

## Return on a Share of Stock

The return on a share of stock is the internal rate of return of the cash flows associated with the stock purchase, dividends, and sale.

### Objectives:

- Determine the return on an investment with a fixed dividend.
- Given an average rate of inflation, determine the lowest price at which a stock can be sold in order to break even.
- Determine the return on an investment where the amount of the dividend is not fixed.

### Example 1:

Four years ago, John purchased Alpha Beta Company shares at \$20 and sold them today at the same price. Each year he received a dividend of \$1. What was his return on the investment?

The **irr**( function calculates the interest rate at which the net present value of the cash flows is equal to zero. The syntax is **irr**(initial cash flow, cash flow list[,frequency list]).

1. From the home screen, press **apps** and select **Finance**. Choose **irr**( from the CALC menu.

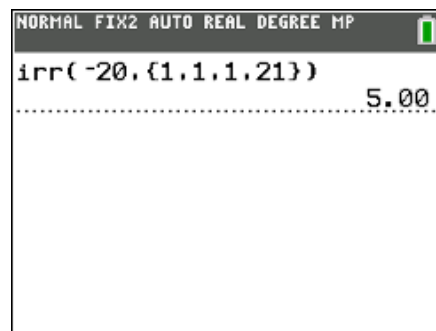
**Note:** The mode DECIMAL SETTING was changed to **FIX2** to round computations to two decimal places.

2. For this problem, the initial cash flow is -20. The cash flow list is { 1, 1, 1, 21}, indicating the \$1 dividend for the first three years and the dividend (\$1) plus the cash from the sale (\$20) in the fourth year. Since the cash flows are listed individually, no frequency list is required.

Enter the values shown, and press **enter**.

The result of 5% was, of course, not unexpected given the dividend rate.

**Note:** The frequency list option would allow **irr**(-20,{1, 1, 1, 21}) to be replaced by **irr**(-20, {1, 21}, {3, 1}) since the \$1 payment occurred three times and the \$21 payment occurred once.

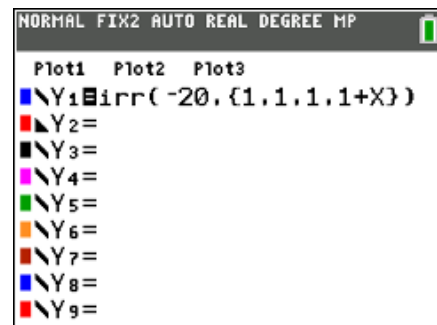


### Table and Graph Exploration

An exploration can be carried out by varying the selling price of the stock and examining the impact on the rate of return. This exploration can be done either graphically or with a table. To do this, replace the sale price with  $X$  in the **irr** calculation and graph the result.

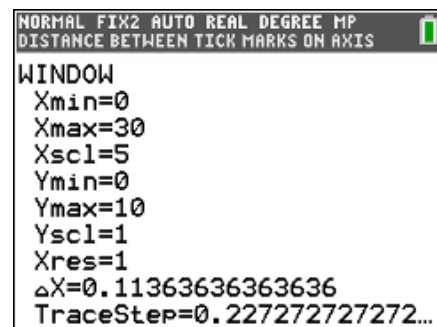
1. Press the **[y=]** key and clear all functions.
2. Press **[apps]** and select **Finance**. Choose **irr(** from the CALC menu.
3. Input **irr(-20, {1, 1, 1, 1+X})** for  $Y_1$ .

$X$  is the stock selling price and  $1 + X$  is the last year's cash flow, a \$1 dividend and \$ $X$  for the stock.



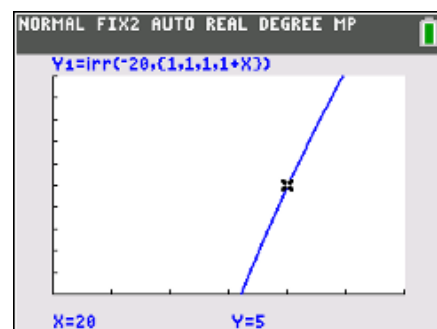
Thus, for each stock sale price  $X$ ,  $Y$  will be the internal rate of return for the purchase, dividends, and selling price.

4. Press the **[window]** key. Enter  $X_{\min} = 0$ ,  $X_{\max} = 30$ ,  $X_{\text{scl}} = 5$ ,  $Y_{\min} = 0$ ,  $Y_{\max} = 10$ , and  $Y_{\text{scl}} = 1$ .



5. Press the **[graph]** key. The graph will take about 30 seconds to complete because the **irr(** function must be calculated for each value of  $X$ . To speed up the graphing, change the  $X_{\text{res}}$  to 5 on the window screen.
6. Press the **[trace]** key. Use the arrow keys to move the cursor along the curve.

Type in a specific  $X$  value (for example, 20), and press **[enter]**. The  $Y$  value will appear on the screen.





7. For the tabular exploration, press **2nd** **[tblset]**. Enter 17 for the TblStart value and 1 for the increment,  $\Delta Tbl$ .

NORMAL FIX2 AUTO REAL DEGREE MP				
TABLE SETUP				
TblStart=17				
$\Delta Tbl=1$				
Indent: <b>Auto</b> Ask				
Depend: <b>Auto</b> Ask				

8. Press **2nd** **[table]**. Use the arrow keys to move down the table of values.

NORMAL FIX2 AUTO REAL DEGREE MP				
PRESS + FOR $\Delta Tbl$				
X	Y1			
17.00	1.32			
18.00	2.60			
19.00	3.82			
20.00	5.00			
21.00	6.14			
22.00	7.24			
23.00	8.31			
24.00	9.35			
25.00	10.36			
26.00	11.34			
27.00	12.29			
X=20				

### Example 2:

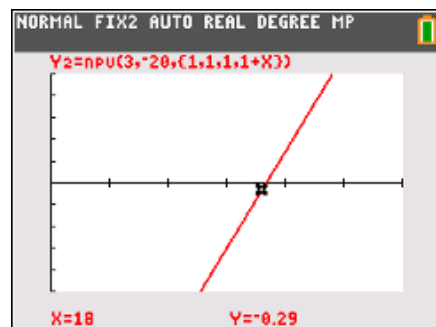
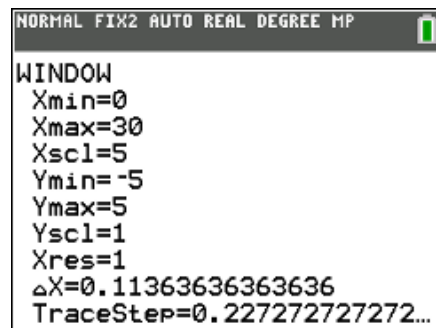
Maria is worried about the purchasing power of her investment. If the average rate of inflation is 3%, what is the lowest price at which the stock in the previous example can be sold and still break even?

- Press the **y=** key.
- Turn Y1 off by moving the cursor to the equals sign of Y1 and pressing **enter**. (If a function is on, it will be turned off; if it is off, pressing **enter** will turn the function on.)
- In Y2, enter **npv(3, -20, {1, 1, 1, 1+X})** so that Y2 is the net present value of the transaction for each stock selling at the price of X.

**Note:** To enter **npv**(, press **apps**, select **Finance**, and choose **npv**( from the CALC menu.

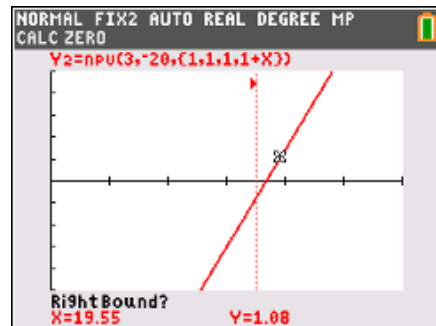
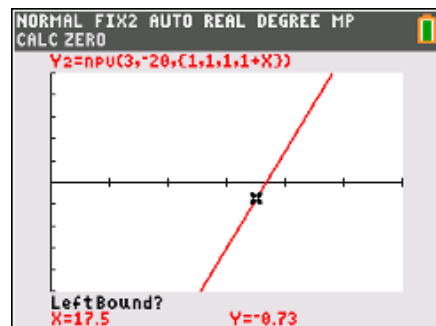
NORMAL FIX2 AUTO REAL DEGREE MP				
Plot1	Plot2	Plot3		
$\text{Y}_1 = \text{irr}(-20, \{1, 1, 1, 1+X\})$				
$\text{Y}_2 = \text{npv}(3, -20, \{1, 1, 1, 1+X\})$				
$\text{Y}_3 =$				
$\text{Y}_4 =$				
$\text{Y}_5 =$				
$\text{Y}_6 =$				
$\text{Y}_7 =$				
$\text{Y}_8 =$				
$\text{Y}_9 =$				

4. Press the **window** key. Enter Xmin = 0, Xmax = 30, Xscl = 5, Ymin = -5, Ymax = 5, and Yscl = 1.
5. Press the **graph** key.
6. Press the **trace** key. Use the arrow keys to move the cursor along the curve.
7. Type in a specific X value (for example, 18), and press **enter**. The Y value will appear on the screen.



When  $Y = 0$ ,  $X$  is the breakeven price for the stock.

8. To determine the value of  $X$  at which  $Y = 0$ , press **2nd** **[calc]** and select **zero**.
9. At the prompt "Left Bound?," arrow to the left of the zero and press **enter**.
10. At the prompt "Right Bound?," arrow to the right of the zero and press **enter**.



11. Move the cursor between the left and right bound and, at the prompt "Guess?," press **enter**. The zero (rounded to two decimal places) is displayed.

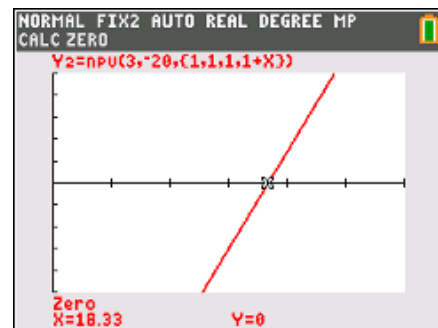
The lowest price at which the stock can be sold to break even is \$18.33.

12. For the tabular exploration, press **2nd** **[tblset]**. Enter 17.8 for the TblStart value and 0.1 for the increment,  $\Delta Tbl$ .

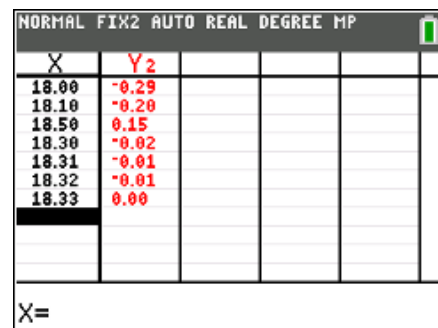
The table exploration can be changed to allow the entry of stock prices manually.

13. Move the cursor to **ASK** on the Indpnt row. Press **enter**.
14. Press **2nd** **[table]**. Note that the independent value is the stock price.
15. Enter values for X.

**Note:** The Y1 values do not show in the table because Y1 was turned off.




NORMAL FIX2 AUTO REAL RADIAN MP  
TABLE SETUP  
TblStart=17.8  
 $\Delta Tbl=0.1$   
Indpnt: Auto Ask  
Depend: Auto Ask



NORMAL FIX2 AUTO REAL DEGREE MP

X	Y2			
18.00	-0.29			
18.10	-0.20			
18.20	-0.15			
18.30	-0.02			
18.40	0.01			
18.50	0.01			
18.60	0.00			
18.70				
18.80				
18.90				
19.00				

X=

A more realistic example would show dividend payments changing.

**Example 3:**

Assume that stock is purchased for \$19 per share and dividend payments received annually were \$1, \$1.06, and \$1.10. The stock was sold for \$22.50. What was the rate of return on the investment?

Year 0	Year 1	Year 2	Year 3
	\$1.00	\$1.06	\$22.50 \$ 1.10
- \$19			

1. Press **2nd** **[quit]** to return to the home screen.
2. Press **apps**, select **Finance**, and choose **irr(** from the CALC menu.
3. Enter **irr(-19, {1, 1.06, 1.10+22.50})**. Press **enter**.

The internal rate of return is 11.04%.

