# 3.10: Complex Time Value of Money Problems

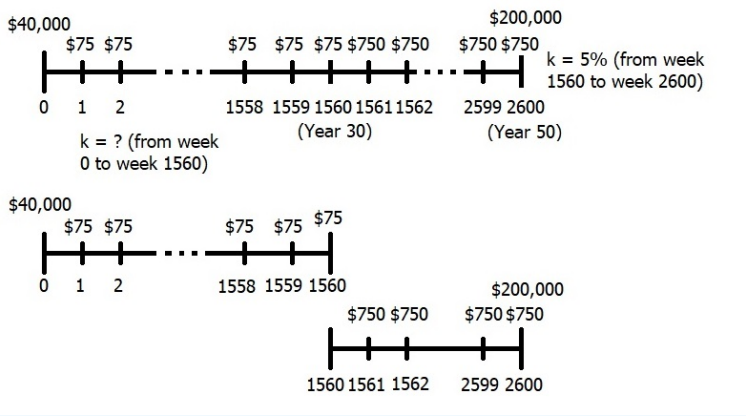
Everything above this point completes your "Time Value of Money Toolbox." All the examples to this point have been straight-forward situations. However, sometimes we have what we refer to as complex time value of money problems where there are multiple issues that need addressed within one problem. One of the most common examples of this would be a retirement problem where you have X dollars available today, want to be able to withdraw a certain cash flow stream at retirement throughout your retirement years and want to find out how much you need to save each month until retirement between now and the day you retire to achieve your goal. In order to solve a problem like this, you need to visualize (a time line is very helpful) what information you have and what you are missing (that you need to solve for). You will often need to break this down into multiple steps.

### ✔ Example 3.10.4: Solve a Complex Time Value of Money Problem

Consider a situation where you are saving for retirement. You currently have $40,000 saved and would like to save an additional $75 per week for the next 30 years. You estimate that when you retire (30 years from today), you want to be able to withdraw $750 each week for the next 20 years and have $200,000 left over at the end of the 20-year retirement period. Assuming you earn 5% during retirement, what rate of return must you earn during the next 30 years to meet your goal?

#### Solution

One way to approach this is to start with a timeline. Note that each period is one week and there are 52 weeks per year. This means that we will have 1560 periods until retirement (1560 = 30×52) and another 1040 periods until the end of retirement (1040 = 20×52). This provides a total of 2600 periods for the entire 50 year time (2600 = 1560 + 1040). Once we've created the timeline, we can split it into two timelines. Timeline one will begin today and go to retirement (period 1560) and timeline 2 will begin at retirement (also period 1560) and go to the end of the retirement time frame (period 2600). Here, the timelines help us visualize the information that we know and what we need to find out (specifically our rate of return we must earn over the first 30 years).




Now we can start the calculations. To start, you need to figure out how much you will require at the end of the 30 years. This is the amount you want to have when you retire.

#### Step 1: Solve for how much you need at retirement.

Set your calculator to 52 periods per year to reflect weekly withdraws during retirement

Set your N to 1040 (52 periods per year for 20 years = 1040 weekly periods)

Set your PMT to 750 (to reflect the weekly withdraw)

Set your FV to 200,000 (to reflect the amount left over)

Set your I/YR to 5 (for your rate of return during retirement)

Solve for PV ⇒$566,527.38

Note – your PMT and FV need to be the same sign. You can make them both positive or both negative, but they are both flowing in the same direction so must be the same sign.

Step 2: Now that you know how much you need when you retire ($566,527.38), you can calculate what rate of return you need to earn over the next 30 years to get there.

Keep your calculator set to 52 periods per year as you are making weekly contributions

Set your N to 1560 (52 periods per year for 30 years = 1560 weekly periods)

Set your PV to -40,000 (to reflect the initial $40,000 contribution)

Set your PMT to -75 (to reflect your weekly $75 contribution)

Set your FV to 566,527.38 (to reflect how much you need at retirement)

Solve for I/YR ⇒5.98%

Note – your PV and PMT both need to be the same sign. Again, you can make them positive or negative, but they are both flowing in the same direction. The FV needs to be the opposite sign. The easiest way to think of this is that you are giving up the $40,000 today and the $75 per week in order to get back the $566,527.38 30 years from today.

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