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A Student Case Study on What is the Return on FICA Taxes?

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Abstract

One of the most common taxes is the Federal Insurance Contributions Act (FICA), which we often know as our social security tax. Nearly three quarters of taxpayers pay more in FICA taxes than they do in income tax. These taxes determine the social security benefits that an individual can receive, and the earning record determines whether an individual qualifies for Medicare.

This paper's analysis is presented from the perspective of a graduating engineer, so that it can be used by faculty in their classes. The case can be analyzed by students individually or in teams. It uses key concepts and tools from engineering economy. Because the data is publicly available, case studies can be structured for students to identify what data are needed and where to find it.

Social security is rarely viewed as an investment, but withheld FICA taxes are the investment that pays for our social security benefits. Most of us will pay into FICA during an entire working career, often with no expectations of a good return. Many younger individuals believe they will receive no benefit due to media statements that the system is or will be insolvent. This paper demonstrates that for many people, social security is a good investment.

Since most retirement systems are now defined contribution, social security has additional importance as an example of how to determine the value of a defined benefit pension. Social security is the centerpiece of retirement planning for most Americans. Engineering economy students have the tools to analyze this aspect of their futures. Engineering economy professors have the responsibility for helping students to achieve mastery of the basics for retirement financial planning. The rate of return on our tax investment is demonstrated as a real example of time value of money and personal financial planning.

While the analysis is applicable to the U.S. social security system as it is defined today, our methodology is applicable to other defined benefit systems. The approach is also applicable internationally, as most countries have some form of public pension system.

Introduction

Engineering economy texts and courses typically include some level of personal finance ranging from loans and savings up to complexities of investing for retirement, insurance, social security, stocks and bonds, and annuities. Class testing has demonstrated that students have a keen interest in personal finance examples [1].

In earlier work [2] and again here, we assert that with the opportunity to teach engineering economy students about retirement planning comes with the responsibility to do so. Engineers who fail to plan and invest for retirement will face additional challenges when it comes to the ethical challenges of engineering practice.

This paper is an introductory case study of how FICA taxes and social security benefits can be determined and linked together to calculate an internal rate of return (IRR). The paper includes a literature review written to help instructors explore social security. For the student case study, the paper begins by explaining the language of social security and its key acronyms. There are many choices required in using this as a case—what to include/simplify/exclude and why. The next step is for students to understand how benefits depend on an earning history. Then how the benefits [= Primary Insurance Amount (PIA)] are calculated based on an individual's Average Indexed Monthly Earnings (AIME). These calculations are done at marginal rates, but their total effect is better measured by average rates at different income levels.

The calculation of FICA taxes owed is straight-forward but stating benefits and taxes in consistent terms required using constant-value dollars. Most social security amounts are stated in nominal dollar terms, that are adjusted by wage or cost of living adjustment (COLA) indexes—so using Social Security published values from a single year achieves constant-value dollars.

The internal rates of return that are calculated using a simple annuity function and the GOAL SEEK spreadsheet function demonstrate that for many people social security is a good investment. They also demonstrate how this can be simplified enough to fit *well* with the material of an introductory course. A graph of the IRR for a worst case income level shows that the IRR is positive except for retirements cut short by early death.

The paper begins with a review of FICA taxes and how social security is a part of most people's retirement portfolio, as applied to a 22-year-old student. A simple case is presented that includes a discussion of possible case variations and opportunities for further research. It ends by summarizing engineering economy principles reinforced by student use of the case.

Literature Review

Social security was created in 1935 [3] as a "comprehensive package of protection" against the "hazards and vicissitudes of life." Taxes were first collected in 1937 and benefits began in 1940. Social security is progressive; the ratio of lifetime benefits to lifetime payments is higher for people with lower incomes [4]. Rate of return has been one of the measures of effectiveness, but such work emphasizes analysis of the system and the dependence of relative returns on different group characteristics [5]. Though social security can be and is analyzed here as an investment, social security provides forms of insurance such as survivors and disability benefits that make it difficult to compare to private investment accounts [6].

Many of today's younger people believe they will never see a return on their FICA taxes [7]. This outcome seems unlikely as there is a large literature that is annually refreshed supporting corrections that include some mix of higher taxable limits [8, 9], higher normal or full retirement ages [10], reducing benefits based on income or wealth (means testing) [11], and higher tax rates [12].

Nearly all of this literature states that while program changes are required, political support for continuing social security is exceptionally strong. It is also worth noting that the last major change (raising the normal retirement age from 65 to 67) was debated for at least a decade, legislation passed in 1983, and phased in over 22 years starting in 2000 (17 years after legislation passed). For those born after 1960, the Normal Retirement Age is 67.

Social security is the centerpiece of retirement planning for most Americans. As noted in [13], 96% of Americans over 62 are eligible for benefits. For 50% of retirees, it is at least 50% of their annual income; for one in four, it is at least 90% of annual income [14]. When the average annual social security retirement benefit (as of July 2023) of $21,455 [14] is compared with engineering salaries, the need for other retirement income is apparent. One guideline for maintaining the same lifestyle after retirement is 80% of pre-retirement spending.

Engineering economy student case studies have been published that apply time value of money principles to social security [2, 15 – 18]. This study builds on that work. There are few engineering economy case studies involving personal financial planning.

The rate of return is largely based on two issues: income level during the working years and age at death. Being a progressive system, a higher benefit (relative to working income) is delivered to those at lower income levels [19]. Higher income people receive a lower marginal benefit and lower rate of the return on the 'investment'. Rate of return has been discussed in the literature, primarily looking at averages for the total population and differences between men and women. Rates of return have been claimed to be on the order of 2-5% over inflation [20, 21], though this is sometimes challenged [22].

The rate of return depends in part on how many years a person collects benefits [23]. The earlier that a person dies, the lower return they will receive. Mortality is a key variable, but one that cannot be predicted for an individual. Average mortality has been identified for several demographic groups [24]; those having an earlier expected age at death receive a lower rate of return.

There are key differences between social security and other retirement investments. Social security is indexed for inflation and is guaranteed for life. Features including benefits for spouses, survivors, and dependent children are usually not present in other investments [19]. Given these added benefits, lower rates of return for social security can be justified relative to private investments.

Social security benefits are modest in relation to average household incomes [14]. For most retirees, social security benefits are intended to be a portion of the retirement portfolio. Social security benefits typically account for about 40% of pre-retirement income. While social security benefits are important, other sources of income from a retirement portfolio are also critical. Investing for retirement needs to take place so that lifestyles that are dependent on engineering salaries can continue after retirement.

Assuming a person lives to the average life expectancy, the net present value of benefits is roughly the same no matter when benefits begin [17, 25]. The system is designed to deliver the same lifetime benefit whether a person begins benefits at age 62, 70, or somewhere in between. We will therefore not consider the benefit starting age in this investigation.

We recommend that students be guided away from the extensive literature of when to start social security. Far too much of it focuses solely on the dollars collected before death (often ignoring the time value of money), while ignoring quantitative measures of risk and the many qualitative factors that often drive decisions [17]. Let that analysis start in mid- to late-career when more is known.

The Language of Social Security and Designing the Case Study

Communicating about social security relies heavily on key concepts and the acronyms used to describe them. The starting point is Average Indexed Monthly Earnings (AIME), which is the average of an individual's highest 35 years of earnings, adjusted for wage inflation. The AIME is used to determine the Primary Insurance Amount (PIA), which is the monthly benefit an individual will receive if they start benefits at their normal retirement age (NRA). The NRA is 67 for those born after 1960. Until recently the NRA was labeled as the full retirement age (FRA).

The Average Wage Index (AWI) is the inflation adjustment for the AIME, and the bend points are used in computing the PIA. The taxable limit, which is the maximum amount of income subject to FICA taxes, is also increased annually using the AWI.

We believe that all of the concepts and acronyms must be part of the case study. However, social security is the subject of a very large literature, and any introductory case study must limit the scope of what is addressed. We simplify the case study by assuming that it is for a *single* [15] individual not a *couple* [16]. The different incomes and ages of spouses, and additional spousal and survivor's benefits available to them are the scope of a graduate thesis not an introductory case.

We assume that benefits are started at NRA, which is 67 for those born in or after 1960. This avoids the details of lower or higher benefits by starting before or after NRA. This is the subject of a very large annually repeated literature on when to start SS benefits. This in turn requires discussion of what quantitative and qualitative measures are used to guide decision-making [17]. We will use the average age at death from National Vital Statistics (NVSS) [24] for individuals who are currently 67.

We will omit the complex arithmetic calculations for AIME. Those calculations use the average wage index for the year the individual turns 60 and adjust earnings for inflation for all earlier (but no later) years. Don't send students down that rabbit hole.

We omit income taxes, which are applied to 0%, 50%, or 85% of SS benefits depending on other income (federal) and which also vary by state. We will also omit mortality distributions, which are more appropriate for a second course with more probability included. When such distributions can be included and the emphasis is on quantitative metrics, a key question becomes the balance between maximizing value (PW or IRR) and minimizing risk (standard deviations of each) [17].

The Federal Insurance Contributions Act, commonly referred to as FICA, codified the payroll tax system that qualifies people for social security benefits. It is estimated that 75% of taxpayers pay more in payroll taxes than they do in income taxes. For employees the tax withheld from their paycheck is matched by their employer. The social security tax is 6.2% and applies to income up to the taxable limit (which changes annually). Additionally, a Medicare tax of 1.45% (for hospitalization) is applied to all income. An additional 0.9% Medicare tax is levied on income exceeding $200K for single filers or $250K for joint filers, but only for employees. Those who are self-employed must pay both the employee and employer shares, which is twice the amount paid by employees.

To qualify for benefits under Social Security and Medicare, one must accumulate 40 quarters with adequate covered earnings (which amount to $1730 per quarter in 2024). Disabled workers and dependents of deceased individuals may qualify with fewer than 40 quarters.

This Paper's Case Study

As detailed in Figure 1, the PIA is 90% of AIME below the first bend point, 32% of AIME between the two bend points, and 15% of AIME above the second bend point. The values used for Figure 1 are the published bend points and the taxable limit for 2024. These are used as a simplification, which matches common practice.

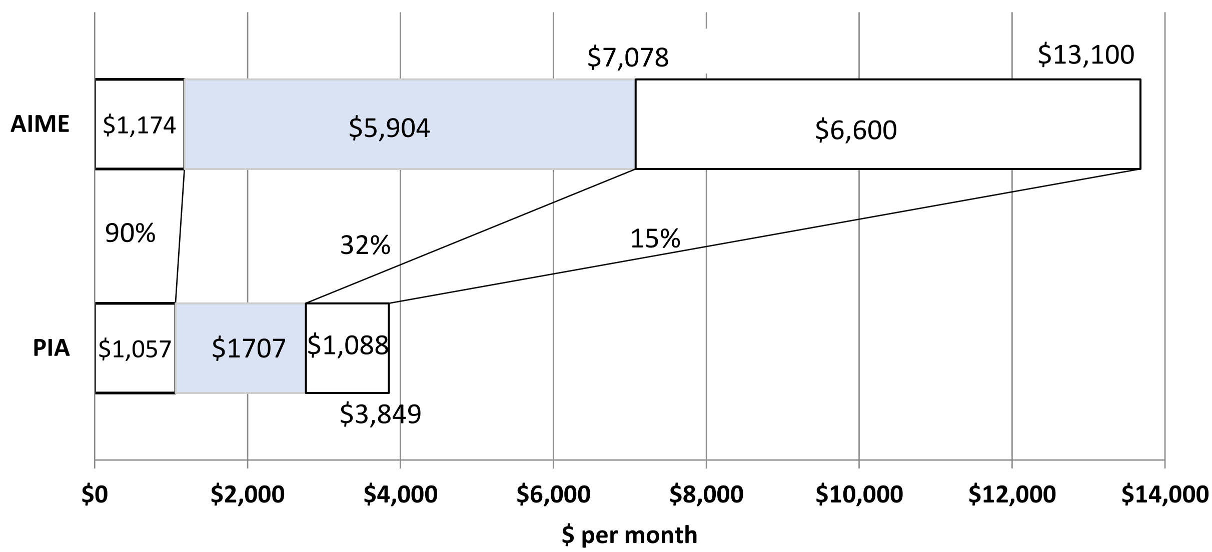

Fig. 1. Average Indexed Monthly Earnings (AIME) and the Calculation of the Primary Insurance Amount (PIA).

In case students dig deeper and ask questions, here are some details of SS calculations (not used here). The bend points for any individual are determined based on the year of initial eligibility for retirement benefits, which is the year they turn 62. Their AIME depends entirely on their salary history; very few individuals earn the taxable limit for their entire career. The maximum AIME is more closely linked to the taxable limit in the year that wage indexing stops for them, at age 60. Cost of living adjustments (COLA) for benefits start at age 62 with only a 2-year gap in inflation adjustments. Working from age 62 to 67 can raise an AIME. Since the wage index is 1 for those years, increases are largest if the top 35 years include years with no taxable income.

Figure 2 summarizes the contribution of each dollar of AIME to the value of the PIA. The relationship shown in Figure 1 is how the PIA is calculated using marginal rates. However, the average rates shown in Figure 2 are the relevant relationship when considering the benefit earned by a particular AIME value. We suggest that Figure 2 be used to emphasize a crucial engineering economy principle—the correct choice of average or marginal rates.

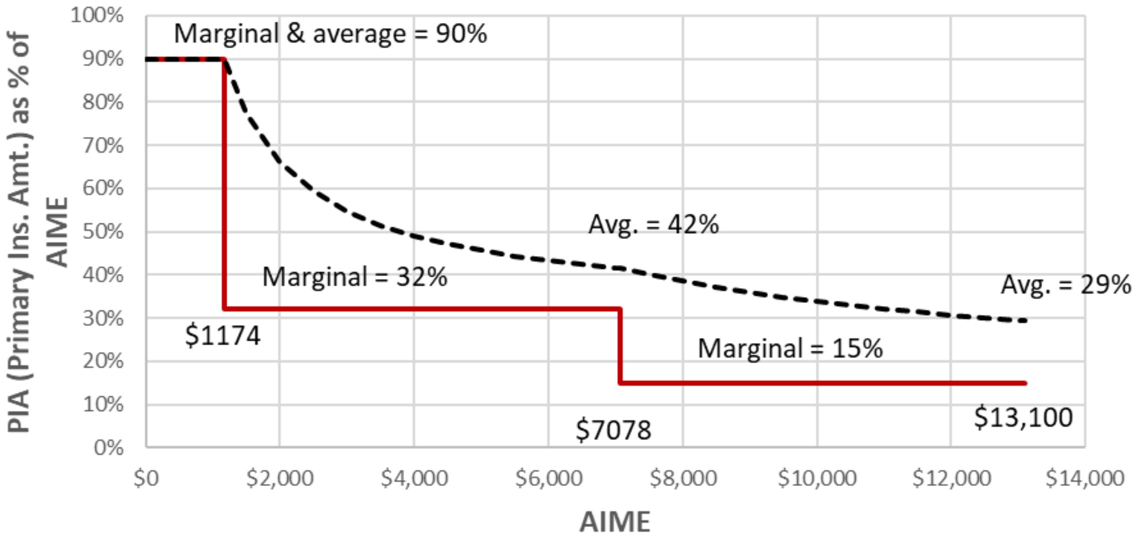

Fig. 2. The Marginal and Average Rates for PIA as a Percentage of Each Added AIME $.

The 15% marginal rate for higher AIMEs is usually emphasized to demonstrate a low return on FICA taxes for larger incomes. The corresponding 29% average rate is virtually never mentioned. Students can also use Figure 2 to make it personal. A monthly salary can be expressed as a % of the taxable limit. Then the matching average rate of return from Figure 2 can be used to estimate benefits. For example, a monthly salary of $6500 ($78,000 annually) is about 50% of recent taxable limits, and the average monthly benefit is about 42% of the taxed monthly earnings.

Taxes paid for retirement in 2024 dollars are estimated at 6.2% of income. For our example, this is the taxable limit (= −.062*$168,600 = −$10,453). A working life of 45 years from 22 to 67 is assumed. Then annual benefits are estimated at $46,188 (= 12*$3849) from Figure 1. To estimate the length of retirement, an estimated age at death is required. Table 1 highlights 9 values from 2021 NVSS data [24]. For the example case, the expected average remaining life at age 67 for the total population is 17 years (= 84.0 – 67).

TABLE 1.
EXPECTED AGE AT DEATH FOR POPULATIONS.

Alive at Age	22	62	67
Total Female	81.0	84.9	86.0
Total Population	78.2	83.3	84.0
Total Male	75.5	81.7	83.3

Equation 1 defines the future worth at age 67. This is the equation that must be solved to find the IRR. Because the tax annuity series and the benefit annuity series have different values and signs, the RATE function cannot be used to find the IRR. GOAL SEEK can be applied to more complex combinations of engineering economy functions. It is used to solve Equation 1 by changing the interest rate cell to make the FW_{67} cell have a value of 0. Equation 2 states this in more general terms.

$$FW_{67\ total} = FV(i, 45, -10453) + PV(i, 17, 46188) \quad (1)$$

$$FW_{67\ total} = FV(i, N_{work}, -.062*\text{Annual Taxable Income}) + PV(i, N_{retired}, \text{Annual Benefit}) \quad (2)$$

While cash flow tables can be built, we recommend analysis using these simple equations with spreadsheet annuity functions. It is much easier for students to follow the engineering economy principle that all cash flows must include or must exclude inflation. In this case constant value dollars are much easier to use.

Using annuity functions here also reinforces the power of their use throughout engineering economy, which is often most important before detailed estimates over time are available. When such estimates become available, then cash flow tables are the answer.

In the case of social security benefits, as the earnings history and retirement plans of the student evolve, the right answer is not a cash flow table. It is to use the online calculators maintained by the Social Security Administration. These can use general data or specific values of an employment history. For instructors who want to use the simplified calculator for maximum benefit calculations enter the taxable limit, birth, and retirement years, which produces an answer with an "average" salary trajectory. Specifying a −5% for a lower than average increase produces a history of maximum taxable earnings.

We suggest that the closing discussion of the case after student work is done show students the online calculators and how to set up access to their social security account. Then emphasize another key principle. Even if simplifying assumptions are required, do the analysis in more than 1 way. Find a way to check results using two or more different approaches or have 2 or more groups do the analysis independently. Understand how much results differ and why.

Spreadsheets using annuity functions and/or cash flow tables increase the importance of this principle. Errors can be as simple as a missing or added $ sign in a formula or as complex as a link to other spreadsheets that may change or may no longer be available as an updating source.

Our cash flow table calculations assumed taxable income at the taxable limit, and the detailed rules so that our work could be checked with published social security examples. Building such spreadsheets is not recommended for students in an introductory course.

Results

The IRR that is calculated is a real IRR since the given cash flows are in constant value dollars. Equation 1 uses 45 years of income at the taxable limit and a 17-year retirement. This assumption is the highest income level and has the lowest average return (29% in Figure 2). Use Goal Seek to find i where $FW_{67\ total}$ is zero, resulting in a 1.6% rate of return.

$$FW_{67\ total} = FV(i, 45, -10453) + PV(i, 17, 46188) \quad (1)$$

The taxes and benefits can also be listed in a table showing 62 years of cash flows. Using IRR results in the same answer, but it is a more cumbersome approach.

As another example, consider the $6500 monthly ($78,000 annually) salary mentioned below Figure 2. This raises the average for the PIA to 42% of the salary. Equation 3 applies Equation 2 or adjusts Equation 1 for this. Using Goal Seek, the resulting real IRR is 2.9%. This is 80% higher than the 1.6% at the taxable limit.

$$FW_{67\ total} = FV(i, 45, -.062*78000) + PV(i, 17, .42*78000) \quad (3)$$

Note that for any IRR calculation, the base year chosen for the constant value does not matter. If a PW or FW is reported, then comparisons will require use of the same base year for all analyses.

For comparison with other investments that are usually described in nominal terms, we suggest adding the average COLA increase since 1975 for SS benefits. That inflation measure's geometric mean is 3.73%. Adding this to the real IRR gives a nominal interest rate of about 5.5% at taxable income limits. At an $80,000 salary or about 50% of the taxable limit, the nominal rate is 6.6%. Both rates are better than the rate on T-bills, savings accounts, and many bonds.

Figure 3 presents the results from a cash flow table approach that models taxable years using exact social security rules. We used this approach to exactly match social security for an example with a detailed explanation (confirming the results presented here). Figure 3 shows the IRR values for different retirement periods (number of years from 67 until death) for the taxable limit case.

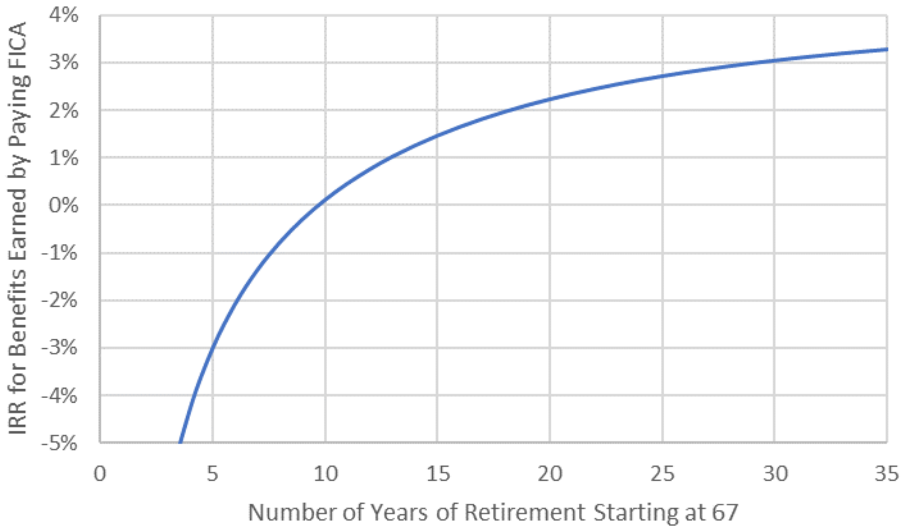

Fig. 3. IRR vs. Number of Years until Death after Retirement at 67.

One of the main reasons that the return is positive for even the highest wage employees is that the employer has 100% match with employee FICA withholdings. In comparison with other investment opportunities, social security has two other advantages that could be quantitatively assessed. First, Average Indexed Monthly Earnings adjusts the earnings records for inflation. Second, the monthly benefits have an annual COLA adjustment. This was 5.9% for 2022, 8.7% for 2023, and 3.2% for 2024.

There is no good quantitative measure for the biggest advantage of social security. The benefits last as long as the individual does. Buying annuities [26] is in many cases insurance that has a negative rate of return, not an investment with a positive rate.

A smaller advantage of social security is that the AIME does not consider the salary trajectory; it counts all years the same. In contrast regular investing compounds early (low salary) investments for more years and later (higher salary investments) for fewer years. The main disadvantage of social security is that since only the high 35 years count (after indexing), more years only matter if low earning years are replaced by higher values.

Alternate Cases / Further Research

Variations on this case are easy. The NVSS data covers 5 ethnicities and 2 genders. Students have family histories. Different retirement ages require coverage of lower percentages for retiring between 62 and 67 or higher percentages for retiring between 67 and 70. Lower levels of AIME can raise the IRR significantly because a higher percentage of income is replaced.

Topics can be researched. For example:

- How much difference does a salary trajectory make?
- New engineers start at about half of the taxable limit. How does that compare?
- Most engineers become engineering managers with many above the taxable limit by the end of their careers.

- How much difference does age at death make?
- How bad is the return for the self-employed who must pay the employer's share?
- How much do spousal and survivor's benefits increase returns if one spouse does not qualify on their own for SS benefits?
- How much value is added by survivor's or SSI payments for dependents or disabled workers?

Conclusions

The value of social security is increased by inflation protection for taxed earnings (wage indexing) and benefits (COLA). The analysis makes us feel even better about our social security taxes. We expected negative rates of return for all but low annual wage earners. We had focused on the 15% marginal "return" on higher earnings—average returns are up to double that. We expected the taxable limit to impact many engineers, but for most it does not or only for a few years. The taxable limit may matter more to engineering managers. But this analysis shows that even if a person earns the taxable limit for 45 years—the return is above that of a T-bill for most average lives.

If we could buy more and add it to our portfolio, we both would.

A class case study can focus on the individual, where a student can determine their expected mortality [18]. This can help the student to personally identify with the situation presented. Class testing of personal finance topics has demonstrated that students become deeply involved when they see a problem being relevant to their personal situation. The engineering economic skills developed apply just as well to the professional tasks of an engineer.

Beyond the learnings that distinguish cases from end-of-chapter problems, there are 3 important principles of engineering economic analysis demonstrated in this case.

- Make the right choice between marginal and average rates for an analysis.
- All cash flows must be in the same terms—constant value with the same basis year or nominal values with inflation adjustments done explicitly.
- Use more than one approach to analyze a real problem where more than a grade is at stake and there is often no partial credit. Spreadsheets in particular demand multiple approaches because errors are so easy to make and can be so hard to find.

In closing, we believe that helping students do better career and retirement planning [2] will help them be better engineers, better engineering managers, and happier people. As instructors we have the opportunity, which comes with the responsibility to do it effectively.

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