

## 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. Press , and select **New** to start a new document. Select **Add Calculator**.

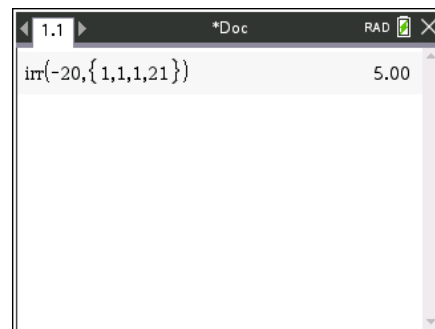
**Note:** To round computations to two decimal places, change the Display Digits setting in the Documents Settings to **Fix 2**.

2. Press **Menu > Finance > Cash Flows**, and select **Internal Rate of Return**.
3. 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 .

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

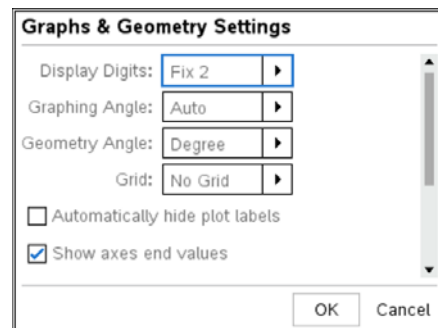
**Note:** The frequency list option would allow **irr**(-20,{1, 1, 1, 21}) to be replaced by **irr**(-20, {1, 21}, {3, 1}) since the \$1 payment occurred three times and the \$21 payment occurred once.



### 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.

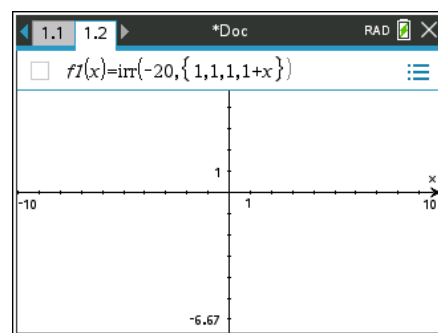
1. Press **ctrl** **doc** to add a new page. Select **Add Graphs**.
2. Press **Menu > Settings**, and change Display Digits to **Fix 2**. Select **OK** or press **enter**.



3. For  $f_1(x)$ , first select **irr** from the catalog. Enter **-20, {1, 1, 1, 1+x}**.

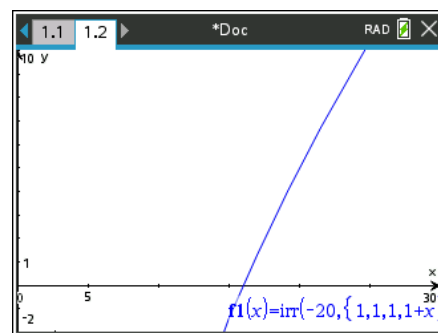
4. Press **enter** to graph.

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



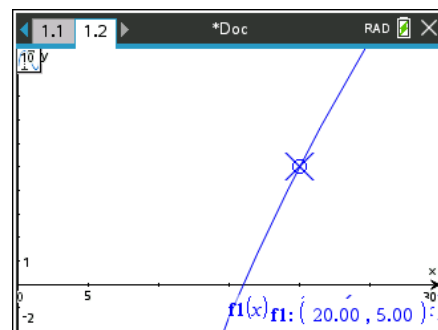
Thus, for each stock sale price  $x$ ,  $f_1(x)$  will be the internal rate of return for the purchase, dividends, and selling price.

5. Press **Menu > Window/Zoom > Window Settings**. Enter XMin = 0, XMax = 30, XScale = 5, YMin = -2, YMax = 10, and YScale = 1. Select **OK** or press **enter**.



6. Press **Menu > Trace > Graph Trace**. Use the arrow keys to move the cursor along the graph.

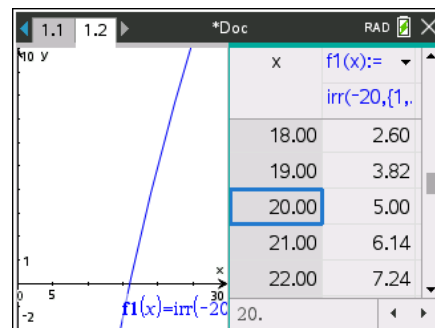
Type in a specific  $x$  value (for example, 20), and press **enter**.



- For the tabular exploration, press **Menu > Table > Split-screen Table**.
- Press **Menu > Table > Edit Table Settings**. Enter 17 for the Table Start value and 1 for the Table Step. Select **OK** or press **enter**.

Use the arrow keys to move down the table of values.

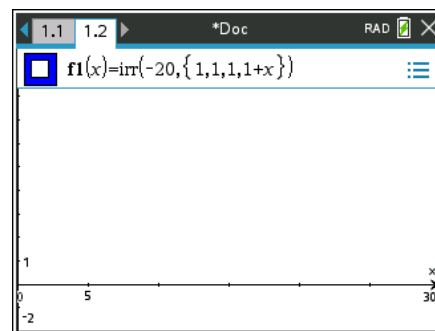
Press **ctrl** **T** to remove the table.



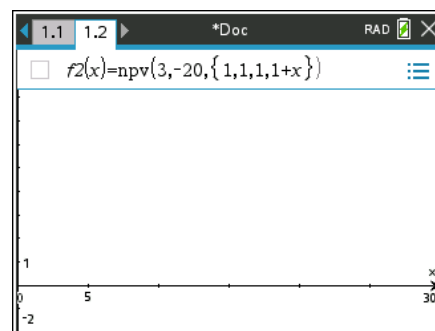
### Example 2:

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?

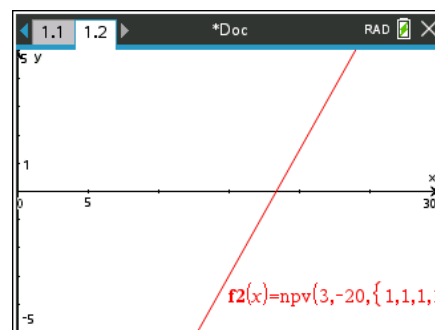
- Press **tab**, and arrow up to  $f1(x)$ . Click on the check mark in the “box” on the left to deselect  $f1(x)$ .



- Arrow down to  $f2(x)$ , select **npv** from the catalog. Enter **3, -20, {1, 1, 1, 1+x}** so that  $f2(x)$  is the net present value of the transaction for each stock selling at the price of  $x$ .
- Press **enter** to graph.

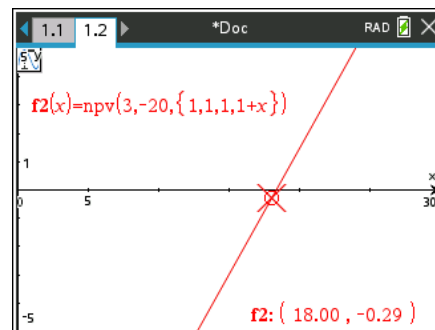


- Press **Menu > Window/Zoom > Window Settings**. Enter XMin = 0, XMax = 30, XScale = 5, YMin = -5, YMax = 5, and YScale = 1. Select **OK** or press **enter**.



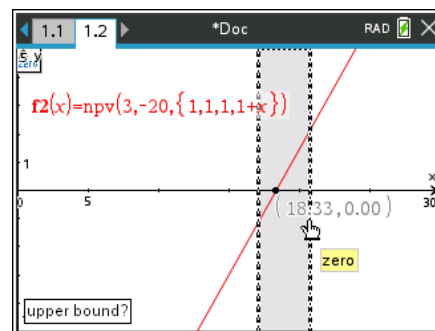
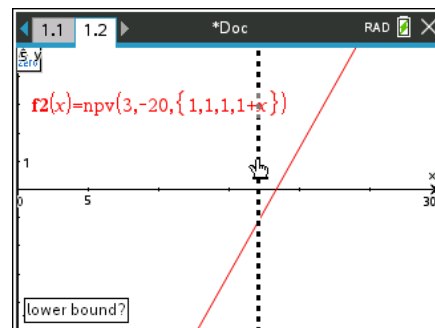
5. Press **Menu > Trace > Graph Trace**. Use the arrow keys to move the cursor along the curve.
6. Type in a specific x value (for example, 18), and press **enter**.

**Note:** The function label was moved in order to better display the ordered pair in the lower right corner of the screen.

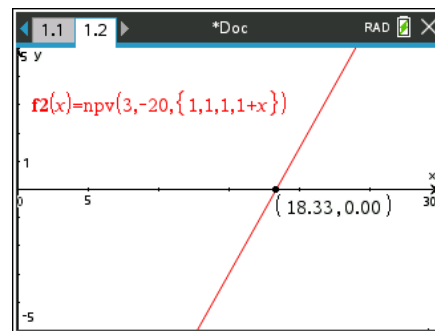


When  $f_2(x) = 0$ ,  $x$  is the breakeven price for the stock.

7. To determine the value of  $x$  at which  $f_2(x) = 0$ , press **Menu > Analyze Graph**, and select **Zero**.
8. At the prompt “lower bound?,” move the cursor to the left of the zero and click or press **enter**.
9. At the prompt “upper bound?,” move the cursor to the right of the zero and click or press **enter**.



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



For the tabular exploration, press **Menu > Table > Split-screen Table**.

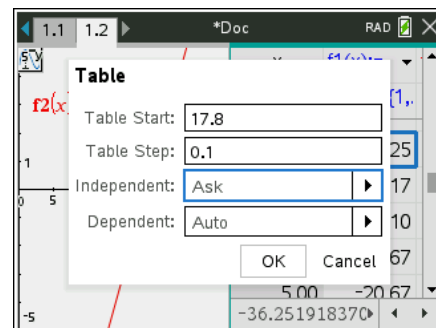
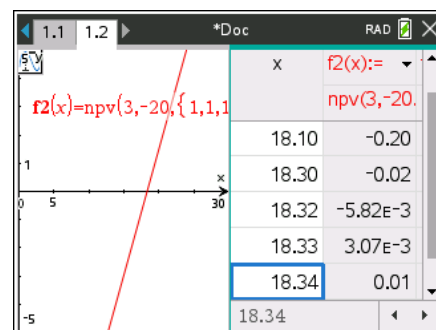
10. Press **Menu > Table > Edit Table Settings**. Enter 17.8 for the Table Start value and 0.1 for the Table Step.

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

11. Move the cursor to Independent, and select **ASK**. Select **OK** or press **enter**.
12. Select **OK** or press **enter**.

In the upper right corner of the table, click on the down arrow next to  $f_1(x):=$ , and select  **$f_2(x)$** .

Enter values for X.

X	$f_2(x):=$
18.10	-0.20
18.30	-0.02
18.32	-5.82E-3
18.33	3.07E-3
18.34	0.01
18.34	18.34

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	} \$23.60
-\$19				

1. Press **on**, and select **New** to start a new document. Select **Add Calculator**.

**Note:** To round computations to two decimal places, change the Display Digits setting in the Documents Settings to **Fix 2**.

2. Press **Menu > Finance > Cash Flow > Internal Rate of Return**.
3. Enter **-19, {1, 1.06, 1.10+22.50}**. Press **enter**.

The internal rate of return is 11.04%.

