General Savings Program

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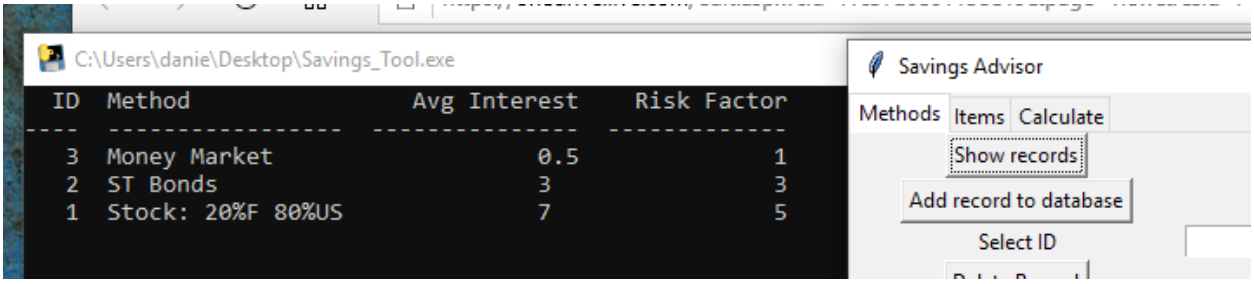
About:

This program was created to help fill a void that I felt was present in my personal savings. I think there are several tools and information available for saving for retirement in an objective manner, but not so much for other personal savings (vehicles, emergency funds, my 5 yr. old daughter's wedding, major house repairs, etc.). A lot of us know we should be saving for short-term needs, but the process for determining how much and where to invest is relatively subjective at best and simply non-existent as worst. This leads many to either be too conservative with their money or over-whelmed and foregoing the exercise of short-term savings. Both of these outcomes hinder us from making the most of our earnings. The approach of determining my short-term savings in theory should be just as methodical and quantitative as the method I (or my financial institute or my saving's advisor) uses for my long-term savings. All the same parameters and assumptions are there. This tool enables one to approach their sort-term savings with the same level of objectiveness. As a result, this enables one to optimize the rest of their earnings for matters such as charity and/or leisure. This document will step through both how I developed as well as how to use this tool for your own savings.

The main revelation that this tool was built for was; I can make better decisions if I approach each component of savings in its own vacuum (independent of the other components). What do I mean by that? In this case, I believe that the 'savings decision process' can be broken up into three main components, and if approached independent of the others, we can make better decisions. The three components are:

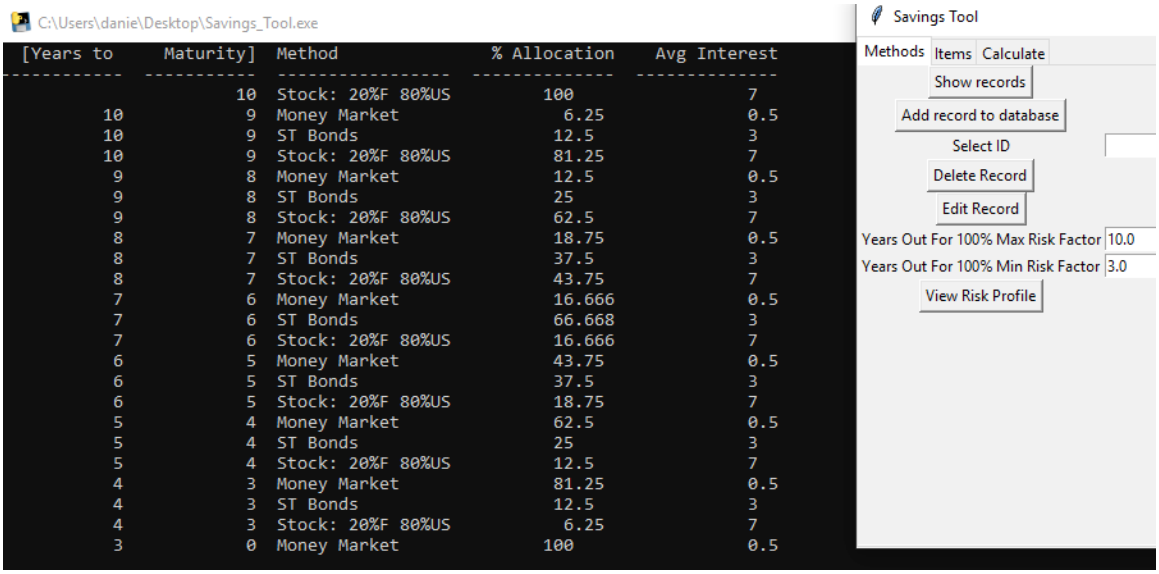
1. What investment methods am I willing to put my money in? (Ex: stocks, bonds, money market, etc.) Once you determine your list, you then assign each option an average interest rate as well as a risk factor. The risk factor can either based off others' analyses, such as a beta, or can be based off your own personal view of the methods. The main thing is that the risk scale you choose to use is consistent (each investment risk factor is appropriately proportional to each other). I would recommend using the latter approach and using a scale of 1 to 5 (1 being the lowest risk and 5 being the highest). Remember, at this point you are not thinking about how much money you need to invest or even what you are saving for. You are simply identifying the investment methods you would be willing to invest in as well has how risky (aka: how volatile) you think each method is relative to each other (via the risk factor). See example below where the created methods are money markets, short-term bonds, and a mix of foreign and US stocks. This is just one example. The methods could be anything. Also, you can have multiple methods with the same risk factor. But, **you must have at least 2 entries with different risk factors** (current algorithm will break if not).

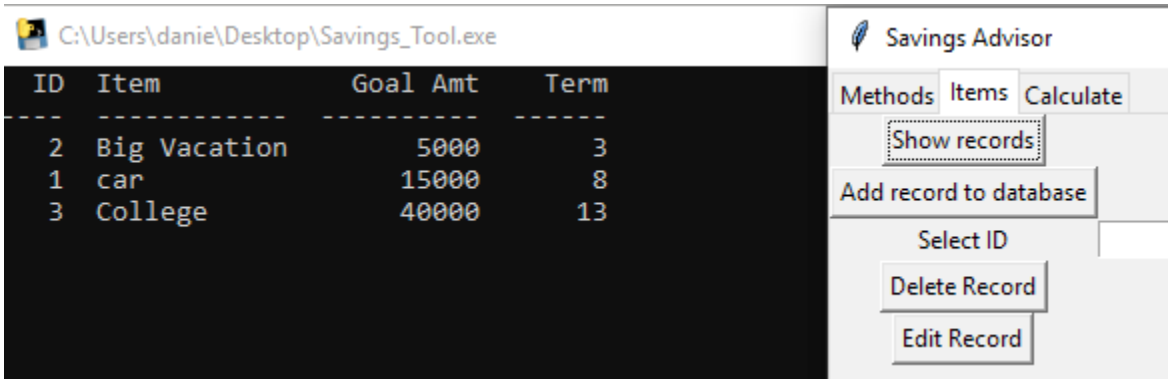


2. Determine how many years out I would be comfortable with all of my savings being invested in the highest risk methods? Determine how many years out I would want all of my savings in the lowest risk methods. For example, if my highest risk method was 'stocks' and my lowest risk was 'money market', I could say I am comfortable with all my savings in stocks as long as I wouldn't need to access it for 10 or more years and by the time that my savings is within 3 years of maturing, I want all of it in money markets. See example below.

At this point, the program has enough information to generate your saving's risk profile. See example below. In this example, I would have 100% of my savings in stocks if the investment was at least 10 [(1)] years from maturity, 100% in money markets if an investment is 3 years or less from maturity, and a more aggressive to a less aggressive combination of all methods for years 10 to 3 respectively. See example out of risk profile and it's percent allocation below.

3.





Note: to use this program optimally, I would want to put in every item I see myself saving for in my lifetime. So, for example, instead of one car, I may have car1, car2, car3, car4 items, at 8, 18, 28, 38 years respectively. The more I can include in the items list, the more accurate/ meaningful/optimal the results will be. Why, because in actuality I want to know what I need to put aside each year for my entire future, not just for the next few years. The more I can invest for items further out now, the more I can leverage the exponential benefits of compounding interest (meaning the less I have to save overall).

Notice that it is not until step 3 where I finally consider for what and how much I are saving. The first two steps are simply used to build a dynamic risk profile tailored to my comfort level (see example in step 2). This third step is where I provide inputs for that profile.

Once each of these three components are completed, I simply provide the program with my current principal (the **current balance** of my savings, which for this example we will say I have $15,000) and hit 'calculate'. The outputs will be a detailed savings plan for each item as well as a summary of how to allocate my current principle among the different investment options and how much I need to invest this next year.

There are two main outputs. The first is a detailed report of each item showing how the money should be invested each year as well as the estimated returns. So, for the car item, you can see that for the first year, I am to put ~$4,400 of our principal in stocks, ~$3,800 in bonds, and ~$1,900 in money market. I am also to try and invest ~$420 annually where the first year I am to put ~$180 dollars in stock, ~$160 dollars in bonds, and ~$80 dollars in cash. You can then see the estimated returns on that for the first year and how it is to be reinvested each subsequent year based on your personal risk profile. Also, notice at the end of the 8 years, I am estimated to end with ~$15,000 (all sitting in money market ready to spend on a car).

RESULTS BY ITEM:
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car

Starting Year	Ending Year	Method	% Interest Rate	% Allocation	Starting Amt	Annual Amt	Ending Amt
0	1	Stock: 20%F 80%US	7	44	4407	183	4899
0	1	ST Bonds	3	38	3778	157	4048
0	1	Money Market	0.5	19	1889	78	1977
1	2	Stock: 20%F 80%US	7	17	1821	70	2018
1	2	ST Bonds	3	67	7283	279	7780
1	2	Money Market	0.5	17	1821	70	1899
2	3	Stock: 20%F 80%US	7	19	2193	78	2425
2	3	ST Bonds	3	38	4386	157	4675
2	3	Money Market	0.5	44	5117	183	5326
3	4	Stock: 20%F 80%US	7	13	1553	52	1714
3	4	ST Bonds	3	25	3107	105	3304
3	4	Money Market	0.5	63	7766	261	8066
4	5	Stock: 20%F 80%US	7	6	818	26	901
4	5	ST Bonds	3	13	1636	52	1737
4	5	Money Market	0.5	81	10631	340	11024
5	8	Money Market	0.5	100	13662	418	15129

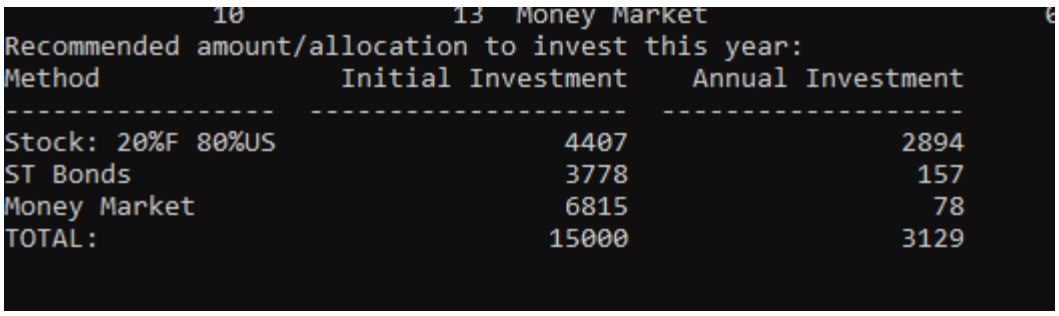
Big Vacation

Starting Year	Ending Year	Method	% Interest Rate	% Allocation	Starting Amt	Annual Amt	Ending Amt
0	3	Money Market	0.5	100	4926	0	5000

College

Starting Year	Ending Year	Method	% Interest Rate	% Allocation	Starting Amt	Annual Amt	Ending Amt
0	3	Stock: 20%F 80%US	7	100	0	2711	8715
3	4	Stock: 20%F 80%US	7	81	7081	2202	9779
3	4	ST Bonds	3	13	1089	339	1461
3	4	Money Market	0.5	6	545	169	717
4	5	Stock: 20%F 80%US	7	63	7473	1694	9690
4	5	ST Bonds	3	25	2989	678	3757
4	5	Money Market	0.5	13	1495	339	1841
5	6	Stock: 20%F 80%US	7	44	6689	1186	8343
5	6	ST Bonds	3	38	5733	1017	6922
5	6	Money Market	0.5	19	2867	508	3389

The second type of output is what I find most useful, and that is a summary of how I should allocate my current principal as well as how much and where I need to contribute savings for this next year. In other words, it's a summary of my "starting amounts" and "annual amounts" for the first year of each item. See example below.


10 13 Money Market
Recommended amount/allocation to invest this year:

Method	Initial Investment	Annual Investment
Stock: 20%F 80%US	4407	2894
ST Bonds	3778	157
Money Market	6815	78
TOTAL:	15000	3129

So, in this case, to meet my goals most optimally given my personal profile, I need to try and save ~$3,130 this year; putting ~2,900 of it in stocks, ~$160 in bonds, and ~$80 in cash. Of the ~$15,000 principal, I am to put $4,400 in stock, ~$3,800 in bonds, and ~$6,800 in money markets.

Notice that the distribution of the principal is proportional to the distribution of the annual contributions for each specific item but not so in the aggregated summary amount. This has to do with the fact that the program properly allocates higher principal to the shorter term items.

For true-up purposes, this exercise is meant to be performed at least once a year. So, one year from now, I would open the program and reduce the term of each item by 1 year (because I would be 1 year

closer to maturity for each item) and update the principal with whatever I actually had in savings at that time. The investment methods will typically not need to ever be edited unless you wanted to change your risk profile or methods. Once these changes have been made, you would re-calculate and allocate your principal and annual contributions per the freshly calculated results. Over time you will see the principal and annual contributions become more and more conservative, and in theory, you will always have enough cash in your lowest risk methods to purchase an item at its time of maturity. [(2)]

How It Works:

What does the program do exactly? Well, I would say three things:

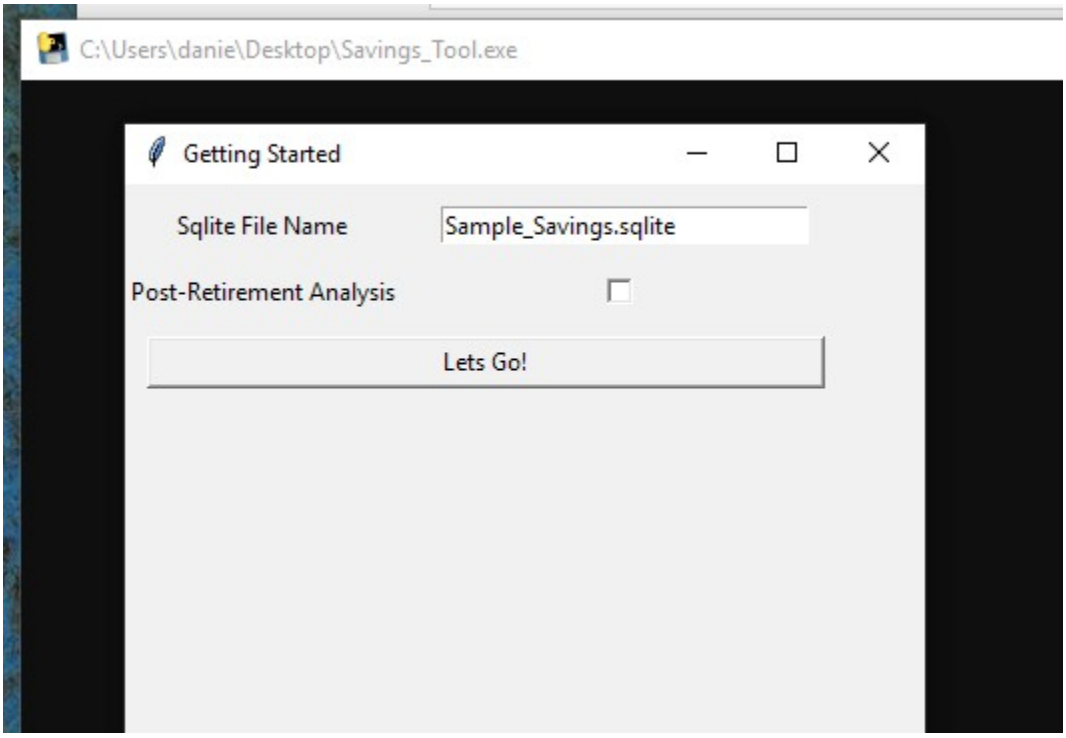
1. First it takes the inputs from components 1 and 2 above and builds a risk profile. It uses the minimum risk and maximum risk year range to build an annual linear profile that changes each year (from highest risk options to lowest risk options).
2. It allocates the given principal to the items that have the shortest term to maturity. This is the most optimal way to use your principal **assuming** that your interest rate on your investment methods is proportional to the risk on your investment methods (Ex: stocks having higher risk and higher interest rate than money market).
3. It runs multiple iterations to then solve for the annual contributions needed in order to meet the future amount desired for each item given your dynamic profile. The algorithm uses time value of money equations to solve for A given P,F,i, and n. It has to be an iterative method because the i and n are likely changing throughout an item's term due to the dynamic risk profile. Note, because this program is solved via iterations, the annual contribution may show a really low number instead of exactly 0 and the solved future amount may not match the desired future amount exactly.

How to run:

There are two ways to run; using executable file or python script. Unless you are familiar with python and/or you want to work with the code, I suggest using the executable file.

1. To Run Using Executable

First, download the 'Savings_Program.exe' **AND** the 'Sample_Savings.sqlite' file and place them in the same directory. Once done, double click on the executable to open. You should see a black dos window, and shortly after, a small program window open.

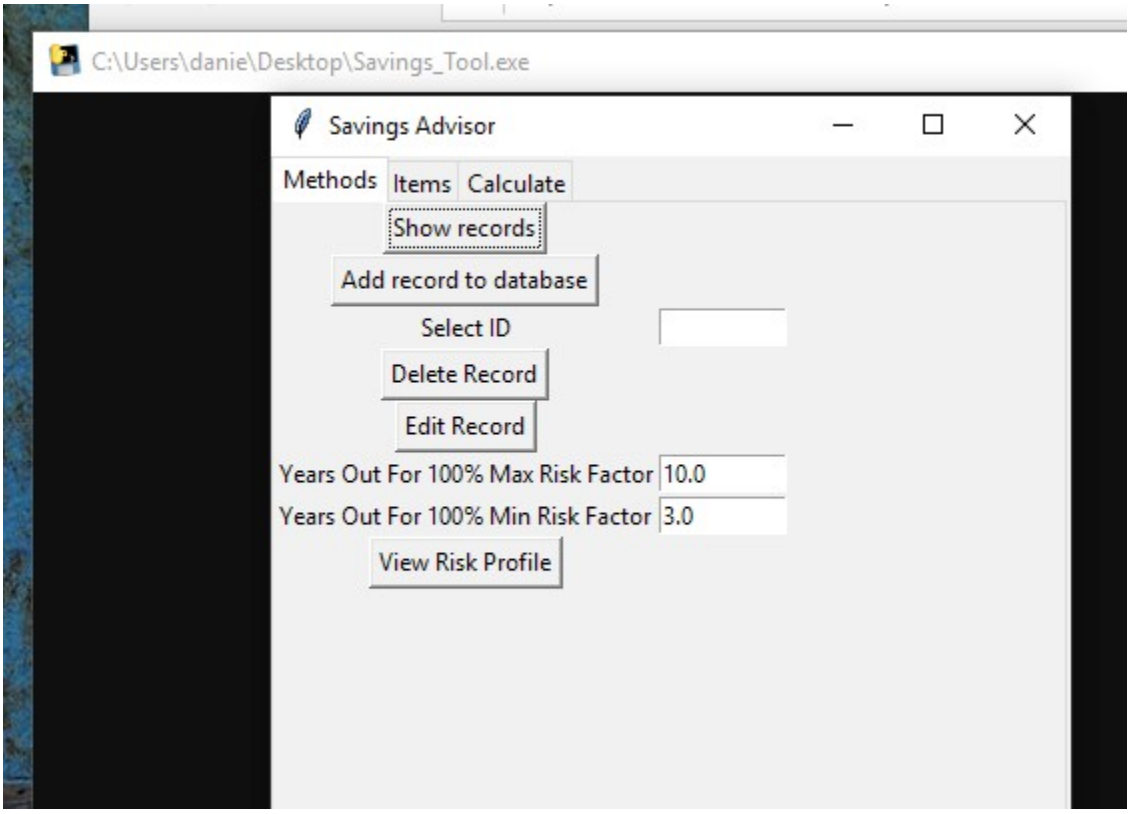


The program window has two settings and then a ‘Let’s Go!’ button.

The first setting is where you can change the ‘sqlite’ file name. An sqlite file is simply a data file, and in this case, it stores all the inputs and some calculations and results for a given savings analysis. If you wanted to have more than one savings analysis (Ex: general savings and retirement), you would copy and rename **one of the existing s**qlite files and change the file name in this first text box to reference that specific sqlite file.

The second setting is a check box that you would select **only if** you were performing a post-retirement analysis. In other words, an analysis where the starting principal is intentionally higher than the desired future amount and you are wanting to solve for annual withdrawals. There are a couple minor differences in the algorithm if this is the case which is why the check mark is required. I included a sample file ‘Sample_Post_Retirement.sqlite’ where this is the case if you wanted to play around with this.

Once these settings are set, you can click ‘Let’s Go’ which opens up a new program window. This window has three tabs in the order that you would step through it. Note: to delete or edit an existing method/item, type the ID of the method in “Select ID” and press the delete or edit button respectively. Leave the dos window open and visible as this is where all the results are printed to for display.



Also available for download are a couple additional sample sqlite files that can be referenced/modified.

1. General Savings (sample 2)

2. Saving for Retirement

Bonus: Post Retirement. This one requires the user to select 'post retirement analysis' in the first window.

2. To Run Source Code

The source code is written in python. If you do not have python yet installed, you will need to install that on your device first. Once installed, you will also need to install a few python libraries:

1. sqlite (pip install pysqlite3)

2. tabulate (pip install tabulate)

3.tkinter (pip install tk)

You will also need to download the 'Savings_Program.py' **AND** the 'Sample_Savings.sqlite' files and keep them together in the same directory (the py file currently relies on the sqlite file to function).

You will open the py script in python shell by double clicking on the python file and then you will run the script (by pressing F5). You should then see a little program open up as well as a blank python shell. Be sure to leave the blank shell open as this is where the information and results gets printed from the program.

Why I Posted This:

I posted this on github for two reasons:

1. I wanted to share this tool with others. I have found it to be very useful and am able to be more content with my family's investment decisions. I could see this also being useful for assisting financial decisions for one's small business or organization.
2. I really want others to maybe 'fork' this program and make improvements. You will very quickly see that the user interface is pretty terrible. I know virtually nothing as far as developing a front-end goes. I feel pretty good about the integrity of the back end, but there is certainly room for cleanup and optimization.

*If you have the interest and resources to turn this functioning program into an app, please contact me as I would be very interested in that! I could see this being either a standalone app that could be used to assist others' savings decisions, or even the algorithm behind a savings app that is used to automatically allocate user's savings based off their inputs (their items they are saving for and their risk profile).

Footnotes:

1. Note that the blank field in the first row of 'years to maturity' will be automatically updated to the longest term for an item if there is an item exceeding the 10 years set for maximum risk factor. For example, in the example provided, there is an item with a 13 year term. If you were to run the risk profile again after the input of this item, you would see that the blank has been replaced with '13'.

2. Something Neat: By performing this exercise annually, you will find yourself investing more into methods when they are at a reduced price (and divesting when they are at a higher price)! How, you might ask, does this program know when investments are cheaper? Well, it doesn't, at least not directly. I will explain by going directly into an example.

Let's say that you ran the program with the example above and allocated our ~$15K as well as invested the ~$3,130 into stocks over the next year. Now lets say that the stock market performed at 3% interest rate (below our estimated 7% average). What this means is that your actual principal a year from now will actually be lower than the estimated calculated principal. When you update the principal and reduce the terms by 1 year and re-run, the output will be a higher estimated annual contribution to make up for the below average returns. And guess what, that extra stock that you are to buy is likely still reduced ~by 4%! Or even better, instead of having an increased annual contribution, you could extend the terms on items where you have flexibility on maturity. In this case, the total calculated annual

contribution would be less but it would have a higher stock allocation (ergo, you are buying more stock at a reduced price)!

The same concept will be true if you have an above average year on returns. Whether you keep the terms the same, or reduce the terms since you have a higher principal than originally estimated, you will be investing less in the investments that are at a higher price.