

EM384: Analytical Methods for Engineering Management  
AT 23-2  
Name:  
Section :



## Homework Set 1

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This assignment is worth 20 points, and is due NLT 1700 the day of Lesson 5. Late submissions will be penalized 4 points (5% of the assignment) for each 24-hour period late after the due time.

- **Documentation.** This deliverable is an individual assignment. Any assistance received must be documented in detail. Document all sources in accordance with the Office of the Dean Pamphlet "Documentation of Academic Work," (June 2015), Appendix E, and course guidance. e-Acknowledge documentation must be turned in through CIS at the time of submission. The deliverable is considered late until all portions of the assignment and the documentation are submitted.
- **Turn-In Requirement:** You will turn in two files to Microsoft TEAMS. The first file is this assignment with your answers to questions, saved as PDF file. The second file is your Excel file.. The file naming convention follows:

Section\_LastName\_FirstName\_EM384\_Homework\_1

For example, the following Excel file name would be used for Cadet Jane Smith, in Section B1, Homework Set 1:

B1\_Smith\_Jane\_EM384\_Homework\_1

Remember that engineering management is about communicating. You will be graded on the clarity and structure of your models.

- **Acknowledgement Statement:** This assignment must be accompanied by a signed e-Acknowledgement Statement (DAW) to be eligible for graded credit. If you submit your files(s) but fail to sign the e-Acknowledgement Statement, your assignment will be considered late until the e-Acknowledgement Statement is signed.
- **Guidelines for Documenting Assistance:** For this assignment, individual work is highly encouraged, but collaboration between individuals is allowed. **ALL collaboration must be documented.** Any discussion of this problem set with anyone other than an EM384 instructor requires documentation. Documentation must be specific and detail the topics discussed and actions taken.
- You must be very specific (which problem, what assistance, etc.) when explaining any assistance used in your documentation or you will be deducted at a higher penalty. Assistance *may* result in a deduction of points in accordance with a holistic assessment by your instructor.
- Sharing of electronic files via email or any other electronic means is **strongly discouraged**. **Using, copying, or being dictated someone else's work will result in a greater point deduction.**

## 1. Tax Model

(a) **(4 Points)** Build a spreadsheet model in Excel (Name your sheet *tax Model*) that shows your annual taxes from age 22 to 80. Use the inflation-adjusted pay data in *officerpay.xls* to determine your annual pay. Your pay should be taxed using the appropriate marginal tax rate(s) beginning at year 0 (Age 22). You should have several columns of inputs and calculations for the tax (it might be useful to model the amount taxable in each bracket), and show the final annual tax in the last column. Place any parameters or useful final values above your model to support your answers to parts (b) and (c). You will make the following additional assumptions:

- Use the 2022 Marginal tax rates available [here](#). Watch this video to better understand how marginal tax rates work.
- Assume the marginal tax rates and tax brackets remain unchanged in the future.
- Assume you will file under *married filing jointly*.
- Assume that you have no tax deductions and that all income is taxed.

(b) **(1 Point)** What is the NPV of all taxes paid at from age 22 to 80?

(c) **(1 Point)** What is the NPV of your lifetime earnings?

## 2. Roth IRA Planning

You are a newly commissioned second lieutenant and have been advised to open a retirement savings account. In addition to the company match for your Thrift Savings Plan, you have decided (upon advice of your Systems Engineering instructor) to Open an Individual Retirement Account (IRA). There are two types of IRAs (You can read more about IRAs here): A *traditional* IRA and a *Roth* IRA.

The main differences between the two types of accounts are listed in Table 1 below.

	Traditional IRA	Roth IRA
Income Limit	No	Yes
Contributions	Pre-tax	After-tax
Distributions are Taxed	Yes	No

Table 1: IRA Differences

You decide to invest in a Roth IRA, and make the following additional assumptions:

- Assume an annual investment after tax of \$6500 in the years you decide to contribute (do not adjust for inflation). This is the maximum allowed in dollars per year as of 2023.
  - Assume an annual rate of inflation between 1% and 4%.
  - Assume an annual portfolio return on investment of 10%.
  - Assume that your portfolio compounds annually.
  - Assume that starting in year 38 (Age 61), you make annual withdrawals equal to 4% of your portfolio, or \$80000, whichever is greater. If there is less than \$80000 in the account in any year, then you withdraw the remaining amount that year.
  - Assume that zero dollars is the lowest amount that your portfolio can go.
  - Assume that you make contributions and withdrawals to your account each year prior to calculating the annual return for that year.
  - Assume you are below the income limit for contributing to a Roth IRA.
- (a) **(3 Points)** Build a spreadsheet model in Excel (Name your sheet *Roth IRA 1*) that shows your Roth IRA portfolio balance from year 0 (Age 22) to year 58 (Age 80), **when contributing \$6500 a year from year 0 through year 9**. Your model should have a separate row for each year, have several columns of inputs and calculations, and show the IRA portfolio balance in the last column. Place your parameters (with labels), the NPV of all contributions, and the NPV of your balance at ages 60 and 80 above your model. Your model should clearly support the answers to (b) and (c) below.
- (b) **(1 Point)** What is the NPV of your portfolio at Age 60? At age 80?
- (c) **(1 Point)** What is the NPV of all contributions made?

- (d) **(1 Points)** On the same Excel Sheet (to the right of your model), build a two-way data table to show your IRA portfolio NPV at age 80 when you vary your annual investment amount between \$1000 and \$6500 (every \$500), and your annual return percentage (from age 61 to 80) between 4% and 12% (every 1%).
- (e) **(3 Points)** Build a spreadsheet model in Excel (Name your sheet *Roth IRA 2*) that shows your Roth IRA portfolio balance from year 0 (Age 22) to year 58 (Age 80), **when contributing \$6500 a year from year 10 through year 29**. Your model should have a separate row for each year, have several columns of inputs and calculations, and show the IRA portfolio balance in the last column. Place your parameters (with labels), the NPV of all contributions, and the NPV of your balance at ages 60 and 80 above your model. Your model should clearly support the answers to (f) and (g) below.
- (f) **(1 Point)** What is the NPV of your portfolio at Age 60? At age 80?
- (g) **(1 Point)** What is the NPV of all contributions made?
- (h) **(1 Points)** On the same Excel Sheet (to the right of your model), build a two-way data table to show your IRA portfolio NPV at age 80 when you vary your annual investment amount between \$1000 and \$6500 (every \$500), and your annual return percentage (from age 61 to 80) between 4% and 12% (every 1%).
- (i) **(2 Points)** Which IRA contribution plan (contributing early for ten years, or later for twenty years) yields ‘better’ results? Support your answer with your analysis, including any insights from your two-way data tables. How sensitive is this choice to the initial assumption of an 10% annual return on investment?