



### Retirement Planning

You will likely spend 1/4 to 1/3 of your life in retirement collecting money while *not* working. Where does your income come from in retirement? This activity investigates a special type of retirement planning scenario: pay yourself first!

#### Objectives:

- Determine the amount of money you will accrue in a retirement account by controlling various parameters.
- Examine the impact of management fees on your retirement savings.

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This might sound like a strange topic for high school students, but it is *never* too soon to plan for retirement!

Retirement income can come from many different sources: a pension plan, a 401K or similar plan, IRAs (Individual Retirement Accounts), USA's Social Security or the Canada Pension Plan (other countries have plans similar government-managed plans). But company-sponsored pension plans can be risky (see Enron), and government plans are usually not sufficient to live on comfortably.

Your personal planning and saving can assure you a secure and rewarding retirement. It's never too soon (or too late) to start saving for retirement. But sooner is better because you will tap 'the power of compounding' as you will see in this activity.

**Teacher Note:** The built-in **Finance Solver** (in the Calculator app, **[menu] > Finance**) lets users solve TVM problems using a simple formula and can solve for any of the feature's parameters. But it is limited in scope, especially in the **pmt** field: it assumes all payments are equal. This activity takes a different approach: as your income increases over time, so should your retirement plan contribution. And, in retirement, your income should *increase* to keep pace with inflation.

The data that the program requires are not just 'pulled out of thin air.' Some preliminary instruction about salaries, taxes, investment options and fees, and economic factors like inflation should be covered.

1. Open the **Retirement Planner** document on your TI-Nspire™ CX II.

**Note:** To round computations to two decimal places, the **Display Digits** setting in the **Documents Settings** has been changed to **Fix 2**. The file is write-protected, so save a copy using a different filename.

The first page of the document is the title page. Look at the rest of the pages in the document, especially the instructions. Then use the document to answer the following Scenarios.

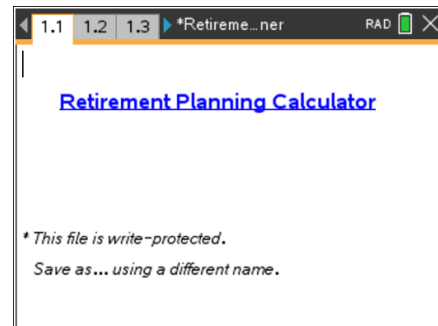
**Scenario 1:** You graduate from college at age 22. Your first job pays \$40,000 a year. You immediately (smart!) open a retirement account starting with \$1,000. You will deposit only \$100 the first year and plan to increase that deposit thanks to your (predicted) increases in salary to cover inflation at 3% plus merit raises of 2%. Your retirement plan charges 3% fees annually. Assume the gross returns on the investment are 8% while working and 6% when retired. You plan to retire at age 70 and expect your retirement plan to last to age 100 (with annual increases to cover inflation).

- a) What *percent* of your annual salary are you depositing each year? Use this value as the **% to save each year**. Regarding the message 'be careful with decimals,' you can include decimals in your data entries: for 2%, enter 2. For 0.2% (two tenths of one percent), enter 0.2. Just don't convert the percents to decimals by dividing by 100. The program does that for you.

Enter all the data into the spreadsheet and run the Python program.

- b) How large is your **nest egg** at retirement?
- c) What is your first monthly retirement payment?

Are you happy with this result?



Your answers:

a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

#### Teacher Notes:

Answers:

- a)  $100/40000 = 0.0025$  or 0.25%. That's only  $\frac{1}{4}$  of one percent. Enter 0.25 for the '% to save each year,' not 25!
  - b) \$55,376.46
  - c) \$152.23
- Not a very promising plan!



**Scenario 2:** Suppose you find a retirement plan that charges a very small fee for administration: 0.1% (one tenth of one percent). Change only this value in your input sheet from Scenario 1 and re-run the program. Report your new

Your answers:

- a) Nest egg value
- b) First month retirement payment
- c) By what percent does your nest egg increase?

a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

### Teacher Notes:

Answers:

- a) \$138,325.37
- b) \$575.56
- c)  $(138325.37 - 55376.46) / 55376.46 = 1.4969...$  or approximately 150%!

While still not a magnificent total, the nest egg is now 2.5 times larger just from smaller fees!

**Scenario 3:** What will it take to retire with one million dollars?

At age 25 you open a retirement account with \$2,000. Your salary is currently \$50,000 a year and you confidently expect 2% *merit* increases each year on top of inflation increases. What *minimum yearly* deposit should you start with to acquire a nest egg of \$1,000,000 at age 70?

**\$1,000,000.00**

Assume the following additional parameters:

Final age: 100

Work Gross Return: 8%

Retire Gross Return: 6%

Annual Fees: 2%

Annual Inflation: 2%

Answer a) \_\_\_\_\_

- a) Work with the “% to save each year” value to get the nest egg just above \$1,000,000. Calculate that % of \$50,000 to arrive at the first year’s deposit.
- b) Suppose you can get an annual fee of only 1%. How does this impact the nest egg?

Answer b) \_\_\_\_\_



### Teacher Notes:

Inputs:

"Age now" 25

"Retirement age" 70

"Final age" 100

"Current savings" 2000

"Current salary" 50000

"% to save each year" --- *Work on this number to get just over a \$1,000,000 nest egg.*

"Work gross return %" 8

"Retire gross return %" 6

"Annual fee %" 2

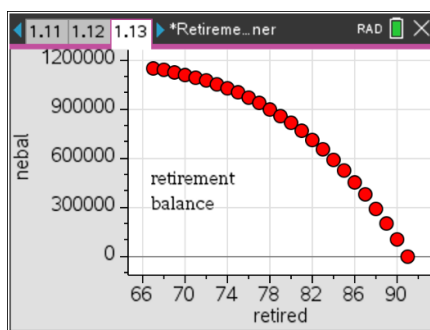
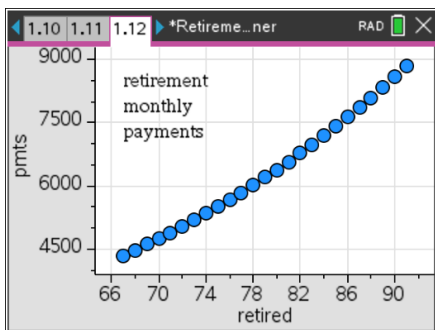
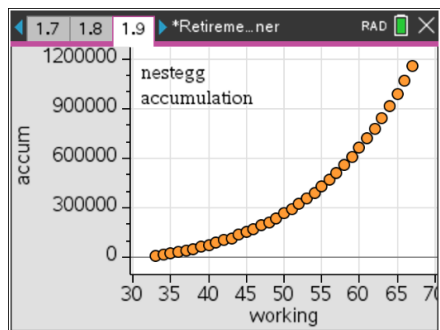
"Annual inflation %" 2

"Job merit %" 2

- A value of 5% (to invest each year) results in a nest egg of \$1,004,634.93. That's a starting yearly deposit of  $.05 \times \$50,000 = \$2,500$  or about \$208 per month.
- The nest egg increases to \$1,317,962.80. That's over a 30% increase just from reducing the fees!

After each run of the program several lists are stored. The stat plots in the document display some trends.

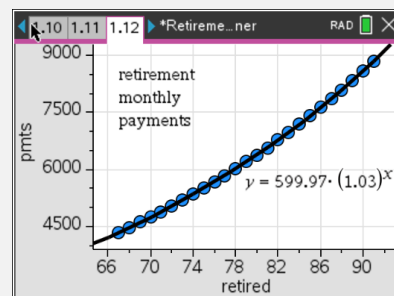
What types of graphs are displayed?



Use the TI-Nspire CX II **Analyze** feature to determine an appropriate mathematical model for each graph.

### Teacher Notes:

All three plots above are some forms of exponential functions. The 'retirement monthly payments' produces a good exponential function but the other two will require some data transformation to get a good exponential fit.



**Summary:**

Some things are out of your control when it comes to retirement planning, but the factors that you *can* control greatly influence the final outcome: the age you start saving, the percent of your income you can put away each year, and the fees that the company charges you to invest your money all have an impact on nest egg values.

Regardless of the actual numbers you use, your retirement plan *with increasing monthly payments* will look like the screen to the right. The final question is: how high can it go? It's up to you: forewarned is forearmed.

**Retirement Planning**  
**TEACHER NOTES**

