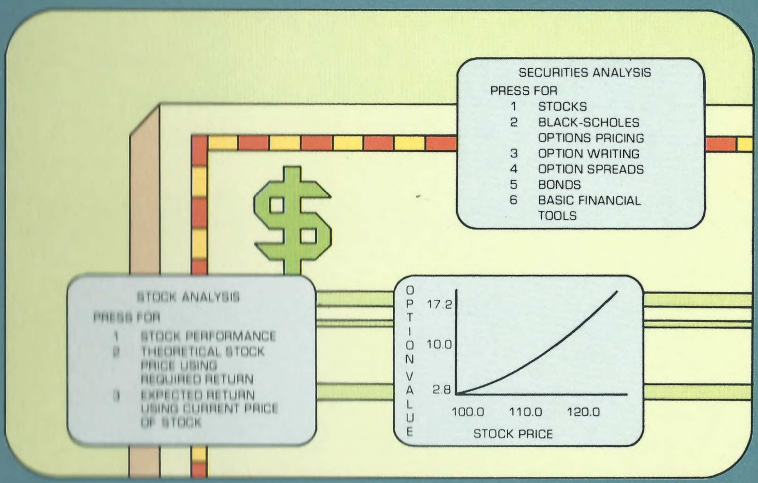
Texas Instruments Home Computer

Securities Analysis

SOLID STATE SOFTWARE™

COMMAND MODULE

Offers you a variety of securities analysis techniques — important financial tools that can help you make sound investment decisions.



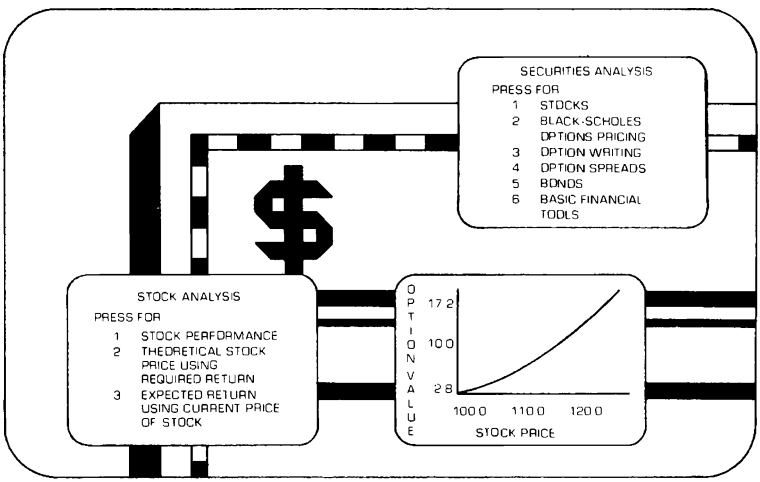
Quick Reference Guide

Note that the key sequences required to access special functions depend on the type of computer console you have. Important keystroke sequences are summarized here for your "quick reference."

TI-99/4	*TI-99/4A*	
ENTER	**ENTER**	Pressing **ENTER** after you have finished typing in your data tells the computer to accept the information and go on to the next step.
SHIFT Z (BACK)	**FCTN 9 (BACK)**	Returns to the beginning of the section on which you are working.
SHIFT W (BEGIN)	**FCTN 5 (BEGIN)**	Returns to the Securities Analysis selection list. All previously entered data is automatically erased.
SHIFT C (CLEAR)	**FCTN 4 (CLEAR)**	Erases data typed into the computer if pressed before **ENTER**.
SHIFT P	**FCTN P**	Prints a copy of a display if you have a printer attached to your computer.
SHIFT Q (QUIT)	**FCTN = (QUIT)**	Returns the display to the master title screen. *Note:* All data you have entered will be lost.

TEXAS INSTRUMENTS
HOME COMPUTER

Securities Analysis



This *Solid State Software*™ Command Module is designed to be used with the Texas Instruments Home Computer. Its preprogrammed solid-state memory expands the power, versatility, and capability of your Home Computer.

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INTRODUCTION

Every investor knows the importance of careful analysis and evaluation in making sound investment decisions. You must consider many factors: market fluctuations, tax effects, stock volatility, expected returns, commissions. Weighing these factors can be a complex — and time-consuming — procedure.

The Securities Analysis *Solid State Software*™ Command Module can help you gather the information needed for informed, effective decisions. You can quickly perform complex financial analyses based on the critical investment values that relate to your situation. For example, you can compute the theoretical value of a stock or use the Black-Scholes Options Pricing Model to estimate a fair value of options. You can compute the appropriate price or yield on a bond, or you can calculate the net present value and Internal Rate of Return for up to 99 variable cash flows.

By following the instructions in this manual and on the display screen, these securities analysis techniques are available to you:

- Stock analysis for yield and valuation
- Option analysis for pricing, hedges, and spreads
- Bond analysis for yield to maturity and market price
- Basic financial analysis tools for compound interest, annuities, variable cash flows, and calendar calculations

For your convenience, the Appendix contains the equations used in the programs and a selected bibliography of reference materials which provide background information.

Each section of this manual includes a brief explanation of the inputs. You can enter a maximum of ten characters, including a decimal point, for all inputs except dates. For dates, the limits are two digits for the month and day and four digits for the year. The following symbols provide the acceptable ranges for each value:

- ($x \geq 0, x < 0$) — input can be negative, zero, or positive
- ($x \geq 0$) — input can be zero or positive
- ($x > 0$) — input must be positive
- ($x = \text{integer} > 0$) — input must be a positive integer

Each of the inputs also has an upper limit which is specified in the explanation. If the numbers you enter do not conform to the acceptable values, the error message, DATA INCONSISTENCIES FOUND, is displayed. If this happens, check each of your inputs and change any that are not within the specified range.

Note: All answers computed by the programs are rounded to two decimal places. If you reenter these answers in other problems, the rounding may cause slight differences in the results.

With the optional Texas Instruments Solid State Thermal Printer attached to the Home Computer, you can make printed copies of the information shown on the displays.

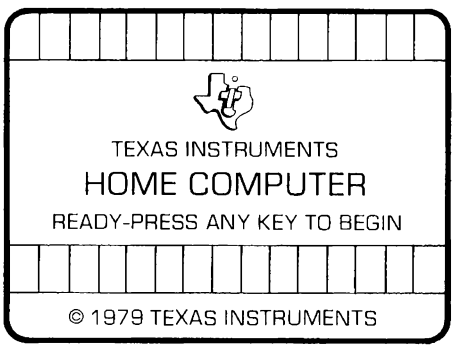
Sensitivity Analysis

One of the most useful features of the Securities Analysis module is the ease it offers for performing a sensitivity analysis — testing an investment calculation to see how it responds to slight changes in key values. Sometimes slight variations in one or more of your input values can influence your final investment decision. An example of a sensitivity analysis (using the Black-Scholes Options Pricing Model) is shown on pages 10-11.

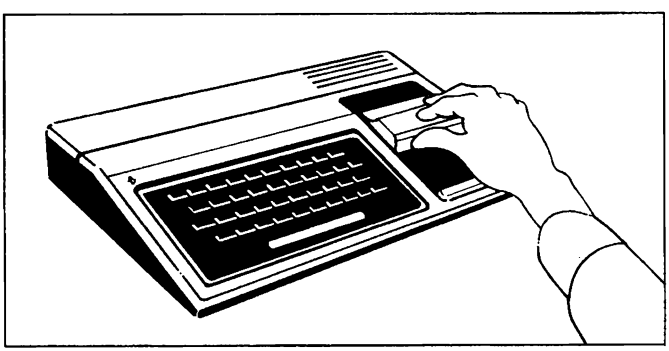
USING THE *SOLID STATE SOFTWARE*™ COMMAND MODULE

An automatic reset feature is built into the computer. When a module is plugged into the console, the computer returns to the master title screen. All data and program material you have entered will be erased.

Note: Be sure the module is free of static electricity before plugging it into the computer (see page 59).



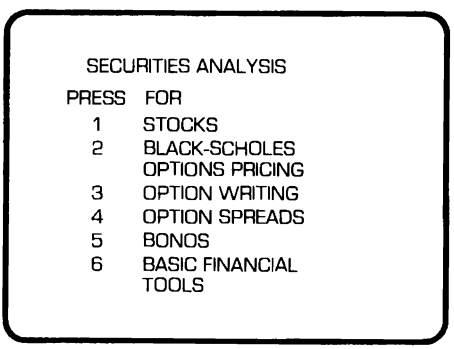
1. Turn the computer ON and wait for the master title screen to appear. Then slide the module into the slot on the console.



2. Press any key to make the master selection list appear. The title, SECURITIES ANALYSIS, is on the list. Select the module by pressing the key that corresponds to the number next to SECURITIES ANALYSIS.

Note: To remove the module, *first* return the computer to the master title screen by pressing **SHIFT Q**. Then remove the module from the slot. If you have any problem inserting the module, or if it is accidentally removed from the slot while in use, please see "In Case of Difficulty" on page 60.

After you choose the module, the title screen for SECURITIES ANALYSIS appears. You can press any key at this time to go immediately to the SECURITIES ANALYSIS selection list. (If you wait a few moments, the SECURITIES ANALYSIS selection list automatically appears.)



Your selection, of course, depends on the situation being analyzed. We'll look at each of these six choices later, but first let's examine the Black-Scholes Options Pricing Model. This model demonstrates the ease with which you can perform useful, but complex, securities analyses on your Home Computer.

DEMONSTRATION (Black-Scholes Options Pricing Model)

On August 16, 1980, the XYZ Company stock is selling for $103 7/8 ($103.875). Although you don't expect any dividends to be declared during 1980, you do expect a substantial price increase in the XYZ stock by the end of October.

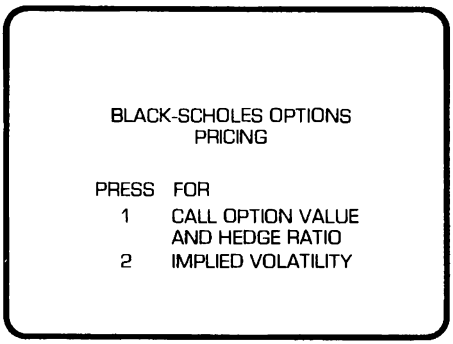
Rather than purchasing 100 shares of the stock, you decide to invest in an XYZ Company call option selling for $3.50 per share. The option has an October 20, 1980 expiration date and a $105 exercise price. This strategy limits your loss to the amount paid for the call option. Your potential gain is the difference between the future stock price and the option's exercise price less the call premium.

You might also prefer to buy an option that is underpriced relative to its theoretical value.

The Black-Scholes model computes an option's theoretical value based on your estimates of the stock's volatility and the risk-free interest rate. As with any evaluation model, you will probably want to vary key estimates, such as volatility, to see how sensitive the results are to changes.

You estimate that the stock's volatility is 25% and that the risk-free interest rate is 9.4%. What is the theoretical value of the "XYZ Co" option selling for $3.50 which expires on October 20, 1980? What is the change in the option's value if the stock price changes by $1.00 — the hedge ratio?

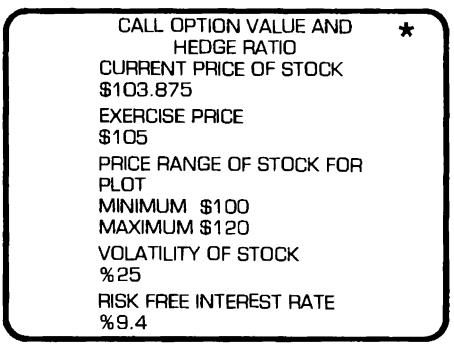
To answer these questions, press **2** to select the *Black-Scholes Options Pricing* model from the SECURITIES ANALYSIS selection list. The selection list for this analysis is shown here:



The Black-Scholes model can compute the call option (theoretical) value and the hedge ratio or the implied volatility. Press **1**, since the option value and hedge ratio are the unknown values. (The other alternative will be covered later.) The display then asks you for specific data, as shown. (Notice that you have only pressed three keys to reach this stage of analysis in the problem.)

When the display appears, the cursor (a flashing underline) will be flashing at the input position (data field) for the first question. Type in 103.875, the current stock price, and press the **ENTER** key. Pressing this key tells the computer you have answered its question. Next the 105 exercise price is typed, and the **ENTER** key is pressed to answer the second question. Now enter 100 for the minimum value and 120 for the maximum value. (These values are used for the graph and table shown later.) The program computes the option value for 11 stock prices over the range you specify.

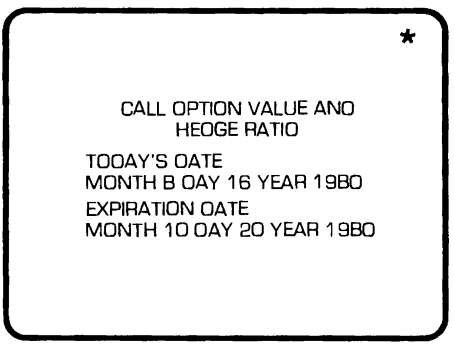
Next, enter 25 as the stock's volatility (your estimate of the stock price's future variability). An asterisk (*) now appears in the upper right-hand corner of the display to indicate that the next prompt is the last one on the display. If the TI Solid State Thermal Printer is attached to the console and you want a printed copy of all the inputs for this screen, follow these steps. First, type 9.4 for the risk-free interest rate; next, hold down the **SHIFT** key and press **P**. Then press **ENTER**. If you do not have a printer attached to your Home Computer or if you do not want a printed copy, type 9.4 and then press **ENTER**.



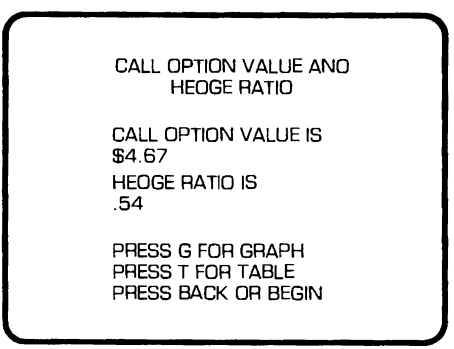
The computer next asks for calendar information.

The cursor is flashing at the input position (data field) for today's date — August 16, 1980 — the date for evaluating the option. Type the month (a number from 1 through 12) and press the **ENTER** key. The cursor then moves to the day input position. Type the day (a number from 1 through 31). When you get to the year data field, 19 appears automatically. Type the last two digits for any year in the 1900's. (For any date not beginning with 19, hold down the **SHIFT** key and press **C**. The 19 disappears from the data field, and you may enter all four digits for any year up to 2200.) Be sure to press the **ENTER** key after you answer each question.

(Notice that the asterisk again appears on the screen. Follow the procedure explained above to obtain a printed copy of this display.) Next, enter the expiration date, 10-20-80, following the same procedure used to enter today's date.



The next display asks for dividend information. For this example, we are not expecting any dividends. To skip these questions, press **SHIFT C** (CLEAR) or the **SPACE BAR**, then press **ENTER**. Now the display says "ONE MOMENT PLEASE." After about a minute, this answer appears:



Based on your inputs, the Black-Scholes model estimates a theoretical value for the XYZ option of $4.67 per share. Assuming the estimates for the volatility and risk-free interest rate are accurate, the option is underpriced since its theoretical value of $4.67 exceeds the quoted price of $3.50.

The hedge ratio of .54 indicates that the stock option will change $0.54 if the stock price changes by $1.00 and that to establish a neutral hedge, you would need to own 54 shares of XYZ stock for each 100-share call option written. To obtain a printed copy of this answer screen, press **SHIFT P** before you press **G** for the graph, **T** for the table, or **ENTER** to continue.

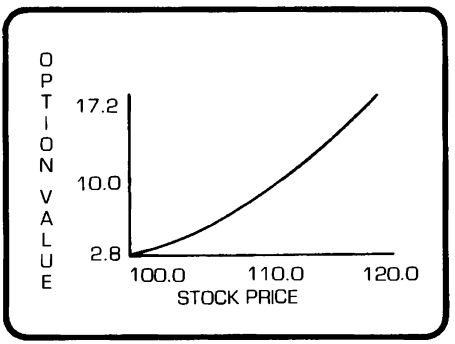
Now press **T**, and the computer displays this table on two screens:

CALL OPTION VALUE AND HEDGE RATIO

Option Value	*Stock Price*
2.84	100.00
3.72	102.00
4.74	104.00
5.91	106.00
7.21	108.00
8.64	110.00
10.18	112.00
11.81	114.00
13.53	116.00
15.31	118.00
17.15	120.00

Based on the minimum and maximum prices entered earlier, the program divided the stock range 100 - 120 into 11 intervals and computed the Black-Scholes value for each point. The results are displayed on the table shown above. To print a copy of the table, press **SHIFT P** before pressing **G** to see the graph or **ENTER** to continue.

By pressing **G** when the second part of the table is displayed, you can also review a graph of the stock prices and option values:



A colored line appears below the stock price range to mark the current stock price value. Pressing **SHIFT P** prints a copy of the graph.

Note: If your computer has less than 16K bytes of Random Access Memory (RAM), only the table is shown.

Press **SHIFT Z** (BACK) to return to the BLACK-SCHOLES OPTIONS PRICING selection list.

Changing Values for Sensitivity Analysis

Now let's change two values in the previous example to see how sensitive the option's calculated value is to slight differences in data. We'll assume you want to evaluate the option's value with a revised estimate of the stock's volatility (20%) and of the risk-free interest rate (9%).

Since the BLACK-SCHOLES OPTIONS PRICING selection list is shown, press **1** to solve for the call option (theoretical) value and the hedge ratio. The display shows 103.875 with the 1 flashing. Press the **ENTER** key and the price stays the same. Then the first number of the exercise price flashes. Press **ENTER** again to go to the next value. Also press **ENTER** for the minimum and maximum stock values.

Since you need to change the 25% volatility, you can choose one of two procedures when the 2 is flashing:

- Simply type in 20 and press the **ENTER** key, or
- Press **SHIFT** [→] (RIGHT) once to make the "5" flash. Then type **0** and press the **ENTER** key.

Next, change the original 9.4% risk-free interest rate to 9%. Then press the **ENTER** key as the first number in each date input position flashes. When the dividend question is asked, you must again enter blanks by pressing **SHIFT C** or the **SPACE BAR** and then pressing **ENTER**. The new values appear next on the screen, showing an option value of $3.77 and a hedge ratio of .54. Notice that the option is still theoretically underpriced after you changed your estimates of the volatility and the risk-free interest rate.

As you can see from this example, the program not only rapidly performs the calculations for you but also makes changing values for sensitivity analysis quick and easy.

OBTAINING PRINTED COPIES

If you have a TI Solid State Thermal Printer attached to your Home Computer, you can obtain printed copies of the information displayed. To print a copy of any answer screen, table, or graph, hold down the **SHIFT** key and press **P** while the data is displayed on the screen (*before* you press a key to go to the next screen).

When you are entering values and press **SHIFT P**, you get a printed copy of the data on the screen at that time. To print an entire input screen, watch for an asterisk (*) to appear in the upper right-hand corner of the screen to indicate that you have entered the next-to-the-last value. If you want a printed copy of all your input values, type your last value and then press **SHIFT P**. When the printed copy is completed, press **ENTER** to go on.

SPECIAL KEYS AND SYMBOLS

Now that you've seen an example of how this module works, you probably realize that most of the information you need is on the display. However, let's review the special keys and symbols which are utilized throughout the various module programs.

] The "end-of-field" symbol. The number of characters you can enter in any input position is limited by the amount of space available. When you reach that limit, this symbol appears to indicate that you cannot enter any more characters.

ENTER The "input completed" key. When you have finished typing in your data and have pressed the **ENTER** key, the computer accepts the information and goes to the next step.

Exception: You do not have to press the **ENTER** key when you are choosing an option on a selection list.

SHIFT Z (BACK) The "back-up" key. If you want to back up to the beginning of the section you're working on, hold down the **SHIFT** key and press **Z**. When you press **SHIFT Z** (BACK), all previously entered data is retained.

SHIFT W (BEGIN) The "start-over" key. If you want to return to the SECURITIES ANALYSIS selection list, hold down the **SHIFT** key and press **W**. When you press **SHIFT W** (BEGIN), all previously entered data is automatically erased.

SHIFT C (CLEAR) The "erase input" key. If you have typed information in a data field but have not pressed the **ENTER** key, you can erase your data by holding down the **SHIFT** key and pressing **C**.

SHIFT P The "print" key. To obtain printed copies of any display (except the Securities Analysis title screen and the "One Moment Please..." screen), hold down the **SHIFT** key and press **P**.

SHIFT ← (LEFT)

SHIFT → (RIGHT)

The "cursor movement" keys. **SHIFT ←** moves the cursor from right to left on the screen and **SHIFT →** moves the cursor from left to right. As the cursor passes over the data already on the screen, it does *not* erase any data.

SPACE BAR

SPACE KEY

The "erase" keys. The **SPACE BAR** and the **SPACE KEY** perform the same function. They enter the "blank space" character on the screen. When you "space" over a character already on the screen, that character is replaced by a blank space (erased).

SHIFT Q

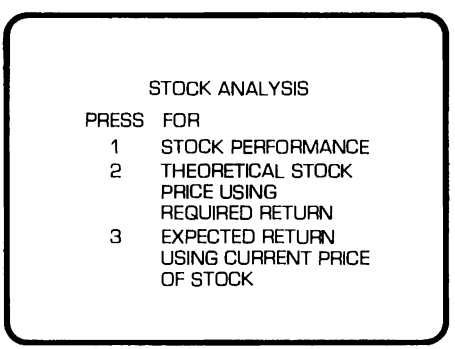
The "quit" key. Pressing **SHIFT Q** returns the display to the master title screen. *Note*: All data you have entered will be lost.

SECURITIES ANALYSIS TECHNIQUES

In addition to the Black-Scholes model, the Securities Analysis module contains five other analysis techniques. The techniques in the following sections are discussed in the order shown on the SECURITIES ANALYSIS selection list.

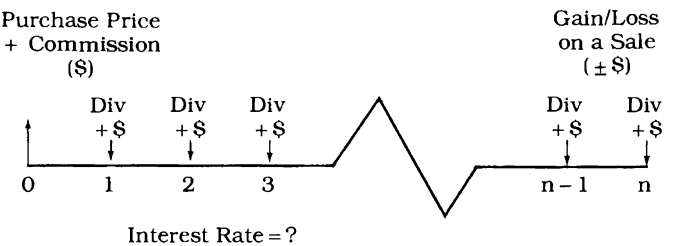
Stock Analysis

There are three types of stock analysis calculations:



Stock Performance

With the Stock Performance program, you can calculate the return (yield) on stock you have sold. Through an iterative method this program finds the interest rate that makes the present value of all after-tax cash flows (dividends and gain/loss on a sale) equal to the original cost of the stock. The following time-line diagram shows these basic cash flow assumptions.



The program allows you to specify your estimated marginal personal income tax rate so that the dividends will be included net of tax. You can also enter an estimated effective capital gains tax rate so that the gain or loss on the stock sale is included in the calculations on an after-tax basis.

The stock purchase price and commission per share are treated as the initial cash outlay (Present Value). Of course, dividends (net of tax) and the proceeds from the sale are treated as cash inflows. The stock sale can produce either a gain or loss. In either case, the stock cost is subtracted from the proceeds of the sale to determine a gain or loss for taxes. The tax on a gain reduces the net after-tax cash flow, but a loss increases the net after-tax flow (the program assumes you have other taxable income to benefit from the loss).

To access this program from the SECURITIES ANALYSIS selection list, press **1** for *Stocks*. Then press **1** again to select *Stock Performance*.

The inputs for the Stock Performance model are:

PERSONAL INCOME TAX BRACKET [x ≥ 0]

Enter your marginal personal income tax bracket as a percent less than 100. For example, if your marginal tax bracket is 42%, enter 42, not .42. The program applies this rate to the dividend payments. (If you want to omit the personal income tax here, enter a zero in this step.)

CAPITAL GAINS TAX RATE [x ≥ 0]

Enter the effective capital gains rate (less than 100%) that applies to the gain or loss on the sale of the stock. (This is the actual rate at which the gain or loss is taxed.) Enter a zero to omit the tax. The program assumes you have other capital gains to offset a loss on the sale and to benefit from the resulting tax reduction. If you did not hold the stock long enough to qualify for capital gains treatment, you may want to enter your personal income tax rate here also.

NUMBER OF DIVIDEND PERIODS PER YEAR [x > 0]

Enter the number (less than 367) of dividend periods per year. For example, enter 4 for quarterly or 1 for annual payments. (If the dividends are paid on an irregular basis, enter a close approximation.)

DIVIDEND PAYMENTS [x ≥ 0]

The program asks for the amount of each dividend. For each dividend period indicated above, enter the dividend amount per share. After you have entered your final dividend and are asked for another one, enter blanks by pressing **SHIFT C** (CLEAR) or the **SPACE BAR**. Then press **ENTER** to go to the next question.

Note: The Stock Performance model assumes that dividends are paid at the *end* of each period and that the stock is sold at the *end* of the last dividend period.

BUYING PRICE PER SHARE [x > 0]

In this step, enter the quoted price paid per share. Do not include commissions because the program automatically adds commissions to the amount entered here.

BUYING COMMISSIONS PER SHARE [x ≥ 0]

Enter the commission dollar amount per share which was paid when the stock was purchased. If commissions are not being considered, enter a zero (0). (The buying commission must be less than the buying price.)

SELLING PRICE PER SHARE [x > 0]

Enter the selling price per share.

SELLING COMMISSION PER SHARE [x ≥ 0]

Enter the dollar amount of commissions paid per share on the stock sale. Again, if commissions are not being considered, enter a zero (0). The amount of these commissions must be less than the selling price.

After you enter the sales commission, the yield (return) automatically appears, showing the percentage yield per dividend period and per year. The yearly rate is found by multiplying the dividend period yield rate by the number of dividends paid each year. (The number of compounding periods per year is equal to the number of times per year dividends are paid.)

Press **SHIFT Z** (BACK) to return to the initial Stock Performance display.

Example: Assume that you have a personal income tax rate of 35% and a capital gains tax rate of 14%. You purchase a stock paying quarterly dividends of the following amounts.

Dividend Number (Quarter)	1	2	3	4	5	6	7	8
Dividend Amount per share	.75	.75	.75	1.25	.75	.75	0	.25

You bought the stock for $30 a share plus $0.55 commission per share. You sold the stock two years later at $38.50 per share with a $0.65 commission per share. *ANSWER*: The yield per dividend period (quarterly) is 3.69% with a 14.75% annual yield on the stock for the two years it was held.

Theoretical Stock Price and Expected Return

Alternatives 2 and 3 on the STOCK ANALYSIS selection list also compute stock price or yield by the same basic approach as the stock performance model, but they employ your estimates of future values rather than actual past values. The estimated dividends for one or more intermediate growth periods and the terminal stock value at the end of the last intermediate growth period are discounted (at your desired rate of return) to present value to determine the current theoretical stock price. If the stock price is known, the yield (discount rate) is computed from the dividends and the terminal stock value.

Both the Theoretical Stock Price and the Expected Return models assume equal dividend periods with payments and compounding occurring at the end of each period. Enter all growth periods as years and all growth rates as annual amounts. For each growth period, the programs automatically convert the years to compounding periods and the annual growth rate to the amount per dividend period. The number of compounding periods in a growth period is equal to the number of years entered multiplied by the number of dividend payments per year. The growth rate per compounding period is equal to the annual growth rate divided by the number of dividend payments per year.

The dividends can have a zero or constant value, or they can vary according to growth estimates. The value of the stock at the end of the last intermediate growth period (the terminal stock value) can be estimated by one of the procedures on page 19.

Since both alternatives 2 and 3 are flexible, you can perform a number of useful and practical sensitivity analyses. The following are the inputs for these analyses.

CURRENT DIVIDEND/ CASH FLOW [x≥0]

For dividends growing at one or more rates, enter the base amount per share in this step. Normally the last current dividend paid is the base amount, but you can enter any desired amount per share in this step. If no dividends are received, enter a zero for the base amount, the number of years the stock is held for the first growth period, and a zero for the growth rate.

NUMBER OF DIVIDENDS PAID PER YEAR [x≥0]

Enter the number (less than 367) of expected dividend payments per year in this step. For example, type 1 for yearly payments or 4 for quarterly payments. The program assumes equal dividend periods with payments and compounding occurring at the end of each period. If no dividends are paid, enter the number of compounding periods per year in this step.

REQUIRED RETURN ON INVESTMENT [x≥0]

If you are solving for the theoretical stock price (alternative 2 on the STOCK ANALYSIS selection list), enter your required annual return rate on the investment (the discount rate) as a percent. If you are solving for the yield (alternative 3 on the STOCK ANALYSIS selection list), this question is omitted, and the next question is asked instead.

CURRENT STOCK PRICE [x>0]

If you are solving for the yield (alternative 3), then enter the dollar amount per share in this step. This step is omitted if you are solving for the theoretical stock price (alternative 2).

DIVIDEND GROWTH RATE PER YEAR [x≥0] AND NUMBER OF YEARS AT THIS GROWTH RATE [x>0]

This display requests information on the first intermediate growth period. Enter the intermediate growth rate (and the length of the growth period in years.) If, for example, a stock is expected to have two years of quarterly dividends growing at 16% annually (compounded quarterly), followed by four years of growth at 10% (compounded quarterly), and then stabilizing to a constant growth rate of 8%, the program automatically computes the two intermediate growth periods (8 dividend periods at 4%, 16 dividend periods at 2.5%) and a final steady state growth rate of 8% annually (2% per compounding period).

In this case, the inputs would be:

Intermediate Growth Rate 01
16 (rate)
2 (years)
Intermediate Growth Rate 02
10 (rate)
4 (years)

You can also analyze two other dividend situations — constant dividends and no dividends.

If the dividends in a growth period are constant (no growth), enter a zero for the growth rate. Then enter the number of years the dividends will be paid.

If no dividends are paid, enter a zero for the current dividend and a zero for the first intermediate growth rate. Then, for the number of years in the first growth period, enter the number of years the stock will be held. (Note that, in this case, the module program assumes no dividends will ever be paid.)

Note: When a non-zero value is entered for the current dividend, large growth rates over a long period of time can generate peculiar results.

After you have entered your final growth rate period and are asked for the next growth rate, enter blanks by pressing **SHIFT C** (CLEAR) or the **SPACE BAR** and then pressing **ENTER**.

Terminal Stock Value (Steady State Value)

After you complete the growth rate information, select the method for determining the terminal stock value (market value) at the end of the last intermediate growth period. Press one of the following keys:

1 for the steady state dividend growth model to determine the terminal stock value.
2 to input an estimate of the terminal stock value.
3 for an earnings per share and/or a price-earnings ratio method of estimating the terminal stock value.

ALTERNATIVE 1: STEADY STATE DIVIDEND GROWTH RATE [x ≥ 0]

This alternative assumes that the terminal stock value is equal to the present value of the steady-state dividends received perpetually. Enter your steady-state dividend growth rate, which must be less than the required return. The terminal stock value is then computed at the end of the last growth period of the steady-state dividends. In other words, the terminal stock value is the present value of an infinite stream of dividends increasing at the steady-state growth rate entered in this step. Consequently, the program uses the dividend amount at the end of the last intermediate growth period as the initial steady-state dividend. When computing the theoretical price, the current discount rate must exceed the steady-state growth rate. If not, the program asks you to reenter the value. Using the example mentioned earlier, the input here for Steady State Growth Rate would be 8(%). If dividends are assumed to remain constant, enter a zero.

Note: If you entered a zero for the current dividend, this alternative is not applicable.

ALTERNATIVE 2: ENDING PRICE [x ≥ 0]

For this alternative, enter your estimate of the stock price per share at the end of the last intermediate growth period. This amount then becomes the terminal stock value.

ALTERNATIVE 3: ENDING EARNINGS PER SHARE [x ≥ 0] AND PRICE EARNINGS [P/E] RATIO METHOD [x ≥ 0]

By selecting this alternative, you can estimate the terminal stock value, based on the estimated earnings per share and the price earnings (P/E) ratio at the end of the last intermediate growth period. First, type in the amount of the earnings per share and press the **ENTER** key. Second, enter the estimated Ending P/E ratio. If this value is positive, the terminal stock value is equal to:

Earnings Per Share × Price to Earnings ratio

If you enter a zero for the P/E ratio, the terminal stock value is computed as the present value (at the end of the last intermediate growth period) of the earnings per share discounted perpetually at the required return rate.

After the inputs are completed, the solution shows either the theoretical stock price or the yield of the stock. Pressing **SHIFT Z** (BACK) returns the display to the first screen for Theoretical Stock Price or Expected Return. You can then make any changes you desire and recompute the new values. Remember, only those items being changed need to be reentered for subsequent sensitivity analyses.

Example: When the STOCK ANALYSIS selection list is displayed, press **2** for *Theoretical Stock Price Using Required Return*. Assume that the current dividend on your stock is $0.75 and that dividends are paid quarterly. Your required return on the investment is 12%, and there are two intermediate growth periods with an 8% steady state rate. The first annual growth rate is 16% for 2 years, and the second is 10% for 4 years. To find the stock value, press **1** for *Steady State Dividend Growth Rate* and enter 8%. *ANSWER*: The Theoretical Stock Price is $95.17.

Option Analysis

Investors have been taking an increasing interest in options, especially since the creation of the Chicago Board Options Exchange. Options let the investor speculate on common stock prices without necessarily owning the stock. An additional advantage is that potential losses or gains can be limited by various option strategies. Since some of the option terminology may be unfamiliar to you, let's briefly discuss options before examining the Securities Analysis module's techniques.

An option is a contract giving an investor the right to buy or sell a specified stock at a given "*exercise*" or "*striking*" price during the life of the agreement. Options are written in 100 share lots and are normally good from one to nine months. The *premium* is the price paid for the option and is quoted on a per share basis. The common stock involved in the option is called the underlying stock. Finally, the option can be exercised at any time up to, and including, the *expiration date*.

The option *buyer* is the person who pays the premium and can decide whether to exercise the option. The option seller (*writer*), on the other hand, receives the premium and is obligated to honor the contract, but has no control over the buyer's subsequent actions.

Call Options and Put Options

A *call* option enables an investor to purchase 100 shares of the underlying stock at the exercise price on or before the expiration date. The opposite of a call is a *put* option. The put option buyer purchases a put contract for the right to sell 100 shares of the stock to the writer (seller) of the contract at a specified exercise price on or before the option expiration date. In other words, the put option buyer purchases the right to sell the stock at a guaranteed price.

Although these descriptions apply to both conventional (arranged with a broker) and listed (traded on listed stock exchanges) options, many investors trade only in listed options. These investors can easily close out their option position before an expiration date to maximize their gain or minimize their loss. The Option Writing and Option Spreads programs (pages 27-34) assume that a secondary market exists for options so that option positions can be reversed or modified.

The Securities Analysis module has three powerful and useful option analysis techniques that can help you plan investment strategies. These techniques are:

- The Black-Scholes Options Pricing Model,
- Option Writing, and
- Option Spreads.

Black-Scholes Call Options Pricing Model

The Black-Scholes model helps you estimate either a call option's theoretical value and its hedge ratio or its implied volatility. The hedge ratio provides you with an estimate of the option's price sensitivity to small changes in the underlying stock's price. You can also use this ratio to establish a neutral hedge between the option and its underlying stock. This technique is discussed under Option Writing and Option Spreads.

In estimating an option's value, the program for the Black-Scholes model makes the following assumptions.

- The short-term or risk-free interest rate is known and constant throughout the contract's life.
- The stock price follows a random pattern with a standard deviation proportional to the stock price. The stock price is lognormally distributed over the time period. The standard deviation (volatility) of the return is constant and known.
- The option can be exercised only on its expiration date (a European option). The model also works for American options written on non-dividend-paying stocks. American options can be exercised at any time prior to expiration.
- No commissions are involved in buying and selling either the option or the stock.
- It is possible to borrow any fraction of the price of the security, and to buy or hold the security, at the short term interest rate.
- There are no penalties for selling a stock or option short.

In its simplest form, the Black-Scholes model *assumes* that the stock pays no dividends during the contract period. The program, however, makes an adjustment to accommodate dividends by reducing the stock price by the present value of the dividends discounted at the risk-free rate.

When the SECURITIES ANALYSIS selection list is displayed, press **2** for *Black-Scholes Options Pricing*. Next, you are asked to select the unknown value. Press **1** to solve for the option value and hedge ratio, or press **2** to solve for the implied volatility. The computer then prompts you for the following information. (Press the **ENTER** key after all inputs, except where indicated otherwise.)

CURRENT PRICE OF STOCK [x > 0]

Enter the underlying stock's current price per share. If you are estimating the option's value at a future date, enter the stock's estimated price per share as of that date.

EXERCISE PRICE [x > 0]

Enter the exercise price per share on the option's expiration date.

PRICE RANGE OF STOCK FOR PLOT [x > 0]

The program will later display a graph and a table showing the relationship between the option value and the stock price. In this step you enter the minimum and maximum stock prices for the graph and table. (The difference in these two prices cannot exceed $900.) *Note*: This question is omitted if you are solving for the implied volatility.

VOLATILITY OF STOCK [x > 0]

An estimate of the stock's volatility (the estimated standard deviation of the stock's return) is necessary if you are solving for the option value and hedge ratio. The volatility is entered as a percent. Since you are estimating the stock's *future* price variation, the volatility is the least certain of all the model's inputs. However, a number of reasonable methods for estimating stock volatility are available. For example, you could call your broker for the value or use the values provided in investment publications, such as the *Value Line Convertible Survey*. You can also use alternative 2 of this program to estimate the volatility.

RISK FREE INTEREST RATE [x > 0]

Estimate the annual short-term risk-free interest rate. Good starting points for estimating are the rates on appropriate Treasury Bills, large denomination Certificates of Deposit, or prime commercial paper during a similar period. Enter the estimated value as a percent. Since the model is sensitive to this value, it must be estimated carefully to get accurate results.

TODAY'S DATE

Enter the date for estimating the option's value or implied volatility in this step. Indicate the month (a number from 1 through 12), the day (a number from 1 through 31), and the year (two digits for 1900's or four digits for 2000 to 2200).

EXPIRATION DATE

Following the same procedure as above, enter the expiration date. If you enter a date which is prior to the previously entered value, the program asks for the expiration date again.

DIVIDEND AMOUNT [x ≥ 0]

The Black-Scholes program can evaluate up to 99 dividend payments. Each payment must be less than the current price, the exercise price, and/or the minimum price. The dividends are discounted back to present value at the annual risk-free interest rate. This value is subtracted from the current stock price before either the option value or implied volatility is computed. If the present value of the dividends exceeds the stock price for any of the 11 values in the price range, an error message is shown.

For each dividend payment, enter the amount and the date. (If you do not expect to receive any dividends, press **SHIFT C** (CLEAR) or the **SPACE BAR** and then press **ENTER**.) If any dividend date falls before the current date or after the exercise date, the program asks for the date again. When you have entered all your dividends and are asked for another one, press **SHIFT C** (CLEAR) or the **SPACE BAR**. Then press **ENTER** to go to the next question.

PRICE PER OPTION [x > 0]

Enter the option price per share (must be less than the current stock price) if you are computing the implied volatility. (This question is not asked if you are solving for the option's value.)

SOLUTION FOR OPTION VALUE AND HEDGE RATIO

The display shows the call option value on a per share basis with the hedge ratio shown as a percent. Press **T** to see a table of the option values over the stock price range entered previously. Press **G** to display a graph plotting the values shown on the table. The original option value will be indicated on the graph by a colored marker. *Note*: If your computer has less than 16K bytes of RAM, only the table is displayed.

To return to the BLACK-SCHOLES OPTIONS PRICING selection list, press **SHIFT Z** (BACK).

SOLUTION FOR IMPLIED VOLATILITY

The display gives the implied volatility as a percentage. The program determines the volatility rate by finding the value which, in conjunction with your other inputs, computes an option value equal to the option price entered above. Note that the table and graph are not available when you are solving for volatility.

Since an example for Option Value and Hedge Ratio was explained previously, an Implied Volatility problem is included here. When the BLACK-SCHOLES OPTIONS PRICING selection list is displayed, press **2** for *Implied Volatility*.

Example: The current stock price is $90, the exercise price is $100, and the risk-free interest rate is 10%. Assume today's date is July 25, 1980 and the stock expires on December 20, 1980. The stock will pay three dividends between the two dates: $0.75 on 8-22-80, $0.90 on 9-26-80, and $0.85 on 10-24-80. The price paid per option is $3.85. *ANSWER*: The Implied Volatility is 31.49%.

Option Writing

The technique of writing (selling) options partially covered by stock is often called "ratio writing" or "variable hedging." The program assumes that you are the option writer.

You can use this program to evaluate two ratio-writing strategies:

1) writing call options and purchasing the underlying stock, or
2) writing put options and shorting the stock. A short sale occurs when you sell stock you do not own, expecting to repurchase it at a lower price on a future date.

If the call or put options are held to maturity, the program computes the maximum possible profit and the stock price range within which a profit is earned. This gain or loss calculation includes commissions.

On the other hand, if the hedge position is closed out on a date prior to the exercise date, the Option Writing model estimates the gain or loss for call options. Both the future option value and the future stock price are unknown values. If you enter estimates of the future stock price range (minimum and maximum prices), the program uses the Black-Scholes model to compute estimated option values for each of the 11 stock prices.

After determining the option values, the Option Writing program estimates the close-out value of the entire position, i.e., the net cash flow if the original transaction is reversed. The option written earlier is now purchased, and the stock is either sold (for a call option) or purchased (to cover the stock shorted for a put option). This procedure is repeated for each stock price. The resulting gains or losses are displayed both in a graph and in a table. Commissions on options sold or purchased are not included when you are calculating the gain or loss before expiration. The gain or loss is the difference between the initial cash position and the close-out cash flow.

The hedge ratio computed by the Black-Scholes model can be utilized in the Option Writing program to establish a neutral (risk-free) hedge so that small price changes over a short period in the underlying stock do not affect the investor's position. Of course, as the prices change over longer periods, the hedge position must be adjusted, and the resulting transaction costs could be prohibitive. (If there were no transaction costs and if the hedge position could be continually adjusted, the position would be risk-free and theoretically could earn the risk-free rate of return.)

When the computer displays the SECURITIES ANALYSIS selection list, press **3** for *Option Writing*. You are then asked to provide the following information. (Use the **ENTER** key for all inputs, except where indicated otherwise.)

NUMBER OF OPTIONS WRITTEN [SOLD] [x = integer > 0]

Type in the number of options written, in 100 share lots. Thus, an option for 400 shares would be entered by typing in 4.

ARE THE OPTIONS PUTS OR CALLS [P OR C]?

Enter **P** for puts or **C** for calls.

PRICE PER OPTION [x > 0]

Enter the option price per share.

TOTAL COMMISSION ON OPTIONS [x ≥ 0]

Enter the *total* commissions (not the per share amount) in dollars. The program assumes the commissions are less than the price paid in total for the option. Any value greater than this or less than zero will cause the question to be repeated.

EXERCISE PRICE [x > 0]

Enter the exercise price on a per share basis.

NUMBER OF SHARES PURCHASED [x = integer > 0]

For call options, the Option Writing program asks for the number of shares purchased; for put options, the program asks for the number of shares shorted.

CURRENT PRICE OF STOCK [x > 0]

Enter the current per share price of the stock.

AVERAGE COMMISSION PER SHARE [x ≥ 0]

Enter the *average* stock commission paid per share *as a percent* less than 100.

DIVIDEND AMOUNT AND DATE [x ≥ 0]

For each dividend payment, enter the amount and date. Each amount must be less than the current price and the exercise price. Remember that when stock is shorted, you must pay the dividends to the person supplying the stock. However, you keep the dividends for stock that is purchased.

After you enter the last payment date, enter blanks by pressing **SHIFT C** (CLEAR) or the **SPACE BAR**. Then press **ENTER** to continue. The next display shows two types of profit projections. Press **1** for profit at expiration or **2** for profit prior to expiration.

Profit Projection: At Expiration

When you press **1**, the display shows three values: the maximum profit (including commissions), the upper breakeven stock price, and the lower breakeven point. The upper breakeven point for calls and the lower breakeven point for puts are the stock prices where the profit is zero, assuming the option is exercised. However, the lower breakeven point for calls and the upper breakeven point for puts are the stock prices where the profit is zero, assuming the option is not exercised. With certain combinations of values, one of the breakeven points does not exist. In these instances, the display shows "NONE" for the breakeven value, and the graph is not available. For the Option Writing program to display a graph, the upper breakeven point must exceed the lower breakeven point and the exercise price must fall between the two points.

After the table appears, press **G** to display the graph. Pressing **T** returns the table. To return to the first Option Writing display, press **SHIFT Z** (BACK).

Profit Projection: Prior to Expiration

From the profit projection display, press **2** to project the profit (ignoring commissions) prior to the expiration date. The program uses the Black-Scholes model to compute the option's value on the projected profit date; therefore, you must enter the following additional information.

VOLATILITY OF STOCK (x > 0)
Enter the underlying stock's volatility as a percent.

RISK FREE INTEREST RATE (x > 0)
Enter the risk-free interest rate as of the projected profit date.

DATE AT WHICH TO COMPUTE THE PROJECTED PROFIT
Enter the date for which you plan to calculate any gain or loss. This date, and the dividend dates entered previously, must be prior to the exercise date.

EXERCISE DATE FOR OPTION PURCHASED
Enter the option's exercise date.

PRICE RANGE OF STOCK FOR PLOT (x > 0)
Enter the minimum and maximum stock ranges for the profit projection. The difference in this range must not exceed $900.

After you have entered the minimum and maximum stock prices, the display shows a table of the projected profit values.

If you press **G** (Graph), the values on the table are shown in a graph. You can press **T** to see the table again. *Note*: If your computer has less than 16K bytes of RAM, only the table is shown.

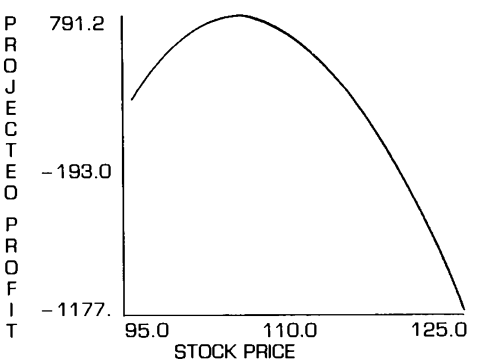
To return to the first Option Writing display, press **SHIFT Z** (BACK).

Example: Assume that you wrote three call options at $5.25 per option, and you paid a total of $76.00 in commissions to sell the options. The exercise price for the options is $110.00. You also established a hedge by purchasing 100 shares of the underlying stock at the current price of $105.00 per share. The commissions averaged 1.5% of the stock's value. You expect one dividend of $2.00 to be paid on October 1, 1980.

First, if you can hold the call option to expiration, what is your potential gain or loss? (Press **1** for *Expiration.*) *ANSWER*: The maximum profit is $1876.50, the upper breakeven point is $115.99, and the lower breakeven point is $90.95.

Second, to evaluate the option prior to expiration, follow these steps. First, press **SHIFT Z** (BACK) to return to the first Option Writing display. Then press **ENTER** for each value since these have not changed. For dividend 2, enter blanks by pressing **SHIFT C** (CLEAR) or the **SPACE BAR** and then **ENTER**. Then press **2** for *Prior to Expiration.*

Assume a 25% volatility and a 9.4% risk-free interest rate. The projected profit date is September 4, 1980, and the exercise date is October 20, 1980. Use a price range of $95 to $125 for the projections.



Call Option Spreads

Option spreading is the technique of simultaneously writing (selling) and buying call options on the same underlying stock. Options with the same expiration dates and different exercise prices are called "Vertical" spreads. "Horizontal" spreads, on the other hand, have different expiration dates and the same exercise price. "Diagonal" spreads can be established when both the expiration dates and exercise prices are different. Spreads can also be established where the ratio of options written to options sold varies.

This program computes the spread value (the cash flow from closing out a position) on the date you specify. However, the cash flow incurred when the position was established is not included in the calculations. To determine your gain or loss on a spread, find the difference between the spread value and the original cash flow resulting from establishing the spread.

As in the other option programs, you enter low and high stock prices to establish a range for the analysis. The range is divided equally to get 11 stock prices, and the spread value is computed for each price. Depending on the spread being evaluated, you may have to experiment with the low and high stock prices before the graph shows all relevant values.

The final entry required is the date at which to compute the spread value.

When the spread value date precedes an option's expiration date, the program uses the Black-Scholes model (and assumes that no dividends are paid) to estimate the option's value. If the spread value date is equal to the option's expiration date, the option's value is calculated by one of two procedures. First, if the stock price exceeds the exercise price, the option's value is the difference between these prices. Second, if the stock price is less than or equal to the exercise price, the option's value is zero. The earliest expiration date is the latest spread value date that can be entered if the options have different expiration dates.

To access this program from the SECURITIES ANALYSIS selection list, press **4** for *Option Spreads*. To answer the following questions, type in the answer and press **ENTER**, except where indicated otherwise.

The program first asks for all of the information on Call Option 1, followed by the same prompts for Call Option 2.

OPTION 1

IS THE CALL A BUY OR A SELL [B OR S]?

Enter **B** (or BUY) if purchasing or **S** (or SELL) if writing Call Option 1. If Call Option 1 is a purchase, then the program will assume Call Option 2 is a sell and vice versa.

NUMBER OF OPTIONS [x = integer > 0]

Enter an integer number (1, 2, 3, 4, etc.) for the number of 100-lot shares in this transaction.

EXERCISE PRICE [x > 0]

Enter the exercise price for the first call option.

EXPIRATION DATE

Type in the month (1 through 12), the day (1 through 31), and the year (two digits for 1900's or four digits for 2000 to 2200).

OPTION 2

Answer the same questions for Call Option 2 as you did for Call Option 1.

PRICE RANGE OF STOCK FOR PLOT [x > 0]

Enter the minimum price and the maximum price. These two values determine the range of stock prices for the graph and table and must have a difference not exceeding $900.

VOLATILITY OF STOCK [x > 0]

Type in the underlying stock's volatility as a percent. If you plan to evaluate the spread value on the exercise date, this input and the next input are not used.

RISK FREE INTEREST RATE [x > 0]

Enter the risk-free interest rate as a percent.

DATE AT WHICH TO COMPUTE SPREAD VALUE

Enter the month, day, and year for evaluating the spread.

The table showing the solution for Option Spreads is displayed on two screens about one to two minutes after you enter the spread value date. This table shows the 11 spread values in the stock price ranges. When you press **G**, you see the graph showing the spread values over the stock price ranges. (*Note*: If your computer has less than 16K bytes of RAM, only the table is shown.)

You can return to the table by pressing **T** or to the start of the spread program by pressing **SHIFT Z** (BACK).

Example: Assume for Call Option 1 that you sell one option at an exercise price of $90.00 with an expiration date of December 19, 1980. Then Call Option 2 is automatically a buy. You purchase one option at an exercise price of $90.00 with an expiration date of November 21, 1980. Use a price range of 91 to 101 for the graph. The stock's volatility is 25%, and the risk-free interest rate is 9.4%. Compute the projected profit on November 21, 1980.

Spread Value	*Stock Price*
239.99	91.00
204.68	92.00
175.01	93.00
150.47	94.00
130.49	95.00
114.49	96.00
101.88	97.00
92.08	98.00
84.60	99.00
78.97	100.00
74.80	101.00

Bond Analysis

For bonds with one or more remaining coupon payments, the program computes the bond's market price or its yield to maturity. It also calculates the bond's duration.

The market price is the amount an investor pays to purchase a bond, and the yield to maturity is the return earned on the bond if it's held to maturity. A bond returns cash to the investor in a series of periodic coupon payments with the last payment equal to the par value (face value) of the security plus the final coupon payment. The coupon payments are usually a set amount paid semi-annually. The amount of the coupon payment is computed by multiplying the bond's nominal interest rate (the value printed on the bond) by the par value and then dividing by the number of payments per year. Since the number and amount of coupon payments and the par value of the bond are fixed, the price paid for the bonds must be adjusted to reflect the market's yield to maturity requirements.

Yield to maturity is the interest rate that discounts the premium payments and par value to an amount equal to the current market price. When the yield to maturity for a bond exceeds its nominal interest rate, the bond sells at a discount relative to its par value. If the nominal interest rate exceeds the yield to maturity, the bond then sells at a premium relative to its par value.

The bond's duration provides a measure of the sensitivity of bond prices to changes in the market interest rates. The duration is a weighted-average measure of the dates at which a bond provides cash payments, weighted by the percentage of the total present value of the Cash Flows represented by each payment. Bonds with similar durations are likely to react similarly when interest rates change. The longer the bond's duration is, the more sensitive the bond's price is likely to be.

You access the Bond program by selecting option 5 when the SECURITIES ANALYSIS selection list is on the screen. The BONDS selection list then appears.

Press **1** to compute the annual yield to maturity or **2** to compute the current market price. The inputs for both alternatives are basically the same. Any differences will be pointed out in the following explanations.

IS THE BOND SOLD ON AN INTEREST DATE [Y or N]?
Enter "Y" if the bond is sold on a coupon interest date or "N" if it is sold between coupon interest dates.

NUMBER OF COUPON PAYMENT PERIODS PER YEAR [x > 0]
Enter the number (less than 367) of times coupon payments are made each year. For example, enter 1 for annual payments, 2 for semi-annual payments, or 4 for quarterly payments.

ANNUAL YIELD TO MATURITY [x > 0]
If you are solving for bond price, enter the annual yield to maturity as a percent in this step. (If you are solving for yield, this question is not shown on the screen.)

ANNUAL COUPON RATE [x > 0]
Enter the annual coupon rate (the annual rate printed on the Bond) as a percent.

MARKET PRICE [POINTS] [x > 0]
If you are solving for yield to maturity, enter the market price of the bond in points. In other words, a bond priced at $1058.75 is entered as 105.875. Do not include any accrued interest which is due the seller. (If you are solving for market price, this question is omitted.)

MATURITY VALUE [POINTS] [x > 0]
Enter a single bond's maturity value in points here. A $1000 par bond, for example, would be entered as 100.

SETTLEMENT DATE
Enter the month, day, and year the bond transaction occurs (the date on which the bond is sold or purchased). This date must be on or before the Next Coupon Date.

DATE OF NEXT COUPON PAYMENT — Enter the month, day, and year of the next coupon payment. This date must be prior to the maturity date.

MATURITY DATE — Enter the date the bond is to be redeemed.

After you have provided all of the requested information, the bond solution is displayed. The screen shows either the annual yield to maturity or the market price and accrued interest. With either of the two solutions, you are also given the bond's duration in years.

This program also computes the accrued interest for bonds sold between interest dates. The program determines the number of accrued interest days (the number of days the seller has held the bond since the last coupon payment) and the number of days in the current coupon period.

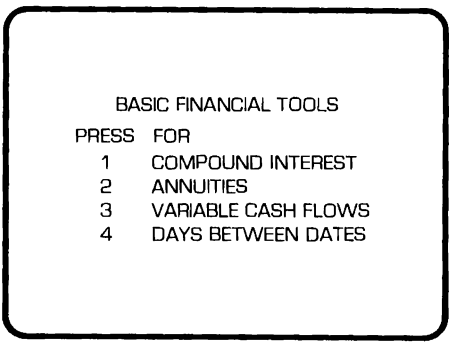
The accrued interest due the seller is found by multiplying the periodic coupon payment by the ratio of the accrued interest days to coupon period days.

Pressing **SHIFT Z** (BACK) returns you to the BONDS selection list.

Example: Assume that you want to estimate the yield on a bond which is to be redeemed on an interest date and which receives semi-annual coupon payments at an annual rate of 7%. The bond's market price in points is 98.5% (985) and its maturity value in points is 100.0% (1000). The settlement date is May 20, 1980; the next coupon payment date is August 15, 1980; and the maturity date is February 15, 1990. *ANSWER*: The annual yield to maturity is 7.21 (%), the duration is 7.58 (years), and the accrued interest is $0.00. (When you are solving for the yield, the accrued interest is always zero.)

Basic Financial Tools

This section of the Securities Analysis module provides a set of fundamental time-value-of-money analysis techniques which apply to many different investment situations. While the SECURITIES ANALYSIS selection list is displayed, press **6** for *Basic Financial Tools*. This selection list appears.



Compound Interest

The compound interest program solves for

- the number of compounding periods (N),
- the annual nominal interest rate (r) as a percent,
- the future value (FV), or
- the present value (PV).

To solve for any of these terms, the program evaluates the basic relationship,

$$FV = PV(1 + [r/(c \times 100)])^N,$$

where c represents the number of compounding periods per year.

This equation says that the present value (today's money) compounded for N periods at the periodic interest rate $[i = r/(c \times 100)]$ gives you the future value.

This program can be used to solve for any term in the above equation when:

- The compounding periods are of equal length
- The interest is compounded at the end of each period
- The interest rate is constant

Now press **1** to select *Compound Interest*. The following instructions tell you how to use this program.

SELECT THE UNKNOWN

You select the value you wish to find by pressing **1** for *Number of Compounding Periods*, **2** for *Interest Rate*, **3** for *Future Value*, or **4** for *Present Value*.

ENTER THE KNOWN VALUES (X>0)

After you select the unknown value, the computer always asks you to enter the number (less than 367) of compounding periods per year (x > o). Then you enter three of the following four values as indicated by the cursor:

- Total Number of Compounding Periods (x > o)
- Interest rate per year as a percent (x > o)
- Future Value (x > o)
- Present Value (x > o)

After you enter the last value, the screen displays the answer. You can then press **SHIFT Z** (BACK) to repeat the compound interest program.

Example: Work the following problem to find Future Value. When the computer displays the BASIC FINANCIAL TOOLS selection list, press **1** for *Compound Interest* and then press **3** for *Future Value*. Suppose that a U.S. investor owns a stock which is compounded annually for four years at an interest rate of 14%. The stock currently sells for $15 per share. *ANSWER*: The future value of the stock is $25.33 per share.

Annuities

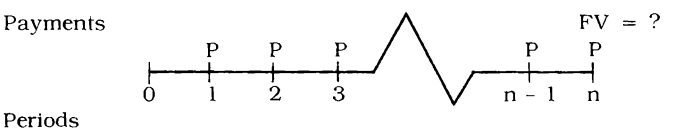
The compound interest program answers an investor's question about the value of money when only one payment, or injection of money into the future stream of funds, occurs. However, in many investments (e.g. mortgages, leases, savings accounts) equal payments occur several times; this is an annuity situation. A wide range of practical investor applications can be evaluated by placing these three simplifying limitations on the cash flows.

- All cash flows are of equal amounts (P).
- All cash flows occur at regular intervals (F times per year).
- Compounding occurs C times per year at the end of each compounding period.

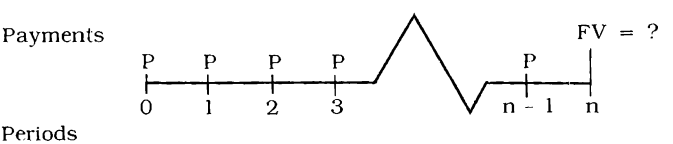
There are four basic annuity cases. To simplify the explanation, a time-line diagram is shown for each case.

Solving for Future Value:

SINKING FUND (ORDINARY ANNUITY/FUTURE VALUE)



ANNUITY DUE/FUTURE VALUE

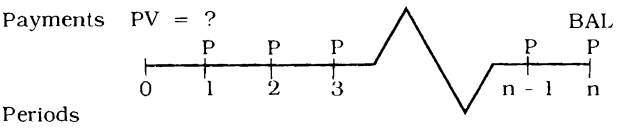


The two future value cases differ in the timing of the payments. The ordinary annuity case assumes that the payments are made at the end of each period. Thus, the future value is calculated at the end of the last period when the last payment is made. Sinking funds are common applications of this annuity situation.

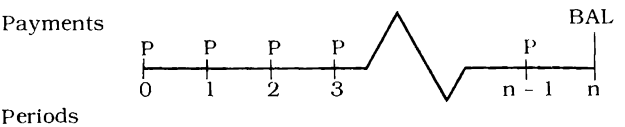
The annuity due case, on the other hand, assumes that the payments are made at the beginning of each period. As a result, the future value is calculated one period *after* the last regular payment is made. This payment pattern is one that often applies to savings accounts.

Solving for Present Value:

ORDINARY ANNUITY/PRESENT VALUE



ANNUITY DUE/PRESENT VALUE



The two present value cases also differ in payment timing. The program includes "Balloon" payments for present value cases. A Balloon is a payment made at the *end* of the *last* payment period *in addition to the last regular payment.*

For ordinary annuities the first payment occurs at the end of the first period, and the last payment occurs at the end of the final period. Mortgages are common applications of ordinary annuities. The remaining balance of a mortgage after *n* payments is the balloon value.

An annuity due, however, has the first payment made at the beginning of the first period and the final payment made at the beginning of the last period. The balloon, if any, occurs at the end of the final period. A lease is often classified as an annuity due because payments are made at the start of payment periods. The residual value is the balloon payment.

For all of the above annuities, interest is compounded at the end of each payment period. The program can also handle annuity situations with compounding periods that differ from payment period intervals. An example is a Canadian mortgage, where monthly payments are made with semi-annual compounding. Or a savings account where compounding occurs daily, but deposits are made monthly. The equation used in the program assumes interest is paid for partial periods. That is, if interest is compounded daily and you deposit funds in the middle of the month, the interest is compounded over the remainder of the month.

This program solves for any unknown value in the annuity situations described above. You access this option from the SECURITIES ANALYSIS selection list by pressing **6** for *Basic Financial Tools*. Next, press **2** for *Annuities*. Then supply the following information.

ANNUITY TYPE

You must indicate the type of annuity problem to be solved. Match a time-line diagram of your cash flows to the diagrams shown earlier to determine your basic case. Then press:

1 for sinking fund
2 for annuity due (FV)
3 for annuity due (PV)
4 for ordinary annuity (PV)

UNKNOWN VALUE

The next display asks you to indicate the value for which you want to solve. Press:

1 for total number of payments
2 for annual interest rate
3 for payment amount
4 for present value or future value
5 for balloon payments (this option omitted for the future value cases)

KNOWN VALUES

After you select the unknown value, the Annuities program asks for all of the following values, except the unknown term.

- Total number of payments ($x > 0$).
- Number (less than 367) of payments per year ($x > 0$).
- Number (less than 367) of compounding periods per year ($x > 0$). If this is equal to the number of payments per year, reenter that value; if it's different, enter the new value. A Canadian mortgage would have 12 payments per year and 2 compounding periods per year.
- Interest Rate per year as a percent ($x > 0$).
- Amount of periodic payment ($x > 0$). This must be less than the present value or future value.
- Present or Future value ($x > 0$).
- Balloon payment (for present value cases) ($x \geq 0$).

After the last of these items is entered, the solution appears. You can then press **SHIFT Z** (BACK) to go back to the initial annuity screen.

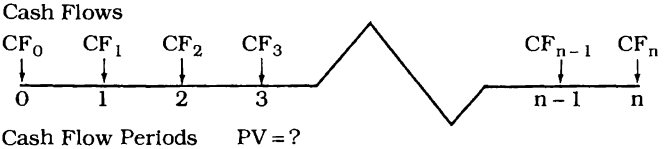
Example: Try out the annuity program by working an Annuity Due/Future Value problem. When the BASIC FINANCIAL TOOLS selection list is displayed, press **2** for *Annuities*. Next press **2** for *Annuity Due (FV)*, and then press **4** for *Present or Future Value*. Assume you make 150 weekly payments into an account with weekly compounding at an annual interest rate of 5.75%. You deposit $25 at the beginning of each week. *ANSWER*: The balance in the account one week after the last deposit is $4080.99.

Variable Cash Flows

The Variable Cash Flows program computes the present value, the internal rate of return, the future value, or the annual compound interest rate for up to 99 variable cash flows. As in the annuity section, the number of compounding periods per year can be equal or unequal to the number of cash-flow periods per year. The program assumes that compounding occurs at the end of each compounding period. It also assumes that interest is paid for fractions of periods (i.e., money deposited at the middle of a month where interest is compounded daily).

To help you understand both the present value and future value cash flow cases, an explanation of the input values for each case is explained below.

Present Value
Cash Flows



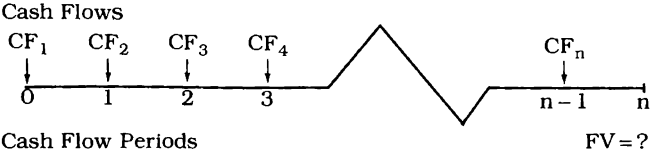
Cash Flow Periods PV = ?

The initial investment (cash flow CF_0) occurs at the beginning of the first period and is not discounted. If you are analyzing a situation where you have an initial cash outlay with subsequent returns, then CF_0 is entered as a negative value. In situations where no initial cash flow occurs, simply enter a zero for CF_0.

The remaining cash flows, CF_1 through CF_n, are entered as positive or negative, based on whether they are inflows (positive) or outflows (negative). They are assumed to occur at the *end* of their payment periods. These values can be positive, zero, or negative.

To calculate the present value of a series of variable cash flows, enter the discount rate (the return you expect to earn on the investment). To solve for internal rate of return (IRR), the initial cash outlay value is assumed to be negative.

Future Value
Cash Flows



Cash Flow Periods FV = ?

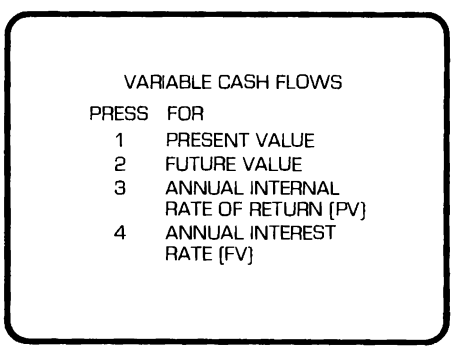
Here all cash flows are assumed to occur at the *beginning* of each payment period. The future value is calculated at the end of the last payment period (one period after the last payment), and the program does not have a CF_0 input. When the interest rate is given, the program can compute the future value; when the future value is given, it can calculate the interest rate.

Solving for IRR or Annual Interest Rate — The internal rate of return (IRR) or Annual Interest Rate is calculated by a iterative method. If a series of cash flows has only one negative value, you get a unique answer. However, if the cash flows include several negative values occurring among positive values, there may be more than one answer that will satisfy the IRR routine. (*Exception*: If all negative values are grouped at the beginning or end of the cash flows, you get a single interest rate.)

Since multiple answers are possible, the Variable Cash Flows program allows you to search for them. The program asks you for an initial guess. You can locate the other interest rates by changing your initial guess, which must be positive or zero. If you use an initial guess of zero and receive an error message, change your initial guess (for example, use 10%) and repeat the problem. This procedure avoids overflow problems.

For an interpretation of multiple rates, please consult one of the references listed in the Appendix.

Now let's use the program. When the computer displays the SECURITIES ANALYSIS selection list, press **6** for *Basic Financial Tools*. Then press **3** for *Variable Cash Flows*. The next display asks you to indicate the value for which you are computing.



Next you are asked for the following values (depending on your selection above).

INITIAL INVESTMENT – CF_0 [x ≥ 0,x < 0]

This input is required if you are solving for IRR and optional if you are computing present value. (The future value case does not require this input.) Remember to include the "–" sign for negative inputs.

CURRENT ANNUAL DISCOUNT RATE [x ≥ 0,x < 0]

Enter the annual desired rate of return as a percent if you are computing present value.

ANNUAL INTEREST RATE [x > 0]

Enter the annual interest rate as a percent if you are computing future value.

INITIAL ESTIMATE OF YIELD [x ≥ 0]

Enter your initial guess for IRR or annual interest rate as a percent. This value must be positive or zero.

FUTURE VALUE [x > 0]

Enter the future value if you are solving for the Annual Interest Rate.

NUMBER OF COMPOUNDING PERIODS PER YEAR [x > 0]

Enter the number (less than 367) of compounding periods per year for all alternatives. For example, enter 12 for monthly compounding, 4 for quarterly compounding, or 1 for annual compounding. All compounding periods are assumed to have equal lengths.

NUMBER OF CASH FLOWS PER YEAR [x > 0]

Enter the number (less than 367) of times each year the cash flows occur. The program assumes the cash flow periods are of equal length.

VARIABLE CASH FLOWS [x ≥ 0,x < 0]

If you're solving for present value or IRR, the program assumes that the cash flows occur at the end of each cash flow period, starting with period 1.

If you're solving for future value or annual interest rate, the program asks for the cash flows occuring at the *start* of each period, beginning with period 1.

After you enter your final cash flow and are asked for another one, enter blanks by pressing **SHIFT C** (CLEAR) or the **SPACE BAR**. Then press **ENTER** to go to the next screen.

Example: Solve the following Variable Cash Flows problem. From the VARIABLE CASH FLOWS selection list, press **3** for *Annual Internal Rate of Return*. Your initial estimate of yield in this case is 0% for an initial investment of $3400 with annual compounding and one cash flow per year. The investment returns these amounts at the end of each year.

PERIOD	1	2	3	4	5
CASH FLOW	500	900	1200	1000	800

ANSWER: The internal rate of return is 8.69%.

Days Between Dates

This program calculates the number of days between any two calendar dates after the year 1752. The calculations are based on the Gregorian calendar.

To access the program from the SECURITIES ANALYSIS selection list, press **6** for *Basic Financial Tools*. Then press **4** for *Days Between Dates*.

The first date is entered by typing in the month as a number (1 through 12), the day (1 through 31) and the year (4 digits). The second date is entered in the same fashion. After you enter the second date, the solution gives the number of days between the two dates.

Note: Erroneous entries such as Feb. 29 in a non-leap year yield incorrect results without any warning.

Example: Compute the days between January 1, 1978 and November 25, 1980. Your inputs are: 1, 1, 1978 and 11, 25, 1980. *ANSWER*: The number of days between the two dates is 1059.

Appendix A
Selected Bibliography

Clasing, Henry K., Jr. *The Dow Jones-Irwin Guide to Put and Call Options, Revised Edition*. Homewood, Illinois: Dow Jones-Irwin, 1978.

Gastineau, Gary L. *The Stock Options Manual, Second Edition*. New York: McGraw-Hill Book Company, 1979.

Greynolds, Elbert B., Jr.; Aronofsky, Julius S.; and Frame, Robert J. *Financial Analysis Using Calculators: Time Value of Money*. New York: McGraw-Hill Book Company, 1980.

Francis, Jack Clark. *Investments: Analysis and Management, Second Edition*. New York: McGraw-Hill Book Company, 1976.

Sharpe, William F. *Investments*. Englewood Cliffs, N.J.: Prentice-Hall, Inc.,1978.

Van Horne, James C. *Financial Management and Policy, Fourth Edition*. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1977.

Weston, J. Fred and Brigham, Eugene F. *Managerial Finance, Sixth Edition*. Hinsdale, Illinois: The Dryden Press, 1978.

Appendix B
Formulas Used

The formulas used by the Securities Analysis module are included here for your information and are explained in the order in which they appear on the Securities Analysis selection list. Each section gives you the formula(s), explains the variables, and provides information on reference materials, as appropriate.

STOCKS

Stock Performance

The module program looks at specified cash flows and determines performance (yield). Calculations are based on the equation:

$$\text{Buy} + \text{Com}_{\text{Buy}} = (1 - \text{Tax}) \sum_{j=1}^{N} \text{Div}_j/(1 + i)^j + \frac{(\text{Sell} - \text{Com}_{\text{Sell}}) - [(\text{Sell} - \text{Com}_{\text{Sell}}) - (\text{Buy} + \text{Com}_{\text{Buy}})]\ \text{CGT}}{(1 + i)^N}$$

where

Buy = Purchase price of stock per share
Com_{Buy} = Commission per share at purchase
Sell = Selling price of stock per share
Com_{Sell} = Commission per share at sale
Div_j = Dividend payment j
Tax = Income tax rate (in decimal form)
CGT = Capital gains tax (in decimal form)
N = Number of income periods
PY = Number of Dividend periods per year
i = Yield/period
Annual Yield = i (PY)

NOTE: This program collects cash flows (dividend/period) for each period, 0 — N, and then uses an iterative routine to find the yield.

Stock Valuation

The module program employs various methods of projecting cash flows and then either:

(1) computes present value (Theoretical Stock Price) of the stream of payments for a given discount rate

Or

(2) computes an internal rate of return that makes the present value of the payments equal to the Theoretical Stock Price.

These equations are used:

$$TSP = PVPMTS + PVTSV$$

$$PVPMTS = PMT_0\,(n_1, u_1) + \frac{PMT_0\,(1 + g_1)^{n1}\,A\,(n_2, u_2)}{(1 + i)^{n1}}$$

$$+ \frac{PMT_0\,(1 + g_1)^{n1}\,(1 + g_2)^{n2}\,A\,(n_3, u_3)}{(1 + i)^{n_1 + n_2}} + \cdots$$

$$+ \frac{PMT_0\,(1 + g_1)^{n1}\,(1 + g_2)^{n2} \cdots (1 + g_{x-1})^{nx-1}\,A\,(n_x, u_x)}{(1 + i)^{n_1 + n_2 + \cdots + n_{x-1}}}$$

PVTSV = (a) Steady state dividend growth method

$$\left(\frac{PMT_x}{i - g\infty}\right) \Big/ (1 + i) \qquad \text{for } i > g\infty$$

(b) Estimate of TSV method

$$\frac{\text{Ending Price Estimate}}{(1 + i)^N}$$

(c) Earnings per share method

$$\left(\frac{\text{Earnings per share}}{i}\right) \Big/ (1 + i)^N$$

(d) Price-earnings ratio method

$$\frac{\text{Earnings per share} \times \text{Price to earnings ratio}}{(1 + i)^N}$$

where

TSP = Theoretical Stock Price

PVPMTS = Present Value of Dividend Payments

TSV = Terminal Stock Value

PVTSV = Present value of TSV

PMT_0 = Last current dividend paid

PMT_x = Payment made at the end of the growth period x.

$= PMT_0\,(1 + g_1)^{n1}\,(1 + g_2)^{n2} \cdots (1 + g_{x-1})^{nx-1}\,(1 + g_x)^{nx}$

X = Number of dividend growth periods

Y = Growth period $(1, 2, 3, \ldots, X)$

n_y = Number of payments made in growth period y

r = Annual discount rate

f = Number of dividend payments per year

i = Discount rate per payment period (i = r/f)

g_y = Growth rate per payment during growth period y

$$\left(g_y = \frac{\text{annual growth rate period y}}{f}\right)$$

$$u_y = [(1 + i)/(1 + g_y)] - 1$$

$$A(n_y,u_y) = \frac{1 - (1 + u_y)^{-n_y}}{u_y} \qquad \text{for } u_y \neq 0$$

$$= n_y \text{ for } u_y = 0$$

N = Total number of payment periods

g_∞ = Steady state growth rate

The module program computes the discount rate per payment period with an iterative procedure.

References:

William F. Sharpe, *Investments* (Englewood Cliffs, N.J.: Pentice Hall Inc., 1978), Chapter 12.

Elbert B. Greynolds, Jr., Julius S. Aronofsky, and Robert J. Frame, *Financial Analysis Using Calculators: Time Value of Money* (New York: McGraw-Hill Book Co., 1980), Chapter 9.

OPTION VALUATION – BLACK-SCHOLES MODEL

The value of a Call Option at time t is found as:

$$w(x,t) = xN(d_1) - ce^{-r\Delta t}\, N(-d_2)$$

for

$$d_1,d_2 = [\ln(x/c) + (r \pm \nu^2/2)\,\Delta t]\,/\nu\sqrt{\Delta t}$$

where

x = Share Price

c = Exercise Price

Δt = Days Until Expiration/365

ν = Volatility (Std. Dev. of Return)

r = Annual Yield

N(d) = Cumulative Normal Density Function

The Hedge Ratio is $N(d_1)$ for a Call Option. When dividends are paid, the share price (x) is reduced by the present value of the dividends.

Reference:

Fischer Black and Myron Scholes, *Journal of Political Economy*, May/June 1973, pp. 637-654.

The Standard Normal Function is determined by finding the right tail area of the function, Q(x), where:

$$Q(x) = \frac{1}{\sqrt{2\pi}} e^{-x^2/2} (b_1t + b_2t^2 + b_3t^3 + b_4t^4 + b_5t^5) + \epsilon(x)$$

In the above:

$t = 1/1 + px$

$p = .2316419$

$b_1 = .319381530$

$b_2 = -.356563782$

$b_3 = 1.781477937$

$b_4 = -1.821255978$

$b_5 = 1.330274429$

$|\epsilon(x)| < 7.5 \times 10^{-8}$

OPTION WRITING

Call Options

Maximum Profit (occurs at exercise price)

$$Max = N_{opt} \times 100 \times P_{opt} - Com + N_{sh}[P_{ex}(1 + \%C) + Div]$$

Upper Break-Even Point (option exercised)

$$U = [Max + (N_{opt} - N_{sh})\, P_{ex}\, (1 - \%C)]\,/(N_{opt} - N_{sh})(1 + \%C)$$

Lower Break-Even Point (option not exercised)

$$L = [Max - N_{sh} \times P_{ex}\, (1 - \%C)]\,/ - N_{sh}\, (1 - \%C)$$

Put Options

Maximum Profit (occurs at exercise price)

$$Max = N_{opt} \times 100\, P_{opt} - Com + N_{sh}\, [P_{sh}\, (1 - \%C) - P_{ex}\, (1 + \%C) - Div]$$

Upper Break-Even Point (option not exercised)

$$U = [Max + N_{sh}\, P_{ex}\, (1 + \%C)]\,/N_{sh}\, (1 + \%C)$$

Lower Break-Even Point (option exercised)

$$L = [Max - (N_{opt} - N_{sh})\, P_{ex}\, (1 + \%C)]\,/ - (N_{opt} - N_{sh})(1 - \%C)$$

where

%C = Average commission per share as a percentage of share price

Com = Total commission on options in dollars

Div = Dividends per share

Max = Maximum Profit

N_{opt} = Number of Options Sold

N_{sh} = Number of Shares Bought or Shorted

P_{ex} = Exercise Price

P_{opt} = Price per Call or Put

P_{sh} = Current per share price of stock

Note: 1. N_{opt} is negated if selling.

2. One option represents 100 shares of underlying stock.

References:

Sharpe, *Investments*, Ch. 14.

Gary L. Gastineau, *The Stock Options Manual, Second Edition* (New York: McGraw-Hill Book Company, 1979).

OPTION SPREADS

Data for the Black-Scholes options model which is different for the two call option contracts:

Contract 1: Buy or Sell?

$N_{opt\,1}$ = Number of options for contract 1

t_1 = Number of days to expiration for contract 1

$P_{ex\,1}$ = Exercise price for contract 1

Contract 2: Buy or Sell?

$N_{opt\,2}$ = Number of options for contract 2

t_2 = Number of days to expiration of contract 2

$P_{ex\,2}$ = Exercise price for contract 2

Common data for both call option contracts:

V = Volatility of underlying stock

r = Risk-free interest rate from now until expiration

Projection Date = Date at which to compute spread value

Computing SV

$$\text{Spread Value (SV)} = (\text{Val 1} \times N_{opt\,1}) + (\text{Val 2} \times N_{opt\,2})$$

The spread value (SV) may be plotted versus stock price at different points in time.

Note: N_{opt} is negative if selling stock and positive if buying stock. The values Val 1 and Val 2 are determined using one of these methods:

(1) Projection date equals expiration date:

The value is zero if the projected stock price is less than the exercise price. The value is equal to the difference between the projected stock price and the exercise price if the stock price exceeds the exercise price.

(2) Projection date precedes the expiration date:

The value is computed using the Black-Scholes model.

References:

Sharpe, *Investments*, Chapter 14.

Gastineau, *The Stock Options Manual, Second Edition.*

BONDS

For a bond sold between coupon interest payments with yield not equal to the annual coupon rate and n greater than 1,

$$\text{BOND PRICE} = \left\{ \text{CPN}\left[\frac{1-(1+i)^{-n+1}}{i}\right] + \text{MAT}\,(1+i)^{-n+1} + \text{CPN} \right\} \times (1+i)^{-B/C} - \text{CPN}\,(A/C)$$

For a bond sold on coupon interest date with $n > 1$,

$$\text{BOND PRICE} = \text{CPN}\left[\frac{1-(1+i)^{-n}}{i}\right] + \text{MAT}\,(1+i)^{-n}$$

where

n = Number of coupon payments remaining ($n > 1$)

CPN = The dollar amount of interest paid per coupon period. The annual decimal coupon rate divided by the number of payments per year times the 100 par value equals the coupon payment.

i = The yield per coupon period expressed as a percent

MAT = The maturity value of the bond

A = Number of calendar days from last coupon payment to settlement date

B = Number of calendar days from settlement date to next coupon payment

C = Number of calendar days in coupon period during which bond was purchased

CPN (A/C) = Accrued interest paid to bond seller

NOTE: The program assumes all bonds are expressed in points. Furthermore, when the bond is sold between interest dates where the annual coupon rate equals the annual yield and the maturity value equals 100, the price is set equal to 100. The yield is computed by an iterative procedure.

References:

Greynolds, Aronofsky & Frame, *Financial Analysis Using Calculators*, pp. 335-347.

Sharpe, *Investments*, Chapter 10.

BOND DURATION

$$\text{Duration} = \sum_{t=1}^{n} t \left[\frac{CPN_t/(1+i)^t}{\sum_{t=1}^{n} CPN_t/(1+i)^t} \right]$$

where

n = Number of coupon payments
CPN = Coupon payment
i = Yield per coupon period
t = Period when CPN_t is paid

NOTE: When coupon payments occur more than once a year, the value computed in the equation is divided by the number of coupon payments per year to convert the duration to a yearly basis. When bonds are sold between interest dates, the equation is adjusted for accrued interest.

References:

Richard W. McEmally, "Duration as a Practical Tool for Bond Management," *The Journal of Portfolio Management*, Summer, 1977, pp. 53-57.

Sharpe, *Investments*, pp. 232-233.

COMPOUND INTEREST

$$FV = PV\left(1 + \frac{r}{c \times 100}\right)^n$$

$$PV = FV/\left(1 + \frac{r}{c \times 100}\right)^n$$

$$N = \ln (FV/PV)/\ln\left(1 + \frac{r}{c \times 100}\right)$$

$$r = [(FV/PV)^{1/n} - 1] \times c \times 100$$

where

FV = Future value
PV = Present value
r = Annual nominal interest rate
c = Number of compounding periods per year
n = Total number of compounding periods

ANNUITIES

Equations for Future Value cases

$$V_k = (1 + i_f)^{k-n} \times PMT \times \left[\frac{(1 + i_f)^n - 1}{i_f} \right]$$

k = n for sinking fund (ordinary annuity — FV)

k = n + 1 for annuity due —FV_d

$$PMT = V_k / \left[(1 + i_f)^{k-n} \times \left(\frac{(1 + i_f)^n - 1}{i_f} \right) \right]$$

when k = n; FV case

$$n = \ln \left(\frac{FV \times i_f}{PMT} + 1 \right) / \ln (1 + i_f)$$

when k = n + 1; FV_d case

$$n = \left[\ln \left(\frac{FV_d \times i_f}{PMT} + 1 + i_f \right) / \ln (1 + i_f) \right] - 1$$

Equations for Present Value Cases

$$V_k = (1 + i_f)^k \times PMT \times \left(\frac{1 - (1 + i_f)^{-n}}{i_f} \right) + \frac{BAL}{(1 + i_f)^n}$$

k = 0 for ordinary annuity—PV

k = 1 for annuity due—PV_d

$$PMT = \frac{V_k - BAL \times (1 + i_f)^{-n}}{(1 + i_f)^k \times \left(\frac{1 - (1 + i_f)^{-n}}{i_f} \right)}$$

$$n = -\ln \left[\frac{i_f \times V_k - (1 + i_f)^k \times PMT}{i_f \times BAL - (1 + i_f)^k \times PMT} \right] \Big/ \ln (1 + i_f)$$

$$BAL = \left[V_k - (1 + i_f)^k \times PMT \times \left(\frac{1 - (1 + i_f)^{-n}}{i_f} \right) \right] (1 + i_f)^n$$

where

$i_f = (1 + i_c)^{c/f} - 1$

c = Number of compounding periods per year

f = Number of payments per year

i_c = Interest rate per compounding period

i_f = Interest rate per payment period

PMT = Equal periodic payment made f times per year

n = Total number of payments

BAL = Balloon payment made at the end of the last payment period

Note: When the interest rate is computed, the value i_f is determined by an iterative procedure and then the following conversion is made to determine the interest rate per compounding period.

$$i_c = (1 + i_f)^{f/c} - 1$$

$$\text{annual interest rate} = i_c \times c$$

Reference:

Greynolds, Aronofsky, and Frame, *Financial Analysis Using Calculators*, Chapters 5 and 8.

VARIABLE CASH FLOWS

$$PV = CF_0 + \sum_{h=1}^{n} CF_h \, (1 + i_f)^{-h}$$

$$FV = (1 + i_f)^n \sum_{h=1}^{n} CF_h \, (1 + i_f)^{-h}$$

$$i_f = (1 + i_c)^{c/f} - 1$$

where

PV = Present value

FV = Future value

CF_h = Cash flow period h where h = 1, 2, 3, . . . , n

c = Number of compounding periods per year

f = Number of payments per year

i_c = Interest rate per compounding period

i_f = Interest rate per payment period

Note: When computing the interest rate, i_f is computed by an iterative procedure with the following conversion to determine i_c.

$$i_c = (1 + i_f)^{f/c} - 1$$

$$\text{annual interest rate} = i_c \times c$$

Reference:

Greynolds, Aronofsky and Frame, *Financial Analysis Using Calculators*, Chapter 7.

DAYS BETWEEN DATES

The number of days between dates is found by calculating a "factor" for each date and then finding the difference between the factors.

The factor is evaluated as:

$$\text{Factor} = 365 \times \text{Year} + \text{Day} + (\text{Month} - 1)\ 31 + \text{Int}\ (\text{Year} - 1)/4 - \text{Int}\ (¾[\text{Int}(\text{Year} - 1)/100 + 1])$$

for Month

$$\text{Factor} = 365 \times \text{Year} + \text{Day} + (\text{Month} - 1)31 - \text{Int}\ (\text{Month} \times .4 + 2.3) + \text{Int}\ (\text{Year}/4) - \text{Int}\ (¾\ [\text{Int}\ (\text{Year}/100) + 1])$$

for Month $\geqslant 3$

CARING FOR THE MODULE

Command modules are durable devices, but they should be handled with the same care you would give any other electronic equipment. Keep the module and its recessed contacts clean and dry.

> CAUTION:
> The contents of a module can be damaged by static electricity discharges.

Static electricity build-ups are more likely to occur when the natural humidity of the air is low (during winter, for example, or in very dry climates). To avoid possible damage to the Command Module, touch any metal object (a doorknob, a desklamp, etc.) before handling the module. Always use this method to ensure that both you and the module are free of static electricity before you install the module on the console.

If static electricity is a problem in your area, you may want to purchase a special carpet treatment that reduces static electricity build-up. These commercial preparations are usually available from local hardware and office supply stores.

IN CASE OF DIFFICULTY

If the module activities do not appear to be operating properly, return to the master title screen by pressing **SHIFT Q**. Withdraw the module, align it with the module opening, and reinsert it carefully. Then press any key to make the master selection list appear. Repeat the module selection process. (*Note*: In some instances, it may be necessary to turn the computer off, wait several seconds, and then turn it on again.)

If the module is accidentally removed from the slot while the module contents are being used, the computer may behave erratically. To restore the computer to normal operation, turn the computer console off, wait a few seconds, reinsert the module, and turn it on again.

If you have any difficulty with your computer or the Securities Analysis Module, please contact the dealer from whom you purchased the unit and/or module for service directions.

Additional information concerning use and service can be found in your *User's Reference Guide*.

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Texas Instruments Incorporated extends this consumer warranty only to the original consumer purchaser.

WARRANTY COVERAGE

This warranty covers the electronic and case components of the software module. These components include all semiconductor chips and devices, plastics, boards, wiring and all other hardware contained in this module ("the Hardware"). This limited warranty does not extend to the programs contained in the software module and in the accompanying book materials ("the Programs").

The Hardware is warranted against malfunction due to defective materials or construction. **THIS WARRANTY IS VOID IF THE HARDWARE HAS BEEN DAMAGED BY ACCIDENT OR UNREASONABLE USE, NEGLECT, IMPROPER SERVICE OR OTHER CAUSES NOT ARISING OUT OF DEFECTS IN MATERIAL OR CONSTRUCTION.**

WARRANTY DURATION

The Hardware is warranted for a period of three months from the date of the original purchase by the consumer.

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During the three month warranty period, defective Hardware will be replaced when it is returned postage prepaid to a Texas Instruments Service Facility listed below. The replacement Hardware will be warranted for a period of three months from date of replacement. Other than the postage requirement, no charge will be made for replacement.

It strongly recommends that you insure the Hardware for value prior to mailing.

TEXAS INSTRUMENTS CONSUMER SERVICE FACILITIES

Texas Instruments Service Facility
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Consumers in California and Oregon may contact the following Texas Instruments offices for additional assistance or information.

Texas Instruments Consumer Service
2141 South Douglas Street
El Segundo, California 90245
(213)973-1803

Texas Instruments Consumer Service
10700 Southwest Beaverton Highway
Park Plaza West
Beaverton, Oregon 97005
(503)643-6758

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- ***Black-Scholes Options Pricing*** — Solves for the option value and hedge ratio or the implied volatility.
- ***Option Writing*** — Evaluates the purchase of underlying stock on a call option or the shorting of a stock on a put option.
- ***Option Spreads*** — Calculates the cash flow resulting from selling and buying call options on the same underlying stock.
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