hp calculators

HP 17bII+ Time-Value-of-Money

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HP 17bII+ Time-Value-Of-Money

One of the wonderful features of your HP 17bll+ is its ability to quickly calculate financial variables used in compounding and discounting in a way that is easy to follow and therefore understandable. In learning how to do these calculations, it is important for you to see what the five variables are that can be used in financial calculations and how they relate to one another. If you can, you will be able to figure out what you have to do to get the right answer.

THE FIVE VARIABLES:

These five variables are in the time-value-of-money menu. To get there, start form the main menu and press 'FIN.' In the next menu that pops up you should see "TVM" way to the left. Press that button and you are in the time-value-of-money menu where you will perform your TVM calculations.

The five registers or memory banks for the financial variables are shown in your display:

N - The total number of compounding, discount, or payment periods

If you have a 30-year loan, for example, that is to be amortized on a monthly basis, the total number of payments would be 360 (12 months per year times 30 years) and this is the number that would go in the 'N' register.

I%YR - the interest rate or discount rate per year

The annual rate shows in this register and the calculator computes what the actual rate will be per compounding or discount period. For example, if the annual rate for a savings account is 6% and the interest is paid (compounded) monthly, the rate per month would be 0.5% (1/12th of the annual rate of 6%). But the annual rate of 6% would still show in the 'I%' register.

PV - the present value of a sum of money or series of monies

This is the amount with which you start when you open up a savings account. Or, it may be the sum you calculate when you are discounting a future sum to a present value. It also could be the starting amount of a loan before payments on it begin.

PMT - payment that is paid or received on a periodic basis

A series of payments or receipts should be shown in this register. But it must be the same amount each time that is paid or received (for varying payments we will go to the discounted cash flow menu) and the payments must be equally spaced apart, that is, every week, every month, every year.

FV - the future value of a sum of money or a series of monies

This could be a future sum of money you expect to receive and want to calculate what it is worth today, its present value. Or, it might be how much money your savings account will have after you deposit money in the bank and allow it to accumulate interest. It might also be the balance of a loan at any one time as it is being amortized.

LEARNING STRATEGY:

We have tried to give you a little bit of an idea what to expect from each of these financial registers. You will start to feel comfortable with them when we get into our practice problems. That way you can see just how each register is used. Try, if you can, to follow the logic of what we do in these problems. That is, see if you can understand why a particular number goes in a particular register. When you develop the ability to do that (and you will!), these financial registers will not only make a lot of sense, they will be easy for you to make them get the information you want.

PAYMENTS PER YEAR:

Just before we get into our practice problems, a couple of points. When you first go to your 'TVM' menu, you'll see some information given to you just above the menu labels. To the left in your display is the number of payments per year for which your calculator is currently set. If you are on a monthly basis, for example, it will say "12 P/YR." To the right of that you will see the mode currently set for your calculator, either "BEGIN" or END."

To see how both of these are set, look to your menu labels in 'TVM.' To the far right you will see the "OTHER" label. Press that and you go to yet another menu. Look to the left. Do you see the "P/YR" label? That stands for "payments per year" and allows you to set this variable. Let's say you are currently at 1 P/YR and you want to change from annual to monthly payments, that is, 12 P/YR. Put in the number of payments per year you want, namely '12,', and then press 'P/YR.' Right above it in the display you should see "12 P/YR." Keep this setting for now.

"BEGIN" VERSUS "END":

To the right of the 'P/YR' menu label you should see 'BEG' and 'END.' These are the keys to set either the Begin or the End mode. The Begin mode would be used if interest on a savings account or maybe a mortgage loan would be paid in advance. That is rare. Normally, you are going to have your calculator set to the End mode. This is used for an "ordinary annuity," meaning interest is paid in arrears. Your monthly mortgage payment that you pay the first of every month is paying interest for the previous month. That is interest paid in arrears. Press 'END' to put your calculator in the End mode.

GETTING THE DIRECTION RIGHT:

One last point before we get into the sample problems. Something called the "cash flow sign convention" is very important. This refers to the point of view of how money is flowing. You will make calculations from someone's perspective, for example, a borrower or a lender. Maybe a saver or a bank offering the savings account. In the transaction you must tell the calculator who is paying the money and who is receiving it. That is, you must describe the directional flow of the money For the paying party the money paid should be shown with a negative sign to indicate the money is flowing away from that party. For the receiving party the money received should have a positive sign to indicate the money is flowing to that party.

PRACTICE PROBLEMS:

Let's get back to the TVM menu and go to work by pressing 'EXIT.' Also, it is a good idea to first clear in a menu before starting a new problem. So, after arriving back in the 'TVM' menu press 'SK' (the color shift key) and 'CLR DATA' and that will clear the menu of any numbers from previous calculations.

As we do these, remember, try to follow the logic of our doing something, the "why" a number goes into a particular register.

Try this problem: A saver deposits $5,000. in a savings account at the local bank
                      paying an annual interest rate of 4% compounded monthly. If
                      the saver leaves this money in the account for 3 years, how
                      much will be in the account after the three years? Do this one
                      from the saver's point of view.

Analysis/solution: You've got five financial registers to work with. Take the
information given you in this problem and decide where each
of the numbers should go.

First, the $5,000. You are starting out with this money, aren't
you? So, that should go in present value. But, how about the
sign? From the saver's point of view, the $5,000. should have a
negative sign. Why? Sure, the money belongs to the saver.
But the money is flowing away from the saver, isn't it,
when the saver hands it over to the bank for the bank's use.
We want to show that direction of cash flow by putting a
negative sign on the $5,000. Press the '+/-' button. Now, if we
were to do this from the bank's viewpoint, then we would
make the $5,000. positive.

Next, the 4%. That pretty clearly goes in the I%YR register,
doesn't it. Remember that you insert the yearly interest or
discount rate in the I%YR register and the calculator will take
care of charging the proper interest per period that is being
compounded or discounted, whether that is weekly, monthly,
annually, or some other time frame. It knows to do this, as
long as you have told it by setting the payments per year as we
described above. It should be set at 12 P/YR.

Now to the 3 years. It is being compounded monthly for three
years, that is, a total of 36 months or compounding periods.
This is the number that should go in the N register and you
can just hit '36' and 'N' to get it into the 'N' register. But
your calculator has a convenient feature that figures this out
for you. Just press in the number of years, hit the shift
key, and press 'N.' It multiplies the number of years by the
payments per year that you have already set and puts the
resulting number in the 'N' register. So, you don't have to
calculate the actual number of periods that will appear in 'N'
as long as you have pre-set your calculator to the number of
payments per year you want.

You have told your HP 17bII+ all the information it needs to
solve for what you will have in this savings account after 3
years. So, press the button of the register you are looking for.
And which register is that? Well, future value, right? You are
looking for how much money you will have in the future. After
you pressed the FV button, are you looking at $5,636.36?
Good. Congratulations!

<u>The Keystrokes</u>

Let's put all the keystrokes below in one spot so that you can
see everything in a single operation as follows:

<div align="center">

5000
+/-
PV
4
I%YR
3
SK
N

</div>

At this point you have all the information in for the calculator
to solve the problem. And, by the way, you can give the
registers the information in any order you want. The interest
rate could have come before the deposit amount, for example,
and it would make no difference, as long as you get the right
information in these different electronic slots we call
"registers." Now, solve for FV by pressing that key:

<div align="center">

FV   Answer: 5,636.36

</div>

<u>Positive and Negative</u>

Note that the answer is positive. Recall that we did this from
the saver's point of view. So, this means the money is flowing
to the saver, which, of course, it is. Had we put in the $5,000.
deposit at the start as a positive, that is, from the bank's point
of view, the future value answer would have been a negative
$5,636.36, meaning the bank would have to pay this money to
the saver. The money would be flowing away from the
bank.

<u>And One More Detail</u>

Now, don't clear your calculator quite yet. Let's see what this
account may have accumulated if the saver had not only
deposited $5,000. at the outset but at the end of each month
(remember we are in the End mode) also deposited $50. for the
full 36 months. All the information we put in the calculator is still
needed. We just have to add one more piece and that is
the monthly deposit of $50. Where do we put this? In the
register where monies are paid or received on a periodic basis,
the 'PMT" register. Do this with the following keystrokes:

<div align="center">

50
+/-
PMT

</div>

Don't forget that before we put the deposit in the PMT register
we have to show the deposit flowing away from the saver by
making it negative with the '+/-' key.

And re-solve for the monies that will now be in the savings
account after three years:

FV   Answer: 7,545.44

Getting the Cash Flow Direction Wrong

Before we leave this problem, take a look at what would
happen if we made an error in the direction of the cash flow.
Let's say that we mistakenly put in the $50. with a positive
sign:

50
PMT
FV   Answer: 3,727.28

What happened? Where did the money go? Recall that we
deposited the $5,000. as a negative, from the saver's point of
view indicating that the money was flowing away from the
saver and to the bank for its use. When we subsequently tell
the calculator the periodic amount of $50. has a positive sign,
we are telling it that the money is flowing in an opposite
direction from the initial $5,000. deposit. We are saying that
the money is going to the saver, in effect saying the saver is
withdrawing $50. every month from this account. The
calculator will do what it is told and so it deducts this monthly
amount and the account has less than what it would have had
without these "withdrawals."

Before we go to our next problem, this is a good time for a reminder that numbers from old calculations can interfere with your
current calculation. So, get rid of those old numbers by clearing your TVM menu with 'SK' and 'CLR DATA.' Good job! Also, set
your calculator to 12 P/YR if it isn't already.

Another problem: A homebuyer borrows a mortgage loan of $300,000. in order to
                    buy a house. The annual interest rate on the loan is 7% and
                    the loan will be paid back over 30 years with monthly
                    payments. What is this monthly payment that will fully
                    amortize, that is, fully pay back, this loan, principal and
                    interest, over the 30 years? Do this one from the
                    homebuyer/borrower's point of view.

Analysis/solution: Choose your registers again! What should go in present value?
                    The loan is what the borrower is getting now and that should
                    go in the 'PV' register. But with a positive or negative sign?
                    Positive, right? Yes, because the money is flowing to the
                    borrower. Press '300000' and 'PV.' Were we doing this from
                    the lender's point of view, the sign on the loan would be
                    negative.

                    Put the loan period in, namely 30 years, and remember the
                    shift key will multiply the years by the number of payments
                    per year that you have set. Press '30,' 'SK,' and 'N.'

Insert the annual interest rate by pressing '7' and 'I%YR.'
Don't worry, the calculator will know to compute 1/12th of the
annual rate every month because you have pre-set your
calculator to 12 payments per year.

Your HP 17bII+ has all the information it needs to solve for
the loan payment that will pay back this loan. Just hit 'PMT.'
You should have -$1,995.91.

From Whose Point of View?

Why the negative sign? Recall that we put in the loan amount,
the $300,000., as a positive number because we were doing
this from the borrower's point of view. Now that we know
what the borrower must pay back every month, that loan
payment should be shown as a negative, since the money every
month is flowing away from the borrower. Had we done this
from the lender's point of view, the $300,000. would have been
put in as a negative, but the loan payment coming to the lender
every month would have come up in the 'PMT' register as a
positive.

The Keystrokes

To summarize, the keystrokes for computing this loan
payment are:

        300000
        PV
        30
        SK
        N
        7
        I%YR
        PMT   Answer: -1,995.91

You can solve for any of the variables (registers) in this TVM
menu.

Solve for a Different Variable

Let's change this problem a little and say the borrower
has only budgeted for a loan payment of $1,500. every month.   If
the interest rate and term offered by the lender remain the
same, how much money could the homebuyer borrow and stay
within budget?

Don't clear your calculator. Just change the information that
needs to be changed. The 'N' and 'I%YR' registers will stay
the same. The difference here is that what was a known
variable, the loan amount, is now what we are trying to solve
for. But we do know what the loan payment is going to be,
namely that $1,500. the borrower has set. So, put the payment
in by pressing '1500,' '+/-,' and 'PMT.' The payment must be

shown as a negative, remember, from the borrower's point of view.

Solve for the loan amount by pressing 'PV.' The answer is the borrower could get a loan of $225,461.35

The Keystrokes

1500
+/-
PMT
PV   Answer: 225,461.35

To Clear or Not to Clear

After all our harping about the importance of clearing the registers, you may be wondering why we recommended you not clear the calculator when we figured this new loan amount. Well, certainly, you could have. But then you would have had   to reinsert the same information as we had before into the N and I%YR registers.

When you find yourself in this kind of a situation, you may find it easier and less time consuming to keep the registers that won't be changed as they are and put new information in those registers that are to be changed. The new loan payment of $1,500. that we put in the 'PMT' register kicks out the previous payment we had and takes its place.

Clear the calculator with 'SK' and 'CLR DATA.'

One more problem: A buyer just financed the purchase of a car with a $25,000. loan at 6% interest over five years. This car owner expects to keep the car for three years. If that turns out to be true, how much will the car owner still owe on the loan after three years?

Analysis/solution: This problem is asking us for the balance still owed on a loan at a point during the loan term. Well, let's first figure what the loan payment is. If we do this from the car buyer's point of view, the keystrokes to compute the loan payment are:

25000
PV
6
I%YR
5
SK
N
PMT   Answer: -483.32

Let's now ask the calculator how much of the loan would be left unpaid after three years of loan payments. We are asking the calculator to look three years in the future for the loan balance then. Tell the calculator this by pressing in the time

factor of three years with these keystrokes:

3
SK
N

That replaces the 60 months in the 'N' register that we needed to calculate the loan payment at the outset with the 36 months we need now to figure out the loan balance. All that is left to do is to ask what that balance will be three years into the future. Press:

FV   Answer: -10,905.09

The car owner has a balloon payment of $10,905.09 to make in order to pay off this old loan. It is negative in your display because it represents more money that must "flow" from the borrower to the lender.

Clear with 'SK' and 'CLR DATA.'

Last problem: All this time we have worked with monthly compounding. Let's go to a different payment schedule with a loan of $80,000. at 6.75% annual interest, a loan term of 15 years and payments made every two weeks. What payment should be made biweekly so that this loan will be paid off by the end of the loan term?

Analysis/solution: Let's first set the new payments per year. From the TVM menu press 'OTHER.' The new menu that comes up has "P/YR" to the far left of the display. How many payments per year will you make if you pay every two weeks? If we divide 52 weeks of the year by 2 weeks, we'll find you will make 26 payments a year. Press in '26,'and then 'P/YR.' Do you see it come up in the display? Good.

Now, press 'EXIT' to get back to the TVM menu and calculate the loan payment with these keystrokes:

80000
PV
6.75
I%YR
15
SK
N
PMT   Answer: -326.45

Your biweekly payment is $326.45. By the way, did you notice that when you put in the 15 years that it really did multiply by 26 payments a year to give the "N=390" that you saw in the display?

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LOGIC AND REPETITION:

We covered a lot of material in this section on the time-value-of-money. You will likely benefit by going over some or all of it again. And recall what we said at the outset that if you can follow the logic of why numbers are going in the registers they do, you will master the use of these applications with your HP 17bII+. Confidence will come as you give yourself the practice you need in the use of these registers.