

ATARI® 800™

INVESTMENT ANALYSIS SERIES
STOCK ANALYSIS*

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Model CX8107
Use with ATARI® 800™
PERSONAL COMPUTER SYSTEM

TABLE OF CONTENTS

PREFACE

1 STOCK ANALYSIS PROGRAM	3
Program Description	3
Write Protect Notch	3
Setting-Up the ATARI® 800™	3
Personal Computer System	3
Selecting a Program	4
Entering Data	4
2 PORTFOLIO ANALYSIS	4
Running Portfolio Analysis	5
Performing an Analysis of your Portfolio	6
Portfolio Analysis Formulas	7
3 STOCK RATE OF RETURN	8
Running Stock Rate of Return	8
Stock Rate of Return Formulas	9
4 STOCK DIVIDEND ANALYSIS	9
User Input	10
Running the Program	10
Stock Divided Analysis Formulas	12
5 TERMINOLOGY USED IN STOCK ANALYSIS	12
BIBLIOGRAPHY	13

returns, and geometric mean of the period returns. The STOCK RATE OF RETURN program computes the annual rates of return, compounded annually, for specific investments and enables the user to analyze the performance of a stock over a period of years. The STOCK DIVIDEND ANALYSIS program calculates the intrinsic value of a stock, using the Nicholas Molodovsky method of computing the discounted present value of the estimated dividends. This program also calculates the length of time a growth rate must be sustained or the price/earnings ratio required for the intrinsic value to equal the current market price. These programs provide a new theoretical approach to the analysis of stock investments.

This manual gives you all the instructions and information you need to run each individual program and understand the computer outputs.

WRITE PROTECT NOTCH

This diskette has a write protect notch in its upper right side. Do not cover this notch with a write protect label. A write protect label would prevent all write operations on this diskette. The STOCK ANALYSIS program performs several write operations to analyze and store your stock data. Covering this notch will interrupt the program and cause an error message to display on the screen. (Refer to the ATARI 810 Disk Drive Operators Manual or Disk Operating System (DOS) Manual for further information about write protection.)

PREFACE

The ATARI STOCK ANALYSIS program is an investment analysis tool. It is designed for users who are familiar with stock market investments. It is not intended as a tutorial or instructional program.

This manual is a guide to the use and interpretation of the three individual programs which make up the STOCK ANALYSIS program diskette. It includes six sections which contain information about each program, a glossary of terminology used in the programs, and a bibliography.

NOTE: Neither ATARI nor the author of this program are responsible for any losses resulting from investment action taken due to the use of this program.

SETTING-UP THE ATARI® 800™ PERSONAL COMPUTER SYSTEM

To use the STOCK ANALYSIS program, you will need the following ATARI® equipment:

- ATARI 800 Personal Computer System
- ATARI 810™ Disk Drive
- ATARI BASIC (Computing Language) Cartridge (Model No. CXL4002)
- ATARI Printer (optional)
- Minimum RAM requirement: 24K

1 STOCK ANALYSIS PROGRAM

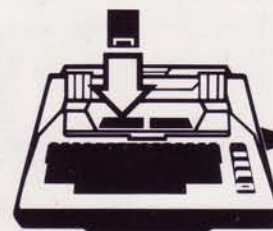
PROGRAM DESCRIPTION

The STOCK ANALYSIS program consists of three sections, each of which is a self-contained analysis program:

- PORTFOLIO ANALYSIS
- STOCK RATE OF RETURN
- STOCK DIVIDED ANALYSIS

The PORTFOLIO ANALYSIS program is used to evaluate portfolios using statistical measures: arithmetic mean and standard deviation, mean and standard deviation of log

BASIC CARTRIDGE



ATARI 800 SYSTEM

ATARI 810 DISK DRIVE



Connect your ATARI 800 Personal Computer System as follows:

1. Verify that the TV Switch Box is connected and the switch is in the GAME or COMPUTER position.
2. As shown in the ATARI 800 Operator's Manual, install enough RAM Memory Modules to provide at least 24K RAM.
NOTE: This can be three 8K RAM Memory Modules, two 16K RAM Memory Modules, or one 8K and one 16K RAM Memory Module.
3. Install an ATARI BASIC (Computing Language) Cartridge into the LEFT cartridge slot in the ATARI 800 computer console.
4. Verify that the AC power adaptor is plugged into a wall outlet (115 volt) and to the jack labeled POWER IN on the side panel of the computer console.
5. Plug another AC power adaptor into a wall outlet (115 volt) and to the power jack (PWR) on your ATARI 810 Disk Drive.
6. Plug one end of the I/O Data Cord provided with your ATARI Disk Drive into the PERIPHERAL connector on the computer console. Plug the other end into either of the I/O CONNECTORS on the disk drive.
7. If the ATARI 820™ or ATARI 822™ Printer is used, plug its I/O Data Cord into the unused I/O CONNECTOR on the disk drive and into either of the I/O CONNECTORS on the back of the printer. Plug the printer's power cord into a wall outlet (115 volt). If the ATARI 825™ 80-Column Printer is used, connect it as instructed in the ATARI 825 Printer Operator's Manual.
NOTE: The STOCK ANALYSIS program is formatted to print on an ATARI 40-column printer and may not be properly aligned on an ATARI 825 80-Column Printer.
8. Verify that the ATARI 810 Disk Drive is set to the correct DRIVE CODE NUMBER, as instructed by the operator's manual for the disk drive.
9. Turn the disk drive POWER switch (PWR) ON.
10. When the BUSY light on the disk drive goes out, insert the STOCK ANALYSIS program diskette and close the disk drive door.
11. Switch the POWER switch on the computer console to ON. The READY prompt will appear on the television screen.
12. If an ATARI 40-column printer is used, turn the printer POWER (PWR) to ON.
13. The ATARI logo will appear on the screen while the STOCK ANALYSIS program loads into your computer's RAM memory.
14. You are now ready to begin the STOCK ANALYSIS program.

SELECTING A PROGRAM

The STOCK ANALYSIS Program diskette begins with an ATARI logo and a program selection MENU. Each individual

program will be listed on your selection MENU with a number preceding the program name. Choose your program selection, and type its designated number. After the individual program loads into your computer RAM, the ATARI and Control Data Corporation credits will appear on the screen. Each program begins with a descriptive paragraph.

ENTERING DATA

Your ATARI 800 Personal Computer System and the STOCK ANALYSIS Program will prompt you for the data required to run the desired program. When data is requested, type the data then press the **RETURN** key. The computer will not act on any data entered until the **RETURN** key is pressed. If more than one value is requested, separate the values with commas. If you submit an insufficient number of values the computer will continue to prompt with a question mark (?) until all necessary values are typed.

With the exception of portfolio names and stock ticker symbols, all of the data entered is numeric. If non-numeric data is typed the program will display:

ERROR - Invalid data. Resubmit it.

Every computer program has a finite range of permissible values. There are two limits on the numerical values within this program:

- values too large to display
- values beyond program range

The output will display values up to 9,999,999.99 correctly. Values greater than 9,999,999.99 will display as: *****.**

If this problem occurs, it is necessary for you to scale down each value before typing it, for example, by dividing the value by 10 or 100. Values that extend beyond the allowable number range may cause the program to interrupt. If this occurs, the screen displays:

ERROR - A result of a calculation has exceeded the maximum allowable value.

Throughout the program you are asked to type **P** for print or **RETURN** to continue. When **RETURN** is typed the program moves to the next screen display. If **P** is typed, the printer automatically prints the screen display. Additional copies may be obtained by typing **P** again after each printout. Do not type any data in the inverse video or ATARI graphic character modes. Refer to your ATARI 800 Operator's manual for special characters and how to recover from them.

2 PORTFOLIO ANALYSIS

The PORTFOLIO ANALYSIS program evaluates portfolios by calculating the arithmetic mean and standard deviation, the mean and standard deviation of the log returns, and the geometric mean of the period returns for one or more portfolios. This program also provides the annualized arithmetic and geometric means if the returns are other than annual. PORTFOLIO ANALYSIS is a modified version of COMPORT by Professor D. Lessard, Amos Tuck School of Business. This program is designed to compute various measures of return and variance for any portfolio from the holding period returns.

The program requires a data file containing at least one portfolio. A sample data file is supplied with this program. This

sample file, BACK, is for demonstration only. You will create your own data files, each with a unique name. You can save several portfolio files on the diskette, but can display only one at a time for individual analysis. To create your data files, the program will ask for a portfolio of stocks and their period returns. The program provides the opportunity to add or delete stocks, change stock data, add new data, or change the length of the holding periods for the stocks listed in a portfolio.

The program calculates and displays the following data on the screen:

- Indexes of portfolio value by period
- Arithmetic mean using Buy/Hold and Constant Proportions
- Standard deviation using Buy/Hold and Constant Proportions
- Mean of log returns using Buy/Hold and Constant Proportions
- Geometric mean using Buy/Hold and Constant Proportions
- Annual arithmetic and geometric means if the returns are other than annual
- Single stock performance averages

RUNNING PORTFOLIO ANALYSIS

The PORTFOLIO ANALYSIS program begins with a descriptive introduction. After the introduction, the screen displays a list of options:

Type **F** to create, examine, or alter FILES
I for INFORMATION about the program
S for a SAMPLE run
RETURN for portfolio analysis

The first time through the program, you should read the information about the program and review the sample run. This will help you to become familiar with the program input format. Once you are familiar with this program, you will be able to begin creating your portfolio.

The first step is to create a data file. Select option **F**. This provides a display of four more options:

- 1 - Create/destroy portfolio
- 2 - Update existing portfolio
- 3 - Perform portfolio analysis
- 4 - Exit from program

Choose (type) option **1** and press **RETURN**

Enter the following information:

PORTFOLIO NAME Your portfolio name cannot exceed eight characters (alphabetical characters only; no extenders).

Length of holding period (months)

Number of holding periods (maximum of ten holding periods)

New stock name (limited to four characters)

For each stock, you will need to provide the price and dividend for all holding periods. It is not necessary to enter a dividend with the beginning price of a stock, because you would not receive a dividend at the point of purchase. When the program says: ENTER PRICE, DIVIDEND; type the price and the dividend separated by a comma. After data has been entered, the program asks if you want to make any changes. If you type **Y**, it asks for the period that is to be changed, and allows you to retype the data correctly. If you type **N** you

may continue to create, list, or update your portfolio using the selection items listed on the following screen display:

```

          UPDATING STOCK  -- SAMP
-----
Period   Price   Dividend
-----
  0       49.5   3.8
  1       49.75  4.2
  2       52.38

          ANY CHANGES (Y/N) ?
  
```

```

PORTFOLIO SAMPLE
STOCKS IN PORTFOLIO (LIMIT IS 15)

AA

After creating or changing a
portfolio, save the changes on disk.

1- Add a new stock
2- Delete an old stock entry
3- Change old stock data
4- Add new data to each stock
5- Change length of holding period
6- Save changes on disk
7- For print option
8- To return to previous MENU

OPTION ?
  
```

NOTE: All data must be saved on diskette to avoid loss of portfolio. Use option **6** to save new or changed data.

Select option **6** to record new data or change previous data on the diskette.

If you are planning to print a list of stocks in your portfolio (option **7**), perform the print function before saving the information on diskette. But, do not return to previous MENU (**8**) before saving your data on diskette.

To analyze your portfolio, select option **8** to return to the previous MENU (PORTFOLIO GENERATION AND UPDATE). Select option **3** to RUN a problem. Saving data on your diskette automatically causes the program to return to the PORTFOLIO GENERATION AND UPDATE MENU.

```

PORTFOLIO GENERATION AND UPDATE
-----

1 - Create/destroy portfolio
2 - Update existing portfolio
3 - Perform portfolio analysis
4 - Exit from program

OPTION (1,2,3,4) ?
  
```


The number of stocks in each portfolio is limited to 15. All stocks in each portfolio will use the same holding periods. This provides a method for comparison of all stocks in a portfolio. The maximum amount of holding periods the program accepts is ten (10).

The maximum number of complete portfolios the STOCK ANALYSIS program accepts is seven (7). This is fifteen stocks each with ten holding periods. You can write more than seven portfolios if each portfolio is less than fifteen stocks and less than ten holding periods.

It is wise to use the print option with each portfolio, because you will want to review which portfolios have been entered and which stocks are in each portfolio. It is also possible to review a list of portfolios saved on the diskette by performing the following function:

1. After loading the STOCK ANALYSIS program into your ATARI Personal Computer System, press **SYSTEM RESET**.
2. When the READY prompt appears on your display screen, type DOS **RETURN**.
3. Type **A** and press **RETURN** twice.



The Disk Operating System (DOS) provides a list of all files stored on diskette. You will see your portfolios listed as well as the files used to create this program. Your portfolios are listed by name, each with a suffix of .PRT (for example, AAA.PRT).

The DOS function also lists the amount of diskette space (sectors) available for data input. A full portfolio (fifteen stocks with ten holding periods) uses approximately sixteen sectors. Should you fill all sectors on your STOCK ANALYSIS diskette, the program will give you an error message to inform you that your diskette is full.

You can interrupt the program at any time by pressing **BREAK**. If this is done prior to saving data on diskette, you will lose your portfolio. If you decide to stop the program, it can be started from the beginning by typing RUN **RETURN**. You can also quickly exit the program by pressing **SYSTEM RESET**. This will cause the program to stop (with a loss of data) and the READY prompt to appear on the screen. To start the PORTFOLIO ANALYSIS program again, type RUN "D:PORTFOL **RETURN**.

PERFORMING AN ANALYSIS OF YOUR PORTFOLIO

To begin an analysis of your portfolio, choose item 3 on the PORTFOLIO GENERATION AND UPDATE MENU. The

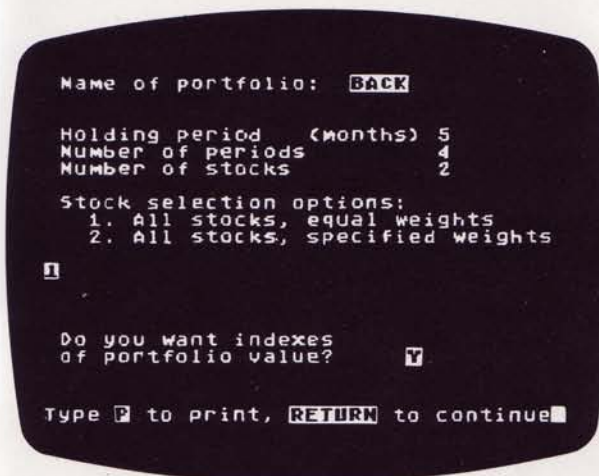
screen displays:

Type **RETURN** for portfolio analysis

After typing **RETURN**, the screen displays:

Name of portfolio?

Enter the name of the portfolio and press **RETURN**. (Do not include the .PRT suffix to the portfolio name.)

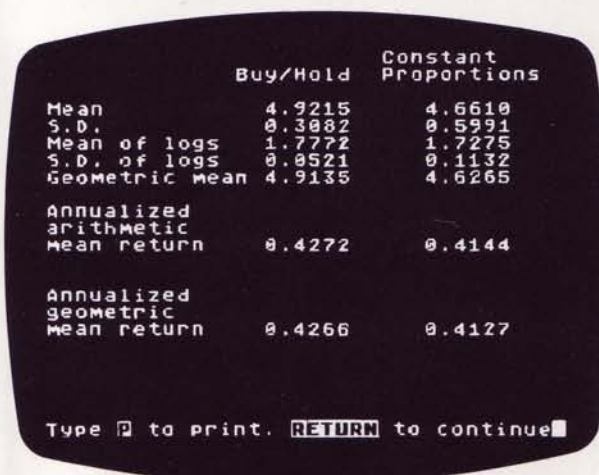


You must also decide whether to weight the stocks equally or assign specific weights to each stock. Type 1 to assign equal weights to all stocks, or type 2 to assign each stock a specific weight. The computer will automatically list the data for holding period length, number of holding periods, and the number of stocks in the portfolio. The program will ask you:

Do you want indexes of portfolio value (Y/N)?

If you type **Y**, a table of the indexes of portfolio value will appear. Buy/hold assumes that the initial weights assigned to each stock are used only in the first period, and that the returns from each stock are reinvested back into the stock. This causes the proportions of the total portfolio of stocks to change by the movement in the prices of the stocks. Constant proportions assumes that with each period the weights are adjusted to maintain the original specified proportions. At this point it is a good idea to print each screen display as a record of the information you are analyzing.

The next screen displays the means and standard deviations under the two conditions, buy/hold and constant proportions. This data always appears in the program. Below is a sample of this screen display:



For the purpose of comparison, the program will ask you:

Do you want average figures (average return—variance of

single stock portfolios) for comparison purposes (Y,N)?

If you type **N**, the program stops and the screen displays the end of problem message:

Type **Y** to run another problem

RETURN to exit to MENU (Program Selection MENU)

If you type **Y** to compare single stock portfolios the screen displays the same statistics as in the previous display, for a group of single stock portfolios using the same stocks and holding periods. This comparison helps to demonstrate the value of diversification.

```

Single stock performance average

Mean                4.6610
S.D.                1.0472
Mean of logs       1.6873
S.D. of logs       0.2072
Geometric mean     4.4048

Annualized mean
returns:

Arithmetic mean     0.4144
Geometric mean     0.4014

Type Y to print. RETURN to continue
    
```

After pressing **RETURN** the program displays the end of problem message:

Type **Y** to run another problem.

RETURN to exit to MENU

PORTFOLIO ANALYSIS FORMULAS

The calculations used to compute PORTFOLIO ANALYSIS are based on the following formulas:

RATE OF RETURN

$$X = \frac{D + (P - PO)}{PO}$$

where:

D = Dividends

P = Price

PO = Previous period's price

The program performs the following calculations on each stock for each period:

BUY/HOLD THEORY

$$\sum (PO * (1 + R)) = x$$

Computation of indexes for each individual stock,

where:

PO = Previous period price

R = % rate of return

$$\frac{Sa1 + Sb1 + Sc1 + Sd1}{n}$$

Accumulate each period stock,

where:

S_{in} = Stock i period n

n = number of stocks

$$C = \frac{Sa1 + Sb1 + Sc1 + Sd1}{PO}$$

Each term of mean deviation

$\sum (c)$ Mean Deviation (numerator)

$\sum (c)^2$ Variance (numerator)

$\sum (\log(c))$ Log Mean Deviation (numerator)

$\sum (\log(c))^2$ Log Variance (numerator)

$\sum (c)/n - 1$ Buy/Hold Mean

$\sum (\log(c))/n$ Buy/Hold Mean of logs

$2.71829^{(\sum (\log(c))/n)}$ Geometric Mean

$s^2 = \frac{n(\sum c^2) - (\sum c)^2}{n(n-1)}$ Standard Deviation

$s^2 = \frac{n(\sum (\log(c))^2) - (\sum (\log(c)))^2}{n(n-1)}$ Standard Deviation of Log Returns

ANNUALIZED RETURNS

$A1 = \frac{1 + \sum (c)}{n - 1} - 1$ Arithmetic Annual Mean Return

where:

$n3$ = Length of holding period

n = number of stocks

$A3 = 2.71829^{((\sum (\log(c))/n) - 1)}$ Annual Geometric Mean Returns

CONSTANT PROPORTIONS THEORY

$\sum (PO * (1 + R)) = x$ Computation of indexes for each stock

where:

PO = Previous period price

R = % rate of return

$W_i = PO_{wi} + (1 + R)^* w$ Weighted index

$R = (PO * w_i)$

$d = \frac{\sum (Sar + Sbr + Scr + Sdr)}{PO}$ Each term of mean deviation

where:

r = Proportions of return to stock

PO = Previous period return

$\sum (d)$ Mean Deviation (numerator)

$\sum (d)^2$ Variance (numerator)

$\sum (\log(d))$ Log Mean Deviation (numerator)

$\sum (\log(d))^2$ Log Variance (numerator)

$\sum (d)/n - 1$ Constant Proportion Mean

$\sum (\log(d))/n$ Constant Proportion Mean of Logs

$2.71829^{(\sum (\log(d))/n)}$ Constant Proportions Geometric Mean

$s^2 = \frac{n(\sum d^2) - (\sum d)^2}{n(n-1)}$ Standard Deviation

$S^2 = \frac{n(\sum (\log(d))^2) - (\sum (\log(d)))^2}{n(n-1)}$ Standard Deviation of Log Returns

ANNUALIZED RETURNS

$$A1 = \frac{1 + \sum (d)^{(1/n3)} - 1}{n - 1}$$

Annual Arithmetic Mean Returns

where:

$n3$ = Length of holding period

n = Number of stocks

$$((\sum (\log(d))/n) - 1)$$

$$A3 = 2.71829$$

Annual Geometric Mean Returns

SINGLE STOCK PERFORMANCE

$\sum (R)$	Accumulate Stock Returns
$\log(1 + \sum (R))$	Accumulate Log Returns on stock
$\sum (R)^2$	Accumulate Squared Returns
$\log(1 + \sum (R))^2$	Accumulate Log Squared Returns
$\sum (R)/n6$	Accumulate Mean Returns for each period

where:

$n6$ = number of periods

$\log(1 + \sum (R))/n6$ Accumulate Mean Return of Logs for each period

$\frac{n(\sum R)^2 - (\sum R)^2}{n(n-1)}$ Standard Deviation of Returns

$\frac{n(\sum (\log(R)^2) - (\sum (\log(R)))^2)}{n(n-1)}$ Standard Deviation of Log Returns

RUNNING STOCK RATE OF RETURN

Choosing item 2 on the STOCK ANALYSIS program Selection MENU selects the STOCK RATE OF RETURN program. After a brief description, the program asks if you are an expert user or a novice user. An expert user is someone who is familiar with the program and its input format. A novice user is someone who is not familiar with this program. It is advisable to use the novice level the first few times through the program until you familiarize yourself with it. The novice level provides more data input prompts to guide you through the program. Type **RETURN** if you are a novice or type an **X** if you are an expert. If you have chosen to run this program as a novice, the computer displays:

Type **I** for information about the program
S for a Sample run
RETURN to run a problem

Typing **I** provides an overview of the STOCK RATE OF RETURN program. If you type **S** the program shows you an example of a problem. The sample problem has three years of stock data, starting in 1972. Dividends per share and closing security prices are given for 1972, 1973, and 1974. Given this information, the computer calculates the percentage of return on investment, compounded annually.

3 STOCK RATE OF RETURN

The STOCK RATE OF RETURN program computes the annual rates of return, compounded annually, for an investment. It may be used to analyze the performance of a particular stock or a portfolio of stocks. The program provides three sets of rates of return. First, the average annual returns are given for every year starting with the base year through the last year for which data has been entered. The calculations assume that dividends are received at the end of each year and all dividends are reinvested in the same security, and the average is a compound, or geometric, average.

The second set of returns is a set of arithmetic average rates of return. These averages are the mean returns from the stated year to each of the subsequent years up to and including the last year for which data has been entered. For example, if dividend and closing price data are entered for five years, 1975 through 1979, the arithmetic average return from 1977 would be the average of the 1977 to 1978 and the 1977 to 1979 annual rates of return. The average rates of return for all possible holding periods are displayed.

The third set of returns displays the arithmetic average rates of return. Standard deviations, and coefficients of variation (standard deviation divided by the average return) are displayed for the various holding periods for which the security could have been held.

```
Enter [separated by a comma]
: Dividend Per Share [DPS]
: Closing Security Price [CSP]
for each of the following 3 years.
```

```

          DPS,  CSP
Year 1972    0.00,47.25
Year 1973    1.05,49.25
Year 1974    1.15,49.50
```

Type **P** to print, **RETURN** to continue

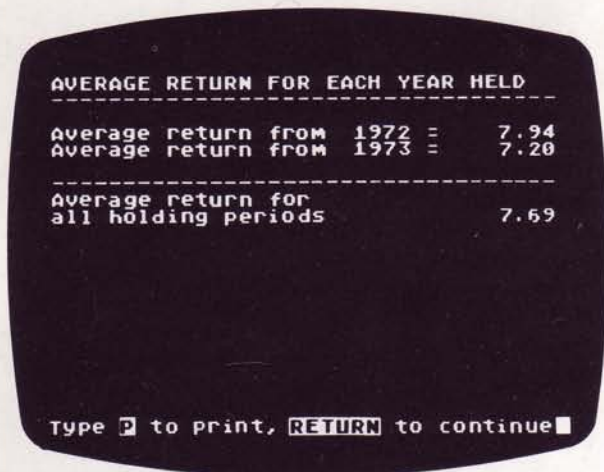
PERCENT RETURN ON INVESTMENT COMPOUNDED ANNUALLY

```

-----
TO      1973    1974
FROM
1972    6.46    9.42
1973    7.20
```

Type **P** to print, **RETURN** to continue

It also computes average returns for each year held, total average return for all holding periods, and arithmetic average return, standard deviation, and coefficient variation.



The sample ends with an End of problem message:

Type **Y** to run another problem
RETURN to exit to MENU

Typing **Y** starts the program again, and returns to this display:

Type **X** if an expert user
RETURN if a novice user

To run a problem, type **RETURN** again. The problem begins the same as the sample problem. You enter the number of years for which you have data (dividends per share and closing security price). Enter more than one year but less than twenty-one years. Also enter the year you want to start, or the first year for which you have data. On the second screen you will begin entering the dividends per share (DPS) and the closing security prices (CPS) for each of the years for which you have data.

After all of the data is entered, the program begins calculating. While the program performs its calculations, the screen displays the progress of the computations at the bottom of the screen. When all calculations are 100% complete, press **RETURN** and the program displays:

- PERCENT RETURN ON INVESTMENT COMPOUNDED ANNUALLY
- AVERAGE RETURN FOR EACH YEAR HELD
- ARITHMETIC AVERAGE RETURN
- STANDARD DEVIATION
- COEFFICIENT VARIATION

After all screens are displayed, the program returns to the End of problem message:

Type **Y** to run another problem
RETURN to exit to MENU (Program Selection MENU)

If you press **BREAK** or **SYSTEM RESET**, you can access the STOCK RATE OF RETURN program by typing RUN" D:RETURN **RETURN**.

STOCK RATE OF RETURN FORMULAS

The calculations performed in the STOCK RATE OF RETURN program are based on the following formulas:

PERCENTAGE OF RETURN ON INVESTMENT

$$X = \frac{\sum (P_i - P_b) + d}{P_b}$$

where: P_i = Price

P_b = Base year price

d = Dividends

AVERAGE RETURNS

$$\frac{\sum (X)}{n - n_i}$$

where: X = Percent on return
 n = number of years total
 n_i = number of each year (year 1, year 2, etc.)

STANDARD DEVIATION

$$S^2 = \frac{n(\sum X^2) - (\sum X)^2}{n(n - 1)}$$

where: X = Rate of return
 n = number of years total

COEFFICIENT VARIATION

$$\frac{n(\sum X^2) - (\sum X)^2/n(n - 1)}{\sum (X)/n - n_i}$$

where: X = Percent on return
 n = number of years total
 n_i = number of each year

4 STOCK DIVIDEND ANALYSIS

"The intrinsic value of a stock, according to the theory described by John Burr Williams in *THE THEORY OF INVESTMENT VALUE* and by Nicholas Molodovsky in a number of articles in *THE FINANCIAL ANALYSTS JOURNAL*, is the discounted present value of the stream of dividends the shareholder expects to receive". The program uses the Nicholas Molodovsky method to compute the discounted present value of the estimated dividends. The required inputs are current earnings per share, discount rates and either a long-term growth rate or a price/earnings ratio forecast. With this program, you can also calculate the length of time a growth rate must continue or the price/earnings ratio that must be reached to make the intrinsic value equal to the current market price.

The author of this program suggests the use of at least two growth rates; one short term and another longer-term. His reasoning is that even high growth companies reach a level of maturity as their growth stabilizes. With this program you can calculate intrinsic value using as many growth rates as you wish.

The author also prefers to calculate intrinsic value from dividend projections alone. With this theory, if you decide to sell the stock in the future, you can estimate the intrinsic value from that time.

Some analysts prefer to predict the price/earnings ratio of a stock at some future time and therefore predict earnings growth rates indefinitely into the future. This program provides calculations to forecast price/earnings ratios.

The STOCK DIVIDEND ANALYSIS program calculates intrinsic value, given normalized current earnings per share, growth rates in earnings, dividend payout ratios, discount rates, and either a long-term growth rate or a price/earnings ratio forecast.

Nicholas Molodovsky describes normalized earnings as the earnings per share that could be expected in this year apart from unusual conditions. One way to estimate normalized earnings is to project a trend line of earnings per share. He describes discount rate as the rate of return an investor expects to earn on the purchase of a particular stock.

*Williamson, J. Peter and Downes, David H., *Manuals for Computer Programs in Finance and Investments*, Dartmouth College 1977

This program offers additional flexibility in forecasting growth rates. You may forecast growth rates for various time spans and also different periods of adjustment from one growth rate to another. You may choose one of three kinds of adjustments:

- 1) STRAIGHT LINE
- 2) FAST
- 3) SLOW

Refer to **TERMINOLOGY USED IN STOCK ANALYSIS** for further explanation of adjustment periods.

USER INPUT

To begin calculations with the **STOCK DIVIDEND ANALYSIS** program, you should be prepared with the following input data:

- **CURRENT MARKET PRICE** The dollar value that the stock last sold for per share.
- **CURRENT EARNINGS PER SHARE** The net earnings divided by the average shares outstanding.
- **NORMALIZED EARNINGS THIS PERIOD** The dollar amount the issuing company would earn per share under normal economic conditions.
- **LONG-TERM DISCOUNT RATE** The rate of return earned on all stocks listed on the New York Stock Exchange, from a specified point in time and continuing indefinitely.
- **LONG-TERM DIVIDEND PAYOUT RATIO** The payout ratio is the ratio of the cash dividends to the per-share profits after taxes. Long-term dividend ratio is simply a historical payout ratio starting from a specified point in time and continuing indefinitely.
- **LONG-TERM GROWTH RATE** The residual industry growth rate.

RUNNING THE PROGRAM

If you interrupt the program at any time by pressing the **BREAK** key, the message: STOPPED AT LINE n will be displayed. You can access this program again by typing **RUN RETURN**.

You can also quickly exit the program by pressing **SYSTEM RESET**. This will cause the program to stop and the **READY** prompt to appear on the screen. To start the **STOCK DIVIDEND ANALYSIS** program again, type **RUN "D:STOCKDIV RETURN**.

Before running a problem, the program allows you to see a Sample run, read more information about the program, or simply run a problem. It is advisable to read the information (type **I**) at least the first time through the program. Then run a sample problem (type **S**) to see the data input format.

The Sample run in the program uses the first option, intrinsic value. If this were an actual run of the program, you would supply the data after the question mark (?).

After you have familiarized yourself with the program and its format, you may run a problem. Type **RETURN**.

```

Calculation wanted:
[1] Intrinsic value
[2] Required duration of
    specific growth rate
[3] Required future
    price/earnings ratio    ?1
Current market price    [$] ?302
Current earnings/share  [$] ?5.85
Normalized earnings
this period             [$] ?7
Long term discount rate [%] ?16
Long term dividend
payout ratio           [%] ?40
Type ? to print, RETURN to continue
    
```

```

Earnings growth rate
[percent]              ?25
Duration of growth rate
[years]                ?10
Dividend payout ratio
[percent]              ?40
Discount rate [percent]
                      ?16
Type of adjustment
[1] Straight line
[2] Fast line
[3] Slow                ?3
Type ? to print, RETURN to continue
    
```

```

Duration of adjustment
[years]                ?5
Dividend payout ratio for
this adjustment period
[percent]              ?40
Discount rate for this
adjustment period
[percent]              ?16
Type ? to print, RETURN to continue
    
```

Because the program can be used to calculate three different outputs, you decide which calculation you would like to see. Choose from these options:

- 1 The intrinsic value of a stock
- 2 The required duration of a specific growth rate
- 3 The required future price/earnings ratio

Depending on the option you choose, the program will request the necessary data for each calculation.

If you are calculating intrinsic value, you have the option to forecast either:

- 1 Long term growth rate
or
- 2 Price/earnings ratio at future point in time

If you choose **1**, you will forecast your expected long-term growth rate. You must enter the current year to provide a starting date for forecasting.

If you choose **2**, you will forecast an expected price/earnings ratio for a future time. You also must type the current year.

The program offers you the option to continue forecasting for the following year. If you choose to continue forecasting, type **Y** and the additional forecast data will be requested. If not, type **N**, and the program will perform its calculations based on the data which you have provided. The program accepts forecast data for up to 25 years beyond the current year. After each set of forecasted data, the program will ask whether you want to continue forecasting, up to 25 years.

In the sample run, data is forecasted for only 15 years (a 10 year duration for the growth rate, with a 5 year adjustment period.)

To forecast future years, the program asks for the following input:

- Earnings growth rate?
- Duration of growth rate?
- Dividend payout ratio?
- Type of adjustment?
 - 1 Straight line
 - 2 Fast line
 - 3 Slow line
- Duration of adjustment?
- Dividend payout ratio for this adjustment period?
- Discount rate for this adjustment period?

After you have forecasted and entered all required data, the program calculates the following values for the current year:

- Price
- Earnings
- P/E Ratio
- Intrinsic value

```

1976 Values
Price           $ 302.00
Earnings        $   6.85
P/E ratio       44.09
Long term growth rate   5.00%
Intrinsic value  $ 138.43

Type Q to print, RETURN to continue
  
```

You have the option to see a list of values in the future years. If you choose to see this list, the screen displays:

YEAR	EARN. PER SHARE	GROWTH RATE [X]	VALUE /EARN. RATIO	INTR. VALUE [AT BEG. OF YEAR]
1977	8.75	25.00	15.82	138.43
1978	10.94	25.00	14.36	157.08
1979	13.67	25.00	13.01	177.83
1980	17.09	25.00	11.75	200.82
1981	21.36	25.00	10.58	226.11
1982	26.70	25.00	9.50	253.74
1983	33.38	25.00	8.50	283.66
1984	41.72	25.00	7.57	315.70
1985	52.15	25.00	6.70	349.52
1986	65.19	25.00	5.90	384.58
1987	80.87	24.00	5.19	420.84
1988	98.78	22.00	4.61	454.89
1989	117.83	19.00	4.14	488.17
1990	136.06	15.00	3.82	519.14
1991	150.64	11.00	3.64	547.78

There are additional results--
Type **Q** to print, **RETURN** to continue

If you choose to calculate required duration of a specific growth rate, you will also be able to forecast an expected long-term growth rate, which must be less the discount rate. The program will ask for the current year. This provides a base to begin calculations. You will then be able to forecast the future years, starting from the next year. If you have chosen to forecast for the future, the program will ask you to enter the following:

- Earnings growth rate?
- Duration of growth rate?
- Dividend payout ratio?
- Discount rate?
- Type of adjustment?
 - 1 Straight line
 - 2 Fast line
 - 3 Slow
- Duration of adjustment?
- Dividend payout ratio for this adjustment period?
- Discount rate for this adjustment period?

When you have entered all of the required values and have forecasted the number of years you wish, the program again asks if you want to continue forecasting. Type **Y** to continue or **N** if you do not want to continue forecasting, and press **RETURN**.

The program lets you know that it is performing the calculations. When the calculations are complete, press **RETURN** and the program displays the length of time your forecasted growth rate must last to justify the price of the stock.

If you have chosen to forecast the required future price/earnings ratio (item **3**) you will be required to enter the same information as requested in the first two options. After all information is entered, the program performs its calculations and provides the required price/earnings ratio to justify the price.

Each option ends with an "end of problem" message which says:

- End of problem
- Type **Y** to run another problem
- RETURN** to continue

Typing **RETURN** branches back to the original program selection MENU.

STOCK DIVIDEND ANALYSIS FORMULAS

This program computes the values using the following formulas:

INTRINSIC VALUE =

$$\frac{e_0(1+g_1)^P}{1+r} + \frac{e_1(1+g_1)^{2P}}{(1+r)^2} + \frac{e_2(1+g_1)^{3P}}{(1+r)^3} + \dots$$

$$\frac{e_k(1+g_1)^nP}{(1+r)^n} + \frac{e_0(1+g_1)^n(1+g_2)^P}{(r-g_2)(1+r)^n}$$

where:

- g_1 = Earnings Growth Rate (unique years)
- g_2 = Long-Term Growth Rate (residual industry growth rate)
- e_0 = Normalized Earnings
- P = Payout Ratio
- r = Discount Rate
- n = The number of years beyond starting year of unique growth rate. i.e., 1976 + 1 = 1977 $n=1$, 1976 + 2 = 1978 $n=2$, 1976 + 3 = 1979 $n=3$, etc.

Forecasted earnings for each unique growth rate are calculated as follows:

$$e_1 = e_0 \text{ times } 1.1, e_2 = e_1 \text{ times } 1.1, \dots, e_{10} = e_9 \text{ times } 1.1$$

where:

- e_0 = Normalized Earnings
- e_1 = Year 1 Forecasted Earnings
- e_2 = Year 2 Forecasted Earnings
- 1.1 = 1 + growth rate (in this example growth rate is .10)

The forecasted earnings calculations used in this program are:

- For $J = T1$ to $T2$ First year to final year
- Let $Y(J) = Y(J-1)*(1+G)$ Year earnings times 1 + growth rate
- Let $G(J) = G$ Earnings growth rate
- Let $X(J) = Y(J)*D$ Forecasted earnings times dividend payout ratio

NOTE: Earnings forecasts are based on normalized earnings. This is why unique years must not be taken into consideration when deciding value to be used for normalized earnings.

ADJUSTMENTS TO GROWTH RATES

1. Straight Line Adjustment:

Growth rate for each year increased by:

$$\frac{(\text{earnings growth rate} - \text{next earnings growth rate})}{(\text{first year of new growth} - \text{final year})}$$

2. Fast Adjustment: Sum-of-the-years-digits

- $K3 = 0$
- For $K = T2 + 1$ to E Final year + 1 to year of new growth rate

$$K3 = K3 + (K - T2) \quad \text{Sum ((final year + 1 to year of new growth) - (final year))}$$

- Next K
- $K1 = G - G6$

Next year
Earnings growth rate - next earnings growth rate

$$K2 = E - J + 1$$

Starting with final year move to start year

$$G = G - K1*(K2/K3)$$

Growth rate = growth rate - difference in rates times year divided by the sum of the years.

3. Slow Adjustment: Sum-of-the-years-digits

- $K3 = 0$
- For $K = T2 + 1$ to E Final year + 1 to year of new growth rate

$$K3 = K3 + (K - T2) \quad \text{Sum ((final year + 1 to year of new growth) - (final year))}$$

- Next K
- $K1 = G - G6$

Next year
Earnings growth rate - next earnings growth rate

$$J = T2 + 1 \text{ to } E$$

Final year + 1 to year of new growth

$$K2 = J - T2$$

Begin at start year and move to final year

$$G = G - K1*(K2/K3)$$

Growth rate = growth rate - difference in rates times year divided by the sum of the years.

After an adjustment is made to the growth rate (G), the program proceeds to calculate forecasted earnings, based on the previous calculations (You will note that through these calculations we have formed the numerator in the equation for calculating intrinsic value.)

This equation continues as follows:

- For $J = 1$ to $T2$ 1 to final year
- Let $V(J) = 0$ Clear variable
- For $I = J$ to $T2$ J to final year

$$\text{Let } V(J) = V(J) + X(I)/(1+R(I))^{(I-J+1)}$$

- Next I
- Next J

Allows for the addition of each year's calculation + $X(I)$ forecasted earnings and dividend payout divided by $(1+R(I)$ discount rate) to the power of $(I-J+1)$ year

5 TERMINOLOGY USED IN STOCK ANALYSIS

1) PORTFOLIO ANALYSIS

- a) **HOLDING PERIOD** - a specified period of time in which the investor plans to hold the asset. The holding period is necessary to calculate such information as holding period yields. Holding period yields are used to calculate distributions and/or variability on debt yields and equity yields.
- b) **STOCK WEIGHTS** - the proportion of the portfolio placed in one security as opposed to another. The weights are the variables which the formulation ad-

justs to derive the optimum portfolio. As the weights vary, the portfolio's expected return and risk vary.

- c) **BUY AND HOLD** - the averages are categorized on the basis of the portfolio policy to buy each of the stocks in the market sample and simply hold these stocks permanently, therefore assuming returns are reinvested.
- d) **CONSTANT PROPORTIONS** - assumes that returns are not reinvested and the portfolio proportions of stock remains the same.
- e) **GEOMETRIC MEAN** - the average rate of return for a specified period of time.

FORMULA: $G_m = (1 + R/100)^n$

where R = percentage return each year, n = the number of years and G_m = the geometric mean, or average rate of return for n years.

- f) **MEAN OF LOG RETURNS** - mean calculated using the logarithm of values instead of the values themselves.

2) STOCK RATE OF RETURN

- a) **CLOSING SECURITY PRICE** - the annual stock market closing price for any given stock.

Stocks are often referred to as Securities

- b) **ARITHMETIC AVERAGE RETURN** - the sum of all values divided by the number of values.
- c) **STANDARD DEVIATION** - a measure of variance, which is the square root of the mean squared deviation.
- d) **COEFFICIENT VARIATION** - the standard deviation divided by the average return.

3) STOCK DIVIDEND ANALYSIS

- a) **INTRINSIC VALUE** - the worth of the stock. The intrinsic value of a stock does not reflect the par value or the market value. The intrinsic value theory states that a share of stock is worth the discounted present value of the payments that will be received by the holder.
- b) **NORMALIZED EARNINGS** - what the company would earn per share under normal conditions.

Example:

One unique year of earnings could throw off the entire projection. If in 8 years a company has 2 years of \$5.80 earnings/share but 6 years of \$5.00 earnings/share the normalized earnings would be \$5.00.

- c) **DISCOUNT RATE** - the rate of return earned on all stocks listed in the New York Stock Exchange.
- d) **LONG-TERM DISCOUNT RATE** - the rate of return earned on all stocks listed in the New York Stock Exchange, from a specified point in time continuing indefinitely.
- e) **LONG-TERM DIVIDEND PAYOUT RATIO** - the payout ratio is the ratio of the cash dividends to per-share profits after taxes. Long-term dividend payout ratio is simply a historical payout ratio starting from a specified point in time, continuing indefinitely.
- f) **ADJUSTMENTS** - all the adjustments refer to adjustments made in the expected growth rate.

1. **STRAIGHT LINE ADJUSTMENT** - implies a steady change in the growth rate.

2. **FAST** - implies that the adjustment follows a sum-of-the-years digits formula and that the rate changes quickly with the beginning of the adjustment period and slowly at the end. Sum-of-the-years digits - add the sum of the # of years, i.e., 5 years = $1 + 2 + 3 + 4 + 5 = 15$ and use this sum as the denominator of a series of fractions used in allocating the adjustment; for example, a 25 percent growth rate is calculated as follows:

Year	Adjustment Calculation	Adjustment	New Growth Rate
1st yr	5/15 of 25	8	17
2nd yr	4/15 of 25	7	18
3rd yr	3/15 of 25	5	20
4th yr	2/15 of 25	3	22
5th yr	1/15 of 25	2	23

3. **SLOW** - implies a reverse sum-of-the-years digits, so that the rate changes slowly in the beginning and quickly toward the end of the adjustment period.

- g) **ADJUSTMENT PERIOD** - refers to the number of years in which the specified adjustment is to be made.
- h) **PRESENT VALUE** - the current worth of a certain sum of money due on a specified future date, after taking interest into consideration.
- i) **P/E RATIO** - the relationship between the price of a stock and its earnings per share. The Price/Earnings ratio is calculated by dividing the stock price by its earnings per share.
- j) **VALUE/EARNINGS RATIO** - the intrinsic value divided by the earnings per share.

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CO16083-07 REV. 2