

ISDA 609 - Mathematical Modeling Techniques for Data Analytics

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Contents

Problem Definition: Final Project #2	2
Project 9.4.2 (page 376): Camparison of 401K VS Social Security for Retirement	2
Solution	2
Notes and References:	2
Prepare Data	4
Comparison of SSA and 401k return.	5
Modeling:	5
Conclusion	7

Problem Definition: Final Project #2

Project 9.4.2 (page 376): Comparison of 401K VS Social Security for Retirement

Retirement and Social Security. Should US citizens build their own retirement through 401Ks or use the current Social Security program? Build models to be able to compare these systems and provide decisions that can help someone to plan a better retirement.

Problem Statement:

This purpose of this project is to determine the best way to maximize savings for retirement. 401K investment returns and Social Security payout from contributions will be analyzed and compared.

Solution

Notes and References:

Average retirement statistics:

- Average age of retirement is 62 years
- Average length of retirement is 18 years
- <http://www.statisticbrain.com/retirement-statistics/>

SSA Calculator Page:

- Avg men live till 84.3 years
- Avg women live till 86.6 years
- <http://www.ssa.gov/retire2/otherthings.htm>

Life Expectancy Tables

- 1991 birth year (22 year old in 2013) is 75.8 years
- http://www.census.gov/compendia/statab/cats/births_deaths_marriages_divorces/life_expectancy.html

Median Income Tables

- Median income of 22 year old in 2013 is \$11,288
- <https://www.census.gov/hhes/www/income/data/historical/people/>

Compound Interest Calculator

- <http://www.investor.gov/tools/calculators/compound-interest-calculator>

SSA Contribution:

- Tax rate for contribution given by supplement13, Table 2.A3
- Maximum tax amount given by supplement13, Table 2.A4

SSA Benefit:

- Benefit calculation involves three steps:
 1. Worker's previous earnings are recalculated in current terms with inflation adjustment.
 2. Earnings for the highest 35 years are averaged and divided by 12 to obtain AIME (Averaged Indexed Monthly Earnings).
 3. SSA benefit formula applied to AIME to obtain PIA (Primary Insurance Amount).
- PIA formula with FRA at 2015:
 1. 90 percent of the first \$826 of his/her average indexed monthly earnings, plus
 2. 32 percent of his/her average indexed monthly earnings over \$826 and through \$4,980, plus
 3. 15 percent of his/her average indexed monthly earnings over \$4,980

– <http://www.ssa.gov/oact/cola/piaformula.html>

- Benefit payouts are adjusted for inflation according to CPI.
- Spousal benefit can also be claimed.
- Taxation of SSA benefits can occur when withdrawing a large amount from IRA due to RMD at 70.5 (“tax torpedo”).
- Effect of Early or Delayed Retirement on Retirement Benefits (yearly),

Year of Birth	FRA	Credit	62	63	64	65	66	67	70
1960 and later	67	8	70	75	80	$86\frac{2}{3}$	$93\frac{1}{3}$	100	124

– http://www.ssa.gov/OACT/ProgData/ar_drc.html

- Average monthly benefit in 2012,

Total Number	ERA (Early retirement)	FRA (Full Retirement Age)
\$1,147.78	\$1,147.78	\$1,577.00

– supplement13, Table 6.B3

- Extrapolate average monthly benefit from 2012,

Age	62	63	64	65	66	67	70
Benefit	1103.90	1182.75	1261.60	1366.62	1471.81	1577.00	1955.48

401K Contribution:

- Tax-deferring contributions until retirement.

- Amount contributed to 401k by retirement without accounting for compound growth

Age	62	63	64	65	66	67	70
401K	690500	708000	725500	743000	760500	778000	795500

- <http://blog.personalcapital.com/financial-planning-2/average-401k-balance-age>
- Growth of 401k determined by investment choices.
 - Average of 7% can be expected.
 - <http://www.thesimpledollar.com/where-does-7-come-from-when-it-comes-to-long-term-stock-returns/>

401K Benefit:

- Withdrawal without penalties start at 59.5 years.
- RMD (required minimum distribution) starts at either 70.5 or on retirement.
- <http://www.irs.gov/Retirement-Plans/Plan-Participant/Employee/Retirement-Topics-Required-Minimum-Distribution-RMDs%29>
- During retirement age, the intended purpose of a 401k was to purchase life annuities. However, average payouts for life annuities have been decreasing.
- Savings could be siphoned off by commissions and management fees.

Prepare Data

Prepared Data:

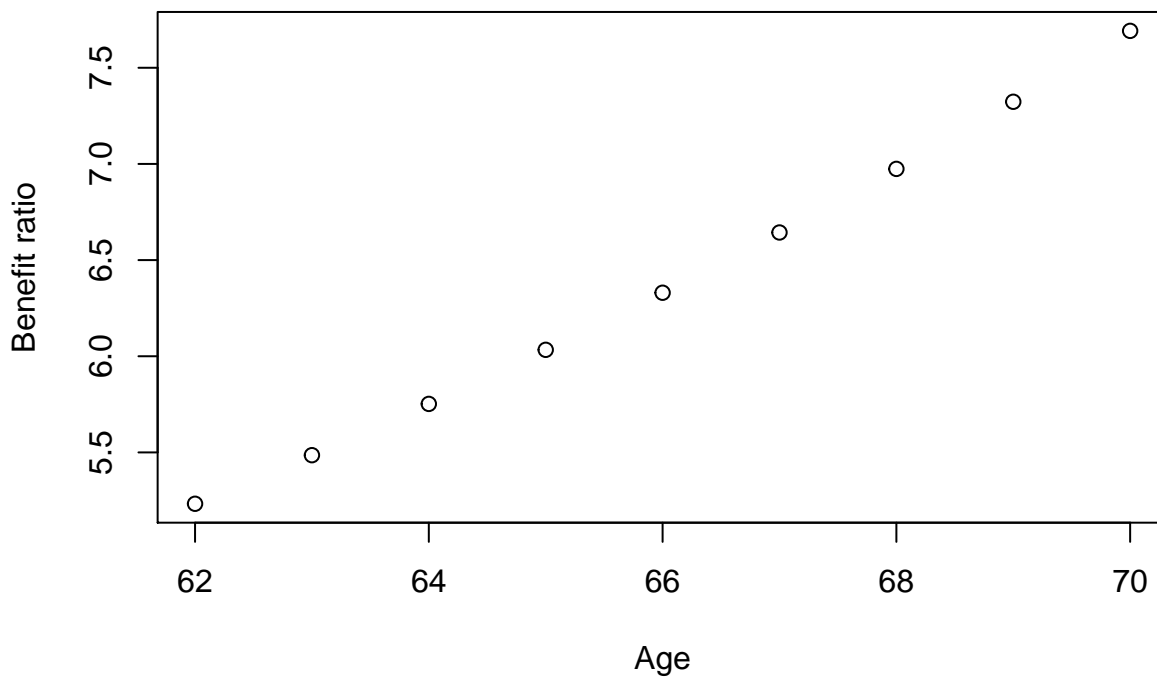
```
##   Age SSA_Monthly_Rate Total_SSA_Benefit Total_401k_Low Total_$01k_High
## 1  62              1104             310637           690500           3613402
## 2  63              1183             318633           708000           3883840
## 3  64              1262             324736           725500           4173209
## 4  65              1367             335369           743000           4482834
## 5  66              1472             343520           760500           4814132
## 6  67              1577             349148           778000           5168621
## 7  68              1703             356642           795500           5547925
## 8  69              1829             361108           813000           5953779
## 9  70              1955             362546           830500           6388044
##   Monthly_$01k_low Monthly_401k_High
## 1              2454             12841
## 2              2628             14417
## 3              2819             16213
## 4              3028             18267
## 5              3258             20626
## 6              3514             23345
## 7              3799             26494
## 8              4119             30161
## 9              4480             34455
```

Comparison of SSA and 401k return.

Assumptions for comparison:

- Start work at age 22.
- Average life expectancy till 85.45 for those reaching 65 in 2014.
- Use average SSA benefit from 2012
- Start contributing to 401k from age 22 with contributions the same amount as SSA contribution.
- Use 7% compound growth for 401k contributions.

401k Ratios of Benefit To Contribution According to Age



Modeling:

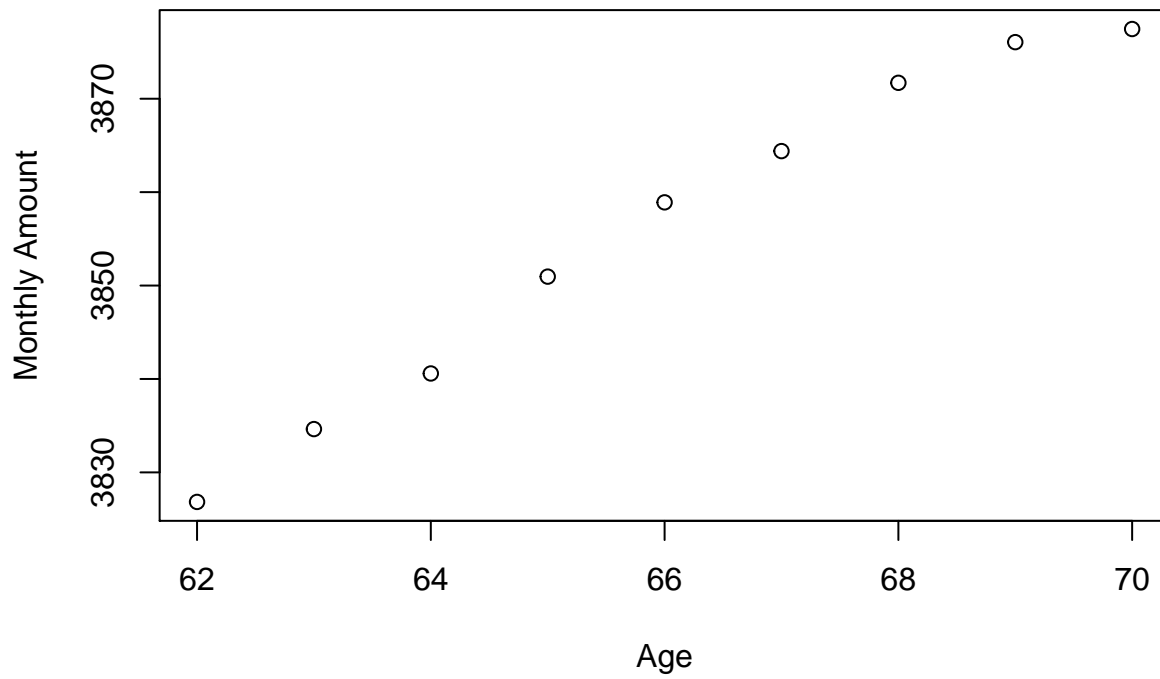
Problem:

- When to start retirement?
- When to start withdrawing from SSA?

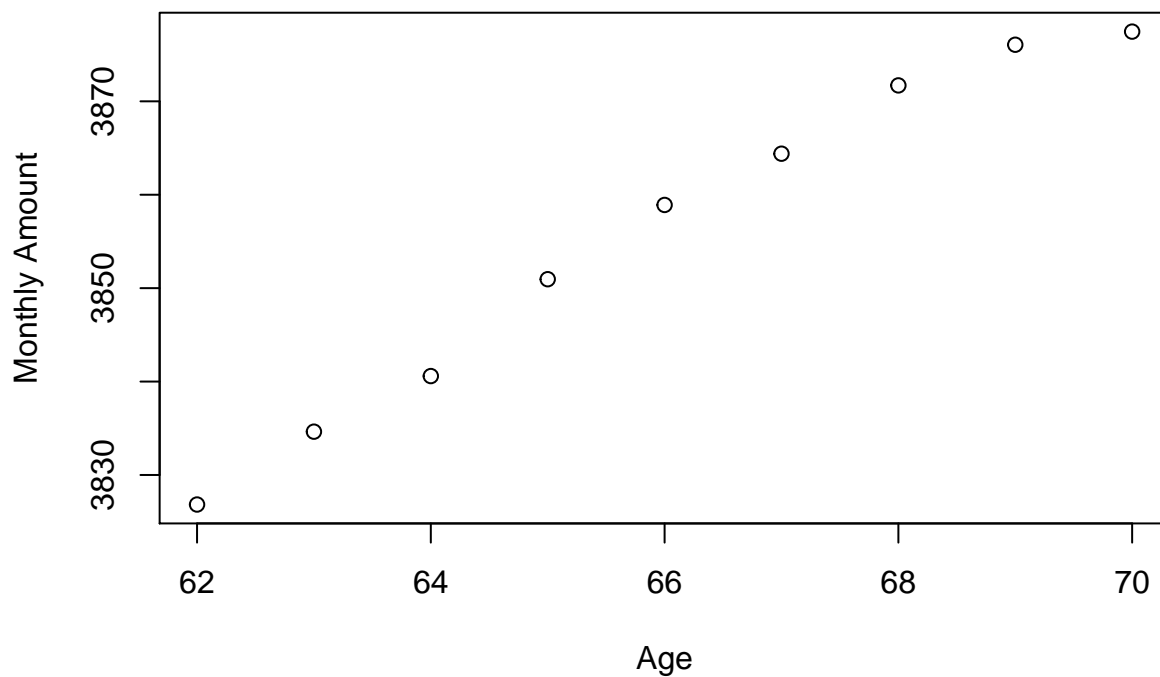
Assumptions for modeling problem:

- Start work at age 22.
- Average life expectancy till 85.45 for those reaching 65 in 2014.
- Using average SSA benefit from 2012
- Start contributing to 401k from age 22 with an initial contribution of \$8,000 and \$17,500 every year after.
- Use 7% compound growth for 401k contributions.

Combined benefit when withdrawing 401k at 62 and delaying SSA



Combined benefit when contributing to 401k until start of SSA



Conclusion

- The best way to maximize savings for retirement is to maximize contributions into a 401K account as early as possible on the planning horizon and to contribute as long as possible.
- Make use of the 401K account earlier, at the start or before retirement.
- Delay the start of SSA benefit payouts as long as possible (up to age 70) to maximize the payout amount throughout retirement.

The contribution and returns on Social Security, 401K, and any other retirement account needs to be considered in combination to better plan for retirement.