This is the first line of the doc

This is the second

Now what about some math?

(1)

Explain:

The objective consists of two present value components. The first component calculates the sum total present value of the taxpayer’s after tax income for n years. The second component calculates the sum total of each TDRA account in the nth year. Thus, the objective specified by equation (1) attempts to maximize the NPV of the withdrawals (after tax) made over the taxpayer’s retirement period plus the NPV of the remaining TDRA balances.

To Add:

* Discriminate between Traditional, Roth Tax deferred accounts and add after tax investment account as well as social security income (taxed at 85%) and other sources of income and the level at which they are taxed (0-100%)
* Capability to handle pre-age 60 effects like a possible 10% penalty for early withdrawal…

Questions to address: Maximizing the after tax yearly income and the TDRA balances at the end may have issues, is this really what I want? Maybe maximize include while keeping estate a certain level? Or meeting an include amount while maximizing the estate? How to handle the estate taxes. I’ve dropped them in the above.

(2)

Explain:

A number of constraints are required to constrain the objective function in equation (1) to optimal values while ensuring that IRS rules are followed and taxes and penalties are properly accounted for. Additional constrains will be given to allow for a minimum level of income per year. To this end we define equation (2) to ensure that each year’s withdrawals (wij) from the TDRA plus other income (oi) is at least as much as the desired income (di) for every year in the modeled retirement period.

To Add:

* Withdrawal from investment accounts and Roth accounts
* SS income (individual and spouse) separate from other income

(3)

Explain: (needs work)

To ensure withdrawals are at least as much as the IRS Minimum Required Distribution (MRD), equation (3), requires withdrawals starting at age 70 (nr) to exceed the balance in the jth TDRA (bij) divided by an IRS defined life expectancy value (aij).

(4)

(5)

Explain:

Equation (4) is forcing the variable representing the amount of income in tax bracket k (xik) to take on an amount related to the total taxable income (the sum of the withdrawals and other income) minus the deductions (standard deduction and exemptions, sdi). Without the objective equation (1) the income could be allocated to incorrect brackets. Because tk is monotonically increasing as k increases equation (1) forces the xik in the lowest brackets to fill first. Equation (5) ensures that the xik portion of the income does not exceed the bracket amount (mik). Mik and sdi are inflation adjusted.

However, Huston we have a problem. This does not account for any deductions, not even the standard deduction and exemption. Need to include this into the mix. MUST FIX. The fix here is to add an additional constant (the standard deduction + exemptions, which can be overridden by the user to set a different amount of deductions)

(6)

Explain:

Equation (6) ensures that the balance for each TDRA at the beginning of the year (bi+1,j) is equal to the balance of the account at the start of the previous year (bij), minus the previous year’s withdrawals (wij) (modeled as being withdrawn at the beginning of the year) times the return on the investment for the year as rate of return (rij). This is somewhat pessimistic because withdrawals are usually not taken out in one transaction at the beginning of the year but this is a small effect for our purposes here.

(7)

Explain:

Equation (7) sets the beginning TDRA account balances to qj.

(8)

Explain:

Finally, equation (8) constrains the model variables to be greater than or equal zero.

Transforming our model into a python implementation:

OK for our current work we will use the python scipy library, specifically the function scipy.optimize.linprog(). This requires the model to conform to the following:

Object function: Minimize ct x

With constraints: A x <= b, and x >= 0

Given this we transform our model equations to match as follows:

(1’)

(2’)

(3’)

(4a’)

(4b’)

(5’)

(6a’)

(6b’)

(7a’)

(7b’)

(8’)

Explain:

To transform our model into the scipy equivalent we have only used a few operations. To transform the object function, equation (1’) we minimize the opposite. For equations (2’, 3’) we multiply both sides by -1 and move oi to the other side for (2’). In equations (4’,6’) we introduce a second constraint for each such that the expression is both less than or equal to and greater than or equal to 0. For both to be true the expressions must be equal. (4’) also moves oi , a constant, to the other side and includes an inflation adjusted standard deduction and personal exemptions value (sdi) as well to more accurately express what should be include in the tax brackets xik. In (6’) we also multiplied out the c(bij – wij) to (cbij – cwij) to more closely match the matrix coding. Constraint (7a’ and 7b’) set the initial TDRA account balances to qj. Finally, no change is needed for constraint (5’) or (8’).

To Do:

* Convert the indices to zero based to match the python code
* Double check all inflation adjustments and where they should be
* X Add sdi to equations (4) in the code
* Add separate rate for increasing other income and percent taxed
* Split out social security as a separate income source with its own growth rate and percent taxed
* Add separate growth rate for desired income
* Add selectable MRD tables (single, joint married, ???)
* Add state taxes
* Add for retirement pre age 60 (TDRA 10% penalties, …)
* Can the tax brackets be changed somehow to significantly lower the number of variable?
  + Want smaller / faster model
* Wrap up the Ragsdale model (store away as is and for the new Auld model)
* New Auld model:
  + One account for Traditional IRA, one for Roth, one for Saving (interest baring like) and one for investments
  + Add pre-retirement, how much to add to tIRA, Roth, Savings, Investments
  + Input to optimize:
    - total after tax withdrawals w/ minimum withdrawal rate
    - total after tax withdrawals + final balances w/ minimum withdrawal rate
    - add a maximum spend rate (to for excess withdrawals into Savings/Investment/Roth accounts
    - Capital gains taxes vs. interest vs. income tax
    - Other sources of income include (my SS, spouse SS, yield (is this interest? From?)
    - Ability to output the breakdown of taxes (how much in each bracket, total, how much capgain…) Like the ORP
    - Like to optimize start year of SS
* Ability to run in simulation mode against a defined return rate for each year (ie., a portion of the historical S&P 500 record).

Beginning user input:

* Accounts with their starting balances
* Desired yearly minimum income
* Age to start retirement and period to model (how long do we plan for?)