INVESTMENTS ANALYSIS SOFTWARE

INCLUDES

- Business Week Mutual Fund Scoreboard
- Bond and stock analysis programs
- Lotus 1-2-3 templates

5 1/4" IBM PC format disks enclosed

Jack Clark Francis

INVESTMENTS ANALYSIS SOFTWARE

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Preface

During the years I taught investments both the quantity and the complexity of the mathematics has increased. At the same time, I noticed that students can increase their understanding of investments theory by taking real numbers and actually computing the average returns, variances, standard deviations, correlations, betas, and other financial quantities. While doing these computations has instructional value, there is no denying that doing them by hand is tedious and error prone. Creating a package of investments analysis software seemed like the natural way to deal with this situation.

As soon as I started out to create a package of investments software, I had to come to grips with some additional problems and concerns. First of all, I worried about what it would cost the student. Since textbooks are not cheap, and since I think that a package of investments analysis software should supplement instead of supplant the textbook, I wanted to keep the cost of the software package down. Second, I had difficulty deciding what computer language to use. I observed that some investments analysts liked to use a spreadsheet (like Lotus 1-2-3, Quattro, Excel, etc.) while others eschewed spreadsheets and preferred to use computer programs written to do investments analysis. Furthermore, I had learned that everyone enjoys analyzing interesting data rather than hypothetical values they had to create for themselves. The way I dealt with these (sometimes conflicting) considerations was to assemble a comprehensive package of computer programs, spreadsheet templates, and empirical data at the minimum possible cost.

I enjoyed some good luck in putting together this comprehensive package of computer software at a minimum cost. My publisher, McGraw-Hill, happens to own *Business Week* (BW) magazine. As luck would have it, BW has created a mutual fund software product named the Mutual Fund Scoreboard that BW sells for $199 per subscription. The Mutual Fund Scoreboard contains many salient facts and statistics on over a thousand mutual funds and sophisticated software to process this massive data bank. BW graciously allowed me to use their Mutual Fund Scoreboard free of charge. All I can say is: God and "Mother McGraw" smiled on us.

Although *Investments Analysis Software* (IAS) is comprehensive in scope,

it will not do everything. Let me tell you some things you should not expect. IAS is not a case book. It is primarily a package of different kinds of software to do investments analysis. There are only a limited number of cases in this book, and those cases are small. If you want numerous investments problems you can find those at the ends of the chapters in several of the better investments textbooks. You probably will not be surprised if I suggest the following three investments books of mine.

1. *Investments: Analysis and Management,* fifth edition, McGraw-Hill Book Company, 1991.
2. *Management of Investments,* third edition, McGraw-Hill, 1993.
3. *Schaum's Investments Outline,* co-authored with Richard W. Taylor, published by the Schaum's Division of McGraw-Hill, 1992.

This book is not tied in any way to the three books listed above. You can use this software package with any other investments textbook just as well. Or, if you want a nice collection of investments cases you could also consider either one of the following paperback case books.

1. Keith V. Smith, *Case Problems and Readings: A Supplement for Investments and Portfolio Management,* McGraw-Hill Book Co., New York, 1990, 351 pages.
2. Michael A. Berry and S. David Young, *Managing Investments: A Case Approach,* Dryden Press, 1990, 545 pages.

Either of these casebooks would make a good supplement for this book by providing input data and concepts for the software to analyze.

What I have put together here is the most comprehensive package of different kinds of computer programs, spreadsheet templates, and empirical data that can be purchased at a modest price. This package was designed to provide something for everyone. The software will run on a small personal computer that has an old version of DOS and a monochrome monitor. We sacrificed some state-of-the-art sophistication to make the software usable on a wide range of machines. However, this software will also run on the newest PCs that have Windows and color screens.

This software package requires no previous computer experience. Stated differently, no programming or spreadsheet knowledge is needed. The software is all menu driven, so that all the user needs to do is make simple menu selections that instruct the computer what to do next. This book explains how to insert the diskette into the computer and what keys to strike, and shows illustrations of what will appear on your computer's screen and presents step-by-step examples of how you can use this software to solve the cases in this book.

Users who want to solve larger problems or analyze massive data will be able to use some of the software in this package without altering it. However, for scientific research or business calculations involving substantial amounts of money, the Basic language programs should have their dimensions increased, be converted to double

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precision, be reprogrammed to allow for the precise number of days each investment lasted, be linked to their data source (if that is appropriate), and be recompiled in QuickBasic.

Many people have assisted me in preparing this book. Dr. McCann, Ph.D., a financial software consultant who lives in Philadelphia; Professor Richard Taylor, Ph.D., C.F.A., Arkansas State University; Professor Susan Mangiero, (her Ph.D. is forthcoming), C.F.A., Sacred Heart University in Fairfield, Connecticut; Professor George Mangiero, Ph.D., Iona College, New Rochelle, NY; Dr. Richard Bookstaber, Ph.D., Vice-President at Morgan-Stanley in NY City; Russell Cornelius, Programmer and Systems Analyst, Morgan-Stanley NY City: David R. Smith, Vice-President at AMBAC in Greenwich, Connecticut; Marilyn Zavidow of Digital Equipment Corporation in Westport, Connecticut; my son, Steven D. Francis, a student at the University of Washington in Seattle; Ed Fuhr of IBM in Stamford, Connecticut; and, other helpful friends whose names have temporarily slipped my mind were contributors. In addition, certain members of the huge McGraw-Hill family graciously provided aid. It was a pleasure to work with Barbara Munder, Vice President at *Business Week* and creator of the Mutual Fund Scoreboard; Al Garfin, Marketing Director for *Business Week* Planners; Bruce Marcus, Software Editor at McGraw-Hill; Peitr Bohen, Assistant Editor at McGraw-Hill; and, Ken MacLeod, my Sponsoring Editor. All of these folks made significant contributions to this book. However, I take full credit for whatever errors we may find.

Jack Clark Francis
Stamford, Connecticut

Contents

Chapter 1

Introduction

The Securities Act of 1933 initiated the "full disclosure of relevant financial facts" concept that still dominates securities law in the United States today. Apparently, those 1933 legislators were trying to protect naive investors by providing avenues for investments analysis that were more productive than simply chasing "hot tips." By requiring financial disclosure the legislators presumably hoped to direct investors' activities toward analyzing audited financial statement data and away from pursuing rumors. In any event, there is no doubt that mandating the disclosure of financial statements did much to advance scientific investment analysis. Other developments also contributed to the advancement of investments analysis.

The profitability of companies like Dow-Jones, Standard & Poors, Moodys, and other investment information services documents that reporting the financial facts has been a growth business for decades. In addition, telecommunications has made up-to-the-second security market data available around the world and around the clock. Any investor with a telephone, a computer at home, and a modem can buy large amounts of investments data about thousands of different companies from any of the following financial service companies: Dow Jones News Retrieval, Compuserve, Prodigy, and others.

Computers have continued to drop in cost each year and, at the same time, become easier to use. Furthermore, investments analysis has become so scientific that three finance professors won Nobel prizes in 1992. The widespread use of quantitative investment analysis that has resulted from the disclosure laws, news services, telecommunications, computers, and Nobel prize-winning models would bring smiles to the faces of the legislators who mandated full financial disclosure in 1933. However, the computational demands on the investment researchers who analyze these numbers has *not* brought smiles to their faces.

Doing calculations by hand is tedious and error-prone. To alleviate these problems, this booklet and the accompanying software have been provided to expedite the "dirty work" of security analysis. This booklet describes several floppy diskettes for an IBM-PC or compatible computer. The software is designed to do different kinds of investments analysis. The separate diskettes contain:

1. Basic language programs
2. Lotus 1-2-3 templates (that also work with other spreadsheet packages)
3. *Business Week* magazine's mutual fund data and programs
4. McCann's quadratic programming (QP) algorithm

The first three disks will produce color displays if the user's computer has color capabilities. None of the software is copy protected, so users can make copies.

Users of 3.5" disks will find the Basic programs, Lotus templates, and Quadratic Program on a single diskette, organized into separate subdirectories. To run the software, first change the prompt to correspond to the drive where you placed the diskette. Then, to access the subdirectory containing the Basic programs, type **cd\basic** and press [ENTER]. Finally, type **invest** and press [ENTER] to start the Basic program. Instructions later in this text explain how to start each specific program module. To access the subdirectory containing the Quadratic Program, type **cd\quad** and press [ENTER]. To access the Lotus templates from inside Lotus 1-2-3, use Lotus's **/FD** command to change to the subdirectory named "Lotus."

Diskette of Basic Language Programs

The diskette Basic language programs do the following kinds of financial computations:

PROGRAM A. Generate a page out of a bond table (or bond price book) for any combination of coupon rate and years to maturity that the user requests. Different tables for annual and semiannual compounding can be created.

PROGRAM B. Compute a bond's present value.

PROGRAM C. Compute a bond's yield-to-maturity.

PROGRAM D. Compute various duration and convexity measures for a bond.

PROGRAM E. Analyze a bond's realized compound yield under different assumptions.

PROGRAM F. Analyze a bond's price volatility.

PROGRAM G. Analyze the durations of different potential bond investments and determine exactly which bonds and in what proportions should be included in a portfolio to immunize it against interest rate risk.

PROGRAM H. Compute the present value of a share of stock's expected future cash dividends.

PROGRAM I. A program to read in the market prices of one or more securities and the simultaneous observations on some market index and calculate statistics such as the period-by-period rates of return, beta coefficients, average rates of return, standard deviations, correlations, and other statistics for each security.

PROGRAM J. Compute the price-earnings ratio that is appropriate for a share of common stock under different assumptions about earnings growth and riskiness.

PROGRAM K. Computations based on the Black-Scholes option pricing model produce option premiums and hedge ratios for puts and calls.

PROGRAM L. Markowitz portfolio analysis. The risk, return, and weights of the assets in efficient portfolios are calculated and displayed. This is a simple quadratic programming (QP) program. (A sophisticated QP may be found on another diskette in this package.)

PROGRAM M. Compute the intercept, slope, correlation, and related statistics for a simple linear regression (of the form y = a + bx + e) between any two random variables.

To start the program, type INVEST and press [ENTER]. Use the cursor keys to select a specific analysis, press [ENTER], and follow the on-screen instructions. If your printer is turned on, the [SHIFT] and the [PRINT SCREEN] keys on most keyboards can be depressed simultaneously to print out the information that appears on your monitor. Some of the graphs may not print, but all of the words and numbers will.

In case you wish to modify any of the programs listed above, the source code is contained in the files named INVEST.BAS, INVEST1.BAS, and INVEST2.BAS on the Basic language diskette. These files can be examined with any word processor that reads ASCII text files. The programs can be modified and recompiled using Microsoft's QuickBasic program. This option was obviously included to make the programmers happy.

Diskette of Lotus 1-2-3 Templates

You need not know how to use Lotus 1-2-3 or any other spreadsheet program to use these templates. All you need to do is select what you want to do from a menu and then supply the needed values when the computer program asks for them. This diskette of spreadsheet templates will perform the following kinds of investments analysis:

BONDTAB.WK1 TEMPLATE: Generate a page out of a bond table (or bond price book) for any combination of coupon rate and years to maturity desired. Tables for annual and semiannual compounding are available.

YTM.WK1 TEMPLATE: Compute a bond's yield-to-maturity, with either annual or semiannual compounding.

STKVAL1.WK1 TEMPLATE: Analyze a share of stock including calculating: (a) the present value of future dividends, (b) the required rate of return (or discount rate) implicit in a given stock price, and, (c) the growth rate implicit in a given stock price.

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OPTION1.WK1 TEMPLATE: Use the Black-Scholes option pricing model to compute call and put premiums (or prices) under simple assumptions.

OPTION2.WK1 TEMPLATE: Calculate put and call premiums and hedge ratios using the Black-Scholes option pricing model, based on more different sets of assumptions than found in the OPTION1.WK1 template.

OPTION3.WK1 TEMPLATE: For any assumed exercise price, underlying stock price, stock riskiness, time to maturity, and riskless interest rate, detailed graphs of put and call positions that are based on Black-Scholes option prices can be constructed for viewing on the monitor and printing out. It is also possible to create graphs of the net position that results from buying and selling *multiple positions* in options.

MRKPRT.WK1 TEMPLATE: Markowitz portfolio analysis of a two-asset portfolio. The risk, return, and weights of the assets in efficient portfolios can be calculated. A graph of the efficient frontier can be generated. Arbitrary (inefficient) portfolios can also be analyzed.

PEMODEL.WK1 TEMPLATE: Compute the price-earnings ratio for a share of common stock under different assumptions about its earnings growth, riskiness, and cash dividend policy.

2STAGE.WK1 TEMPLATE: Compute the present value of the cash dividends from a share of stock that grows at a rate of G1 during the first period. Then, during a second period of growth, the cash dividends increase at a rate that is designated G2. The G2 growth rate continues to infinity. Assumptions must also be made about stock's riskiness and cash dividend policy to compute its value.

3STAGE.WK1 TEMPLATE: Compute the present value of the cash dividends from a share of stock that grows at a rate of G1 during the first period. Then, during the second growth period, the cash dividends decrease at a steadily changing rate of growth until they reach the growth rate designated G2. G2 is the growth rate during the third period of time. Assumptions must also be made about stock's riskiness and cash dividend policy to compute its value.

Additional templates containing problems and their solutions that may be solved with the Lotus 1-2-3 templates are also on the spreadsheet diskette. These templates have names that are spelled PROB***.WK1; the asterisks represent alphabetical letters that suggest what kind of problems and solutions are on the template.

Some Lotus 1-2-3 templates have a one- or two-page introduction, and some templates also generate graphs to illustrate the results of their analysis. If desired, the [SHIFT] and the [PRINT SCREEN] keys on your keyboard can be depressed simultaneously to print out the Introduction, Problems and Solutions, and your worksheet, or most other information that appears in your monitor. Most of the graphs will not print on paper, but all of the words and numbers will. High-quality graphs can be

generated using the spreadsheet's graphics capabilities (for instance, Lotus PrintGraph).

The diskettes were all written to be compatible with Version 2.2 of Lotus 1-2-3, or any later version. No "add-ins" are required. We developed these diskettes to be compatible with as many users as possible. These templates will also work on similar spreadsheet programs (like Quattro, Excel, Symphony, and others), although modifications may be required.

The following summary of Lotus 123 commands may be helpful.

/ — This "slash" invokes the command menu.

/FileDirectory — This command allows you to tell Lotus 123 where your diskette was inserted.

/FileRetreive — This command pulls up a list of templates and lets you select what template to load.

/FileSaveReplace — This command saves the template on which you are working for later use.

/GraphView, or **F10** — This command lets you view a graph, if the template you are using is capable of generating a graph.

/WorksheetGlobalRecalculationAutomatic — This command sets the spreadsheet program to recompute new solutions automatically anytime you insert new values into your template. If the automatic recompute feature is turned off, you can simply touch the **F9** key to recompute.

Ctrl-Break — This is not a Lotus command. Pressing these two keys simultaneously allows Lotus 123 experts to break out of the menu-driven routine and use the spreadsheet as they wish.

Esc — This command cancels your selection and returns you to the previous level.

Shift-Print Screen — This is not a Lotus command. If your printer is turned on, pressing these two keys simultaneously will print most things (but not all graphs) that appear on your monitor.

Diskette of Mutual Fund Data and Programs

This diskette contains data on 1,359 mutual funds and computer programs to process the data and provide answers to the questions potential investors might ask.

1. The user merely needs to type MFSEQ and press [ENTER] to start the program. The program is menu driven, so that the user need only select the desired mutual fund or category of mutual funds from an easy-to-read menu. Most of the

computations a mutual fund investor might want (such as average rates of return, beta coefficients, statements of the fund's investment objective, etc.) are stored on the mutual fund diskette. As a result, you can sort (or screen) through hundreds of mutual funds on the diskette for one or more characteristics of interest.

2. *Business Week* magazine prepared the mutual fund disk and has sold thousands of copies at annual fees of $199 for the quarterly or $299 for the monthly subscription. The funds on the diskette comprise almost every common and preferred mutual fund in the United States. Up-to-date disks are prepared monthly by *Business Week* for those who wish to pay the subscription fee to obtain the latest data.

3. The mutual fund diskette has several screens full of data for each mutual fund. Data about each fund's management fee, load fee, redemption fee, total assets, year-to-year change in total assets, address, phone number, principal holdings, performance ranking, investment recommendation, etc., are available for each fund. Average rates of return over different periods for both the fund and the S&P500 stock market average are presented for direct comparison. Beta systematic risk statistics, the portfolio's turnover rate, and other data are also available.

4. The mutual fund diskette contains screening programs that can be used to screen out either individual mutual funds or categories of mutual funds that meet selected criteria. For instance, the user can ask for a list of (a) all no-load funds that have (b) average rates of return in excess of 10 percent over the last decade, and, (c) annual management fees of less than 1.0 percent of the value of the assets. The mutual funds meeting these three screening criteria will instantly be listed on the screen. More than three criteria may be used when screening.

5. Data on the mutual fund disk can be transferred (or exported, or downloaded) to Lotus 1-2-3 or other computer programs for further analysis. Menu-driven programs are provided on the diskette to export the mutual fund data.

Quadratic Programming (QP) Program

Douglas McCann, Ph.D., has written an "industrial strength" quadratic programming (QP) algorithm for serious portfolio analysts. This sophisticated computer program will analyze the expected rates of return, variances, and correlation coefficients of N assets and compute the Markowitz efficient frontier. Different upper and lower bounds may be inserted for each asset. The program outputs the weights of the assets in each "corner portfolio" along the efficient frontier and the risk and return statistics of each of these efficient portfolios.

The program is written in C language and is compiled so that the disk may be copied but the program may not be altered. The program in this package has been crippled so that it will not analyze more than 10 assets. The uncrippled algorithm that will analyze any number of assets may be purchased from Dr. McCann. This is not a simple program for neophytes portfolio analysts to use for their first portfolio analysis case.

The Rest of the Book

The remaining chapters in this book contain small investments cases and their solutions. These "caselettes" and their solutions are presented to demonstrate how to use the software. The chapter title suggests the kind of investments analysis problem addressed in each chapter. And, two identification lines beneath the title of each case tell you which diskette (or diskettes, if more than one is appropriate) and which program on each diskette is demonstrated in the solution to the case.

Every case's solution (except in Chapters 1, 20, and 23) employs one or more of the computer programs in this package to do the computations. If a Basic language program can be used, that solution will be presented. If a Lotus 123 spreadsheet template can be used, that will be demonstrated. If the mutual fund data and programs can be used, the use of that diskette will be documented. If the quadratic programming program can be used, that diskette will be employed. For those problems that can be solved with more than one computer program in this package, different solutions (which all reach the same answer) are illustrated using more than one of the different computer programs. We have tried to put together enough different programs written in enough different languages so that multiple programs of interest to each investment analyst will be provided.

Throughout this book the computer solutions are presented in a manner that will be easy-to-understand for those who may not be experienced with computers. The solutions show how to take the needed data from the problem and input it into the computer program. Printed samples of the computer input and output are shown. Then, the solution to each problem is written with data taken from the computer output. In deciding how much detail to delve into we decided it was better to err on the side of providing too much detail (and please the neophytes) than to present the material on a level that only experienced users could comprehend.

The enclosed software was not written to accompany a particular finance book. It can be used to supplement any one of a number of investments textbooks written by different authors. Or, it can be used for a case-oriented investments course. Or, this book could be used as the textbook for a computer-oriented finance course. And, of course, this book will be useful as a personal reference for those who want to study computerized investments analysis techniques.

Chapter 2

Finding Yields or Prices from a Bond Table

DISKETTES: Lotus 123 and Basic language programs

SOFTWARE: Lotus template: BONDTAB.WK;
Basic program: Bond table generator

Bond tables are used to answer two kinds of questions. The first is: If a bond that is compounded annually has eight years to maturity, a coupon rate of 6 percent, and a yield to maturity of 7 percent, what will its price be? (The answer is that the price will be 94.03 percent of the bond's face value.) The second kind of question is: If an eight-year bond that is compounded semiannually has a coupon rate of 6 percent and is selling for 94.6 percent of its face value (that is, a bond with a face value of $1,000 is selling for $946, or a $10,000 bond is selling for $9,460), what will the bond's yield to maturity be? (The answer is 3.445 percent per six-month period, or 2 x 3.445 equals 6.89 percent per year).

Essentially, if you know the yield to maturity you can find the price, and vice versa. All bond tables are based on four pieces of information:

1. The bond's coupon rate
2. The bond's market price (or, synonymously, its present value)
3. The bond's yield to maturity
4. The compounding interval (semiannual or annual)

This software package has both a spreadsheet template for Lotus 1-2-3 (and some other spreadsheet programs) and a Basic language program to generate whatever bond table you request. Either of these pieces of software will answer the questions above for any combination of years to maturity, coupon rate, yield to maturity, and price. The Basic language program to generate bond tables is explained first.

Basic Language Program

Insert the diskette of Basic language programs into your disk drive. If necessary, change the prompt on your screen to correspond to the drive in which you inserted the disk. Type INVEST to obtain the menu shown in Figure 2-1. Select choice A. Figure 2-2 lists the interactive questions you must answer to obtain the bond table you want.

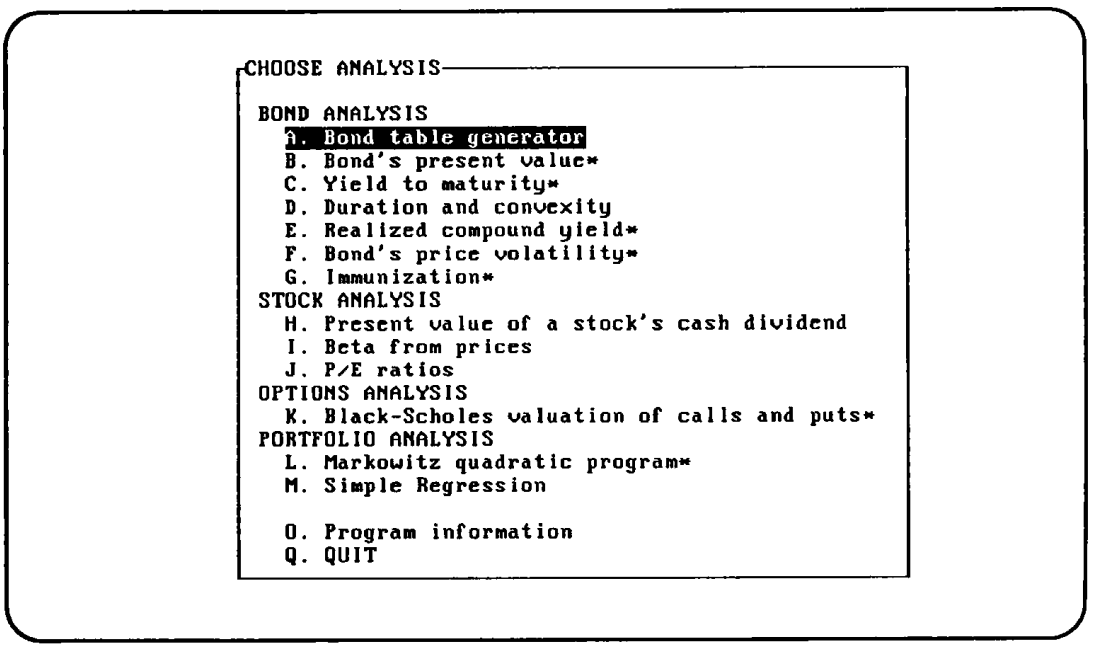

Figure 2-1 — Menu of Basic language programs from which to select

Annual Compounding

If you select annual compounding, you will obtain the bond table shown at Figure 2-3. The information in Figure 2-3 shows that an annually compounded eight-year bond with a coupon rate of 6 percent and a yield to maturity of 7 percent will be priced at 94.03 percent of the bond's face value (namely, $940.30 for a $1,000 face-value bond).

Traditional Semiannual Compounding

If you want to know the yield to maturity of an eight-year bond with a $100 face value that is compounded semiannually, has a 6 percent coupon rate, and is selling for 94.60 percent of its face value, then you should select choice B from Figure 2-2 for semi-annual compounding. Figure 2-4 can be interpolated to determine that this semiannual bond will have a yield to maturity of 6.89 percent per year.

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