value is set equal to the adjusted price of the bond multiplied by MULT1_VAL, multiplied by the adjusted quantity. The use of MULT1_VAL is to account for the fact that prices are entered as a percentage of par.

At this point the function also calculates the total Market Value of the portfolio by summing each individual bond's market value.

Credit Agencies Information

Moody's

This portion begins by setting the variable FIND_STR and TEMPO_MATRIX(i,10) equal to nothing.

An if-statement then begins to check that the ith value in TEMPO_MATRIX(i,2) does not equal the NR_STR variable recall that NR_STR equals "NR".

If it doesn't and if the CREDIT_AGENCY_FLAG is activated, then the LOOK_STR variable is set equal to the value in TEMPO_MATRIX(i,2). The value in TEMPO_MATRIX(i,2) recall was already set equal to the ith bond's Moody rating. The code is then sent to the sub CREDIT_RATINGS_MOODY_LINE.

The CREDIT_RATINGS_MOODY_LINE works by using the CREDIT_AGENCIES_MATRIX and LOOK_STR. The code loops through the CREDIT_AGENCIES_MATRIX until it reaches the rating that matches the one in LOOK_STR. When the rating is found the numeric position of the rating is stored in variable n and the sub returns to the main code.

When the code returns it checks to see if n is greater than 0. If it is then j is set equal to n and TEMPO_MATRIX(i, 6) which is the Moody Value of the bond is set equal to TEMPO_MATRIX(i, 74) which was already set equal to the market price of the bond. The function then also calculates the portfolio's Moody Value by summing the Moody Value of each bond.

At this point the reader might find this process redundant with the Market Value column discussed previously. The key difference between the Moody Value and the Market Value of a bond is that the Moody Value is only calculated when the bond has a Moody Rating. In other words all bonds will have a Market Value but not all bonds will have a Moody Value. This is also why the conditions for setting the Moody Value depend on n being greater than 0.

TEMPO_MATRIX(i,8) (the Moody's Rank column) and TEMPO_MATRIX(i,10) (the Average Rank Column) are then set equal to variable j.

S&P

Next a similar process then begins doing essentially the same operation that was done with the Moody Ratings for S&P Ratings.

First FIND_STR is set equal to nothing. Then the value in TEMPO_MATRIX(i,3), which holds the S&P ratings, is checked to make sure it does not equal NR_STR or in other words, it is checked to make sure it has a rating.

Then the code checks to see if the CREDIT_AGENCIES_FLAG is activated. If it is, then LOOK_STR is set equal to the value in TEMPO_MATRIX(i,3). The code is then sent to sub CREDIT_RATINGS_SP_LINE. This sub performs the same function to CREDIT_RATINGS_MOODY_LINE and outputs the rating in variable n. When the code returns, it checks that n is greater than zero. If it is, then j is set equal to n.

Similar to the Moody's section TEMPO_MATRIX(i,7) is set equal to TEMPO_MATRIX(i,74). Similar to above TEMPO_MATRIX(i,74) represents the Market value of a bond, TEMPO_MATRIX(i,7) is the S&P value of the bond. These two columns will equal each other only if the bond has an S&P rating.

The total Portfolio S&P Value however, is calculated differently than what was done with the Moody Value above. This time in order for the S&P value to be added to the portfolio the bond must have both

a Moody's and S&P rating. In the code this is expressed in the condition that `TEMPO_MATRIX(i,6) <>""` in order for the *i*th bond to be included in the S&P portfolio Value.

`TEMPO_MATRIX(i,9)` (the S&P Rank column) is then set equal to *j* and

`TEMPO_MATRIX(i,10)` (the Average Rank column) is set equal to the value being currently stored from the Moody's section + the S&P ranking + tolerance all divided by 2. This value is then rounded to the nearest whole number.

Average Tier

The last part of the Credit Rating section is to determine the average tier of the bond. This is done using the average ranking in a process almost identical to the ones seen above.

First `FIND_STR` is set equal to nothing. Then an if-statement checks to see if there is an Average Rating value in the *i*th column of `TEMPO_MATRIX(i,10)` that is being passed. If there is and the `CREDIT_AGENCIES_FLAG` is activated then `LOOK_STR` is set equal to the value in `TEMPO_MATRIX(i,10)` and that value is converted into a string variable. `LOOK_STR` is then passed through `CREDIT_RATINGS_TIER_LINE`.

Like the two subs before it `CREDIT_RATINGS_TIER_LINE` uses the `LOOK_STR` and searches through the `CREDIT_AGENCIES_MATRIX` until it reaches the index value that matches the one in `LOOK_STR`. Once it finds the location, it then cross references the row number in the fourth column of the `CREDIT_AGENCIES_MATRIX` to find the Tier value that corresponds with the index number. The tier value is then returned in the variable *n*.

If *n* is greater than zero then *j* is equal to *n* and `TEMPO_MATRIX(i,11)` (the AVG Tier column) is set equal to *j*. If *n* is not greater than zero then `TEMPO_MATRIX(i,11)` is set equal to `NR_INT`.

If `TEMPO_MATRIX(i,10)` does not equal a value and the `CREDIT_AGENCIES_FLAG` is activated then `LOOK_STR` is set equal to `NR_STR` and is sent into the `CREDIT_RATINGS_SP_LINE`. When it returns if *n* is greater than zero then *j* is set equal to *n* and the average rating becomes the value in *j*.

If the `CREDIT_AGENCIES_FLAG` is not activated and `TEMPO_MATRIX` does not equal any value then the average rating is left blank and the Average Tier value will be set equal to `NR_INT` or 8.

General Price Information Part II

`TEMPO_MATRIX(i, 12)` is set equal to `INSURANCE_NAME_VECTOR(i, 1)`

`TEMPO_MATRIX(i, 13)` is set equal to `CUSIP_VECTOR(i, 1)`

`TEMPO_MATRIX(i, 14)` is set equal to `ISSUE_NAME_VECTOR(i, 1)`

`TEMPO_MATRIX(i, 15)` is set equal to `BOND_TYPE_VECTOR(i, 1)`

Next the code inputs the adjusted coupon/year into `TEMPO_MATRIX(i, 18)`.

First if `TEMPO_MATRIX(i, 17)` (the coupon/ year which is inputted as Frequency) equals 0 then the adjusted coupon/year equals 1.

If the coupon/year equals 12 then the adjusted coupon/year equals 4.

For any other coupon/year the two are equal.

Next the function sets the value in COUNT_BASIS_VECTOR, which defaults to zero, equal to the variable B_VAL.

TEMPO_MATRIX(i, 20) which is the column for the first coupon month is then set equal to the month of the maturity date in TEMPO_MATRIX(i, 19).

TEMPO_MATRIX(i, 21) which is the years to maturity column then employs the YEARFRAC_FUNC using the SETTLEMENT date, maturity date and B_VAL to determine the value.

At the same time the portfolio line for the year to maturity column is calculated. It will report the year of the bond with the longest years to maturity. It does this by comparing each ith bond's year to maturity with the most recent bond that had the longest year to maturity. It uses the MAXIMUM_FUNC function to determine which one of the two numbers is larger. It then rounds the value.

TEMPO_MATRIX(i, 30) is set equal to the total cost of the bond and the total portfolio cost is calculated. This is done by multiplying the adjusted quantity by the adjusted price times MULT1_VAL and then adding the total product to the adjusted fees.

TEMPO_MATRIX(i,31) is set equal to the annual coupon and the total portfolio annual coupon is calculated. This is done by multiplying the adjusted quantity by MULT3_VAL and then multiplying the product by the coupon divided by MULT2_VAL.

To determine TEMPO_MATRIX(i,35) (Coupon Amount) an if statement is used. If the Coupon/Year is zero then so is the Coupon Amount. Otherwise it is equal to the Annual Coupon divided by Coupon/Year.

Taxes

The taxes sections begin by checking to see if the PORT_BOND_TYPES_FLAG is activated. If it is then LOOK_STR is set equal to TEMPO_MATRIX(i, 15) or the type of Bond. The LOOK_STR is then sent into the sub PORT_TAXES_LINE.

The PORT_TAXES_LINE works in a similar fashion to the rating subs. It uses the PORT_BOND_TYPES_MATRIX and LOOK_STR to find the tax amount that corresponds to the type of bond. When it is found it is set equal n equal to the Bond Type index and the tax percentage equal to FIND_STR.

If FIND_STR equals a value then TEMPO_MATRIX(i, 69) (the Bond Type Index column) is set equal to n otherwise it is set equal to nothing.

If the PORT_BOND_TYPES_FLAG isn't active then FIND_STR is set equal to nothing as well.

Monthly Cash Flows

To calculate the monthly cash flows from bond coupon payments a loop is used.

The loop, loops for j equals 1 to k where k=12 or the number of months.

Variable l is set equal to the Coupon/Year and variable m is set equal to the 1st coupon month.

If there is no Coupon/Year then l=0 and then TEMPO_MATRIX(i, 36 + j - 1) and TEMPO_MATRIX(i, 48 + j - 1) both equal 0. Or each month receives zero pre-tax and after-tax cash flow for that bond.

The reason for the $j-1$ in both the column section of the `TEMPO_MATRIX` is because the columns for the Pre-Tax payments and After-Tax payments start in column 36 and 48 respectively. In other words column 36 would be January's pre-tax cash flows, 37 would be February's pre-tax cash flows and so on. Same for the after tax cash flows. 48 would be January's after-tax cash flows the February in column 49 and so on.

If l doesn't equal 0 then `TEMP1_VAL` is set equal to $(m - j) / (12 / l)$ it then uses `TEMP1_VAL` in the equation $TEMP1_VAL - 1 * \text{Int}(TEMP1_VAL/l)$. If the result of the last equation is zero then the month j has a coupon payment and `TEMPO_MATRIX(i, 36 + j - 1)` will be set to `TEMPO_MATRIX(i, 35)` (the Coupon Amount) otherwise it is set to zero.

To see why the above formula works, take for example a bond that pays cash 2 times a year with the first payment in January.

On the first pass $j=1$, $l=2$ and $m=1$. $TEMP1_VAL = (1-1)/(12/2) = 0$

$$0 - 1 * \text{int}(0/1) = 0$$

The next coupon payment, which is in July, will be the only other time the formula equals zero.

$$j=7, l=2 \text{ and } m=1. TEMP1_VAL = (1-7)/(12/2) = -1$$

$$-1 - 1 * \text{int}(-1/1) = -1 - 1 * -1 = -1 + 1 = 0$$

At the same time the pre-tax portfolio cash flows is being calculated by adding all the coupon payments from each bond in the given month.

For the after tax cash flows the function first checks that `FIND_STR` is set to a value. If a value is being placed in the pre-tax cash flows section then the after tax of the cash flow is also determined using $(1 - \text{FIND_STR})$. If a zero is placed in any month in the pre-tax section then the after-tax month will also be zero.

Yield to Maturity

Purchase Price

Yield to maturity based on purchase price is stored in `TEMPO_MATRIX(i, 60)` and is found using the `PORT_BOND_YIELD_LINE` using the following inputs:

`P_VAL` = Adj. Price + (Adj. Fees / `MULT1_VAL`) / Adj. Quantity)

`S_VAL` = Purchase Date

`M_VAL` = Maturity

`C_VAL` = Coupon / `MULT2_VAL`

`F_VAL` = Adj. Coupon/Year

`R_VAL` = 100

`G_VAL` = 0.5

Current Price

The next yield is the yield to maturity (YTM) based on the current price. This information is stored in `TEMPO_MATRIX(i,62)` and is also found using `PORT_BOND_YIELD_LINE` and the following changes to the inputs above:

P_VAL = Adj. Price
S_VAL = SETTLEMENT

Yield to Call

The next yield is the yield to call (YTC). First an if-statement is used to check three conditions. The first is that the bond has a call date and price and the last is that the call date is after the settlement date.

If all the conditions are met then the Yield to Call is found and stored in TEMPO_MATRIX(i, 64). Again the yield is found using the PORT_BOND_YIELD_LINE and the following changes to the inputs above:

P_VAL = Adj. Price
S_VAL = SETTLEMENT
M_VAL = Call Date
R_VAL = Call Price

Once the yield to call is found the code then checks to see which yield is lower between the YTM and YTC. The lower of the two yield is then placed in TEMPO_MATRIX(i, 65) with the corresponding maturity date being placed in TEMPO_MATRIX(i, 68). E.g. if the YTC is lower, then that yield will be used in the adjusted yield, and the call date will be used as the Adjusted maturity date.

If there are no call options on the bonds then the regular YTM and maturity date will be placed into TEMPO_MATRIX(i, 65) and TEMPO_MATRIX(i, 68) respectively.

TEMPO_MATRIX(i, 76) (the Adj. Lower Yield) is then set equal to TEMPO_MATRIX(i, 65).

Fair Yield to Maturity

This section uses current Market yield data to determine the YTM that would be paid on a similar grade bond with the same maturity.

First TEMPO_VAL is set equal to the number of years to maturity.

If that value is less than zero or greater than 29, TEMPO_MATRIX(i, 70) (the Fair YTM) is set equal to the Lowest Yield in column TEMPO_MATRIX(i, 65).

Otherwise, if the MARKET_YIELDS_FLAG and PORT_BOND_TYPES_FLAG are both activated and TEMPO_MATRIX(i, 69) (the Bond Type Index) has a value then the code precedes. If not the Fair YTM is set equal to the value in the Lowest Yield column.

The code then sets j equal to the value in Bond Type Index. LOOK_STR then finds the name of the bond type using the index number and the PORT_BOND_TYPES_MATRIX and converts the name to a string.

LOOK_STR is then sent to sub MARKET_YIELDS1_LINE where LOOK_STR is looped through the column headings until it finds the name in the PORT_BOND_TYPES_MATRIX that matches the one in LOOK_STR. The position number is then returned in the variable n.

If n is greater than zero then the sub MARKET_YIELDS2_LINE is activated.

This sub will loop through the PORT_BOND_TYPES_MATRIX starting with the maturity column. It first looks to see if the value number in the maturity column its looping through is less than or equal to the Years to maturity of the bond being evaluated. It also looks to see if the number in the maturity column one position ahead is greater than the years to maturity of the bond being evaluated. If both conditions

are met then, if the position in the loop plus 2 is still less than the size of the data set (i.e. you are still three positions back from the last data point in the data set) then TEMP1_VAL is set equal to the yield value in column n that is one position ahead and TEMP2_VAL is set equal to the yield value in column n that is two positions ahead. If you are not three positions back from the last data point in the data set then TEMP1_VAL is set equal to the yield value in column n in the position it is currently in and TEMP2_VAL is set equal to the yield value in column n that is one position ahead.

If TEMP1_VAL and TEMP2_VAL do not come back blank then TEMPO_MATRIX(i, 70) is set equal to $TEMP1_VAL + (TEMP2_VAL - TEMP1_VAL) * (TEMPO_VAL - ASYM_DOWN_FUNC(TEMPO_VAL, 1))$. Note that the ASYM_DOWN_FUNC is a function similar to Int() which asymmetrically rounds numbers down.

If TEMP1_VAL and TEMP2_VAL do come back blank then TEMPO_MATRIX(i, 70) is just set equal to TEMPO_MATRIX(i, 69).

Next the function determines the Fair Price of the bond using the PORT_BOND_PRICE_LINE sub. To find the fair price the function uses the following inputs:

S_VAL = SETTLEMENT
M_VAL = Maturity
C_VAL = Coupon / MULT2_VAL
Y_VAL = Fair YTM
F_VAL = Adjusted Coupon/Year
R_VAL = 100

The output price is stored in TEMPO_MATRIX(i, 71).

The yield premium that the bond offers compared to bonds with a similar maturity and rating is then calculated by subtracting the Adjusted Lower Yield by the Fair YTM. The value is stored in TEMPO_MATRIX(i,72).

Value by Maturity Bracket

This section of the code categorizes each bond by their maturity bracket and places the Market Value of the bond into their appropriate bracket.

The code begins by setting variable k equal to h(1), which is the number of rows in the PORT_BOND_MATURITIES_MATRIX. A loop then begins from j = 1 to k.

First DATE1_VAL is set equal to the jth maturity date in PORT_BOND_MATURITIES_MATRIX.

If j is equal to 1 then the code checks to see if the maturity of the bond is less than or equal the first maturity date in PORT_BOND_MATURITIES_MATRIX. If it is, then the Market Value of the bond is placed into TEMPO_MATRIX(i, 76 + j). Since the Value by Maturity Brackets columns start at TEMPO_MATRIX(i, 77) and run for j number of columns, the 76 + j ensures the market value is placed correctly. In the portfolio line the sum of all the bonds market values with common maturities are calculated and placed in TEMPO_MATRIX(NROWS + 1, 76 + j).

If j is not equal to 1, then the code checks to see is the maturity of the bond is less than or equal to DATE1_VAL and greater than DATE2_VAL. To understand where DATE2_VAL comes from we must back

up a bit. In the first pass when $j=1$ the code will skip the “Else” condition that we are currently discussing. The last line before the loop loops is to set DATE2_VAL equal to DATE1_VAL. The “Else” situation that we are currently discussing can only occur after the first pass when j does not equal 1. So in this case the DATE1_VAL would be the j th maturity in PORT_BOND_MATURITIES_MATRIX and DATE2_VAL would be the j th-1 maturity in PORT_BOND_MATURITIES_MATRIX.

If these conditions are met, then the Market Value of the bond is placed into TEMPO_MATRIX($i, 76 + j$) and again the portfolio line for the respective maturity date is calculated.

Value by Bond Type

The function also does something similar with the type of bond as it does with the maturity of the bond. This section categorizes the bonds by Type and places the Market Value of the bonds into their respective category.

First jj is set equal to $hh + h(1)$. Recall that hh is equal to the minimum amount of cells outputted (76) and $h(1)$ is equal to the number of rows in PORT_BOND_MATURITIES_MATRIX.

kk is then set equal to $h(2)$ which recall is the number of rows in PORT_BOND_TYPES_MATRIX.

A loop then begins from $j = 1$ to kk .

If the type of bond being passed through the i loop is equal to the j th bond in PORT_BOND_TYPES_MATRIX then TEMPO_MATRIX($i, jj + j$) is set equal to the Market Value of the bond. In the portfolio line the sum of all the bonds market values that are the same type of bond are calculated and placed in TEMPO_MATRIX($NROWS + 1, jj + j$).

If the reader is confused by the logic behind $jj+j$ in TEMPO_MATRIX, it helps to look at the final output.

Column 76	Column $hh + 1$	Column $hh + 2$...	Column $hh + h(1)$	Column $jj + 1$	Column $jj + 2$...	Column $jj + h(2)$
V) ADJUSTED LY	VI) VALUE BY MATURITY BRACKET: 1.0 Years	VI) VALUE BY MATURITY BRACKET: 2.0 Years		VI) VALUE BY MATURITY BRACKET: n Years	VII) VALUE BY BOND TYPE: A	VII) VALUE BY BOND TYPE: B		VII) VALUE BY BOND TYPE: n

Since the number of columns that need to be filled and the column number that the values are placed into are dependent upon the optional variables being present and the number of data points in the optional variables, this notation allows the function to be dynamic.

Value by Credit Quality

The last categorizing that the data does with the bonds and their respective Market Value is for Credit Quality. This process is almost identical to the one seen in Value by Bond type and proceeds as follows.

The function begins by setting jj equal to itself plus $h(2)$. The reasoning for this should be clear given the example above. We want to start at the column right of $jj+h(2)$, so our starting position is set to $jj+h(2)$.

k is then set equal to $h(3)$ and a loop begins from $j= 1$ to k .

If the value in TEMPO_MATRIX(i, 11) (the Average Tier), equals the j value being passed then the Market Value is placed into cell TEMPO_MATRIX(i, jj + j). At the same time the portfolio market value for each Credit Quality column is calculated by summing all the market values being placed into the respective column.

TEMPO_MATRIX(i, nn) is then set equal to interest earned. Recall that nn is the starting position of the last section. This is done by sending the purchase and settlement date through the YEARFRAC_FUNC function to return the year as a fraction. This is then multiplied by the adjusted quantity times MULT3_VAL. Then all this is multiplied by the coupon divided by MULT2_VAL.

As this is happening the portfolio line for the interest earned column is found by summing all the value being passed through TEMPO_MATRIX(i, nn).

The Total Return is then calculated by adding the market value to the interest earned, less the total cost all divided by the total cost.

Bond Analysis

This section contains a few analytics columns that show modified duration, bond risk, and bond sensitivity. Together, these metrics can be used to gauge the portfolio's sensitivity to changes in interest rates. In particular, the bond risk column attempts to estimate the change in market value in each bond and the portfolio overall that would likely result from an X basis point (Y%) change in interest rates.

The Modified Duration and Bond Sensitivity columns are used to give an indication of what might happen to the value of each holding and the portfolio overall as interest rates change.

– Notes from BOND_PORT_ANALYSIS_FUNC

The entire Bond analysis section is controlled by one if-statement. This if statement initially checks that there is a value in the YTM column TEMPO_MATRIX(i, 63) if there is then the code precedes.

If YTM is also greater than zero then, TEMPO_MATRIX(i, nn + 2) is set equal to modified duration. This is done using the BOND_CONVEXITY_DURATION_FUNC and the inputs:

```
S_VAL = SETTLEMENT
M_VAL = Maturity
C_VAL = Coupon / MULT2_VAL
Y_VAL = YTM
F_VAL = Adjusted Coupon/Year
R_VAL = 100
```

Next the function computes the change in price that would result in a 100 basis point decrease or increase in the bond. This information is stored in TEMPO_MATRIX(i, nn + 3) and TEMPO_MATRIX(i, nn + 4) respectively.

To do this, the code first checks that the YTM is greater than the DELTA_VAL. If it is, then Y_VAL is set equal to the YTM minus the DELTA_VAL, otherwise Y_VAL is set equal to epsilon.

The sub PORT_BOND_PRICE_LINE is used to determine the price.

For the increase in rates adjusted price the Y_VAL is set equal to YTM plus DELTA_VAL and PORT_BOND_PRICE_LINE is used again.

If the YTM is less than zero then,

TEMPO_MATRIX(i, nn + 2) is set equal to zero.

TEMPO_MATRIX(i, nn + 3) and TEMPO_MATRIX(i, nn + 4) are set equal to the current price.

Duration is then calculated and set equal to TEMPO_MATRIX(i, nn + 5). This is done by subtracting the Price if there is a drop in 100 basis points from the Price if there is a gain in 100 basis points. Divided by the product of 2 times the adjusted price times the DELTA_VALUE times (one plus YTM).

Next, if TEMPO_MATRIX(i, nn + 2) equals zero, then TEMPO_MATRIX(i, nn + 7) is set equal to zero.

Otherwise the bond convexity is calculated. This is done by adding the Price if there is a gain in 100 basis points from the Price if there is a drop in 100 basis points minus the adjusted price. That value is then divided by the adjusted price times DELTA_VAL squared.

Next, TEMPO_MATRIX(i, nn + 9) is set equal to the Bond Risk which is a more accurate indicator of interest rate sensitivity that takes into account the effects of curvature in the relationship between price and yield. This is done by multiplying the modified duration by the DELTA_VAL and then subtracting that value by the product of the bond convexity times DELTA_VAL squared.

Finally, TEMPO_MATRIX(i, nn + 11) is set equal to Bond Sensitivity which is how much the value of a bond will change from a 100 basis points change in bond yield. This is done by multiplying the bond risk value by the market value of the bond.

The next i is then triggered and the whole giant i loop repeats.

Completing the Function

The Portfolio Lines

Once all the main inputs are placed in the matrix and the i loop finishes, the code begins to fill in any missing values; Most notably the values in the portfolio line.

This section begins with mm being set equal to jj. Recall that at this point jj is equal to hh + h(1) +h(2).

The value in TEMPO_MATRIX(NROWS + 1, 21) then has its decimals removed and a one added to it.

Next TEMPO_MATRIX(NROWS + 1, nn + 1) is set equal to (TEMPO_MATRIX(NROWS + 1, 74) + TEMPO_MATRIX(NROWS + 1, nn) - TEMPO_MATRIX(NROWS + 1, 30)) / TEMPO_MATRIX(NROWS + 1, 30).

TEMPO_MATRIX(NROWS + 1, 4) and TEMPO_MATRIX(NROWS + 1, 5) are set equal to zero.

Then the following columns also have their portfolio lines also set equal to zero:

Column 22, 34, 66, 67, 73, 75, nn +6, nn +8 and nn +10.

Next the variable ii is set equal to h(0) + h(1) + h(2) + h(3), jj is set equal to ii + h(2) + h(1), kk is set equal to jj + h(2) + h(3), ll is set equal to kk + h(2) and k is set equal to h(2)

A loop then beings for j = 1 to k to place zeros in the respective columns below:

```
TEMPO_MATRIX(NROWS + 1, ii + j)
TEMPO_MATRIX(NROWS + 1, jj + j)
TEMPO_MATRIX(NROWS + 1, kk + j)
TEMPO_MATRIX(NROWS + 1, ll + j)
```

Next ii is set equal to ii + h(2), jj is set equal to ll + h(2), kk is set equal to jj + h(1) and k is set equal to h(1)

A j loop begins again from 1 to k to place zeros in the following columns:

```
TEMPO_MATRIX(NROWS + 1, ii + j)
TEMPO_MATRIX(NROWS + 1, jj + j)
TEMPO_MATRIX(NROWS + 1, kk + j)
```

Finally, ii is set equal to ii + h(1) +h(2), jj is set equal to kk +h(1), kk is set equal to jj + h(3) and k is set equal to h(3).

A j loop begins again from 1 to k to place zeros in the following columns:

```
TEMPO_MATRIX(NROWS + 1, ii + j)
TEMPO_MATRIX(NROWS + 1, jj + j)
TEMPO_MATRIX(NROWS + 1, kk + j)
```

jj is then set equal to mm + h(3).

Second i Loop

An i loop then begins for $i = 1$ to NROW. This i loop is to complete some sections of the output that were not entered in the original i loop. These sections were not originally entered because they are dependent on some of the other outputs being completed first.

The first if-statement checks that there is a value in both the Moody Value and Moody Ranking column. If there is and if the Moody Value does not equal zero, then the Moody score is calculated by dividing the Moody value by the product of the Moody Value and Moody Ranking. The score is stored in `TEMPO_MATRIX(NROWS + 1, 4)`. During this process the sum of the Moody Scores is also determined and stored in the Portfolio line in the Moody Score column.

The exact same process then ensures for the S&P Score, only using the S&P Value and S&P Ranking Column. The score is stored in `TEMPO_MATRIX(NROWS + 1, 5)`.

Next the code checks to see if there is a value present in the Market Value column. If there is and if it doesn't equal zero then the percentage of that bond in the overall portfolio is calculated; This is done by dividing the Market Value of the bond by the Market value of the portfolio. The value is stored in `TEMPO_MATRIX(i, 75)`. The sum of all the percentages is also calculated and stored in the Portfolio line in the Percent Portfolio column.

Weighted Columns

Next the Weighted Year to Maturity is calculated and the value is stored in `TEMPO_MATRIX(NROWS + 1, 22)`. To do this, the function first checks that there is a value in both the Years to Maturity and Percent Portfolio columns. If there are then the two values are multiplied together and stored. At the same time the sum of all the weighted year to maturities is also calculated and stored in the Portfolio line in the Weighted Year to Maturity column.

Next the Weighted YTM is calculated and stored in `TEMPO_MATRIX(i, 34)`. This is done by first checking that there are values in the Total Cost, and YTM at Buy columns, and also that the portfolio line under the Total Cost column has a value. If the conditions are met, then the Weighted YTM is calculated by multiplying the YTM at Buy by the Total Cost of the bond divided by the Total cost of the portfolio. Again, the Portfolio Weighted YTM is also calculated by summing the weights of each individual bond.

Next, the Premium Weight is calculated and stored in `TEMPO_MATRIX(i, 73)`. To do this the function first checks that there is a value present in both the Percent Portfolio and Lower Yield Premium columns. If there is, then both values are multiplied together and the product is stored. The sum of each bond's Premium Weighting is also calculated for the Portfolio line.

Next the code checks to see if the `PORT_BOND_TYPES_FLAG` is activated. If it is, then `LOOK_STR` is set equal to the Type of bond and sent to the sub `PORT_TAXES_LINE`. The sub returns with the tax rate that corresponds to that type of bond stored in `FIND_STR`. If the `PORT_BOND_TYPES_FLAG` is not activated then `FIND_STR` is set to blank.

Next if there are values in the Percent Portfolio and Adjusted Lower Yield columns then the weighted yield is determined by multiplying the two values together. Once again the Portfolio line is also determined by summing all the weighted yield values.

The code then checks to see if there is a value being stored in FIND_STR. If there is, then the weighted yield is multiplied by $1 - \text{FIND_STR}$. This figure represents the after tax weighted yield and is placed in TEMPO_MATRIX(i, 67). Again, the sum of all the weighted after tax yields is calculated and stored in the portfolio line.

Next, the Duration Weight column is calculated and stored in TEMPO_MATRIX(i, nn + 6). The process is similar to the ones above. First the Percent Portfolio and Modified Duration columns are checked to make sure there is a value in them and if there is they are multiplied together. The portfolio line is then calculated the same as for the other columns above.

The Convexity Weight column is calculated in a similar manner as the Duration Weight column. Only the Bond Convexity and Market Value columns are used. After they are checked to make sure they both have values, the total market value of the portfolio is checked to make sure it also has a value. If it also does then TEMPO_MATRIX(i, nn + 8) is set equal to the Market Value of the Bond divided by the Market Value of the portfolio multiplied by the Bond Convexity. The total portfolio Convexity Weight is also determined in the same fashion as above.

Finally, the Risk Weight column is calculated and stored in TEMPO_MATRIX(i, nn + 10). This is done first by checking that there are values in the Percent Portfolio and Bond Risk columns. If there are, then the two values are multiplied together and stored. The total portfolio Risk Weight is also determined in the same fashion as above.

Next kk is set equal to jj + h(2), ll is set equal to kk + h(1) + h(2) * 3 + h(3), mm is set equal to ll + h(1) and k is set equal to h(1)

Completing Sections for the Optional Values

A loop then begins for j = 1 to k

The first if-statement is for finding the values for Credit Quality by Bond Type section. This value is found by multiplying the Average Ranking by the value in the ii + jth column of Value By Bond Type and dividing that by the Portfolio's Value By Bond Type of the ii + jth column. Like the if-statements above, this calculation doesn't proceed unless all of the values needed to calculate it are present. The Portfolio line is then also determined by summing each value in the Values for Credit Quality by Bond ii+jth column.

The next if-statement is for determining the Modified Duration by Bond Type section. The logic for the code is exactly the same as determining the values for the Credit Quality by Bond Type section, only this time the input Average Ranking is substituted for Modified Duration. The rest of the if-statement logic is identical. The values, however, are stored in the kk + jth column in the code.

The next if-statement is for determining the Pre-Tax Yield by Bond Type and store the values in the ll + jth column. This is done using the same equation above with the only change to the inputs being that the Adjusted Lower Yield is used in place of the Average Ranking. The Portfolio line for this section is also determined using the same methods as discussed above.

This if-statement has an added condition that if FIND_STR equals a value then the function also inputs the After Tax Yield by Bond Type. It does this by multiplying the value in the ll + jth column by 1 minus

the appropriate tax rate. The information is stored in the mm +jth column. The sum of all the values in each column is also calculated for the Portfolio Line.

The next four if-statements follow almost identical logic to the if-statements seen above.

The first two are used to find the information for the Credit Quality by Maturity Bracket section and the information for the Pre-Tax and After-Tax Yield by Maturity Bracket sections. These are most similar to the first and third if-statements seen for the Credit Quality sections discussed directly above.

The last two are used to find the information for the Modified Duration by Credit Quality and the Pre-Tax and After-Tax Yield by Credit Quality sections. These are most similar to the second and third if-statements seen for the Credit Quality sections discussed directly above.

The next i is then triggered and the loop repeats with the next i value.

More Portfolio Lines

TEMPO_MATRIX(NROWS + 1, 4) is set equal to Round(TEMPO_MATRIX(NROWS + 1, 4), 2)

TEMPO_MATRIX(NROWS + 1, 5) is set equal to Round(TEMPO_MATRIX(NROWS + 1, 5), 2)

TEMPO_MATRIX(NROWS + 1, 13) is set equal to (TEMPO_MATRIX(NROWS + 1, 4) + TEMPO_MATRIX(NROWS + 1, 5)) / 2

TEMPO_MATRIX(NROWS + 1, 14) is set equal to "Avg Rating"

TEMPO_MATRIX(NROWS + 1, 16) is set equal to TEMPO_MATRIX(NROWS + 1, 22)

TEMPO_MATRIX(NROWS + 1, 17) is set equal to "Avg Yrs Maturity"

TEMPO_MATRIX(NROWS + 1, 60) is set equal to TEMPO_MATRIX(NROWS + 1, 34)

TEMPO_MATRIX(NROWS + 1, 63) is set equal to TEMPO_MATRIX(NROWS + 1, 66)

TEMPO_MATRIX(NROWS + 1, 65) is set equal to TEMPO_MATRIX(NROWS + 1, 66)

TEMPO_MATRIX(NROWS + 1, 68) is set equal to "Avg Yield"

TEMPO_MATRIX(NROWS + 1, 72) is set equal to TEMPO_MATRIX(NROWS + 1, 73)

TEMPO_MATRIX(NROWS + 1, nn + 2) is set equal to TEMPO_MATRIX(NROWS + 1, nn + 6)

TEMPO_MATRIX(NROWS + 1, nn + 7) is set equal to TEMPO_MATRIX(NROWS + 1, nn + 8)

TEMPO_MATRIX(NROWS + 1, nn + 9) is set equal to TEMPO_MATRIX(NROWS + 1, nn + 10)

TEMPO_MATRIX(NROWS + 1, nn + 11) is set equal to TEMPO_MATRIX(NROWS + 1, 74) *

TEMPO_MATRIX(NROWS + 1, nn + 10)

CREDIT_AGENCIES_FLAG section

The last three if statements all check to see if CREDIT_AGENCIES_FLAG is active.

The first if-statement uses the CREDIT_AGENCIES_LINE sub and the Portfolio's overall Moody's score. The sub returns a text rating based on the weighted average Moody's rating for the overall portfolio. This value is stored in TEMPO_MATRIX(NROWS + 1, 2).

The next if statement does the same thing only with the S&P score. The text rating is stored in TEMPO_MATRIX(NROWS + 1, 3).

The last if-statement uses a loop to provide a text rating for every column in the Credit Quality by Bond Type section of the output (Section 9). This is done in the same manner as above. In all cases if CREDIT_AGENCIES_FLAG is not active the output is left blank.

Select Case Output

The function can produce six different output depending on what the user specifies.

They are summarized in the table below

Case	Output
0	TEMP0_MATRIX
1	TEMP1_MATRIX- Portfolio Cash Flow Table
2	TEMP2_MATRIX- Bond Portfolio Maturity Table
3	TEMP3_MATRIX- Portfolio Bond Type Table
4	TEMP4_MATRIX- Portfolio Credit Quality Table
Not Specified	All possible outputs

Source Code

```

*****
*****
'FUNCTION   : BOND_PORT_ANALYSIS_FUNC
'LIBRARY   : BOND
'GROUP     : PORT
'ID        : 001
'AUTHOR    : RAFAEL NICOLAS FERMIN COTA
'LAST UPDATE : 10/04/2015
*****
*****

```

Function BOND_PORT_ANALYSIS_FUNC(ByRef VALOR_RNG As Variant, _

- ByRef MOODY_RATING_RNG As Variant, _
- ByRef SP_RATING_RNG As Variant, _
- ByRef INSURANCE_NAME_RNG As Variant, _
- ByRef CUSIP_RNG As Variant, _
- ByRef ISSUE_NAME_RNG As Variant, _
- ByRef BOND_TYPE_RNG As Variant, _
- ByRef COUPON_RNG As Variant, _
- ByRef FREQUENCY_RNG As Variant, _
- ByRef MATURITY_RNG As Variant, _
- ByRef CALL_PRICE_RNG As Variant, _
- ByRef CALL_DATE_RNG As Variant, _
- ByRef PURCHASE_DATE_RNG As Variant, _
- ByRef PURCHASE_PRICE_RNG As Variant, _
- ByRef PURCHASE_QUANTITY_RNG As Variant, _
- ByRef PURCHASE_FEES_RNG As Variant, _
- ByRef CURRENT_PRICE_RNG As Variant, _
- Optional ByRef MARKET_YIELDS_RNG As Variant, _
- Optional ByRef CREDIT_AGENCIES_RNG As Variant, _

Optional ByRef PORT_BOND_TYPES_RNG As Variant, _
 Optional ByRef PORT_MATURITIES_RNG As Variant, _
 Optional ByRef PORT_CREDIT_QUALITIES_RNG As Variant, _
 Optional ByVal DELTA_VAL As Double = 0.01, Optional ByVal REBALANCING_SLACK As Double = 1000, _
 Optional ByVal SETTLEMENT As Date = 0, Optional ByRef GUESS_YIELD As Variant = 0.5, _
 Optional ByRef COUNT_BASIS As Variant = 0, Optional ByVal OUTPUT As Integer = 0)

'-----

'SETTLEMENT: date to base bond price/yield/maturity calculations on. The default value is a reference to the built-in function Today(). If you want to compute values relative to another date (such as settlement dates), change it and all calculations will be based off the new date.

'-----

'INSURANCE_NAME_RNG:

'This vector is used to populate the validation drop-down for the insurance companies.

""MBIA""

""FSA""

""AMBAC""

""FDIC""

""None""

'-----

'DELTA_VAL: 100 * Basis Points (e.g., 100 basis points)

'-----

'MARKET_YIELDS_RNG:

'General bond market maturity and yield data to support calculations on Bond Portfolio. Yields should be for AAA bonds...

'-----

'C1: Maturity

'C2: Agency Yield
'C3: Corporate Yield
'C4: Muni Yield
'C5: TIPS Yield
'C6: Treasury Yield

'The data entered into MARKET_YIELDS_RNG could be interpolated and then used to produce a simulated "market yield" value for a bond with a given maturity. This yield value is an estimate of the yield on a generic security with a given maturity in years. Each bond's actual yield can then be compared with this "market" yield.

'Note: These calculations don't adjust for differences in bond quality so if the market yield curve data is for aaa and the bond being compared is bbb, the results will not be valid.

For current data

'<http://www.bloomberg.com/markets/rates/index.html>
'<http://www.bondsonline.com/asp/news/composites.html>
'<http://www.bondtalk.com/global.cfm?S=charts&SS=bmyieldsummary>
'<http://bonds.yahoo.com/rates.html>

'-----

'REBALANCING_SLACK: This value is used in the Bond Maturity, Bond Type, and Credit Quality. This value creates some "slack" for the rebalancing algorithm (between desired percent and actual percent) to reduce clutter in the cases where the difference between the target percent allocation and the current percent allocation is small.

For example, if the difference between the desired percent and the actual percent is only a few hundred dollars, the rebalancing slack setting can be used to blank out the Adjustment. This allows the entry with significant differences to be more prominent.

'-----

'COUNT_BASIS:

'This setting is used by several bond calculation functions throughout the algorithm. The built-in bond functions require this value to be set. Most bonds sold in the U.S. use the 30/360 (default) day count method. List of supported Day Count methods:

30/360 (Default); Actual/actual; Actual/360; Actual/365; European 30 / 360

'(Day Count Type) --> These are in order relative to the numerical value that must be passed into the bond routines for day-count-method.

'-----

'DESIRED_PERCENT_X_Y:

'Enter the desired percent of the portfolio for each maturity range to construct a ladder. For example, the entry for a maturity of 10 years shows values for all bonds in the portfolio that mature between 7 years (the previous entry) and 10 years. Set the percent for this entry to the percent of the portfolio that you desire to mature between 7 and 10 years.

'-----

Dim h() As Long

Dim i As Long

Dim j As Long

Dim k As Long

Dim l As Long

Dim m As Long

Dim n As Long

Dim hh As Long

Dim ii As Long

Dim jj As Long

Dim kk As Long

Dim ll As Long

Dim mm As Long

Dim nn As Long

Dim NROWS As Long

Dim NCOLUMNS As Long

Dim Y_VAL As Double

Dim P_VAL As Double

Dim S_VAL As Date

Dim M_VAL As Date
Dim C_VAL As Double
Dim F_VAL As Integer
Dim R_VAL As Double
Dim B_VAL As Integer
Dim G_VAL As Double
Dim NA_STR As String
Dim NR_INT As Integer
Dim NR_STR As String
Dim FIND_STR As String
Dim LOOK_STR As String

Const MULT1_VAL As Double = 10 '100 prices to \$1,000 mult

Const MULT2_VAL As Double = 100 'Coupon Rate to %

Const MULT3_VAL As Double = 1000 'Adj Quantity to \$1,000 mult

'Static HEADINGS0_STR As String

Dim HEADINGS0_STR As String
Dim HEADINGS1_STR As String
Dim HEADINGS_ARR() As String
Dim TEMPO_VAL As Variant
Dim TEMP1_VAL As Variant
Dim TEMP2_VAL As Variant
Dim DATE1_VAL As Date
Dim DATE2_VAL As Date
Dim TEMPO_MATRIX As Variant
Dim TEMP1_MATRIX As Variant
Dim TEMP2_MATRIX As Variant
Dim TEMP3_MATRIX As Variant
Dim TEMP4_MATRIX As Variant

Dim PORT_BOND_TYPES_FLAG As Boolean
Dim PORT_BOND_TYPES_MATRIX As Variant
Dim PORT_MATURITIES_FLAG As Boolean
Dim PORT_BOND_MATURITIES_MATRIX As Variant
Dim PORT_CREDIT_QUALITIES_FLAG As Boolean
Dim PORT_CREDIT_QUALITIES_MATRIX As Variant
Dim CREDIT_AGENCIES_FLAG As Boolean
Dim CREDIT_AGENCIES_MATRIX As Variant
Dim MARKET_YIELDS_FLAG As Boolean
Dim MARKET_YIELDS_MATRIX As Variant
Dim VALOR_VECTOR As Variant
Dim MOODY_RATING_VECTOR As Variant
Dim SP_RATING_VECTOR As Variant
Dim INSURANCE_NAME_VECTOR As Variant
Dim CUSIP_VECTOR As Variant
Dim ISSUE_NAME_VECTOR As Variant
Dim BOND_TYPE_VECTOR As Variant
Dim COUPON_VECTOR As Variant
Dim FREQUENCY_VECTOR As Variant
Dim MATURITY_VECTOR As Variant
Dim CALL_PRICE_VECTOR As Variant
Dim CALL_DATE_VECTOR As Variant
Dim PURCHASE_DATE_VECTOR As Variant
Dim PURCHASE_PRICE_VECTOR As Variant
Dim PURCHASE_QUANTITY_VECTOR As Variant
Dim PURCHASE_FEES_VECTOR As Variant
Dim CURRENT_PRICE_VECTOR As Variant
Dim COUNT_BASIS_VECTOR As Variant
Dim GUESS_YIELD_VECTOR As Variant
Dim tolerance As Double
Dim epsilon As Double

On Error GoTo ERROR_LABEL

NA_STR = "N/A": NR_STR = "NR"

tolerance = 10 ^ -15: epsilon = 0.0000001

If SETTLEMENT = 0 Then: SETTLEMENT = Now()

SETTLEMENT = DateSerial(Year(SETTLEMENT), Month(SETTLEMENT), Day(SETTLEMENT))

VALOR_VECTOR = VALOR_RNG

If UBound(VALOR_VECTOR, 1) = 1 Then

VALOR_VECTOR = MATRIX_TRANSPOSE_FUNC(VALOR_VECTOR)

End If

MOODY_RATING_VECTOR = MOODY_RATING_RNG

If UBound(MOODY_RATING_VECTOR, 1) = 1 Then

 MOODY_RATING_VECTOR = MATRIX_TRANSPOSE_FUNC(MOODY_RATING_VECTOR)

End If

SP_RATING_VECTOR = SP_RATING_RNG

If UBound(SP_RATING_VECTOR, 1) = 1 Then

 SP_RATING_VECTOR = MATRIX_TRANSPOSE_FUNC(SP_RATING_VECTOR)

End If

INSURANCE_NAME_VECTOR = INSURANCE_NAME_RNG

If UBound(INSURANCE_NAME_VECTOR, 1) = 1 Then

INSURANCE_NAME_VECTOR = MATRIX_TRANSPOSE_FUNC(INSURANCE_NAME_VECTOR)

End If

CUSIP_VECTOR = CUSIP_RNG

If UBound(CUSIP_VECTOR, 1) = 1 Then

CUSIP_VECTOR = MATRIX_TRANSPOSE_FUNC(CUSIP_VECTOR)

End If

ISSUE_NAME_VECTOR = ISSUE_NAME_RNG

If UBound(ISSUE_NAME_VECTOR, 1) = 1 Then

ISSUE_NAME_VECTOR = MATRIX_TRANSPOSE_FUNC(ISSUE_NAME_VECTOR)

End If

'-----

NROWS = UBound(ISSUE_NAME_VECTOR, 1)

'-----

If IsArray(COUNT_BASIS) = True Then

 COUNT_BASIS_VECTOR = COUNT_BASIS

 If UBound(COUNT_BASIS_VECTOR, 1) = 1 Then

 COUNT_BASIS_VECTOR = MATRIX_TRANSPOSE_FUNC(COUNT_BASIS_VECTOR)

 End If

Else

 If COUNT_BASIS = "" Then: COUNT_BASIS = 0

 ReDim COUNT_BASIS_VECTOR(1 To NROWS, 1 To 1)


```
For i = 1 To NROWS: COUNT_BASIS_VECTOR(i, 1) = COUNT_BASIS: Next i
```

```
End If
```

```
'-----
```

```
If IsArray(GUESS_YIELD) = True Then
```

```
    GUESS_YIELD_VECTOR = GUESS_YIELD
```

```
    If UBound(GUESS_YIELD_VECTOR, 1) = 1 Then
```

```
        GUESS_YIELD_VECTOR = MATRIX_TRANSPOSE_FUNC(GUESS_YIELD_VECTOR)
```

```
    End If
```

```
Else
```

```
    If GUESS_YIELD = 0 Or GUESS_YIELD = "" Then: GUESS_YIELD = 0.5
```

```
    ReDim GUESS_YIELD_VECTOR(1 To NROWS, 1 To 1)
```

```
For i = 1 To NROWS: GUESS_YIELD_VECTOR(i, 1) = GUESS_YIELD: Next i
```

```
End If
```

```
'-----
```

```
BOND_TYPE_VECTOR = BOND_TYPE_RNG
```

```
If UBound(BOND_TYPE_VECTOR, 1) = 1 Then
```

```
    BOND_TYPE_VECTOR = MATRIX_TRANSPOSE_FUNC(BOND_TYPE_VECTOR)
```

```
End If
```

```
COUPON_VECTOR = COUPON_RNG
```

```
If UBound(COUPON_VECTOR, 1) = 1 Then
```

```
    COUPON_VECTOR = MATRIX_TRANSPOSE_FUNC(COUPON_VECTOR)
```

End If

FREQUENCY_VECTOR = FREQUENCY_RNG

If UBound(FREQUENCY_VECTOR, 1) = 1 Then

 FREQUENCY_VECTOR = MATRIX_TRANSPOSE_FUNC(FREQUENCY_VECTOR)

End If

MATURITY_VECTOR = MATURITY_RNG

If UBound(MATURITY_VECTOR, 1) = 1 Then

 MATURITY_VECTOR = MATRIX_TRANSPOSE_FUNC(MATURITY_VECTOR)

End If

CALL_PRICE_VECTOR = CALL_PRICE_RNG

If UBound(CALL_PRICE_VECTOR, 1) = 1 Then

CALL_PRICE_VECTOR = MATRIX_TRANSPOSE_FUNC(CALL_PRICE_VECTOR)

End If

CALL_DATE_VECTOR = CALL_DATE_RNG

If UBound(CALL_DATE_VECTOR, 1) = 1 Then

CALL_DATE_VECTOR = MATRIX_TRANSPOSE_FUNC(CALL_DATE_VECTOR)

End If

PURCHASE_DATE_VECTOR = PURCHASE_DATE_RNG

If UBound(PURCHASE_DATE_VECTOR, 1) = 1 Then

PURCHASE_DATE_VECTOR = MATRIX_TRANSPOSE_FUNC(PURCHASE_DATE_VECTOR)

End If

PURCHASE_PRICE_VECTOR = PURCHASE_PRICE_RNG

If UBound(PURCHASE_PRICE_VECTOR, 1) = 1 Then

PURCHASE_PRICE_VECTOR = MATRIX_TRANSPOSE_FUNC(PURCHASE_PRICE_VECTOR)

End If

PURCHASE_QUANTITY_VECTOR = PURCHASE_QUANTITY_RNG

If UBound(PURCHASE_QUANTITY_VECTOR, 1) = 1 Then

PURCHASE_QUANTITY_VECTOR = MATRIX_TRANSPOSE_FUNC(PURCHASE_QUANTITY_VECTOR)

End If

PURCHASE_FEES_VECTOR = PURCHASE_FEES_RNG

If UBound(PURCHASE_FEES_VECTOR, 1) = 1 Then

PURCHASE_FEES_VECTOR = MATRIX_TRANSPOSE_FUNC(PURCHASE_FEES_VECTOR)

End If

CURRENT_PRICE_VECTOR = CURRENT_PRICE_RNG

If UBound(CURRENT_PRICE_VECTOR, 1) = 1 Then

CURRENT_PRICE_VECTOR = MATRIX_TRANSPOSE_FUNC(CURRENT_PRICE_VECTOR)

End If

ReDim h(0 To 3): h(0) = 76

'-----

If IsArray(MARKET_YIELDS_RNG) = True Then 'Perfect

 MARKET_YIELDS_MATRIX = MARKET_YIELDS_RNG

 MARKET_YIELDS_FLAG = True

Else

 MARKET_YIELDS_FLAG = False

End If

'-----

If IsArray(PORT_MATURITIES_RNG) Then 'Perfect

PORT_BOND_MATURITIES_MATRIX = PORT_MATURITIES_RNG

h(1) = UBound(PORT_BOND_MATURITIES_MATRIX, 1)

PORT_MATURITIES_FLAG = True

Else

PORT_MATURITIES_FLAG = False

h(1) = 0

End If

'-----

If IsArray(PORT_BOND_TYPES_RNG) = True Then 'Perfect

'Edit the table to enter tax rates for each supported bond type.

'Include federal and state where applicable.

PORT_BOND_TYPES_FLAG = True

PORT_BOND_TYPES_MATRIX = PORT_BOND_TYPES_RNG

h(2) = UBound(PORT_BOND_TYPES_MATRIX, 1)

j = h(2)

Else

PORT_BOND_TYPES_FLAG = False

h(2) = 0

End If

If IsArray(PORT_CREDIT_QUALITIES_RNG) = True Then

PORT_CREDIT_QUALITIES_FLAG = True

PORT_CREDIT_QUALITIES_MATRIX = PORT_CREDIT_QUALITIES_RNG

```
h(3) = UBound(PORT_CREDIT_QUALITIES_MATRIX, 1)
```

```
Else
```

```
PORT_CREDIT_QUALITIES_FLAG = False
```

```
h(3) = 0
```

```
End If
```

```
'-----
```

```
If IsArray(CREDIT_AGENCIES_RNG) = True Then 'Fix dimension here!!!
```

```
CREDIT_AGENCIES_FLAG = True
```

```
CREDIT_AGENCIES_MATRIX = CREDIT_AGENCIES_RNG
```

```
j = UBound(CREDIT_AGENCIES_MATRIX, 1)
```

```
For i = 1 To j: CREDIT_AGENCIES_MATRIX(i, 1) = Trim(CREDIT_AGENCIES_MATRIX(i, 1)): Next i
```

If IsNumeric(CREDIT_AGENCIES_MATRIX(j, 4)) = True Then NR_INT = CREDIT_AGENCIES_MATRIX(j, 4) Else NR_INT = 8 'Unknown rating or unrated bond

Else

CREDIT_AGENCIES_FLAG = False

NR_INT = 8

End If

'-----

GoSub HEADINGS_LINE

'-----

TEMPO_MATRIX(NROWS + 1, 1) = "Portfolio"

For j = 6 To 7: TEMPO_MATRIX(NROWS + 1, j) = 0: Next j

TEMPO_MATRIX(NROWS + 1, 21) = 0

For j = 30 To 31: TEMPO_MATRIX(NROWS + 1, j) = 0: Next j

For j = 36 To 59: TEMPO_MATRIX(NROWS + 1, j) = 0: Next j

TEMPO_MATRIX(NROWS + 1, 74) = 0

hh = h(0)

ii = hh + 1

jj = hh + h(1) + h(2) + h(3)

For j = ii To jj: TEMPO_MATRIX(NROWS + 1, j) = 0: Next j

nn = hh + h(1) * 4 + h(2) * 5 + h(3) * 4 + 1 'Section XIX

TEMPO_MATRIX(NROWS + 1, nn) = 0

'-----

For i = 1 To NROWS

VALOR_VECTOR(i, 1) = Trim(VALOR_VECTOR(i, 1))

CURRENT_PRICE_VECTOR(i, 1) = Trim(CURRENT_PRICE_VECTOR(i, 1))

MATURITY_VECTOR(i, 1) = Trim(MATURITY_VECTOR(i, 1))

PURCHASE_DATE_VECTOR(i, 1) = Trim(PURCHASE_DATE_VECTOR(i, 1))

PURCHASE_PRICE_VECTOR(i, 1) = Trim(PURCHASE_PRICE_VECTOR(i, 1))

PURCHASE_QUANTITY_VECTOR(i, 1) = Trim(PURCHASE_QUANTITY_VECTOR(i, 1))

PURCHASE_FEES_VECTOR(i, 1) = Trim(PURCHASE_FEES_VECTOR(i, 1))

COUPON_VECTOR(i, 1) = Trim(COUPON_VECTOR(i, 1))

FREQUENCY_VECTOR(i, 1) = Trim(FREQUENCY_VECTOR(i, 1))

CALL_PRICE_VECTOR(i, 1) = Trim(CALL_PRICE_VECTOR(i, 1))

CALL_DATE_VECTOR(i, 1) = Trim(CALL_DATE_VECTOR(i, 1))

MOODY_RATING_VECTOR(i, 1) = Trim(MOODY_RATING_VECTOR(i, 1))

SP_RATING_VECTOR(i, 1) = Trim(SP_RATING_VECTOR(i, 1))

INSURANCE_NAME_VECTOR(i, 1) = Trim(INSURANCE_NAME_VECTOR(i, 1))

CUSIP_VECTOR(i, 1) = Trim(CUSIP_VECTOR(i, 1))

ISSUE_NAME_VECTOR(i, 1) = Trim(ISSUE_NAME_VECTOR(i, 1))

BOND_TYPE_VECTOR(i, 1) = Trim(BOND_TYPE_VECTOR(i, 1))

'General Bond Information

'-----

'In order to experiment with what-if scenarios, you can exclude a bond from

'ALL portfolio calculations by changing the # for that bond's row to a blank

'(clear contents). To restore calculations for that row simply restore the

'number for that row.

 If VALOR_VECTOR(i, 1) = "" Then: GoTo 1983

'-----

 If MATURITY_VECTOR(i, 1) = "" Or Val(MATURITY_VECTOR(i, 1)) = 0 Then: GoTo 1983

 If CURRENT_PRICE_VECTOR(i, 1) = "" Then: GoTo 1983

 If PURCHASE_DATE_VECTOR(i, 1) = "" Or Val(PURCHASE_DATE_VECTOR(i, 1)) = 0 Then: GoTo 1983

If PURCHASE_PRICE_VECTOR(i, 1) = "" Then: GoTo 1983

If PURCHASE_QUANTITY_VECTOR(i, 1) = "" Or Val(PURCHASE_QUANTITY_VECTOR(i, 1)) = 0 Then: GoTo 1983

'If PURCHASE_FEES_VECTOR(i, 1) = "" Or IsNumeric(PURCHASE_FEES_VECTOR(i, 1)) = False Then: GoTo 1983

'-----

TEMPO_MATRIX(i, 1) = VALOR_VECTOR(i, 1)

TEMPO_MATRIX(i, 2) = MOODY_RATING_VECTOR(i, 1)

TEMPO_MATRIX(i, 3) = SP_RATING_VECTOR(i, 1)

TEMPO_MATRIX(i, 19) = CDate(MATURITY_VECTOR(i, 1))

If InStr(1, CURRENT_PRICE_VECTOR(i, 1), "-") = 0 Then

TEMPO_MATRIX(i, 61) = CURRENT_PRICE_VECTOR(i, 1)


```
If Val(TEMPO_MATRIX(i, 61)) > 0 Then: TEMPO_MATRIX(i, 61) = CDbI(TEMPO_MATRIX(i, 61))
```

```
Else
```

```
TEMPO_MATRIX(i, 61) = CURRENT_PRICE_VECTOR(i, 1)
```

```
End If
```

```
'-----
```

```
'Purchase Information
```

```
'This section allows you to put in purchase information for the issue.
```

```
'The YTM column is calculated automatically and makes use of the built-in YTM()
```

```
'function. The easiest way to understand what's going on is to select one of
```

```
'the cells in the YTM column.
```

'If you click on the text of this formula on the formula bar, you should get

'a visual display of which cells are referenced by the various cell labels in

'the formula. Most of the columns are referenced by name in the complicated

'formulas. You can see the mapping of Names to cells by selecting

'Insert->Name->Define on the menu bar.

'-----

TEMPO_MATRIX(i, 25) = CDate(PURCHASE_DATE_VECTOR(i, 1))

'Enter price as a percent of par.

'For example, if a \$1000 dollar par bond is selling at a discount for \$975,

'enter price as \$97.50. For Treasuries, you can enter prices as a dollar

'figure and number of 32nds by using a "-" instead of a "." For example, a

'price of 101-08 is interpreted as 101 and 8/32 or 101.25. This conversion

'also supports formats such as 99-10+ (with + meaning add 1/16) and 99-102

'(with the 2 at the end indicating additional 2/256).

'Also, price should be a "clean" price rather than a dirty price and should

'not include any markup for accrued interest. It's ok if price includes a

'dealer markup. Alternately, you could subtract out the markup from the price

'and enter it explicitly as a fee.

```
If InStr(1, PURCHASE_PRICE_VECTOR(i, 1), "-") = 0 Then
```

```
    TEMPO_MATRIX(i, 26) = PURCHASE_PRICE_VECTOR(i, 1)
```

```
    If Val(TEMPO_MATRIX(i, 26)) > 0 Then: TEMPO_MATRIX(i, 26) = CDbI(TEMPO_MATRIX(i, 26))
```

Else

TEMPO_MATRIX(i, 26) = PURCHASE_PRICE_VECTOR(i, 1)

End If

TEMPO_MATRIX(i, 27) = Cdbl(PURCHASE_QUANTITY_VECTOR(i, 1)) 'Number of bonds purchased (assuming \$1000 par value per bond).

If Val(PURCHASE_FEES_VECTOR(i, 1)) > 0 Then

TEMPO_MATRIX(i, 28) = Cdbl(PURCHASE_FEES_VECTOR(i, 1)) 'Enter any transaction fee on this purchase.

'If the price already includes the markup, don't reenter the fee separately (unless you decrease the price appropriately first).

'Finally , don't include incrued interest in the fees.

Else

TEMPO_MATRIX(i, 28) = 0

End If

'-----'

If Val(COUPON_VECTOR(i, 1)) > 0 Then

 TEMPO_MATRIX(i, 16) = CDb1(COUPON_VECTOR(i, 1))

Else

 TEMPO_MATRIX(i, 16) = 0

End If

If Val(FREQUENCY_VECTOR(i, 1)) > 0 Then

 TEMPO_MATRIX(i, 17) = CInt(FREQUENCY_VECTOR(i, 1))

'Coupons Per Year

Else

TEMPO_MATRIX(i, 17) = 0

End If

If Val(CALL_PRICE_VECTOR(i, 1)) = 0 Then

TEMPO_MATRIX(i, 23) = ""

Else

TEMPO_MATRIX(i, 23) = CDbI(CALL_PRICE_VECTOR(i, 1))

End If

If CALL_DATE_VECTOR(i, 1) = "" Or Val(CALL_DATE_VECTOR(i, 1)) = 0 Then

```
TEMPO_MATRIX(i, 24) = "" 'Leave Call Price and Call Date blank if bond is non-callable
```

```
Else
```

```
TEMPO_MATRIX(i, 24) = CDate(CALL_DATE_VECTOR(i, 1))
```

```
End If
```

```
'-----
```

```
TEMP1_VAL = TEMPO_MATRIX(i, 61): GoSub BOND_PRICE_PARSE_LINE: TEMPO_MATRIX(i, 62) = TEMP2_VAL
```

```
TEMP1_VAL = TEMPO_MATRIX(i, 26): GoSub BOND_PRICE_PARSE_LINE: TEMPO_MATRIX(i, 29) = TEMP2_VAL
```

```
'-----
```

```
TEMPO_MATRIX(i, 32) = TEMPO_MATRIX(i, 27)
```

```
TEMPO_MATRIX(i, 33) = TEMPO_MATRIX(i, 28)
```

```
TEMPO_MATRIX(i, 74) = (TEMPO_MATRIX(i, 62) * MULT1_VAL) * TEMPO_MATRIX(i, 32)
```

```
TEMPO_MATRIX(NROWS + 1, 74) = TEMPO_MATRIX(NROWS + 1, 74) + TEMPO_MATRIX(i, 74)
```

```
FIND_STR = "": TEMPO_MATRIX(i, 10) = ""
```

```
If TEMPO_MATRIX(i, 2) <> NR_STR Then
```

```
    If CREDIT_AGENCIES_FLAG = True Then
```

```
        LOOK_STR = TEMPO_MATRIX(i, 2)
```

```
        GoSub CREDIT_RATINGS_MOODY_LINE
```

```
    End If
```

```
If n > 0 Then
```

```
    j = n
```


TEMPO_MATRIX(i, 6) = TEMPO_MATRIX(i, 74)

TEMPO_MATRIX(NROWS + 1, 6) = TEMPO_MATRIX(NROWS + 1, 6) + TEMPO_MATRIX(i, 6)

TEMPO_MATRIX(i, 8) = j

TEMPO_MATRIX(i, 10) = j

End If

End If

FIND_STR = ""

If TEMPO_MATRIX(i, 3) <> NR_STR Then

If CREDIT_AGENCIES_FLAG = True Then

LOOK_STR = TEMPO_MATRIX(i, 3)

GoSub CREDIT_RATINGS_SP_LINE

End If

If n > 0 Then

j = n

TEMPO_MATRIX(i, 7) = TEMPO_MATRIX(i, 74)

If TEMPO_MATRIX(i, 6) <> "" Then

TEMPO_MATRIX(NROWS + 1, 7) = TEMPO_MATRIX(NROWS + 1, 7) + TEMPO_MATRIX(i, 6)

End If

TEMPO_MATRIX(i, 9) = j

TEMPO_MATRIX(i, 10) = Round((TEMPO_MATRIX(i, 10) + j + (tolerance)) / 2, 0)

End If

End If

FIND_STR = ""

If TEMPO_MATRIX(i, 10) <> "" Then

 If CREDIT_AGENCIES_FLAG = True Then

 LOOK_STR = CStr(TEMPO_MATRIX(i, 10))

 GoSub CREDIT_RATINGS_TIER_LINE

 End If

If n > 0 Then

 j = n

 TEMPO_MATRIX(i, 11) = j

Else

TEMPO_MATRIX(i, 11) = NR_INT '-> Tier

End If

Else

If CREDIT_AGENCIES_FLAG = True Then

LOOK_STR = NR_STR

GoSub CREDIT_RATINGS_SP_LINE

End If

If n > 0 Then

j = n

TEMPO_MATRIX(i, 10) = j

Else

TEMPO_MATRIX(i, 10) = ""

End If

TEMPO_MATRIX(i, 11) = NR_INT

End If

TEMPO_MATRIX(i, 12) = INSURANCE_NAME_VECTOR(i, 1)

TEMPO_MATRIX(i, 13) = CUSIP_VECTOR(i, 1)

TEMPO_MATRIX(i, 14) = ISSUE_NAME_VECTOR(i, 1)

TEMPO_MATRIX(i, 15) = BOND_TYPE_VECTOR(i, 1)

If TEMPO_MATRIX(i, 17) = 0 Then

TEMPO_MATRIX(i, 18) = 1

Else

If TEMPO_MATRIX(i, 17) = 12 Then

TEMPO_MATRIX(i, 18) = 4

Else

TEMPO_MATRIX(i, 18) = TEMPO_MATRIX(i, 17)

End If

End If

B_VAL = CInt(COUNT_BASIS_VECTOR(i, 1))

TEMPO_MATRIX(i, 20) = Month(TEMPO_MATRIX(i, 19))

TEMPO_MATRIX(i, 21) = YEARFRAC_FUNC(SETTLEMENT, TEMPO_MATRIX(i, 19), B_VAL)

TEMPO_MATRIX(NROWS + 1, 21) = MAXIMUM_FUNC(TEMPO_MATRIX(NROWS + 1, 21), TEMPO_MATRIX(i, 21))

TEMPO_MATRIX(i, 30) = TEMPO_MATRIX(i, 32) * (MULT1_VAL * TEMPO_MATRIX(i, 29)) + TEMPO_MATRIX(i, 33)

TEMPO_MATRIX(NROWS + 1, 30) = TEMPO_MATRIX(NROWS + 1, 30) + TEMPO_MATRIX(i, 30)

TEMPO_MATRIX(i, 31) = (TEMPO_MATRIX(i, 32) * MULT3_VAL) * (TEMPO_MATRIX(i, 16) / MULT2_VAL)

TEMPO_MATRIX(NROWS + 1, 31) = TEMPO_MATRIX(NROWS + 1, 31) + TEMPO_MATRIX(i, 31)

If TEMPO_MATRIX(i, 17) = 0 Then

 TEMPO_MATRIX(i, 35) = 0

Else

 TEMPO_MATRIX(i, 35) = TEMPO_MATRIX(i, 31) / TEMPO_MATRIX(i, 17)

End If

If PORT_BOND_TYPES_FLAG = True Then LOOK_STR = TEMPO_MATRIX(i, 15): GoSub PORT_TAXES_LINE Else FIND_STR = "" 'Look for taxes

If FIND_STR <> "" Then TEMPO_MATRIX(i, 69) = n Else TEMPO_MATRIX(i, 69) = ""

k = 12

For j = 1 To k 'Monthly

l = TEMPO_MATRIX(i, 17)

m = TEMPO_MATRIX(i, 20)

If l = 0 Then

TEMPO_MATRIX(i, 36 + j - 1) = 0

TEMPO_MATRIX(i, 48 + j - 1) = 0

Else

'These Cells labelled 1-12 are used to compute coupon payments that occur in each month, and thus the portfolio's cash flows.

$$\text{TEMP1_VAL} = (m - j) / (12 / I)$$

If $\text{TEMP1_VAL} - 1 * \text{Int}(\text{TEMP1_VAL} / 1)$ Then

'Returns the remainder after number is divided by divisor.

'The result has the same sign as divisor.

$$\text{TEMPO_MATRIX}(i, 36 + j - 1) = 0$$

$$\text{TEMPO_MATRIX}(i, 48 + j - 1) = 0$$

Else

$$\text{TEMPO_MATRIX}(i, 36 + j - 1) = \text{TEMPO_MATRIX}(i, 35)$$

$$\text{TEMPO_MATRIX}(\text{NROWS} + 1, 36 + j - 1) = \text{TEMPO_MATRIX}(\text{NROWS} + 1, 36 + j - 1) + \text{TEMPO_MATRIX}(i, 36 + j - 1)$$

'-----> Values about (1-12) are for after tax cash flows for each month

'These Cells labelled 1-12 are used to compute coupon payments that occur in each month, and thus the portfolio's cash flows.

If FIND_STR <> "" Then

TEMPO_MATRIX(i, 48 + j - 1) = TEMPO_MATRIX(i, 35) * (1 - CDBL(FIND_STR))

TEMPO_MATRIX(NROWS + 1, 48 + j - 1) = TEMPO_MATRIX(NROWS + 1, 48 + j - 1) + TEMPO_MATRIX(i, 48 + j - 1)

Else

TEMPO_MATRIX(i, 48 + j - 1) = 0

End If

End If

End If

Next j

P_VAL = TEMPO_MATRIX(i, 29) + (TEMPO_MATRIX(i, 33) / MULT1_VAL) / TEMPO_MATRIX(i, 32)

S_VAL = TEMPO_MATRIX(i, 25)

M_VAL = TEMPO_MATRIX(i, 19)

C_VAL = TEMPO_MATRIX(i, 16) / MULT2_VAL

F_VAL = TEMPO_MATRIX(i, 18)

R_VAL = 100

G_VAL = CDbI(GUESS_YIELD_VECTOR(i, 1))

GoSub PORT_BOND_YIELD_LINE

TEMPO_MATRIX(i, 60) = Y_VAL 'Yield to maturity based on Purchase Price

'This section contains a column where you can update the price of the bond

'several computed columns that contain information about the various financial

'properties of the bond and the portfolio.

'Most of the columns in this section have comments (indicated by red marks on

'the top right of the column name) that activate when you hold the mouse over

'the column header for a couple of seconds. These should explain what's being

'done here.

'There is some magic in the computation of the "Fair YTM". This column attempts

'to indicate how the bond is priced compared to the current market yield curve by

'extrapolation. You need to enter the current market yield curve data on the

'yield curve matrix for this column to be meaningful.

'-----

P_VAL = TEMPO_MATRIX(i, 62)

S_VAL = SETTLEMENT

GoSub PORT_BOND_YIELD_LINE

TEMPO_MATRIX(i, 63) = Y_VAL 'Yield to Maturity based on current price

If (TEMPO_MATRIX(i, 24) <> "" And TEMPO_MATRIX(i, 23) <> "" And _

TEMPO_MATRIX(i, 24) > SETTLEMENT) Then 'Version 3.03

' TEMPO_MATRIX(i, 19) > SETTLEMENT) Then

P_VAL = TEMPO_MATRIX(i, 62)

S_VAL = SETTLEMENT 'TEMPO_MATRIX(i, 25)

```
M_VAL = TEMPO_MATRIX(i, 24)
```

```
R_VAL = TEMPO_MATRIX(i, 23) 'Redemption -> Call Price
```

```
GoSub PORT_BOND_YIELD_LINE
```

```
TEMPO_MATRIX(i, 64) = Y_VAL
```

```
If TEMPO_MATRIX(i, 63) < TEMPO_MATRIX(i, 64) Then 'IF(YTM<YTC,YTM,YTC)
```

```
TEMPO_MATRIX(i, 65) = TEMPO_MATRIX(i, 63) 'The lowest yield taking into
```

```
'account current price and any calls on the bond
```

```
TEMPO_MATRIX(i, 68) = TEMPO_MATRIX(i, 19)
```

```
Else
```

```
TEMPO_MATRIX(i, 65) = TEMPO_MATRIX(i, 64)
```

TEMPO_MATRIX(i, 68) = TEMPO_MATRIX(i, 24)

End If

Else

TEMPO_MATRIX(i, 64) = ""

TEMPO_MATRIX(i, 65) = TEMPO_MATRIX(i, 63)

TEMPO_MATRIX(i, 68) = TEMPO_MATRIX(i, 19)

End If

TEMPO_MATRIX(i, 76) = TEMPO_MATRIX(i, 65)

TEMPO_VAL = TEMPO_MATRIX(i, 21)

If TEMPO_VAL > 0 Then

If TEMPO_VAL > 29 Then 'Maturity over 29 years....

TEMPO_MATRIX(i, 70) = TEMPO_MATRIX(i, 65)

Else

If MARKET_YIELDS_FLAG = True And PORT_BOND_TYPES_FLAG = True And TEMPO_MATRIX(i, 69) <> "" Then

j = CInt(TEMPO_MATRIX(i, 69))

If j = 0 Then: GoTo 1982

LOOK_STR = CStr(PORT_BOND_TYPES_MATRIX(j, 1))

GoSub MARKET_YIELDS1_LINE

If n > 0 Then

GoSub MARKET_YIELDS2_LINE

If TEMP1_VAL <> "" And TEMP2_VAL <> "" Then 'Based on the current Market yield data,

'this is the YTM that would be paid on an AAA bond with the same maturity as this bond


```
TEMPO_MATRIX(i, 70) = TEMP1_VAL + (TEMP2_VAL - TEMP1_VAL) * (TEMPO_VAL - ASYM_DOWN_FUNC(TEMPO_VAL, 1))
```

```
Else
```

```
TEMPO_MATRIX(i, 70) = TEMPO_MATRIX(i, 65)
```

```
End If
```

```
Else
```

```
TEMPO_MATRIX(i, 70) = TEMPO_MATRIX(i, 65)
```

```
End If
```

```
Else
```

```
'1982:
```

```
TEMPO_MATRIX(i, 70) = TEMPO_MATRIX(i, 65)
```

```
End If
```

End If

S_VAL = SETTLEMENT

M_VAL = TEMPO_MATRIX(i, 19)

C_VAL = TEMPO_MATRIX(i, 16) / MULT2_VAL

Y_VAL = TEMPO_MATRIX(i, 70)

F_VAL = TEMPO_MATRIX(i, 18)

R_VAL = 100

GoSub PORT_BOND_PRICE_LINE

TEMPO_MATRIX(i, 71) = P_VAL 'Based on the current Market yield data,

'this is the YTM that would be paid on an AAA bond with the same maturity

'and coupon as this bond

TEMPO_MATRIX(i, 72) = TEMPO_MATRIX(i, 76) - TEMPO_MATRIX(i, 70) 'Yield premium that this bond offers compared

'to similar maturity bond based on mkt yield curve

End If

'-----
'-----

'You can change the bond maturity time brackets.

'The first entry is entered in months and the rest are entered in years.

'You must enter values in ascending order with no overlap.

'For each entry, all bonds maturing between the time entered in the previous

'entry (or today for the first entry) and the current entry are included in

'calculations for that entry.

'-----

k = h(1)

For j = 1 To k

DATE1_VAL = PORT_BOND_MATURITIES_MATRIX(j, 1)

If j = 1 Then

If TEMPO_MATRIX(i, 19) <= DATE1_VAL Then

TEMPO_MATRIX(i, 76 + j) = TEMPO_MATRIX(i, 74)

TEMPO_MATRIX(NROWS + 1, 76 + j) = TEMPO_MATRIX(NROWS + 1, 76 + j) + TEMPO_MATRIX(i, 76 + j)

End If

Else

If (TEMPO_MATRIX(i, 19) <= DATE1_VAL And TEMPO_MATRIX(i, 19) > DATE2_VAL) Then

TEMPO_MATRIX(i, 76 + j) = TEMPO_MATRIX(i, 74)

TEMPO_MATRIX(NROWS + 1, 76 + j) = TEMPO_MATRIX(NROWS + 1, 76 + j) + TEMPO_MATRIX(i, 76 + j)

End If

End If

DATE2_VAL = DATE1_VAL

Next j

jj = hh + h(1)

k = h(2)

For j = 1 To k

If TEMPO_MATRIX(i, 15) = PORT_BOND_TYPES_MATRIX(j, 1) Then

TEMPO_MATRIX(i, jj + j) = TEMPO_MATRIX(i, 74)

TEMPO_MATRIX(NROWS + 1, jj + j) = TEMPO_MATRIX(NROWS + 1, jj + j) + TEMPO_MATRIX(i, jj + j)

End If

Next j

jj = jj + h(2)

k = h(3)

For j = 1 To k

If TEMPO_MATRIX(i, 11) = j Then

TEMPO_MATRIX(i, jj + j) = TEMPO_MATRIX(i, 74)

TEMPO_MATRIX(NROWS + 1, jj + j) = TEMPO_MATRIX(NROWS + 1, jj + j) + TEMPO_MATRIX(i, jj + j)

End If

Next j

TEMPO_MATRIX(i, nn) = (YEARFRAC_FUNC(TEMPO_MATRIX(i, 25), SETTLEMENT, 0) * (TEMPO_MATRIX(i, 32) * MULT3_VAL) * (TEMPO_MATRIX(i, 16) / MULT2_VAL))

TEMPO_MATRIX(NROWS + 1, nn) = TEMPO_MATRIX(NROWS + 1, nn) + TEMPO_MATRIX(i, nn)

TEMPO_MATRIX(i, nn + 1) = (TEMPO_MATRIX(i, 74) + TEMPO_MATRIX(i, nn) - TEMPO_MATRIX(i, 30)) / TEMPO_MATRIX(i, 30)

'-----

If TEMPO_MATRIX(i, 63) <> 0 Then 'Fix this if Statement - 63: YTM

'-----

'Bond Analysis

'This section contains a few analytics columns that show modified duration,

'bond risk, and bond sensitivity. Together, these metrics can be used to gauge

'the portfolio's sensitivity to changes in interest rates. In particular,

'the bond risk column attempts to estimate the change in market value in each

'bond and the portfolio overall that would likely result from a X basis

'point (Y%) change in interest rates.

'The Modified Duration and Bond Sensitivity columns are used to give an indication

'of what might happen to the value of each holding and the portfolio overall as

'interest rates change.

'Interest Rate Sensitivity (BondRisk) is determined by %dP =

'(Modified Duration)*(dy) - .5*convexity*(dy)^2

'This takes into account the overstatement of sensitivity in Modified Duration

'(straight line estimate of relationship)

'by removing the excess in Duration that is caused by the convexity of a best

'fit parabola fitted to the bond's yield curve. In english, this shows the

'estimated change in value from 100 bp (1%) change in interest rates

'LY Premium is calculated by comparing the yield on the bond with the yield

'returned by plugging the Bond 's maturity into the muni market yield curve

'entered in the yield curve matrix

'-----

If TEMPO_MATRIX(i, 63) > 0 Then

S_VAL = SETTLEMENT

M_VAL = TEMPO_MATRIX(i, 19)

C_VAL = TEMPO_MATRIX(i, 16) / MULT2_VAL

Y_VAL = TEMPO_MATRIX(i, 63)

F_VAL = TEMPO_MATRIX(i, 18)

R_VAL = 100

TEMPO_MATRIX(i, nn + 2) = BOND_CONVEXITY_DURATION_FUNC(S_VAL, M_VAL, C_VAL, Y_VAL, F_VAL, R_VAL, B_VAL, 0)(2) 'Modified
Duration:

'This measure gives an indication of the timing of the bonds cash flows. Duration is represented in years.

If TEMPO_MATRIX(i, 63) > DELTA_VAL Then Y_VAL = TEMPO_MATRIX(i, 63) - DELTA_VAL Else Y_VAL = epsilon

GoSub PORT_BOND_PRICE_LINE

TEMPO_MATRIX(i, nn + 3) = P_VAL 'This column computes the Price that would result from a 100 bp (1%) decrease

'in bond yield (interest rates)

Y_VAL = TEMPO_MATRIX(i, 63) + DELTA_VAL

GoSub PORT_BOND_PRICE_LINE

TEMPO_MATRIX(i, nn + 4) = P_VAL 'This column computes the Price that would result from a 100 bp (1%) decrease

'in bond yield (interest rates)

Else

TEMPO_MATRIX(i, nn + 2) = 0

TEMPO_MATRIX(i, nn + 3) = TEMPO_MATRIX(i, 61)

TEMPO_MATRIX(i, nn + 4) = TEMPO_MATRIX(i, 61)

End If

TEMPO_MATRIX(i, nn + 5) = (TEMPO_MATRIX(i, nn + 3) - TEMPO_MATRIX(i, nn + 4)) / (2 * TEMPO_MATRIX(i, 62) * DELTA_VAL) * (1 + TEMPO_MATRIX(i, 63))

If TEMPO_MATRIX(i, nn + 2) = 0 Then TEMPO_MATRIX(i, nn + 7) = 0 Else TEMPO_MATRIX(i, nn + 7) = (TEMPO_MATRIX(i, nn + 4) + TEMPO_MATRIX(i, nn + 3) - (2 * TEMPO_MATRIX(i, 62))) / ((TEMPO_MATRIX(i, 62) * (DELTA_VAL * DELTA_VAL)))

TEMPO_MATRIX(i, nn + 9) = TEMPO_MATRIX(i, nn + 2) * DELTA_VAL - ((0.5) * TEMPO_MATRIX(i, nn + 7) * DELTA_VAL * DELTA_VAL) 'This is a more

'accurate indicator of interest rate sensitivity that takes into account the effects of curvature in the relationship between price

'and yield for this bond

TEMPO_MATRIX(i, nn + 11) = TEMPO_MATRIX(i, 74) * TEMPO_MATRIX(i, nn + 9) 'Change in value of holding that will

'result from a 100 basis point (1%) change in bond yield

'-----

End If

'-----

'-----

1983:

Next i

'-----

mm = jj

'-----

TEMPO_MATRIX(NROWS + 1, 21) = REMOVE_DECIMALS_NUMBER_FUNC(TEMPO_MATRIX(NROWS + 1, 21)) + 1

TEMPO_MATRIX(NROWS + 1, nn + 1) = (TEMPO_MATRIX(NROWS + 1, 74) + TEMPO_MATRIX(NROWS + 1, nn) - TEMPO_MATRIX(NROWS + 1, 30)) / TEMPO_MATRIX(NROWS + 1, 30)

'-----

For j = 4 To 5: TEMPO_MATRIX(NROWS + 1, j) = 0: Next j

'-----

TEMPO_MATRIX(NROWS + 1, 22) = 0: TEMPO_MATRIX(NROWS + 1, 34) = 0

TEMPO_MATRIX(NROWS + 1, 66) = 0: TEMPO_MATRIX(NROWS + 1, 67) = 0

TEMPO_MATRIX(NROWS + 1, 73) = 0: TEMPO_MATRIX(NROWS + 1, 75) = 0

TEMPO_MATRIX(NROWS + 1, nn + 6) = 0: TEMPO_MATRIX(NROWS + 1, nn + 8) = 0

TEMPO_MATRIX(NROWS + 1, nn + 10) = 0

'-----

ii = h(0) + h(1) + h(2) + h(3) '95

jj = ii + h(2) + h(1) '106

kk = jj + h(2) + h(3) '119

ll = kk + h(2) '124

```
k = h(2) '5
```

```
For j = 1 To k
```

```
    TEMPO_MATRIX(NROWS + 1, ii + j) = 0
```

```
    TEMPO_MATRIX(NROWS + 1, jj + j) = 0
```

```
    TEMPO_MATRIX(NROWS + 1, kk + j) = 0
```

```
    TEMPO_MATRIX(NROWS + 1, ll + j) = 0
```

```
Next j
```

```
ii = ii + h(2) '100
```

```
jj = ll + h(2) '129
```

```
kk = jj + h(1) '135
```

k = h(1) '6

For j = 1 To k

TEMPO_MATRIX(NROWS + 1, ii + j) = 0

TEMPO_MATRIX(NROWS + 1, jj + j) = 0

TEMPO_MATRIX(NROWS + 1, kk + j) = 0

Next j

ii = ii + h(1) + h(2) '111

jj = kk + h(1) '141

kk = jj + h(3) '149

k = h(3) '8

For j = 1 To k


```
TEMPO_MATRIX(NROWS + 1, ii + j) = 0
```

```
TEMPO_MATRIX(NROWS + 1, jj + j) = 0
```

```
TEMPO_MATRIX(NROWS + 1, kk + j) = 0
```

```
Next j
```

```
jj = mm + h(3)
```

```
'-----
```

```
For i = 1 To NROWS
```

```
'-----
```

```
If TEMPO_MATRIX(i, 6) <> "" And TEMPO_MATRIX(i, 8) <> "" Then
```

```
    If TEMPO_MATRIX(NROWS + 1, 6) <> 0 Then
```

```
        TEMPO_MATRIX(i, 4) = TEMPO_MATRIX(i, 6) / TEMPO_MATRIX(NROWS + 1, 6) * TEMPO_MATRIX(i, 8)
```

```
TEMPO_MATRIX(NROWS + 1, 4) = TEMPO_MATRIX(NROWS + 1, 4) + TEMPO_MATRIX(i, 4)
```

```
End If
```

```
End If
```

```
If TEMPO_MATRIX(i, 7) <> "" And TEMPO_MATRIX(i, 9) <> "" Then
```

```
  If TEMPO_MATRIX(NROWS + 1, 7) <> 0 Then
```

```
    TEMPO_MATRIX(i, 5) = TEMPO_MATRIX(i, 7) / TEMPO_MATRIX(NROWS + 1, 7) * TEMPO_MATRIX(i, 9)
```

```
    TEMPO_MATRIX(NROWS + 1, 5) = TEMPO_MATRIX(NROWS + 1, 5) + TEMPO_MATRIX(i, 5)
```

```
  End If
```

```
End If
```

```
If TEMPO_MATRIX(i, 74) <> "" Then
```

If TEMPO_MATRIX(NROWS + 1, 74) <> 0 Then

TEMPO_MATRIX(i, 75) = TEMPO_MATRIX(i, 74) / TEMPO_MATRIX(NROWS + 1, 74)

TEMPO_MATRIX(NROWS + 1, 75) = TEMPO_MATRIX(NROWS + 1, 75) + TEMPO_MATRIX(i, 75)

End If

End If

If TEMPO_MATRIX(i, 21) <> "" And TEMPO_MATRIX(i, 75) <> "" Then

TEMPO_MATRIX(i, 22) = TEMPO_MATRIX(i, 21) * TEMPO_MATRIX(i, 75)

TEMPO_MATRIX(NROWS + 1, 22) = TEMPO_MATRIX(NROWS + 1, 22) + TEMPO_MATRIX(i, 22)

End If

If TEMPO_MATRIX(i, 30) <> "" And TEMPO_MATRIX(i, 60) <> "" And TEMPO_MATRIX(NROWS + 1, 30) <> 0 Then

TEMPO_MATRIX(i, 34) = TEMPO_MATRIX(i, 60) * (TEMPO_MATRIX(i, 30) / TEMPO_MATRIX(NROWS + 1, 30))

TEMPO_MATRIX(NROWS + 1, 34) = TEMPO_MATRIX(NROWS + 1, 34) + TEMPO_MATRIX(i, 34)

End If

If TEMPO_MATRIX(i, 75) <> "" And TEMPO_MATRIX(i, 72) <> "" Then

TEMPO_MATRIX(i, 73) = TEMPO_MATRIX(i, 75) * TEMPO_MATRIX(i, 72)

TEMPO_MATRIX(NROWS + 1, 73) = TEMPO_MATRIX(NROWS + 1, 73) + TEMPO_MATRIX(i, 73)

End If

If PORT_BOND_TYPES_FLAG = True Then LOOK_STR = TEMPO_MATRIX(i, 15): GoSub PORT_TAXES_LINE Else FIND_STR = "" 'Look for taxes

If TEMPO_MATRIX(i, 75) <> "" And TEMPO_MATRIX(i, 76) <> "" Then

TEMPO_MATRIX(i, 66) = TEMPO_MATRIX(i, 76) * TEMPO_MATRIX(i, 75)

TEMPO_MATRIX(NROWS + 1, 66) = TEMPO_MATRIX(NROWS + 1, 66) + TEMPO_MATRIX(i, 66)

If FIND_STR <> "" Then

```
TEMPO_MATRIX(i, 67) = TEMPO_MATRIX(i, 66) * (1 - CDbI(FIND_STR))
```

```
TEMPO_MATRIX(NROWS + 1, 67) = TEMPO_MATRIX(NROWS + 1, 67) + TEMPO_MATRIX(i, 67)
```

```
End If
```

```
End If
```

```
If TEMPO_MATRIX(i, 75) <> "" And TEMPO_MATRIX(i, nn + 2) <> "" Then
```

```
TEMPO_MATRIX(i, nn + 6) = TEMPO_MATRIX(i, 75) * TEMPO_MATRIX(i, nn + 2)
```

```
TEMPO_MATRIX(NROWS + 1, nn + 6) = TEMPO_MATRIX(NROWS + 1, nn + 6) + TEMPO_MATRIX(i, nn + 6)
```

```
End If
```

```
If TEMPO_MATRIX(i, 74) <> "" And TEMPO_MATRIX(i, nn + 7) <> "" Then
```

If TEMPO_MATRIX(NROWS + 1, 74) <> 0 Then

$$\text{TEMPO_MATRIX}(i, nn + 8) = (\text{TEMPO_MATRIX}(i, 74) / \text{TEMPO_MATRIX}(\text{NROWS} + 1, 74)) * \text{TEMPO_MATRIX}(i, nn + 7)$$
$$\text{TEMPO_MATRIX}(\text{NROWS} + 1, nn + 8) = \text{TEMPO_MATRIX}(\text{NROWS} + 1, nn + 8) + \text{TEMPO_MATRIX}(i, nn + 8)$$

End If

End If

If TEMPO_MATRIX(i, 75) <> "" And TEMPO_MATRIX(i, nn + 9) <> "" Then

$$\text{TEMPO_MATRIX}(i, nn + 10) = \text{TEMPO_MATRIX}(i, 75) * \text{TEMPO_MATRIX}(i, nn + 9)$$
$$\text{TEMPO_MATRIX}(\text{NROWS} + 1, nn + 10) = \text{TEMPO_MATRIX}(\text{NROWS} + 1, nn + 10) + \text{TEMPO_MATRIX}(i, nn + 10)$$

End If

'-----

ii = jj - h(2) - h(3)

kk = jj + h(1) + h(2)

ll = kk + h(2) + h(3)

mm = ll + h(2)

k = h(2)

For j = 1 To k

'-----

If TEMPO_MATRIX(i, 10) <> "" And TEMPO_MATRIX(i, ii + j) <> "" Then

If TEMPO_MATRIX(NROWS + 1, ii + j) <> 0 Then

TEMPO_MATRIX(i, jj + j) = TEMPO_MATRIX(i, 10) * (TEMPO_MATRIX(i, ii + j) / TEMPO_MATRIX(NROWS + 1, ii + j))

TEMPO_MATRIX(NROWS + 1, jj + j) = TEMPO_MATRIX(NROWS + 1, jj + j) + TEMPO_MATRIX(i, jj + j)

End If

End If

'-----

If TEMPO_MATRIX(i, nn + 2) <> "" And TEMPO_MATRIX(i, ii + j) <> "" Then

If TEMPO_MATRIX(NROWS + 1, ii + j) <> 0 Then

TEMPO_MATRIX(i, kk + j) = TEMPO_MATRIX(i, nn + 2) * (TEMPO_MATRIX(i, ii + j) / TEMPO_MATRIX(NROWS + 1, ii + j))

TEMPO_MATRIX(NROWS + 1, kk + j) = TEMPO_MATRIX(NROWS + 1, kk + j) + TEMPO_MATRIX(i, kk + j)

End If

End If

'-----

If TEMPO_MATRIX(i, 76) <> "" Then

 If TEMPO_MATRIX(i, ii + j) <> "" Then

 If TEMPO_MATRIX(NROWS + 1, ii + j) <> 0 Then

 TEMPO_MATRIX(i, ll + j) = TEMPO_MATRIX(i, 76) * (TEMPO_MATRIX(i, ii + j) / TEMPO_MATRIX(NROWS + 1, ii + j))

 TEMPO_MATRIX(NROWS + 1, ll + j) = TEMPO_MATRIX(NROWS + 1, ll + j) + TEMPO_MATRIX(i, ll + j)

 If FIND_STR <> "" Then

 TEMPO_MATRIX(i, mm + j) = TEMPO_MATRIX(i, ll + j) * (1 - CDbI(FIND_STR))

 TEMPO_MATRIX(NROWS + 1, mm + j) = TEMPO_MATRIX(NROWS + 1, mm + j) + TEMPO_MATRIX(i, mm + j)

 End If

 End If

End If

End If

'-----

Next j

'-----

'-----

kk = jj + h(2)

ll = kk + h(1) + h(2) * 3 + h(3)

mm = ll + h(1)

k = h(1)

For j = 1 To k

'-----

If TEMPO_MATRIX(i, 10) <> "" And TEMPO_MATRIX(i, 76 + j) <> "" Then

If TEMPO_MATRIX(NROWS + 1, 76 + j) <> 0 Then

TEMPO_MATRIX(i, kk + j) = TEMPO_MATRIX(i, 10) * (TEMPO_MATRIX(i, 76 + j) / TEMPO_MATRIX(NROWS + 1, 76 + j))

TEMPO_MATRIX(NROWS + 1, kk + j) = TEMPO_MATRIX(NROWS + 1, kk + j) + TEMPO_MATRIX(i, kk + j)

End If

End If

'-----

If TEMPO_MATRIX(i, 76) <> "" Then

If TEMPO_MATRIX(i, 76 + j) <> "" Then

If TEMPO_MATRIX(NROWS + 1, 76 + j) <> 0 Then

```
TEMPO_MATRIX(i, ll + j) = TEMPO_MATRIX(i, 76) * (TEMPO_MATRIX(i, 76 + j) / TEMPO_MATRIX(NROWS + 1, 76 + j))
```

```
TEMPO_MATRIX(NROWS + 1, ll + j) = TEMPO_MATRIX(NROWS + 1, ll + j) + TEMPO_MATRIX(i, ll + j)
```

```
If FIND_STR <> "" Then
```

```
    TEMPO_MATRIX(i, mm + j) = TEMPO_MATRIX(i, ll + j) * (1 - CDbI(FIND_STR))
```

```
    TEMPO_MATRIX(NROWS + 1, mm + j) = TEMPO_MATRIX(NROWS + 1, mm + j) + TEMPO_MATRIX(i, mm + j)
```

```
End If
```

```
End If
```

```
End If
```

```
End If
```

```
'-----
```

```
Next j
```

```
'-----
```

ii = ii + h(2)

kk = jj + h(1) + h(2) * 2

ll = kk + h(1) * 2 + h(2) * 2 + h(3)

mm = ll + h(3)

'-----

k = h(3)

For j = 1 To k

'-----

If TEMPO_MATRIX(i, nn + 2) <> "" And TEMPO_MATRIX(i, ii + j) <> "" Then

If TEMPO_MATRIX(NROWS + 1, ii + j) <> 0 Then

TEMPO_MATRIX(i, kk + j) = TEMPO_MATRIX(i, nn + 2) * (TEMPO_MATRIX(i, ii + j) / TEMPO_MATRIX(NROWS + 1, ii + j))

```
TEMPO_MATRIX(NROWS + 1, kk + j) = TEMPO_MATRIX(NROWS + 1, kk + j) + TEMPO_MATRIX(i, kk + j)
```

```
End If
```

```
End If
```

```
'-----
```

```
If TEMPO_MATRIX(i, 76) <> "" Then
```

```
  If TEMPO_MATRIX(i, ii + j) <> "" Then
```

```
    If TEMPO_MATRIX(NROWS + 1, ii + j) <> 0 Then
```

```
      TEMPO_MATRIX(i, ll + j) = TEMPO_MATRIX(i, 76) * (TEMPO_MATRIX(i, ii + j) / TEMPO_MATRIX(NROWS + 1, ii + j))
```

```
      TEMPO_MATRIX(NROWS + 1, ll + j) = TEMPO_MATRIX(NROWS + 1, ll + j) + TEMPO_MATRIX(i, ll + j)
```

```
    If FIND_STR <> "" Then
```

TEMPO_MATRIX(i, mm + j) = TEMPO_MATRIX(i, ll + j) * (1 - CDbI(FIND_STR))

TEMPO_MATRIX(NROWS + 1, mm + j) = TEMPO_MATRIX(NROWS + 1, mm + j) + TEMPO_MATRIX(i, mm + j)

End If

End If

End If

End If

'-----

Next j

'-----

Next i

'-----

'-----

TEMPO_MATRIX(NROWS + 1, 4) = Round(TEMPO_MATRIX(NROWS + 1, 4), 2)

TEMPO_MATRIX(NROWS + 1, 5) = Round(TEMPO_MATRIX(NROWS + 1, 5), 2)

'-----

TEMPO_MATRIX(NROWS + 1, 13) = (TEMPO_MATRIX(NROWS + 1, 4) + TEMPO_MATRIX(NROWS + 1, 5)) / 2

'This value is a numerical representation of the average credit rating of

'the portfolio.

'This "score" is created by translating the coded ratings (Aa1, etc) from

'S&P/Fitch and Moody's for each holding into a numerical score and averaging them

'based on portfolio weights of each holding.

'The lower the "score" the better the average credit quality of the portfolio.

'-----

TEMPO_MATRIX(NROWS + 1, 14) = "Avg Rating"

TEMPO_MATRIX(NROWS + 1, 16) = TEMPO_MATRIX(NROWS + 1, 22)

TEMPO_MATRIX(NROWS + 1, 17) = "Avg Yrs Maturity"

'-----

TEMPO_MATRIX(NROWS + 1, 60) = TEMPO_MATRIX(NROWS + 1, 34)

TEMPO_MATRIX(NROWS + 1, 63) = TEMPO_MATRIX(NROWS + 1, 66)

TEMPO_MATRIX(NROWS + 1, 65) = TEMPO_MATRIX(NROWS + 1, 66)

TEMPO_MATRIX(NROWS + 1, 68) = "Avg Yield"

'-----

TEMPO_MATRIX(NROWS + 1, 72) = TEMPO_MATRIX(NROWS + 1, 73)

TEMPO_MATRIX(NROWS + 1, nn + 2) = TEMPO_MATRIX(NROWS + 1, nn + 6)

TEMPO_MATRIX(NROWS + 1, nn + 7) = TEMPO_MATRIX(NROWS + 1, nn + 8)

TEMPO_MATRIX(NROWS + 1, nn + 9) = TEMPO_MATRIX(NROWS + 1, nn + 10)

TEMPO_MATRIX(NROWS + 1, nn + 11) = TEMPO_MATRIX(NROWS + 1, 74) * TEMPO_MATRIX(NROWS + 1, nn + 10)

'-----

If CREDIT_AGENCIES_FLAG = True Then

FIND_STR = ""

n = 2: TEMPO_VAL = TEMPO_MATRIX(NROWS + 1, 4): GoSub CREDIT_AGENCIES_LINE

TEMPO_MATRIX(NROWS + 1, 2) = FIND_STR

'This is a weighted average Moody's rating for the overall portfolio.

'This rating is created by translating the Moody's rating for each holding
'into a numerical score and averaging them based on portfolio weights of each
'holding. Finally, the average is converted to a text rating.

Else

TEMPO_MATRIX(NROWS + 1, 2) = ""

End If

'-----

If CREDIT_AGENCIES_FLAG = True Then

FIND_STR = ""

n = 3: TEMPO_VAL = TEMPO_MATRIX(NROWS + 1, 5): GoSub CREDIT_AGENCIES_LINE

TEMPO_MATRIX(NROWS + 1, 3) = FIND_STR

'This is a weighted average S&P/Fitch rating for the overall portfolio.

'This rating is created by translating the S&P rating for each holding

'into a numerical score and averaging them based on portfolio weights of

'each holding. Finally, the average score is converted back to a text rating.

Else

TEMPO_MATRIX(NROWS + 1, 3) = ""

End If

'-----

k = h(1) + h(2)

jj = hh + k + h(3)

If CREDIT_AGENCIES_FLAG = True Then

For j = 1 To k

FIND_STR = ""

n = 2: TEMPO_VAL = Round(TEMPO_MATRIX(NROWS + 1, jj + j), 2): GoSub CREDIT_AGENCIES_LINE

TEMPO_MATRIX(NROWS + 1, jj + j) = FIND_STR

'This is a weighted average S&P/Fitch rating for the overall portfolio.

'This rating is created by translating the S&P rating for each holding

'into a numerical score and averaging them based on portfolio weights of

'each holding. Finally, the average score is converted back to a text rating.

Next j

Else

For j = 1 To k: TEMPO_MATRIX(NROWS + 1, jj + j) = "": Next j

End If

'-----

Select Case OUTPUT

'-----

Case 0

'-----

BOND_PORT_ANALYSIS_FUNC = TEMPO_MATRIX

'-----

Case 1

'-----

GoSub CASH_FLOW_TABLE_LINE 'Portfolio Cash Flow Table

Erase TEMPO_MATRIX

BOND_PORT_ANALYSIS_FUNC = TEMP1_MATRIX

'-----

Case 2

'-----

GoSub MATURITY_TABLE_LINE 'Bond Portfolio Maturity Table

Erase TEMPO_MATRIX

BOND_PORT_ANALYSIS_FUNC = TEMP2_MATRIX

'-----

Case 3

'-----

GoSub BOND_TYPE_TABLE_LINE 'Portfolio Bond Type Table

Erase TEMPO_MATRIX

BOND_PORT_ANALYSIS_FUNC = TEMP3_MATRIX

'-----

Case 4

'-----

GoSub CREDIT_QUALITY_TABLE_LINE 'Portfolio Credit Quality Table

Erase TEMPO_MATRIX

BOND_PORT_ANALYSIS_FUNC = TEMP4_MATRIX

'-----

Case Else

'-----

GoSub CASH_FLOW_TABLE_LINE: GoSub MATURITY_TABLE_LINE: GoSub BOND_TYPE_TABLE_LINE: GoSub CREDIT_QUALITY_TABLE_LINE

BOND_PORT_ANALYSIS_FUNC = Array(TEMPO_MATRIX, TEMP1_MATRIX, TEMP2_MATRIX, TEMP3_MATRIX, TEMP4_MATRIX)

'-----

End Select

'-----

Exit Function

'-----

HEADINGS_LINE:

'-----

If HEADINGS0_STR <> "" Then: GoTo 1985

NCOLUMNS = 19

ReDim HEADINGS_ARR(1 To NCOLUMNS) '19 Sections

For j = 1 To NCOLUMNS: HEADINGS_ARR(j) = "": Next j

HEADINGS_ARR(1) = "I) VALOR,I) MOODY,I) S&P/FITCH,I) MOODY SCORE,I) S&P/FITCH SCORE,I) MOODY VALUE,I) S&P/FITCH VALUE,I) MOODY RANK,I) S&P/FITCH RANK,I) AVG RANK,I) AVG TIER,I) INSURANCE,I) CUSIP,I) ISSUE NAME,I) TYPE,I) COUPON,I) COUPON/YEAR,I) ADJUSTED COUPON/YEAR,I) MATURITY,I) 1ST COUPON MONTH,I) YEARS TO MATURITY,I) WEIGHTED YEAR TO MATURITY,I) CALL PRICE,I) CALL DATE,"

HEADINGS_ARR(2) = "II) PURCHASE DATE,II) PURCHASE PRICE,II) PURCHASE QUANTITY,II) PURCHASE FEES,II) ADJUSTED PRICE,II) TOTAL COST,II) ANNUAL COUPON,II) ADJUSTED QUANTITY,II) ADJUSTED FEES,II) WEIGHTED YTM,II) COUPON AMOUNT,"

HEADINGS_ARR(3) = "III) PRE-TAX PAYMENTS: JANUARY,III) PRE-TAX PAYMENTS: FEBRUARY,III) PRE-TAX PAYMENTS: MARCH,III) PRE-TAX PAYMENTS: APRIL,III) PRE-TAX PAYMENTS: MAY,III) PRE-TAX PAYMENTS: JUNE,III) PRE-TAX PAYMENTS: JULY,III) PRE-TAX PAYMENTS: AUGUST,III) PRE-TAX PAYMENTS: SEPTEMBER,III) PRE-TAX PAYMENTS: OCTOBER,III) PRE-TAX PAYMENTS: NOVEMBER,III) PRE-TAX PAYMENTS: DECEMBER,"

HEADINGS_ARR(4) = "IV) AFTER-TAX PAYMENTS: JANUARY,IV) AFTER-TAX PAYMENTS: FEBRUARY,IV) AFTER-TAX PAYMENTS: MARCH,IV) AFTER-TAX PAYMENTS: APRIL,IV) AFTER-TAX PAYMENTS: MAY,IV) AFTER-TAX PAYMENTS: JUNE,IV) AFTER-TAX PAYMENTS: JULY,IV) AFTER-TAX PAYMENTS: AUGUST,IV) AFTER-TAX PAYMENTS: SEPTEMBER,IV) AFTER-TAX PAYMENTS: OCTOBER,IV) AFTER-TAX PAYMENTS: NOVEMBER,IV) AFTER-TAX PAYMENTS: DECEMBER,"

```
HEADINGS_ARR(5) = "V) YTM AT BUY,V) CURRENT PRICE,V) ADJUSTED PRICE,V) YTM,V) YTC,V) LY,V) WEIGHTED YLD,V) WEIGHTED AT YLD,V)
ADJUSTED MATURITY,V) BOND TYPE INDEX,V) FAIR YTM,V) FAIR PRICE,V) LY PREM,V) PREMIUM WEIGHT,V) MARKET VALUE,V) PERCENT
PORTFOLIO,V) ADJUSTED LY,"
```

```
HEADINGS_ARR(19) = "XIX) INTEREST EARNED,XIX) TOTAL RETURN,XIX) MODIFIED DURATION," & "XIX) PRICE IF (-)" & Format(DELTA_VAL *
10000, 0#) & "BP,XIX) PRICE IF (+)" & Format(DELTA_VAL * 10000, 0#) & "BP,XIX) DURATION,XIX) DURATION WEIGHT,XIX) BOND CONVEXITY,XIX)
CONVEXITY WEIGHT,XIX) BOND RISK,XIX) RISK WEIGHT,XIX) BOND SENSITIVITY,"
```

```
k = h(1)
```

```
For j = 1 To k
```

```
LOOK_STR = Format(PORT_BOND_MATURITIES_MATRIX(j, 2), "0.0")
```

```
HEADINGS_ARR(6) = HEADINGS_ARR(6) & "VI) VALUE BY MATURITY BRACKET: " & LOOK_STR & " Years" & ","
```

```
HEADINGS_ARR(10) = HEADINGS_ARR(10) & "X) CREDIT QUALITY BY MATURITY BRACKET: " & LOOK_STR & " Years" & ","
```

```
HEADINGS_ARR(15) = HEADINGS_ARR(15) & "XV) PRE-TAX YIELD BY MATURITY BRACKET: " & LOOK_STR & " Years" & ","
```

```
HEADINGS_ARR(16) = HEADINGS_ARR(16) & "XVI) AFTER-TAX YIELD BY MATURITY BRACKET: " & LOOK_STR & " Years" & ","
```

```
Next j
```

k = h(2)

For j = 1 To k

LOOK_STR = PORT_BOND_TYPES_MATRIX(j, 1)

HEADINGS_ARR(7) = HEADINGS_ARR(7) & "VII) VALUE BY BOND TYPE: " & LOOK_STR & ","

HEADINGS_ARR(9) = HEADINGS_ARR(9) & "IX) CREDIT QUALITY BY BOND TYPE: " & LOOK_STR & ","

HEADINGS_ARR(11) = HEADINGS_ARR(11) & "XI) MODIFIED DURATION BY BOND TYPE: " & LOOK_STR & ","

HEADINGS_ARR(13) = HEADINGS_ARR(13) & "XIII) PRE-TAX YIELD BY BOND TYPE: " & LOOK_STR & ","

HEADINGS_ARR(14) = HEADINGS_ARR(14) & "XIV) AFTER-TAX YIELD BY BOND TYPE: " & LOOK_STR & ","

Next j

k = h(3)

For j = 1 To k

```
LOOK_STR = PORT_CREDIT_QUALITIES_MATRIX(j, 1)
```

```
HEADINGS_ARR(8) = HEADINGS_ARR(8) & "VIII) VALUE BY CREDIT QUALITY: " & LOOK_STR & ","
```

```
HEADINGS_ARR(12) = HEADINGS_ARR(12) & "XII) MODIFIED DURATION BY CREDIT QUALITY: " & LOOK_STR & ","
```

```
HEADINGS_ARR(17) = HEADINGS_ARR(17) & "XVII) PRE-TAX YIELD BY CREDIT QUALITY: " & LOOK_STR & ","
```

```
HEADINGS_ARR(18) = HEADINGS_ARR(18) & "XVIII) AFTER-TAX YIELD BY CREDIT QUALITY: " & LOOK_STR & ","
```

```
Next j
```

```
HEADINGS0_STR = ""
```

```
For j = 1 To NCOLUMNS
```

```
  If HEADINGS_ARR(j) <> "" Then: HEADINGS0_STR = HEADINGS0_STR & HEADINGS_ARR(j)
```

```
Next j
```

```
Erase HEADINGS_ARR
```

1985:

NCOLUMNS = 0: i = 1

Do

j = InStr(i, HEADINGS0_STR, ",")

NCOLUMNS = NCOLUMNS + 1

i = j + 1

Loop Until i = 1

NCOLUMNS = NCOLUMNS - 1

ReDim TEMPO_MATRIX(0 To NROWS + 1, 1 To NCOLUMNS)

i = 1

For k = 1 To NCOLUMNS

j = InStr(i, HEADINGS0_STR, ",")

```
TEMPO_MATRIX(0, k) = Mid(HEADINGS0_STR, i, j - i)
```

```
i = j + 1
```

```
Next k
```

```
For i = 1 To NROWS + 1: For j = 1 To NCOLUMNS: TEMPO_MATRIX(i, j) = "": Next j: Next i
```

```
'-----
```

```
Return
```

```
'-----
```

```
CASH_FLOW_TABLE_LINE: 'Portfolio Cash Flow Table
```

```
'This routine shows the monthly and quarterly cash flows that the portfolio
```

```
'will provide. After tax ash flows from each bond are reduced based on the
```

'tax rate that applies to the bond's type (ie. muni, tres, agency, corp).

'Tax rates are taken from the tax rate table.

'-----

k = 12

ReDim TEMP1_MATRIX(0 To k + 1, 1 To 3)

HEADINGS1_STR = "MONTH,PRE-TAX CASH FLOW,AFTER-TAX CASH FLOW,"

i = 1

For l = 1 To 3

 j = InStr(i, HEADINGS1_STR, ",")

 TEMP1_MATRIX(0, l) = Mid(HEADINGS1_STR, i, j - i)

 i = j + 1

Next l

HEADINGS1_STR = "JANUARY,FEBRUARY,MARCH,APRIL,MAY,JUNE,JULY,AUGUST,SEPTEMBER,OCTOBER,NOVEMBER,DECEMBER,TOTAL,"

i = 1

For l = 1 To 13

j = InStr(i, HEADINGS1_STR, ",")

TEMP1_MATRIX(l, 1) = Mid(HEADINGS1_STR, i, j - i)

i = j + 1

Next l

For j = 1 To k

TEMP1_MATRIX(j, 2) = TEMPO_MATRIX(NROWS + 1, 35 + j)

TEMP1_MATRIX(k + 1, 2) = TEMP1_MATRIX(k + 1, 2) + TEMP1_MATRIX(j, 2)

```
TEMP1_MATRIX(j, 3) = TEMPO_MATRIX(NROWS + 1, 47 + j)
```

```
TEMP1_MATRIX(k + 1, 3) = TEMP1_MATRIX(k + 1, 3) + TEMP1_MATRIX(j, 3)
```

```
Next j
```

```
'-----
```

```
Return
```

```
'-----
```

```
MATURITY_TABLE_LINE: 'Bond Portfolio Maturity Table
```

```
'This routine displays the amount of the portfolio that will be maturing in
```

```
'various timeframes. Also, for all the bonds maturing within a given time
```

```
'bracket, average yield and credit quality are computed. The time brackets
```

```
'are user customizable.
```

'-----

If PORT_MATURITIES_FLAG = False Then Return

k = h(1)

ReDim TEMP2_MATRIX(0 To k + 1, 1 To 13)

HEADINGS1_STR = "MATURITY,MATURITY IN DAYS,PRETAX YIELD,AFTER TAX YIELD,AVG RATING,AMOUNT,PERCENT,CUMULATIVE
PERCENT,DESIRED PERCENT,ACTION,ADJUSTMENT,NEW AMOUNT,WEIGHTED MATURITY,"

i = 1

For l = 1 To 13

j = InStr(i, HEADINGS1_STR, ",")

TEMP2_MATRIX(0, l) = Mid(HEADINGS1_STR, i, j - i)

i = j + 1

Next l

'-----

'This column shows the percent of the portfolio maturing between now and the

'Maturity for the given row. For example, for the row for maturity at 10 years,

'percent shows percent of maturity maturing between 5 and 10 years while cumulative

'percent shows the percent of the portfolio maturing between now and 10 years.

'-----

kk = hh + h(1) + h(2) * 2 + h(3) '100

ii = kk + h(1) + h(2) * 3 + h(3) '129

jj = ii + h(1) '135

TEMP2_MATRIX(k + 1, 9) = 0

For j = 1 To k

```
TEMP2_MATRIX(j, 1) = Format(PORT_BOND_MATURITIES_MATRIX(j, 2), "0.0") & " Years"
```

```
TEMP2_MATRIX(j, 2) = COUNT_DAYS_FUNC(SETTLEMENT, PORT_BOND_MATURITIES_MATRIX(j, 1), 0)
```

```
If TEMPO_MATRIX(NROWS + 1, ii + j) <> 0 Then
```

```
    TEMP2_MATRIX(j, 3) = TEMPO_MATRIX(NROWS + 1, ii + j)
```

```
Else
```

```
    TEMP2_MATRIX(j, 3) = NA_STR
```

```
End If
```

```
If TEMPO_MATRIX(NROWS + 1, jj + j) <> 0 Then
```

```
    TEMP2_MATRIX(j, 4) = TEMPO_MATRIX(NROWS + 1, jj + j)
```

```
Else
```

```
    TEMP2_MATRIX(j, 4) = NA_STR
```

```
End If
```

If TEMPO_MATRIX(NROWS + 1, kk + j) <> 0 Then

TEMP2_MATRIX(j, 5) = TEMPO_MATRIX(NROWS + 1, kk + j)

Else

TEMP2_MATRIX(j, 5) = NA_STR

End If

TEMP2_MATRIX(j, 6) = TEMPO_MATRIX(NROWS + 1, 76 + j)

TEMP2_MATRIX(j, 9) = PORT_BOND_MATURITIES_MATRIX(j, 3)

TEMP2_MATRIX(k + 1, 9) = TEMP2_MATRIX(k + 1, 9) + TEMP2_MATRIX(j, 9)

Next j

TEMP2_MATRIX(k + 1, 1) = "OVERALL"

```
TEMP2_MATRIX(k + 1, 2) = ""
```

```
If TEMPO_MATRIX(NROWS + 1, 66) <> 0 Then
```

```
    TEMP2_MATRIX(k + 1, 3) = TEMPO_MATRIX(NROWS + 1, 66)
```

```
Else
```

```
    TEMP2_MATRIX(k + 1, 3) = NA_STR
```

```
End If
```

```
If TEMPO_MATRIX(NROWS + 1, 67) <> 0 Then
```

```
    TEMP2_MATRIX(k + 1, 4) = TEMPO_MATRIX(NROWS + 1, 67)
```

```
Else
```

```
TEMP2_MATRIX(k + 1, 4) = NA_STR
```

```
End If
```

```
If TEMPO_MATRIX(NROWS + 1, 2) <> "" Then
```

```
TEMP2_MATRIX(k + 1, 5) = TEMPO_MATRIX(NROWS + 1, 2)
```

```
Else
```

```
TEMP2_MATRIX(k + 1, 5) = NA_STR
```

```
End If
```

```
TEMP2_MATRIX(1, 8) = 0: TEMP2_MATRIX(k + 1, 6) = TEMPO_MATRIX(NROWS + 1, 74)
```

```
TEMP2_MATRIX(k + 1, 7) = 0: TEMP2_MATRIX(k + 1, 8) = ""
```

```
TEMP2_MATRIX(k + 1, 10) = "": TEMP2_MATRIX(k + 1, 11) = ""
```


TEMP2_MATRIX(k + 1, 12) = 0: TEMP2_MATRIX(k + 1, 13) = 0

If TEMP2_MATRIX(k + 1, 6) = 0 Then: Return

For j = 1 To k

TEMP2_MATRIX(j, 7) = TEMP2_MATRIX(j, 6) / TEMP2_MATRIX(k + 1, 6)

TEMP2_MATRIX(k + 1, 7) = TEMP2_MATRIX(k + 1, 7) + TEMP2_MATRIX(j, 7)

TEMP2_MATRIX(j, 8) = TEMP2_MATRIX(j, 8) + TEMP2_MATRIX(k + 1, 7)

If Abs((TEMP2_MATRIX(j, 9) * TEMP2_MATRIX(k + 1, 6)) - TEMP2_MATRIX(j, 6)) > REBALANCING_SLACK Then

If (TEMP2_MATRIX(j, 9) * TEMP2_MATRIX(k + 1, 6)) - TEMP2_MATRIX(j, 6) > 0 Then

TEMP2_MATRIX(j, 10) = "Add"

Else

TEMP2_MATRIX(j, 10) = "Remove"

End If

TEMP2_MATRIX(j, 11) = (TEMP2_MATRIX(j, 9) * TEMP2_MATRIX(k + 1, 6)) - TEMP2_MATRIX(j, 6)

TEMP2_MATRIX(j, 12) = TEMP2_MATRIX(j, 6) + TEMP2_MATRIX(j, 11)

Else

TEMP2_MATRIX(j, 10) = ""

TEMP2_MATRIX(j, 11) = "None"

TEMP2_MATRIX(j, 12) = TEMP2_MATRIX(j, 6)

End If

TEMP2_MATRIX(k + 1, 12) = TEMP2_MATRIX(k + 1, 12) + TEMP2_MATRIX(j, 12)

'This total may not be exactly the same as the portfolio amount due

'to rounding errors. To eliminate these errors, adjust the Rebalancing

'Slack setting.

If IsNumeric(PORT_BOND_MATURITIES_MATRIX(j, 2)) Then

Select Case j

Case 1

' TEMP2_MATRIX(j, 13) = TEMP2_MATRIX(j, 9) * (PORT_BOND_MATURITIES_MATRIX(j, 2) / 2)

 TEMP2_MATRIX(j, 13) = TEMP2_MATRIX(j, 9) * ((PORT_BOND_MATURITIES_MATRIX(j, 2) / 2) / 12)

Case 2

' TEMP2_MATRIX(j, 13) = TEMP2_MATRIX(j, 9) * (PORT_BOND_MATURITIES_MATRIX(j, 2) - PORT_BOND_MATURITIES_MATRIX(j - 1, 2))

```
TEMP2_MATRIX(j, 13) = TEMP2_MATRIX(j, 9) * (PORT_BOND_MATURITIES_MATRIX(j, 2) - (PORT_BOND_MATURITIES_MATRIX(j - 1, 2) / 12))
```

```
Case Else
```

```
TEMP2_MATRIX(j, 13) = TEMP2_MATRIX(j, 9) * (PORT_BOND_MATURITIES_MATRIX(j - 1, 2) + ((PORT_BOND_MATURITIES_MATRIX(j, 2) - PORT_BOND_MATURITIES_MATRIX(j - 1, 2)) / 2))
```

```
End Select
```

```
'TEMP2_MATRIX(j, 13) = PORT_BOND_MATURITIES_MATRIX(j, 2) * TEMP2_MATRIX(j, 9)
```

```
TEMP2_MATRIX(k + 1, 13) = TEMP2_MATRIX(k + 1, 13) + TEMP2_MATRIX(j, 13)
```

```
'Target average maturity in years
```

```
End If
```

```
Next j
```

```
'-----
```

```
Return
```

'-----

BOND_TYPE_TABLE_LINE: 'Portfolio Bond Type Table

'This routine displays the amount of the portfolio that's in each type of

'Bond (muni, corp, tres, agency) and also shows the current portfolio yield

'by bond type. Average Yield, duration, and credit quality per bond type

'is also displayed.

'-----

If PORT_BOND_TYPES_FLAG = False Then Return

k = h(2)

ReDim TEMP3_MATRIX(0 To k + 1, 1 To 11)

HEADINGS1_STR = "BOND TYPE,PRE-TAX YIELD,AFTER-TAX YIELD,AVG RATING,MODIFIED DURATION,AMOUNT,PERCENT,DESIRED
PERCENT,ACTION,ADJUSTMENT,NEW AMOUNT,"

```
i = 1
```

```
For l = 1 To 11
```

```
    j = InStr(i, HEADINGS1_STR, ",")
```

```
    TEMP3_MATRIX(0, l) = Mid(HEADINGS1_STR, i, j - i)
```

```
    i = j + 1
```

```
Next l
```

```
'-----
```

```
TEMP3_MATRIX(k + 1, 1) = "OVERALL"
```

```
If TEMPO_MATRIX(NROWS + 1, 66) <> 0 Then
```

```
TEMP3_MATRIX(k + 1, 2) = TEMPO_MATRIX(NROWS + 1, 66)
```

```
Else
```

```
TEMP3_MATRIX(k + 1, 2) = NA_STR
```

```
End If
```

```
If TEMPO_MATRIX(NROWS + 1, 67) <> 0 Then
```

```
TEMP3_MATRIX(k + 1, 3) = TEMPO_MATRIX(NROWS + 1, 67)
```

```
Else
```

```
TEMP3_MATRIX(k + 1, 3) = NA_STR
```

```
End If
```

```
If TEMPO_MATRIX(NROWS + 1, 2) <> "" Then
```

```
TEMP3_MATRIX(k + 1, 4) = TEMPO_MATRIX(NROWS + 1, 2)
```

```
Else
```

```
TEMP3_MATRIX(k + 1, 4) = NA_STR
```

```
End If
```

```
If TEMPO_MATRIX(NROWS + 1, nn + 2) <> 0 Then
```

```
TEMP3_MATRIX(k + 1, 5) = TEMPO_MATRIX(NROWS + 1, nn + 2)
```

```
Else
```

```
TEMP3_MATRIX(k + 1, 5) = NA_STR
```

```
End If
```


TEMP3_MATRIX(k + 1, 6) = 0: TEMP3_MATRIX(k + 1, 7) = 0

TEMP3_MATRIX(k + 1, 8) = 0: TEMP3_MATRIX(k + 1, 9) = ""

TEMP3_MATRIX(k + 1, 10) = "": TEMP3_MATRIX(k + 1, 11) = 0

mm = hh + h(1) '82

kk = mm + h(2) + h(3) '95

ll = kk + h(1) + h(2) '106

ii = ll + h(2) + h(3) '119

jj = ii + h(2)

For j = 1 To k

TEMP3_MATRIX(j, 1) = PORT_BOND_TYPES_MATRIX(j, 1)

```
TEMP3_MATRIX(j, 8) = PORT_BOND_TYPES_MATRIX(j, 3)
```

```
TEMP3_MATRIX(k + 1, 8) = TEMP3_MATRIX(k + 1, 8) + TEMP3_MATRIX(j, 8)
```

```
If TEMPO_MATRIX(NROWS + 1, ii + j) <> 0 Then
```

```
    TEMP3_MATRIX(j, 2) = TEMPO_MATRIX(NROWS + 1, ii + j)
```

```
Else
```

```
    TEMP3_MATRIX(j, 2) = NA_STR
```

```
End If
```

```
If TEMPO_MATRIX(NROWS + 1, jj + j) <> 0 Then
```

```
    TEMP3_MATRIX(j, 3) = TEMPO_MATRIX(NROWS + 1, jj + j)
```

```
Else
```

```
    TEMP3_MATRIX(j, 3) = NA_STR
```

End If

If TEMPO_MATRIX(NROWS + 1, kk + j) <> 0 Then

TEMP3_MATRIX(j, 4) = TEMPO_MATRIX(NROWS + 1, kk + j)

Else

TEMP3_MATRIX(j, 4) = NA_STR

End If

If TEMPO_MATRIX(NROWS + 1, ll + j) <> 0 Then

TEMP3_MATRIX(j, 5) = TEMPO_MATRIX(NROWS + 1, ll + j)

Else

TEMP3_MATRIX(j, 5) = NA_STR

End If

TEMP3_MATRIX(j, 6) = TEMPO_MATRIX(NROWS + 1, mm + j)

TEMP3_MATRIX(k + 1, 6) = TEMP3_MATRIX(k + 1, 6) + TEMP3_MATRIX(j, 6)

Next j

For j = 1 To k

TEMP3_MATRIX(j, 7) = TEMP3_MATRIX(j, 6) / TEMP3_MATRIX(k + 1, 6)

TEMP3_MATRIX(k + 1, 7) = TEMP3_MATRIX(k + 1, 7) + TEMP3_MATRIX(j, 7)

If Abs((TEMP3_MATRIX(j, 8) * TEMP3_MATRIX(k + 1, 6)) - TEMP3_MATRIX(j, 6)) > REBALANCING_SLACK Then

If (TEMP3_MATRIX(j, 8) * TEMP3_MATRIX(k + 1, 6)) - TEMP3_MATRIX(j, 6) > 0 Then

TEMP3_MATRIX(j, 9) = "Add"

Else

TEMP3_MATRIX(j, 9) = "Remove"

End If

TEMP3_MATRIX(j, 10) = (TEMP3_MATRIX(j, 8) * TEMP3_MATRIX(k + 1, 6)) - TEMP3_MATRIX(j, 6)

TEMP3_MATRIX(j, 11) = TEMP3_MATRIX(j, 6) + TEMP3_MATRIX(j, 10)

Else

TEMP3_MATRIX(j, 9) = ""

TEMP3_MATRIX(j, 10) = "None"

TEMP3_MATRIX(j, 11) = TEMP3_MATRIX(j, 6)

End If

TEMP3_MATRIX(k + 1, 11) = TEMP3_MATRIX(k + 1, 11) + TEMP3_MATRIX(j, 11)

'This total may not be exactly the same as the portfolio amount due

'to rounding errors. To eliminate these errors, adjust the Rebalancing

'Slack setting.

Next j

'-----

Return

'-----

CREDIT_QUALITY_TABLE_LINE: 'Portfolio Credit Quality Table

'Breaks down portfolio value by credit quality and shows yields

'for each credit tier.

'-----

If PORT_CREDIT_QUALITIES_FLAG = False Then Return

k = h(3)

ReDim TEMP4_MATRIX(0 To k + 1, 1 To 11)

HEADINGS1_STR = "CREDIT QUALITY,PRE-TAX YIELD,AFTER-TAX YIELD,MODIFIED DURATION,AMOUNT,PERCENT,CUMULATIVE
PERCENT,DESIRED PERCENT,ACTION,ADJUSTMENT,NEW AMOUNT,"

i = 1

For l = 1 To 11

j = InStr(i, HEADINGS1_STR, ",")

TEMP4_MATRIX(0, l) = Mid(HEADINGS1_STR, i, j - i)

i = j + 1

Next l

'-----

'Cumulative percent in the percent of the portfolio that has a credit rating as

'good or better than the rating for the given row. For example, for the row that

'lists credit quality as Upper Med, the cumulative percent shows the percent of

'the portfolio with a credit rating at least as good as Upper Med.

'-----

TEMP4_MATRIX(k + 1, 1) = "OVERALL"

If TEMPO_MATRIX(NROWS + 1, 66) <> 0 Then

TEMP4_MATRIX(k + 1, 2) = TEMPO_MATRIX(NROWS + 1, 66)

Else

TEMP4_MATRIX(k + 1, 2) = NA_STR

End If

If TEMPO_MATRIX(NROWS + 1, 67) <> 0 Then

TEMP4_MATRIX(k + 1, 3) = TEMPO_MATRIX(NROWS + 1, 67)

Else

TEMP4_MATRIX(k + 1, 3) = NA_STR

End If

If TEMPO_MATRIX(NROWS + 1, nn + 2) <> 0 Then

TEMP4_MATRIX(k + 1, 4) = TEMPO_MATRIX(NROWS + 1, nn + 2)

Else

TEMP4_MATRIX(k + 1, 4) = NA_STR

End If

TEMP4_MATRIX(1, 7) = 0: TEMP4_MATRIX(k + 1, 5) = 0

TEMP4_MATRIX(k + 1, 6) = 0: TEMP4_MATRIX(k + 1, 7) = ""

TEMP4_MATRIX(k + 1, 8) = 0: TEMP4_MATRIX(k + 1, 9) = ""

TEMP4_MATRIX(k + 1, 10) = "": TEMP4_MATRIX(k + 1, 11) = 0

ll = hh + h(1) + h(2) '87

kk = ll + h(1) + h(2) * 2 + h(3) '111

ii = kk + h(1) * 2 + h(2) * 2 + h(3) '141

jj = ii + h(3) '149

For j = 1 To k

TEMP4_MATRIX(j, 1) = PORT_CREDIT_QUALITIES_MATRIX(j, 1)

TEMP4_MATRIX(j, 8) = PORT_CREDIT_QUALITIES_MATRIX(j, 2)

TEMP4_MATRIX(k + 1, 8) = TEMP4_MATRIX(k + 1, 8) + TEMP4_MATRIX(j, 8)

If TEMPO_MATRIX(NROWS + 1, ii + j) <> 0 Then

TEMP4_MATRIX(j, 2) = TEMPO_MATRIX(NROWS + 1, ii + j)

Else

TEMP4_MATRIX(j, 2) = NA_STR

End If

If TEMPO_MATRIX(NROWS + 1, jj + j) <> 0 Then

```
TEMP4_MATRIX(j, 3) = TEMPO_MATRIX(NROWS + 1, jj + j)
```

```
Else
```

```
TEMP4_MATRIX(j, 3) = NA_STR
```

```
End If
```

```
If TEMPO_MATRIX(NROWS + 1, kk + j) <> 0 Then
```

```
TEMP4_MATRIX(j, 4) = TEMPO_MATRIX(NROWS + 1, kk + j)
```

```
Else
```

```
TEMP4_MATRIX(j, 4) = NA_STR
```

```
End If
```

```
TEMP4_MATRIX(j, 5) = TEMPO_MATRIX(NROWS + 1, ll + j)
```

```
TEMP4_MATRIX(k + 1, 5) = TEMP4_MATRIX(k + 1, 5) + TEMP4_MATRIX(j, 5)
```

```
Next j
```

For j = 1 To k

TEMP4_MATRIX(j, 6) = TEMP4_MATRIX(j, 5) / TEMP4_MATRIX(k + 1, 5)

TEMP4_MATRIX(k + 1, 6) = TEMP4_MATRIX(k + 1, 6) + TEMP4_MATRIX(j, 6)

TEMP4_MATRIX(j, 7) = TEMP4_MATRIX(j, 7) + TEMP4_MATRIX(k + 1, 6)

If Abs((TEMP4_MATRIX(j, 8) * TEMP4_MATRIX(k + 1, 5)) - TEMP4_MATRIX(j, 5)) > REBALANCING_SLACK Then

If (TEMP4_MATRIX(j, 8) * TEMP4_MATRIX(k + 1, 5)) - TEMP4_MATRIX(j, 5) > 0 Then

TEMP4_MATRIX(j, 9) = "Add"

Else

TEMP4_MATRIX(j, 9) = "Remove"

End If

TEMP4_MATRIX(j, 10) = (TEMP4_MATRIX(j, 8) * TEMP4_MATRIX(k + 1, 5)) - TEMP4_MATRIX(j, 5)

TEMP4_MATRIX(j, 11) = TEMP4_MATRIX(j, 5) + TEMP4_MATRIX(j, 10)

Else

TEMP4_MATRIX(j, 9) = ""

TEMP4_MATRIX(j, 10) = "None"

TEMP4_MATRIX(j, 11) = TEMP4_MATRIX(j, 5)

End If

TEMP4_MATRIX(k + 1, 11) = TEMP4_MATRIX(k + 1, 11) + TEMP4_MATRIX(j, 11)

'This total may not be exactly the same as the portfolio amount due

'to rounding errors. To eliminate these errors, adjust the Rebalancing

'Slack setting.

Next j

'-----

Return

'-----

PORT_BOND_YIELD_LINE:

'-----

Y_VAL = BOND_YIELD_FUNC(P_VAL, S_VAL, M_VAL, C_VAL, F_VAL, R_VAL, B_VAL, G_VAL)

'-----

Return

'-----

PORT_BOND_PRICE_LINE:

'-----

P_VAL = BOND_CASH_PRICE_FUNC(S_VAL, M_VAL, C_VAL, Y_VAL, F_VAL, R_VAL, B_VAL, 1)

'-----

Return

'-----

BOND_PRICE_PARSE_LINE:

'-----


```
I = InStr(1, TEMP1_VAL, "-")
```

```
If I = 0 Then
```

```
    If Val(TEMP1_VAL) > 0 Then TEMP2_VAL = CDbI(TEMP1_VAL) Else GoTo 1983
```

```
Else
```

```
    TEMP2_VAL = CDbI(Left(TEMP1_VAL, I - 1)) + (1 / 32) * CDbI(Mid(TEMP1_VAL, I + 1, 2))
```

```
    If Len(Right(TEMP1_VAL, Len(TEMP1_VAL) - I - 2)) = 1 Then
```

```
        If Mid(TEMP1_VAL, I + 3, 1) = "+" Then
```

```
            TEMP2_VAL = TEMP2_VAL + 1 / 64
```

```
        Else
```

```
            TEMP2_VAL = TEMP2_VAL + CDbI(Mid(TEMP1_VAL, I + 3, 1)) * (1 / 256)
```

```
    End If
```

End If

End If

If TEMP2_VAL = 0 Then: GoTo 1983

'-----

Return

'-----

PORT_TAXES_LINE:

'-----

FIND_STR = "": m = h(2): n = 0

For l = 1 To m

If PORT_BOND_TYPES_MATRIX(l, 1) = LOOK_STR Then

n = I

FIND_STR = PORT_BOND_TYPES_MATRIX(I, 2)

If IsNumeric(FIND_STR) = False Then: FIND_STR = 0

Exit For

End If

Next I

'-----

Return

'-----

CREDIT_RATINGS_TIER_LINE:

'-----

m = UBound(CREDIT_AGENCIES_MATRIX, 1)

n = 0

For l = 1 To m

 If CREDIT_AGENCIES_MATRIX(l, 1) = LOOK_STR Then

 If IsNumeric(CREDIT_AGENCIES_MATRIX(l, 4)) Then: n = CREDIT_AGENCIES_MATRIX(l, 4)

 Exit For

End If

Next l

'-----

Return

'-----

CREDIT_RATINGS_SP_LINE:

'-----

m = UBound(CREDIT_AGENCIES_MATRIX, 1)

n = 0

For l = 1 To m

 If CREDIT_AGENCIES_MATRIX(l, 3) = LOOK_STR Then

 n = l

 Exit For

End If

Next l

'-----

Return

'-----

CREDIT_RATINGS_MOODY_LINE:

'-----

m = UBound(CREDIT_AGENCIES_MATRIX, 1)

n = 0

For l = 1 To m

 If CREDIT_AGENCIES_MATRIX(l, 2) = LOOK_STR Then

 n = l

 Exit For

End If

Next l

'-----

Return

'-----

CREDIT_AGENCIES_LINE:

'-----

m = UBound(CREDIT_AGENCIES_MATRIX, 1) - 1

For I = 1 To m

If Val(CREDIT_AGENCIES_MATRIX(I, 1)) <> 0 And Val(CREDIT_AGENCIES_MATRIX(I + 1, 1)) <> 0 Then

If CDbI(CREDIT_AGENCIES_MATRIX(I, 1)) <= TEMPO_VAL And CDbI(CREDIT_AGENCIES_MATRIX(I + 1, 1)) > TEMPO_VAL Then

FIND_STR = CREDIT_AGENCIES_MATRIX(I, n)

Exit For

End If

End If

Next I

'-----

Return

'-----

MARKET_YIELDS1_LINE:

'-----

m = UBound(MARKET_YIELDS_MATRIX, 2)

n = 0

For I = 1 To m

If MARKET_YIELDS_MATRIX(1, I) = LOOK_STR Then

n = l

Exit For

End If

Next l

'-----

Return

'-----

MARKET_YIELDS2_LINE:

'-----

m = UBound(MARKET_YIELDS_MATRIX, 1) - 1

TEMP1_VAL = "": TEMP2_VAL = ""

For l = 1 To m

If IsNumeric(MARKET_YIELDS_MATRIX(l, 1)) Then 'Exclude Headings

If (MARKET_YIELDS_MATRIX(l, 1) <= TEMPO_VAL) And (MARKET_YIELDS_MATRIX(l + 1, 1) > TEMPO_VAL) Then

If l + 2 < UBound(MARKET_YIELDS_MATRIX, 1) Then

TEMP1_VAL = MARKET_YIELDS_MATRIX(l + 1, n)

TEMP2_VAL = MARKET_YIELDS_MATRIX(l + 2, n)

Else

TEMP1_VAL = MARKET_YIELDS_MATRIX(l + 0, n)

TEMP2_VAL = MARKET_YIELDS_MATRIX(l + 1, n)

End If

Exit For

End If

End If

Next I

'-----

Return

'-----

ERROR_LABEL:

BOND_PORT_ANALYSIS_FUNC = Err.number

End Function