**hp calculators**

**HP 17bII+** Time value of money basics

The time value of money

The time value of money application
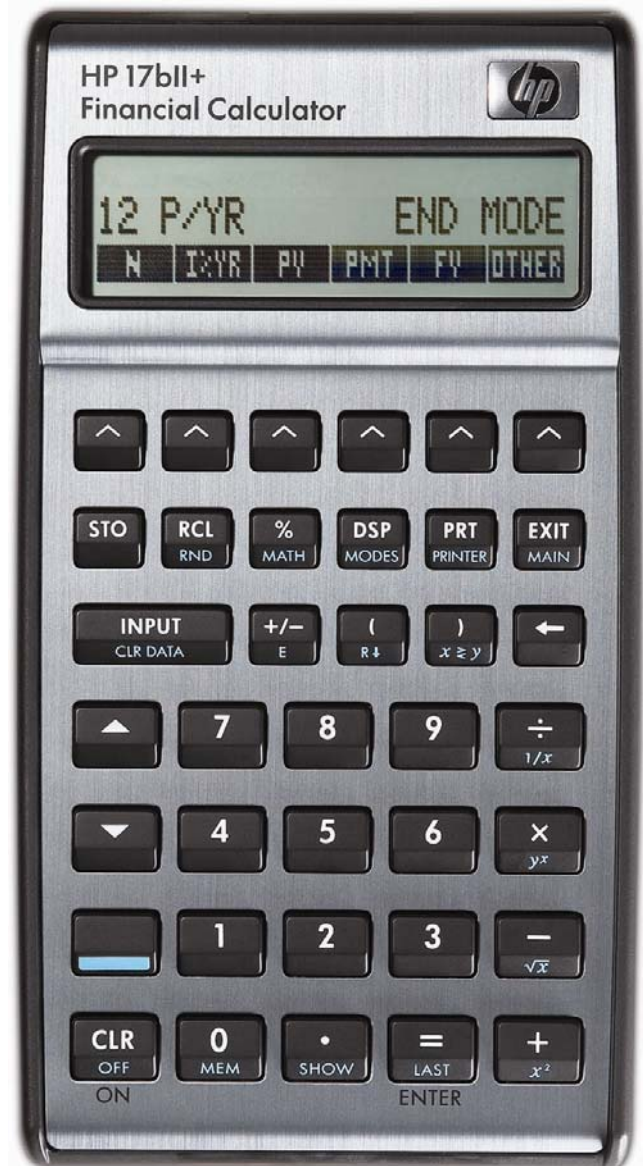
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## The time value of money

Money has a time value. That simple statement is the basis for all of finance. The fact that money has a time value is easily understood by answering the question: "Would you rather have $100 today or $100 in 20 years?"

The answer should be "today." At the very least, the $100 today could be deposited into a savings account and you would have more than $100 in 20 years. It is also probably true that $100 today would buy more pizzas than $100 in 20 years. Therefore, money has a time value.

If you loan money to someone today and they will repay you in 5 years, you would expect to get more money back than you loaned. This incremental amount you would be repaid is called interest. Interest is effectively the cost of money.

Depending on the complexity of the financial arrangement, the appropriate solution may involve simple interest, compound interest, an annuity, or cash flow analysis.

This learning module will describe some basics of using the time value of money on the HP 17bII+ calculator. Other learning modules will go into these topics in more detail.

## The time value of money application

The time value of money application built into the HP 17bII+ is used to solve compound interest problems and annuities that involve regular, uniform payments. This application is accessed from the main menu level of the HP 17bII+ by pressing ▉FIN▉ then ▉TVM▉. Note that to access these menus, you must press the appropriate ▭ key just below the symbols on the screen. If you do not see ▉FIN▉ displayed on the screen, you may be inside a different menu. You can return to the main menu and select the ▉FIN▉ menu by pressing ▭ ▉EXIT MAIN▉.

When you enter the TVM environment for the first time, the screen will appear as shown in Figure 1 below.

```
12 P/YR          END MODE
 N  I%YR  PV  PMT  FV  OTHER
```
Figure 1

Compound interest problems require the input of 3 of these 4 values: ▉N▉ ▉I%YR▉ ▉PV▉ ▉FV▉. Annuity problems require the input of 4 of these 5 values: ▉N▉ ▉I%YR▉ ▉PV▉ ▉PMT▉ ▉FV▉. Once these values have been entered in any order, the unknown value can be computed by pressing the key for the unknown value.

Interest rates are always entered as the number is written in front of the percent sign, i.e., 5% is entered as a 5 rather than as 0.05.

## Special settings

There are several settings that affect the operation of the time value of money application.

**Clearing the time value of money registers.** The 5 storage registers that hold the time value of money values, ▉N▉ ▉I%YR▉ ▉PV▉ ▉PMT▉ ▉FV▉, are cleared when ▭ ▉INPUT CLR DATA▉ is pressed when the calculator is showing the TVM menu.

**Begin/End Mode.** A special mode setting relates to the solution of problems known as annuities. This mode tells the HP 17bII+ to solve these problems assuming that payments are made either at the beginning of a period or at the end of a period, which is why this mode is called Begin / End mode. The default mode is END as shown in Figure 2.

```
12 P/YR          END MODE
 N  I%YR  PV  PMT  FV OTHER
```
Figure 2

This mode is changed by pressing OTHER from the main TVM menu and then choosing BEG or END. To return to the previous page of the TVM menu, press EXIT/MAIN.

If you receive an unexpected result when solving an annuity problem, make sure that the calculator is in the proper mode and try resolving the problem.

Begin / End mode does not affect compound interest problems.

**Periods per year.** The default setting is 12 P/YR as shown in Figure 2 above. Problems involving annual compounding or annual payments should be solved with this value set to 1. Problems involving monthly compounding or monthly payments should be solved with this value set to 12. To set this value to 4 for quarterly payments / quarterly compounding, for example, you would press OTHER from the main TVM menu then press 4 and P/YR.

```
4 P/YR           END MODE
P/YR  BEG  END          AMRT
```
Figure 3

To return to the previous page of the TVM menu, press EXIT/MAIN.

**Cash flow diagrams and sign conventions**

The sign conventions for cash flows in the HP 17bII+ follow this simple rule: money received is positive (arrow pointing up), money paid out is negative (arrow pointing down). The key is keeping the same viewpoint through each complete calculation. The time value of money application operates on the convention that money invested is considered positive and money withdrawn is considered negative. In a compound interest problem, for example, if a positive value is input for the PV, then a computed FV will be displayed as a negative number. In an annuity problem, of the three monetary variables, at least one must be of a different sign than the other two. For example, if the PV and PMT are positive, then the FV will be negative. If the PV and FV are both negative, then the PMT must be positive. An analysis of the monetary situation should indicate which values are being invested and which values are being withdrawn. This will determine which are entered as positive values and which are entered as negative values.

The regular use of cash flow diagrams allows a faster approach to solve most TVM-related problems. The cash flow diagram below represents the borrower viewpoint of the most problems and their relationship to the TVM variables.
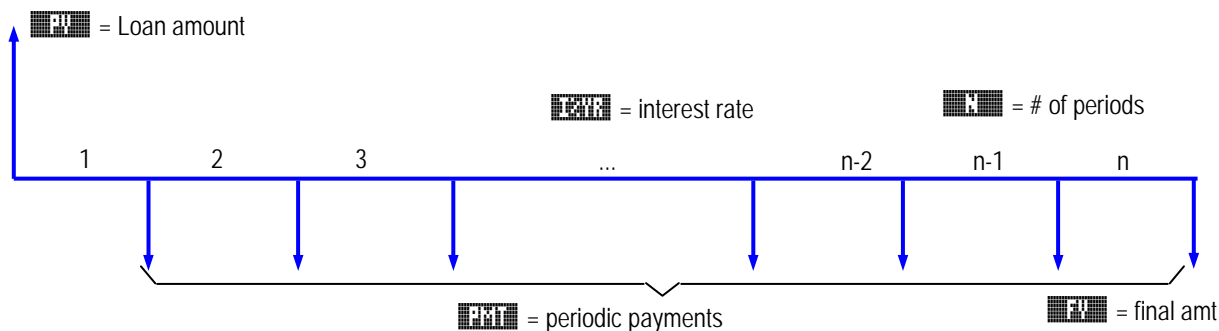
**Practice solving time value of money problems**

NOTE:     Once you begin working these problems, the keystrokes shown assume you do not leave the TVM menu environment. Should you leave that environment and then decide to work a problem below other than Example 1, you should press ▭ 🄴🅇🄸🅃 🄵🄸🄽 🅃🅅🄼 to return to the TVM environment.

Example 1:     If you deposit $100 today, how much is it worth in 20 years, if interest is compounded at a 4% annual rate?

Solution:     ▭ EXIT MAIN ▮FIN▮ ▮TVM▮ ▭ INPUT CLR DATA
              ▮OTHER▮ 1 ▮P/YR▮ EXIT MAIN
              2 0 ▮N▮
              4 ▮I%YR▮
              1 0 0 ▮PV▮
              ▮FV▮

FV=-219.11
| N | I%YR | PV | PMT | FV |OTHER|     Figure 4

Answer:     $-219.11. Note that the solution is displayed as a negative value. The problem is set up with the $100 as a deposit. The value at the end of the 20-year period would be a withdrawal and is therefore shown as a negative value.

Example 2:     If you deposit $50 a month starting one month from today, how much do you have in the account in 10 years, if the account begins with $1000 in it and earns 5%, compounded monthly?

Solution:     ▭ INPUT CLR DATA ▮OTHER▮ 1 2 ▮P/YR▮ EXIT MAIN
              1 2 0 ▮N▮
              5 ▮I%YR▮
              1 0 0 0 ▮PV▮
              5 0 ▮PMT▮
              ▮FV▮

FV=-9,411.12
| N | I%YR | PV | PMT | FV |OTHER|     Figure 5

Answer:     $-9,411.12.

Example 3:     If you need $50,000 in 20 years, how much do you need to deposit each quarter into an account, if the account earns 6%, compounded quarterly?

Solution:     ▭ INPUT CLR DATA ▮OTHER▮ 4 ▮P/YR▮ EXIT MAIN
              8 0 ▮N▮
              6 ▮I%YR▮
              5 0 0 0 0 +/− ▮FV▮
              ▮PMT▮

PMT=327.42
| N | I%YR | PV | PMT | FV |OTHER|     Figure 6

Answer:     $327.42. Note that the $50,000 is entered as a negative number since it will be withdrawn from the account in 20 years.