

Excel Solver and What-If Analysis: Optimizing Tax Refunds Involving Education Credits and Scholarships

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ABSTRACT: This case teaches students advanced Excel modeling functions and analytic tools like Solver and What-If Analysis. The case scenario involves preparation of a student tax return that focuses on minimizing federal income tax liability by utilizing education credits and reporting scholarships as taxable income. Solver is used to determine the optimal allocation of non-tuition-based scholarships or grants as taxable income. What-If Analysis is then used to demonstrate how a practitioner might illustrate the tax outcomes and plans in different scenarios. Additionally, critical thinking and analysis are required of students to explain how additional income affects both nonrefundable and refundable credits to find the best outcome for the client. Considering that the current CPA evolution curriculum focuses more on analytical skills, tax planning, and personal financial planning, students will benefit academically, professionally, and personally from the knowledge and skills learned in this case.

JEL Classifications: A22; H24; K34.

Keywords: education credits; scholarship and grant; data analytics; education tax credit; individual income tax; Excel.

I. THE CASE

Case Requirements (2023 Tax Year)

- You will assume the role of a Volunteer Income Tax Assistance (VITA) tax preparer who has been asked to help maximize the refund for a taxpayer in multiple scenarios.
- First, read through the case facts and complete the “Scenario 1—Baseline Scenario” column in the “Credit maximization” worksheet of the [2023 Excel template.xlsx](#) provided. Then, answer the Scenario 1 questions.
 - To accomplish this task, you will first perform necessary tax research (using your book and IRS publications) to form a good understanding of the taxation of scholarships, qualifying and nonqualifying education expenses, calculation and eligibility requirements for the American Opportunity Tax Credit (AOTC), Lifetime Learning Tax Credit (LLTC), Earned Income Tax Credit (EITC), Child Tax Credit (CTC), and Additional Child Tax Credit (ACTC).

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Supplemental material is available online, as linked in the text.

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- Then, use the provided Excel template credit maximization worksheet to create a fully automated spreadsheet to perform the required analyses. Use the “Excel Formulas and Analysis” table in [Appendix A](#) for a guide in creating the formulas and performing the analysis. Cells highlighted in green should be hard keyed. All other cells should have formulas. Format the formulas in the baseline column so they can be copied to the other columns.
- After completing Scenario 1, copy your formulas to Scenarios 2 and 3. Complete the required analyses and answer the respective questions.
- Your completed project submission should include the Excel workbook that correctly performs the analysis with questions answered below.

Case Facts

Olivia Learner is single and 20 years old. She cannot be claimed as a dependent on anybody else’s return. She works as an administrative assistant in a local real estate company part time. Her W-2 showed compensation of \$15,000 with federal income tax withheld of \$50.

Olivia attended school as a full-time student during the spring and fall semesters. Olivia received a 1098-T with \$8,500 in Box 1 (Tuition) and \$12,000 in Box 5 (Scholarships and Grants). Olivia also paid \$500 for books and \$500 for a campus parking pass. Olivia had a tuition-based scholarship of \$6,000 and a Federal Pell grant of \$6,000.

She has never taken the American Opportunity Credit since her grants and scholarships have always exceeded her tuition and book expenses. Her Form 1098-T reflects her second year of postsecondary school. She has not been convicted of a felony and her earned income is over half of her support.

Use the “Credit maximization” worksheet to answer Questions 1–14.

Scenario 1—Baseline Scenario

Assume Olivia files her tax return using tax software and does not understand how to maximize her education credit. The tax software automatically reports the excess of scholarships and grants over qualified education expenses as gross income.

1. For an undergraduate student, which education tax credit generally results in the greatest tax benefit?
 - a. AOTC
 - b. LLTC
2. In the baseline scenario, which tax credit(s) does Olivia claim on her tax return? More than one answer can be selected.
 - a. AOTC
 - b. LLTC
 - c. EITC
 - d. None
3. How much federal income tax due (refund) (Form 1040 Line 34/37) will she have for the current tax year?
\$ _____

Scenario 2

Now assume Olivia came to the Volunteer Income Tax Assistance (VITA) site where you volunteer as a preparer to maximize her refund. Since you have done extensive research on the American Opportunity Credit, you found the following in IRS Publication 970 ([IRS 2022](#)):

Coordination with Pell grants and other scholarships. You may be able to increase your American opportunity credit when the student (you, your spouse, or your dependent) includes certain scholarships or fellowship grants in the student’s gross income. Your credit may increase only if the amount of the student’s qualified education expenses minus the total amount of scholarships and fellowship grants is less than \$4,000. If this situation applies, consider including some or all the scholarship or fellowship grant in the student’s income in order to treat the included amount as paying nonqualified expenses instead of qualified education expenses. Nonqualified expenses are expenses, such as room and board, that aren’t qualified education expenses such as tuition and related fees.

4. What portion of scholarships/grants can Olivia potentially allocate to gross income to increase her net qualified education expenses?
 - a. \$0
 - b. \$6,000
 - c. \$12,000
 - d. None of the above

5. Use the Solver Add-in in Excel to figure out how much of her grant to allocate to income to maximize her refund. How much grant should she allocate to income?
 - a. \$0
 - b. \$5,000
 - c. \$6,000
 - d. \$7,000
6. How much did the additional taxable grant income increase her:
 - a. Tentative tax: \$ _____
 - b. AOTC (nonrefundable): \$ _____
 - c. AOTC (refundable): \$ _____
7. How much money did Olivia save by filing her tax return at the VITA site (Scenario 2) compared with Scenario 1?
\$ _____
8. Provide a screenshot of your solver parameters that found the solution.

Scenario 3

Use the same information as used in Scenario 1, except now assume the following additional facts. Olivia is 25 years old and her filing status is married filing jointly. Her husband (Liam) has W-2 compensation of \$25,000 with \$0 federal income tax withheld. They have one child that qualifies them for the child tax credit and the earned income tax credit. They come to the VITA site to maximize their refund. You understand that, based on their situation, they may be eligible for additional tax credits and that maximizing one credit may not achieve the optimal overall refund. You read the following in IRS Publication 970 (IRS 2022, 16):

Scholarships and fellowship grants that the student includes in income don't reduce the student's qualified education expenses available to figure your American opportunity credit. Thus, including enough scholarship or fellowship grant in the student's income to report up to \$4,000 in qualified education expenses for your American Opportunity Credit may increase the credit by enough to increase your tax refund or reduce the amount of tax you owe even considering any increased tax liability from the additional income. However, the increase in tax liability as well as the loss of other tax credits may be greater than the additional American opportunity credit and may cause your tax refund to decrease or the amount of tax you owe to increase. Your specific circumstances will determine what amount, if any, of scholarship or fellowship grant to include in income to maximize your tax refund or minimize the amount of tax you owe.

9. Which tax credit(s) should they claim on their tax return? More than one answer can be selected.
 - a. AOTC
 - b. LLTC
 - c. EITC
 - d. CTC
 - e. ACTC
 - f. None
10. Use What-If Analysis in Excel to calculate her tax due (refund) if she chooses to recognize \$6,000, \$5,100, \$5,000, \$4,900, or \$3,000 of her Pell Grant as income in order to increase her qualified education expenses. Provide your What-If Analysis table below. In the Scenario Summary, update the "Changing Cells" and "Results Cells" cell references to the actual names for easier interpretation.
11. What is the optimum amount of net qualified education expenses to maximize their refund?
 - a. \$3,000
 - b. \$2,100
 - c. \$2,000
 - d. \$1,900
12. Essay questions. Please provide extensive analysis for each of the following questions.
 - a. Why wouldn't you fully maximize the AOTC in Scenario 3 (as you did in Scenario 2)?
 - b. What interesting insights do you discover when examining the trends in the EITC, the AOTC (refundable), the ACTC, and the combination of the three credits at the following allocation levels: \$5,100, \$5,000, and \$4,900?
 - c. Why is the net qualified education expenses (QEEs) post-allocation the "sweet spot" to maximize the overall refund? Use your What-If Analysis from Q10 to complete the following tables to analyze how each of the credits changes when allocating \$100 above and below the sweet spot. Use the provided formulas in the calculation column.

Allocate \$100 Above

- **AOTC (refundable) change** = (40 percent * (100 percent of the first \$2,000 of net QEEs \$100 above the sweet spot + 25 percent of the next \$2,000)) – (40 percent * (100 percent of the first \$2,000 of net QEEs at the sweet spot + 25 percent of the next \$2,000))
- **EITC change** = –15.98 percent * (adjusted gross income (AGI) \$100 above the sweet spot – AGI at the sweet spot)
- **ACTC change** = (American opportunity tax credit (nonrefundable) \$100 above the sweet spot – American opportunity tax credit (nonrefundable) at the sweet spot) – (tentative tax \$100 above the sweet spot – tentative tax at the sweet spot)
- **Total change** = change in AOTC (refundable) + change in EITC + change in ACTC

	Allocate \$100 Above	“Sweet Spot”	Difference	Calculation
<i>AOTC (refundable)</i>				
<i>EITC</i>				
<i>ACTC</i>				
<i>Total change</i>				

Allocate \$100 Below

- **AOTC (refundable) change** = (40 percent * (100 percent of the first \$2,000 of net QEEs \$100 below the sweet spot + 25 percent of the next \$2,000)) – (40 percent * (100 percent of the first \$2,000 of net QEEs at the sweet spot + 25 percent of the next \$2,000))
- **EITC change** = –15.98 percent * (AGI \$100 below the sweet spot – AGI at the sweet spot)
- **ACTC change** = (American opportunity tax credit (nonrefundable) \$100 below the sweet spot – American opportunity tax credit (nonrefundable) at the sweet spot) – (tentative tax \$100 below the sweet spot – tentative tax at the sweet spot)
- **Total change** = change in AOTC (refundable) + change in EITC + change in ACTC

	Allocate \$100 Below	“Sweet Spot”	Difference	Calculation
<i>AOTC (refundable)</i>				
<i>EITC</i>				
<i>ACTC</i>				
<i>Total change</i>				

13. How much money did Olivia save by maximizing her refund in Scenario 3 (Hint: The tax refund difference between allocating \$5,000 and \$3,000 in the What-If Scenario Summary)?

\$ _____

14. **Final File Upload**

Please upload the completed Excel worksheet.

APPENDIX A

Automate Your Spreadsheet Using Excel Formulas and Complete Solver and What-If Analysis

- When you discuss tax planning with a client, it is important to fully automate your tax formula spreadsheet in order to perform on-the-spot sophisticated projections. The following table provides the formulas to use in each cell.
- The simple formulas are not delineated in this table but should still be used (e.g., taxable income = adjusted gross income – standard deduction).
- Use relative, absolute, and mixed references¹ in order to copy your formulas into other columns.

Excel Formulas and Analysis

Excel Spreadsheet Line	Formula(s) Explanation	Formula Syntax (Use Cell References to Fully Automate the Spreadsheet, Blue Text Represents a Cell Reference, Red Text Represents a Named Range)
Tax Return (Tax Formula) Grant and scholarship income	This is the amount of scholarships and grants that Olivia will recognize as income. She must recognize scholarships and grants in excess of qualified education expenses as income. In Scenarios 2 and 3, she may decide to allocate more scholarships and grants to income to maximize her credit.	= Allocate a portion of scholarships and grants to income
Standard deduction	VLOOKUP ^a —“Use VLOOKUP when you need to find things in a table or a range by row.” Here, we need to look up the standard deduction amount by filing status. Named range ^b —“You can quickly create a named range by using a selection of cells in the worksheet.” Select the standard deduction table range and name it Standard_deduction for use in this formula.	= VLOOKUP(Filing Status, Standard_deduction,2,False). Named range • Select the standard deduction table in cell range B90:C93 • Change the name in the box next to the formula bar to “Standard_deduction”
Tentative tax	Named range ^b —Select each respective tax rate table and name them “Single, MFJ, HH, MFS” VLOOKUP ^a —Here, we need to use VLOOKUP to calculate the tentative tax based on Filing Status and Taxable Income amount INDIRECT ^c —This function allows you to pull text from a specific cell to use in your formula. “Use INDIRECT when you want to change the reference to a cell within a formula without changing the formula itself.” In this case, we want to use the INDIRECT function to pull the Filing Status text. The Filing Status text should match a named range that corresponds to the correct tax rate schedule (i.e., Single in this formula will pull the tax rate schedule for a single taxpayer).	= VLOOKUP(Taxable Income,INDIRECT (Filing Status),4,TRUE) + (Taxable Income-VLOOKUP(Taxable Income, INDIRECT(Filing Status),1,TRUE))* VLOOKUP (Taxable Income,INDIRECT (Filing status),3,TRUE)
Child tax credit (nonrefundable)	IF ^d —In this case, the nonrefundable CTC is only pulled if the taxpayer qualifies for this credit.	= IF(Eligible for CTC? = “Yes”,Child tax credit (non-refundable),0)

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¹ <https://support.microsoft.com/en-us/office/switch-between-relative-absolute-and-mixed-references-dfec08cd-ae65-4f56-839e-5f0d8d0baca9>

APPENDIX A (continued)

Excel Formulas and Analysis

Excel Spreadsheet Line	Formula(s) Explanation	Formula Syntax (Use Cell References to Fully Automate the Spreadsheet, Blue Text Represents a Cell Reference, Red Text Represents a Named Range)
American opportunity credit (nonrefundable)	IF ^d —In this case, the nonrefundable portion of the AOTC is only pulled if the taxpayer qualifies for this credit. MIN ^e —Returns the smallest number from a list of two or more numbers. For this calculation, the nonrefundable credit (60% of the total AOTC credit) cannot exceed the tentative tax, so this formula returns the lower of the two numbers.	= IF(Eligible for AOTC? = "Yes",MIN (AOTC after phase-out*0.6,Tentative Tax),0)
Earned income tax credit	IF ^d —The EITC is only pulled if the taxpayer qualifies for this credit.	= IF(Eligible for EITC? = "Yes",Earned income tax credit after phase-out,0)
Additional child tax credit	IF ^d —The ACTC is only pulled if the taxpayer qualifies for this credit.	= IF(Eligible for CTC? = "Yes",Additional child tax credit,0)
American opportunity credit (refundable)	IF ^d —The refundable portion of the AOTC is only pulled if the taxpayer qualifies for this credit. The refundable portion of the AOTC is 40% of the credit.	= IF(Eligible for AOTC? = "Yes",AOTC after phase-out*0.4,0)
The American Opportunity Tax Credit		
Education Credit Calculation AOTC—Preallocation		
Net qualified education expense preallocation	Net qualified education expenses (tuition + books less nontaxable scholarships/grants) of a student.	= Qualified tuition expense from 1098-T Box 1 + Books and required course supplies-Scholarships/grants from 1098-T Box 5
Potentially allocable portion of scholarship and grants	This is the amount of scholarships/grants that a student could potentially allocate to income. Note, scholarships that are strictly limited to paying tuition are not allocable, whereas government grants are allocable.	
Allocate a portion of scholarships and grants to income	This is the amount of potentially allocable scholarships and grants that Olivia decides to allocate to income. Note: If "Net qualified education expense preallocation" is negative, the taxpayer must recognize at least that negative amount as income.	
Education Credit Calculation AOTC—Post-Allocation		
Net qualified education expense post-allocation	MAX ^f —The greater of 0 or net qualified education expense preallocation + any nontaxable grants the student recognizes as taxable income. This number cannot be negative, as any excess will need to be allocated to income.	= MAX(0,Net qualified education expense pre-allocation + Allocate a portion of scholarship and grants to income)
Maximum AOTC before phaseout	Nested IF ^g —Similar to the IF function, allows you to make a comparison between a value and what you expect but allows multiple comparisons. Since the American Opportunity Credit is 100% of the first \$2,000 of QEEs and 25% of the next \$2,000 of QEEs, the calculation will differ depending on three potential levels of QEEs: \$2,000 or less, between \$2,000 and \$4,000, and above \$4,000.	= IF(Net qualified education expense post-allocation = 0,0,IF(Net qualified education expense post-allocation <= 2000,Net qualified education expense post-allocation, IF(Net qualified education expense post-allocation <= 4000,2000 + (Net qualified education expense post-allocation-2000)* 0.25,2500)))

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APPENDIX A (continued)

Excel Formulas and Analysis

Excel Spreadsheet Line	Formula(s) Explanation	Formula Syntax (Use Cell References to Fully Automate the Spreadsheet, Blue Text Represents a Cell Reference, Red Text Represents a Named Range)
Phaseout%	<p>IF(OR)^h—“But what if you need to test multiple conditions, where let’s say all conditions need to be True or False (AND), or only one condition needs to be True or False (OR), or if you want to check if a condition does NOT meet your criteria? All 3 functions can be used on their own, but it’s much more common to see them paired with IF functions.” We need to use this function since the phaseout modified adjusted gross income (MAGI) thresholds differ by filing status. MEDIANⁱ—“Returns the median of the given numbers. The median is the number in the middle of a set of numbers.” In this case, the AOTC begins to phase out at modified AGI of \$80,000 (\$160,000 married filing jointly (MFJ)), so we need to calculate the phaseout percentage based on three potential levels of MAGI: less than or equal to \$80,000, between \$80,000 and \$90,000, and above \$90,000 (double for MFJ). We want to set up the MEDIAN function at 0%, 100%, and the phaseout percentage.</p>	<p>= IF(OR(Filing status = “Single”, Filing status = “HH”), MEDIAN(0,1,(Adjusted gross income-AOTC phase-out beginning:Single/HH)/AOTC phase-out range:Single/HH), MEDIAN(0,1,(Adjusted gross income-AOTC phase-out beginning:MFJ)/AOTC phase-out range:MFJ))</p> <p>***Note: Use absolute cell references for the phaseout table references (e.g., AOTC phase-out beginning:Single/HH), so when you copy the cells from the baseline column, the formula will still work.</p>
AOTC after phaseout	<p>Is the total AOTC credit less any phaseout due to MAGI?</p>	<p>= Maximum AOTC before phase-out*(1-Phase-out%)</p>
The Earned Income Tax Credit		
<p>Maximum credit allowed (credit before phaseout)</p>	<p>Named range^b—Select the EITC table range and name it EITC for use in this formula. MIN^c—Returns the smallest number from a list of two or more numbers.</p>	<p>= MIN(VLOOKUP(# of qualifying children (EITC),EITC,2,FALSE),Taxpayer’s earned income)*VLOOKUP(# of qualifying children (EITC),EITC,3,FALSE)</p>
<p>Greater of AGI or earned income</p>	<p>VLOOKUP^a—Here, we need to use VLOOKUP to calculate the EITC based on filing status and number of qualifying children.</p>	<p>= MAX(Taxpayer’s AGI,Taxpayer’s earned income)</p>
<p>Phaseout beginning</p>	<p>MAX^f—Returns the largest number from a list of two or more numbers.</p> <p>IF^d—We need to use this function since the phaseout MAGI thresholds differ by filing status.</p> <p>VLOOKUP^a—Here, we need to use VLOOKUP to calculate the EITC based on filing status and number of qualifying children.</p>	<p>= IF(Filing Status = “MFJ”,VLOOKUP(# of qualifying children (EITC),EITC,5,FALSE),VLOOKUP(# of qualifying children (EITC),EITC,8,FALSE))</p>
<p>Excess of income over phaseout beginning</p>	<p>MAX^f—We use the max function to set a boundary of 0 since the excess cannot be less than 0.</p>	<p>=MAX(Greater of AGI or earned income-Phase-out beginning,0)</p>
<p>Phaseout % (reduction%)</p>	<p>IF^d—We need to use the IF function since the phaseout MAGI thresholds differ by filing status.</p> <p>VLOOKUP^a—Here, we need to use VLOOKUP to calculate the EITC based on filing status and number of qualifying children.</p>	<p>= IF(Filing status = “MFJ”,VLOOKUP(# of qualifying children (EITC),EITC,7,FALSE),VLOOKUP(# of qualifying children (EITC),EITC,10,FALSE))</p>

(continued on next page)

APPENDIX A (continued)

Excel Formulas and Analysis

Excel Spreadsheet Line	Formula(s) Explanation	Formula Syntax (Use Cell References to Fully Automate the Spreadsheet, Blue Text Represents a Cell Reference, Red Text Represents a Named Range)
Phaseout amount	Multiply excess income over the lower phaseout threshold by the phaseout percentage.	= Excess of income over phase-out beginning*Phaseout % (reduction %)
Earned income tax credit after phaseout	MAX ^f —We use the max function to set a boundary of 0 since the EITC cannot be a negative number.	= MAX(0,Maximum credit allowed (credit before phase out)-Phaseout amount)
Child Tax Credit		
Number of children under 17 with required social security number (SSN)	Number of children who qualify for the child tax credit	= # of qualifying children (CTC)
Phaseout threshold: \$400,000—MFJ, \$200,000—Others	IF ^d —We need to use this function since the phaseout MAGI thresholds differ by filing status.	= IF(Filing status = “MFJ”,400000,200000)
Excess AGI over threshold (round up to nearest \$1,000)	IF ^d —The excess is only calculated if the taxpayer’s AGI exceeds the phaseout threshold. ROUNDUP ⁱ —ROUNDUP behaves like the ROUND function, except that it always rounds a number up.	= IF(Taxpayer’s AGI-Phaseout threshold: \$400,000-MFJ, \$200,000-Others < 0,0, ROUNDUP(Taxpayer’s AGI-Phaseout threshold: \$400,000-MFJ, \$200,000-Others,-3))
Credit after phaseout	IF ^d —We use the IF statement here to subtract the phaseout amount from the tentative credit. If the phaseout exceeds the credit, then the credit is 0.	= IF(Multiply number of qualifying children by \$2,000 > Credit phaseout: Multiply excess AGI over threshold by 5%, Multiply number of qualifying children by \$2,000-Credit phaseout: Multiply excess AGI over threshold by 5%,0)
Credit limit	Since the child tax credit is nonrefundable, this function limits the credit to the amount of tax due after applying the nonrefundable portion of the American Opportunity Credit.	= Tentative tax-American opportunity tax credit (nonrefundable)
Child tax credit (nonrefundable)	MIN ^e —The credit is limited if tax due after applying other nonrefundable credits is less than the credit after phaseout.	= MIN(Credit after phaseout,Credit limit)
Additional Child Tax Credit		
Potential additional child tax credit	Subtract the nonrefundable CTC from the total CTC to see if any remains to be used for the additional child tax credit.	= Credit after phaseout-Child tax credit (non-refundable)
Lesser of potential and maximum ACTC	MIN ^e —Use the lesser of the potential additional child tax credit and \$1,600 times the number of qualifying children.	= MIN(Potential additional child tax credit, Number of children under 17 with required SSN x \$1,600)
Earned income limitation (\$2,500)	IF ^d —Calculate the 15% of earned income limitation base, unless earned income is less than \$2,500, in which case the credit is disallowed.	= IF(Taxpayer’s earned income > 2500, Taxpayer’s earned income-2500,0)
15% of earned income ceiling	The credit will be limited for taxpayers with earned income that is too low.	= Earned income limitation (\$2,500)*0.15
Additional child tax credit (ACTC)	MIN ^e —The credit cannot exceed the 15% of earned income ceiling.	= MIN(Lesser of potential and maximum ACTC,15% of earned income ceiling)

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APPENDIX A (continued)

Excel Formulas and Analysis

Formula Syntax (Use Cell References to Fully Automate the Spreadsheet, Blue Text Represents a Cell Reference, Red Text Represents a Named Range)

Excel Spreadsheet Line

Formula(s) Explanation

Solver

Solver add-in

Solver^k—“Put simply, you can use Solver to determine the maximum or minimum value of one cell by changing other cells.” See <https://support.microsoft.com/en-us/office/load-the-solver-add-in-in-excel-612926fc-d53b-46b4-872c-e24772f078ca> for instructions on how to load the Solver add-in in Excel. In Scenario 2, we want to maximize the tax refund by changing the amount of scholarships/grants that will be recognized as taxable. Subject to the constraint that the amount of scholarships/grants recognized as taxable cannot exceed the Pell Grant amount since the scholarship is limited to tuition expenses.

- Select Data—Solver
 - Set Objective: Tax due (refund)
 - By Changing Variable Cells: Allocate a portion of scholarship and grants to income
 - Subject to the Constraints:
 - Allocate a portion of scholarship and grants to income <= Potentially allocable portion of scholarship and grants
 - Net qualified education expense post-allocation <= 4000
- Your starting point in Allocate a portion of scholarship and grants to income should be the baseline scenario value of \$3,000.

What-If Analysis

What-If Analysis

What-if^l—“By using What-If Analysis tools in Excel, you can use several different sets of values in one or more formulas to explore all the various results.” In Scenario 3, we want to maximize the tax refund by changing the amount of scholarships/grants that will be recognized as taxable. Subject to the constraint that the amount of scholarships/grants recognized as taxable cannot exceed the Pell Grant amount since the scholarship is limited to tuition expenses. We will choose multiple different allocation amounts to find the maximum.

- Select Data—What-If Analysis—Scenario Manager—Add
 - Scenario Name: Allocate \$6,000
 - Changing Cells: Allocate a portion of scholarship and grants to income
 - Enter values for each of the changing cells: 6000
 - Repeat the above to create four additional scenarios: \$5,100, \$5,000, \$4,900, and \$3,000
 - In the Scenario Manager, select Summary...
 - Report type: Scenario summary
 - Result cells: \$E\$11:\$E\$30,\$E\$39:\$E\$47
 - Copy the names of the result cells from your credit maximization sheet into your Scenario Summary sheet for easier analysis.

(The full-color version is available online.)

^a <https://support.microsoft.com/en-us/office/vlookup-function-0bbc8083-26fe-4963-8ab8-93a18ad188a1>

^b <https://support.microsoft.com/en-us/office/create-a-named-range-from-selected-cells-in-a-worksheet-fd8905ed-1130-4cca-9bb0-ad02b7e594fd>

^c <https://support.microsoft.com/en-us/office/indirect-function-474b3a3a-8a26-4f44-b491-92b6306fa261>

^d <https://support.microsoft.com/en-us/office/if-function-69aed7c9-4e8a-4755-a9bc-aa8bbff73be2#:~:text=The%20IF%20function%20is%20one,if%20your%20comparison%20is%20false>

^e <https://support.microsoft.com/en-us/office/min-function-61635d12-920f-4ce2-a70f-96f202dcc152>

^f <https://support.microsoft.com/en-us/office/max-function-e0012414-9ac8-4b34-9a47-73e662c08098>

^g <https://support.microsoft.com/en-us/office/if-function-nested-formulas-and-avoiding-pitfalls-0b22ff44-f149-44ba-aeb5-4ef99da241c8>

^h <https://support.microsoft.com/en-us/office/using-if-with-and-or-and-not-functions-in-excel-d895f58c-b36c-419e-b1f2-5c193a236d97>

ⁱ <https://support.microsoft.com/en-us/office/median-function-d0916313-4753-414c-8537-ce85bdd967d2>

^j <https://support.microsoft.com/en-us/office/roundup-function-f8bc9b23-e795-47db-8703-db171d0c42a7#:~:text=ROUNDUP%20behaves%20like%20ROUND%2C%20except,up%20to%20the%20nearest%20integer>

^k <https://support.microsoft.com/en-us/office/define-and-solve-a-problem-by-using-solver-5d1a388f-079d-43ac-a7eb-f63e45925040>

^l <https://support.microsoft.com/en-us/office/introduction-to-what-if-analysis-22bffa5f-e891-4acc-bf7a-e4645c446fb4>

INDEX OF SUPPLEMENTAL MATERIALS

2023 Excel template.xlsx

II. CASE LEARNING OBJECTIVES AND IMPLEMENTATION GUIDANCE

Case Motivation and Literature Review

The nature of professional tax planning is evolving due to emerging technologies and data analytics. Although technology has been expected to disrupt the accounting profession for years, the disruption has accelerated (Holmes and Douglass 2022). Coman et al. (2022) find that the role of professional accountants is shifting to analyst and consultant for entrepreneurs. To prepare future tax professionals for this new environment, the AICPA and the National Association of State Boards of Accountancy (NASBA) jointly resolved to reshape the CPA licensure module to integrate the changing skills and competencies required of CPAs—coined CPA Evolution. As part of this evolution, the AICPA recently released the Tax Compliance and Planning (TCP) discipline exam section of the CPA exam. This new exam section concentrates heavily on tax planning and personal financial planning and requires the application of analytical skills.

Motivated by the changing landscape, we developed this case to teach students advanced Excel skills and demonstrate the use of Excel in tax planning. Multiple recent tax case studies have used Excel to model tax planning strategies. Evans, Brink, Lee, and Hennig (2016) require students to perform a tax analysis of an S-Corp conversion. Best and Schafer (2017) focus on simulating a corporate tax return engagement, with Excel playing a key role. More recently, Lee, Hansen, and Brink (2020) use Excel as a decision aid for retirement plan decisions. Data analytics can be incorporated into tax courses to calculate effective tax rates, examine a firm's book-tax differences and tax risk, and analyze the effects of tax code changes (Cheng, Sapkota, and Yurko 2021; Laplante and Vernon 2021; Sledgianowski, Petra, Pelaez, and Zhu 2021). This case builds on prior Excel tax cases (e.g., Larson, Lewis, and Spilker 2017; Morrow and Stinson 2016). It teaches students problem solving by requiring them to zero in on the minimal tax liability using Solver. It also requires critical thinking, as the minimization of the tax liability differs in a counterintuitive way from scenario to scenario due to offsetting credits. Students will gain a better understanding of how nonrefundable and refundable credits work and how additional taxable income affects each credit differently. Finally, students use What-If Analysis to demonstrate differences between one reporting/planning scenario compared with others. The What-If Analysis also requires that students think critically to explain what exactly is happening with each credit (i.e., the AOTC and the ACTC increase while the EITC decreases).

Another purpose of the case is for students to gain a deeper knowledge of the intricacies of the AOTC and learn how to maximize tax benefits by reporting the optimal amount of scholarship income. This is particularly relevant because millions of students fail to take advantage of or maximize education credits, resulting in “hundreds of millions of dollars of unclaimed credits each year” (IRS 2014). Students often miss out on education tax credits since net qualified education expenses are often \$0 or less when they receive full-ride scholarships or have their tuition paid with Pell Grants. However, an often-overlooked passage in IRC § 117 allows a student to recognize a nontaxable scholarship or grant as taxable income. Since taxable scholarships and grants do not reduce qualified education expenses, a student can elect to increase taxable income by all or a portion of the scholarship if it is deemed to be used for nonqualified education expenses. Treating the scholarship as taxable income may result in an increased education credit, which can reduce the total tax liability to an amount below what it would have been if the scholarship had been excluded from income. A nontaxable scholarship or grant is taxable if, by its terms, the scholarship or grant is permitted to be applied to nonqualified education expenses and to the extent the student includes it as taxable income, such as room and board. A strictly tuition-based scholarship cannot be included in gross income since it cannot be used for nonqualified education expenses.

In practice, students often use low-cost or free income tax preparation software or tax preparers that overlook the maximization of these education credits. When the dollar amount of scholarships and grants received exceeds qualified education expenses, the excess is generally reported as income. Additionally, phaseouts, limitations, and coordination with other tax credits can make the maximization of the credit more complicated. Multiple articles have illustrated the inherent complications and potential strategies to maximize a student's education credit (Madison and Royalty 2018; Gamboa and Wheeler 2019; Li, Lytvynenko, Chen, and Jones 2021). The IRS states,

Maximizing the total value of scholarships and tax benefits can therefore require complicated calculations of the value of the credit (to the student *or* to the parent, if applicable) relative to the tax liability resulting from counting the scholarship as income. Students may not understand that they have this option, and many would benefit from better guidance in their decision making. (IRS 2014; emphasis in the original)

Issues related to education credits and earned income tax credits frequently trigger IRS audits. The case can also be used to help train students who participate in “Volunteer Income Tax Assistance” (VITA) programs. Implementing these case studies could help lower income taxpayers save money and reduce the risk of audits. Furthermore, this

initiative would allow participating schools to contribute to their communities, generate positive public relations, and provide real benefits to taxpayers. An example of how one University VITA site applied these strategies is included in the Evidence of Efficacy section.

To illustrate with an example from the case, a student may qualify for the Earned Income Tax Credit (EITC) and the American Opportunity Tax Credit (AOTC). However, maximizing the AOTC could potentially decrease the EITC if the taxpayer is in the EITC phaseout range. Consequently, a tax consultant would need to find the “sweet spot” where multiple tax credits are in play. Also, there may be other nontax considerations in the allocation decision as well. For example, allocating too much grant money to income could affect Pell Grant eligibility or marketplace health insurance premiums. Although there are many moving parts and considerations, this case study teaches students how to build an automated model to minimize the tax liability for a student in different situations. It can be used presently and in the future.

Learning Objectives

The case covers five learning objectives that are aimed at helping accounting students gain critical thinking skills in the tax field. The foundation of the case is the technical knowledge necessary to identify the tax issues related to education credits.

We present a summary of the learning objectives below.

1. Comprehend the eligibility requirements of tax credits and the differences between refundable tax credits and nonrefundable tax credits by applying the appropriate tax credits in tax scenarios.
2. Apply the formulas and tax rules to compute the AOTC and EITC, considering the various limitations and phaseouts by solving realistic problems in different scenarios.
3. Analyze when the student can and should include certain scholarship or fellowship grants in the student’s gross income instead of excluding those from income and reducing the qualified education expenses for education credits by comparing and contrasting different situations and outcomes.
4. Evaluate the various options for maximizing a taxpayer’s refund by applying advanced formulas and data analysis features (e.g., Solver and What-If Analysis) in Excel beyond the use of tax preparation software.
5. Analyze the intricacies of the tax rules and document findings by answering essay questions.

The goals of Learning Objectives 1, 2, and 3 are to increase student knowledge about how to maximize education credits considering the interplay of the AOTC and the EITC. For Learning Objectives 4 and 5, students are developing the ability to use advanced data analytics in Excel to solve complicated tax issues and communicate their findings in writing. Those learning objectives directly address four skills: technical tax research, critical thinking, data analytics, and communication.

Table 1 maps the learning objectives to their related case requirements.

Implementation Guidance

This case is intended as a group project for students in a tax class at the undergraduate or graduate level. This case by itself can be quite complicated, with extensive Excel modeling and tax research requirements, so we provide recommended implementation guidance depending on the course and level (i.e., undergraduate or graduate).

Undergraduate-Level Implementation and Suggested Modification

The case was initially implemented in two undergraduate tax courses but could potentially be used in any of the following undergraduate courses: Individual Tax, Tax Research, Taxes for Individuals and Business, and Data Analytics. Since Excel experience in the undergraduate tax course will likely vary, more support from the instructor will be required at this level. It is recommended that the case be used when covering the tax credits section of the tax formula as four quite important tax credits are covered (i.e., the AOTC, EITC, CTC and ACTC).

The case was found to be particularly effective when students were walked through the entire Excel model, Solver, and What-If Analysis. This can be difficult, depending on available class time, so supplemental videos walking through the entire model (including Solver and What-If Analysis) are provided in the Teaching Notes. These videos were found to be extremely effective for online students. Walking through each function helps students feel less intimidated by the large “scary” formulas, and it opens students’ eyes to the extensive possibilities in Excel. Alternatively, instructors could provide a walkthrough of the 2023 case and then students could complete the 2024 case. In the most recent use of the case, many students had used several of the Excel functions in the past but did not know what each function accomplished precisely. Some students had forgotten how to use the functions. Walking through each function step by step (whether in class or through the online videos provided in the Teaching Notes) strengthened students’ abilities to use the

TABLE 1
A Map of Learning Objectives to Case Requirements

No.	Learning Objectives	Case Requirements
LO 1	Comprehend the eligibility requirements of tax credits and the differences between refundable tax credits and nonrefundable tax credits by applying the appropriate tax credit in tax scenarios.	Scenario 1: Q1–2
LO 2	Apply the formulas and tax rules to compute the AOTC and EITC considering the various limitations and phaseouts by solving realistic problems in different scenarios.	Scenario 1: Q3 Scenario 3: Q9
LO 3	Analyze when the student can and should include certain scholarship or fellowship grants in the student's gross income instead of excluding those from income and reducing the qualified education expenses for education credits by comparing and contrasting different situations and outcomes.	Scenario 2: Q4–8 Scenario 3: Q11, Q13
LO 4	Evaluate the various options for maximizing a taxpayer's refund by applying advanced formulas and data analysis features (e.g., Solver and What-If Analysis) in Excel beyond the use of tax preparation software.	Scenario 2: Q5 Scenario 3: Q10
LO 5	Analyze the intricacies of the tax rules and document findings by answering essay questions.	Scenario 3: Q12

formulas, as evidenced by their written feedback. The following are a few examples of student responses to the question “What was the most useful Excel function you learned in this project and why?”

Vlookups, they seemed a lot harder when I first used them.

The solver has been and is one of my favorites. I just forgot how to access it.

What-If-Analysis because I have used it before in other classes but never in a way that helped me understand its uses in real life.

Most useful was how the Nested what IF functions work. I knew how they were used before but I never had one explained to me so well. All the other functions were also great refreshers but the IF functions were the best refresher.

The most useful Excel function I learned is the solver function. This was one that I didn't completely grasp after my information systems class, so it was good to see another example and reinforce its usefulness.

Definitely the What-if analysis; I feel like it is the most applicable to understanding and testing dynamics in various financial or accounting scenarios and finding an outcome.

After completing the Excel model with assistance, students completed the questions related to the analysis. This included an extensive analysis of how the tax credits interact to maximize the overall refund. Both online and face-to-face students said the case took four hours on average. Work on the case outside class time can be completed individually or in groups of up to three students.

Graduate-Level Implementation and Suggested Modification

At the graduate level, less instructor assistance may be required as students will potentially be more proficient in Excel. The case would work well in any of the advanced tax courses or data analytics for the tax track of the CPA Evolution curriculum. It is recommended that the instructor spend one class period introducing the case with a brief discussion of why students often fail to maximize the AOTC and how increasing the AOTC may affect the taxpayer's EITC, CTC, and ACTC. The instructor should also provide an overview of the appendix that contains all of the required functions for the Excel model. Supplemental videos can also be provided in the Teaching Notes. The videos walk through an example of each Excel function used: VLOOKUP, Named range, INDIRECT, IF, IF(OR, IF(AND, Nested IF, MIN, MAX, MED)). Students will complete the Excel tax formula model and then use Solver and What-If Analysis to demonstrate how to use the automated Excel model to minimize tax liability.

The majority of the work on the case can be completed outside of class, individually, or in groups of up to three students. Students should be able to complete the case outside of class in a period of four to five hours. After completing the case, students submit an Excel workbook and answers to the questions related to each scenario.

The following teaching materials are available to instructors and included in the Teaching Notes: (1) Excel templates, suggested solutions, and grading rubrics for tax year 2023 and 2024 and (2) supplemental walkthrough videos for the entire case and each Excel function.

Alternative Implementation Guidance

Due to the substantial number of students who miss or fail to maximize the AOTC every year, one instructor gave students an alternative for the final project. After completing the automated tax model, if students missed or failed to maximize their own AOTC in the past, they could prepare an amended tax return to maximize the AOTC using the template. In one semester alone, six students claimed over \$7,000 in missed credits. Interestingly, while completing this alternative, one student came upon an interesting and unexpected result using Solver. This student qualified for the AOTC, CTC, ACTC, and EITC in 2021. We learned in the case that a taxpayer can maximize all three credits by allocating sufficient income to have \$2,000 of adjusted net qualified education expenses when the taxpayer's AGI (or earned income) falls within the EITC phaseout range. However, this student's AGI fell below the EITC phaseout range preallocation and within the phaseout range post-allocation. Consequently, Solver recommended allocating enough scholarships to income to just meet the lower threshold of the EITC phaseout range with adjusted net qualified education expenses of roughly \$2,300. It was a great experience for the student to see how, when a taxpayer's scenario changes, the model still worked to maximize their refund. Although it takes more effort, this is a practical way for students to apply what they have learned to their lives.

Evidence of Efficacy

We measure the efficacy of the case in three ways. First, we use a survey of student perceptions conducted through Qualtrics (pre- and post-case). Second, we obtain independent validation of the case from four tax instructors at three different universities and tax practitioners in a local accounting firm. Third, one of the authors trained VITA volunteers on the principles in this case, resulting in over \$200,000 of additional tax refunds for students over the past two tax seasons.

Results of the Student Survey

The assessment process included the distribution of pre- and post-case questionnaires conducted in Qualtrics. The case, pre-case questionnaire, and post-case questionnaire² were completed by 175 students in the undergraduate accounting programs at two regional public universities: one in the West and one in the Midwest. At one of the universities, the case was administered in the Individual Tax course when the tax credits material was covered in the Fall of 2022. The 2022 version of the case has since been administered at this university in the Individual Tax class in the Spring and Summer 2023 semesters. At the other university, the case was administered in the Taxes for Individuals and Businesses course as a final project in the Fall of 2022. Each of the administering instructors is an author of the case.

The precase questionnaire included 13 student experiential feedback statements. Each of the statements is mapped to one or more learning objectives. Students were asked to provide their level of agreement for each of these 13 statements using a five-point Likert scale of 1 (strongly disagree) to 5 (strongly agree). The same 13 questions were also asked in the post-case questionnaire after the completion of the case. We present the results in [Table 2](#). The post-case mean is significantly higher than the pre-case mean for all statements. The analysis of the survey results shows that this case, in its entirety, was successful in meeting all the learning objectives that were established.

In addition, the post-case questionnaire also included a statement related to student's opinions about the case. The mean response (4.38) was statistically greater than neutral (untabulated). Overall, the students agreed that the case study was a good learning tool. The result provides additional evidence of case efficacy.

The post-case questionnaire also included additional open-ended questions to collect more feedback about the case. The written feedback about the case centers around the usefulness of Excel functions and how the tax rules learned from this case can benefit the students in the future. The written responses to those open-ended questions confirm that the case integrated various key tax topics and required them to think critically about a number of issues simultaneously to address complex tax issues. Comments regarding the most useful Excel function suggest that students found Solver and What-If Analysis valuable tools for maximizing tax benefits when multiple tax credits are in play. The students indicate that they can apply this tax knowledge and advanced data analytical tools to other situations in the future.

Below is a sample of responses to each of the three open-ended questions.

² The survey was deemed exempt from board review by the Institutional Review Board (IRB) at the authors' academic institution. The data used in the case are real data that were disguised to preserve confidentiality.

TABLE 2
Pre- and Post-Case Survey Results

#	Item (Learning Objectives)	Pre-Case Mean (n = 175)	Post-Case Mean (n = 175)	Diff. (Sig.)	% Change
1	I feel competent that I can maximize a taxpayer's tax refund by utilizing the American Opportunity Tax Credit. (LO 2)	3.66	4.16	0.50***	13.57
2	I understand how to coordinate Pell Grants with other scholarships to maximize education tax credits. (LO 3)	3.33	4.14	0.81***	24.19
3	I feel prepared to provide tax planning services for students. (LO 4)	3.38	3.93	0.54***	16.05
4	I feel prepared to use advanced Excel data analysis tools to perform tax-planning services. (LO 4)	3.43	4.13	0.70***	20.30
5	I feel comfortable using Solver to meet an objective in Excel. (LO 4)	3.61	4.27	0.66***	18.38
6	I feel comfortable performing What-If Analysis in Excel. (LO 4)	3.49	4.17	0.67***	19.31
7	I understand how to apply various limitations and phaseouts for the calculation of a taxpayer's education tax credit. (LO 2)	3.20	3.95	0.75***	23.57
8	I understand how to reference a range name in a formula using the INDIRECT function in Excel. (LO 4)	3.08	4.02	0.94***	30.61
9	I understand how to apply various limitations and phaseouts for the calculation of the earned income tax credit. (LO 2)	3.19	3.98	0.79***	24.73
10	I feel comfortable using a nested IF statement in Excel. (LO 4)	3.51	4.11	0.60***	17.07
11	I feel comfortable using the MEDIAN function in Excel to calculate the correct phaseout percentage. (LO 4)	3.75	4.22	0.47***	12.50
12	I feel confident that I can identify the various tax rules that benefit college students. (LO 1-3)	3.57	4.17	0.61***	16.99
13	I feel prepared to research technical tax questions. (LO 5)	3.73	4.16	0.43***	11.66

*** Indicates significant differences in the pre-case and post-case t-statistics ($p < 0.001$).

5 = strongly agree; 1 = strongly disagree

Q1: What was the most useful Excel function you learned in this project and why?

The most useful Excel function that I learned in this project was how to add and use Solver. It was interesting to see how to input restraints and analyze the changes between Scenario 1 and Scenario 2. I believe that Solver will be used in the future and I am glad to have this knowledge and introduction to it.

The what-if and solver functions were actually both very useful tools to learn about because I honestly had no idea they existed and am excited to use them in any future projects both in school and the workplace.

The what-if analysis tool were most useful because it allows me to see results for different situation without having to delete everything or making a ton of different copies.

Q2: In what ways can the tax rules you learned from this case benefit you in the future?

This case was a good learning tool, and I am glad that I was able to complete it while learning how I could apply it to my future.

The case was a cool way to learn new functions in excel and to learn how specific tax credits interact with each other. I think more cases like this would be a good way to teach tax rules and excel functions to students in the future.

Q3: Please provide any other feedback about the case below.

This was a really helpful project and I'm really glad that we were assigned to do it. I learned a lot and I discovered more ways to use excel. I knew there were a lot of really neat and in-depth functions in excel, but until now I had never really had an opportunity to dive into some of them. Great learning experience and I had fun doing it—especially because it has real-life implications and benefits.

Not only does it benefit me as a student in filing my own tax returns, but it will also help me with my brothers and other family members. I think it also opened my eye to the “there is more than one way to skin a cat” type thing. The first time may not give you the best return. Often times we too have to think outside of the box.

I will be using this sheet at the CPA firm that I work at to help our clients optimize the tax credits and maximize their refunds. I am planning to save this sheet to my personal files as well.

I can tell a lot of work has been put into the case and it is truly interesting to witness firsthand the powers of excel which is such a great resource. It’s hard to know how many of these cool functions there are without practicing with them.

Case Validation by Other Tax Instructors and Tax Practitioners

The case was shared with tax instructors from three universities for the purpose of verifying the accuracy of the case analysis and results. All of the tax instructors verified the technical accuracy of the case and spoke highly about its relevance. The first tax instructors provided the following feedback:

Overall, this is a wonderful illustration of how tax software is not completely reliable.

The second instructor teaches individual taxation and business taxation at a four-year public university. The instructor made the comment below about the case.

This is a really good project that students can train on data analytic skills.

Additionally, we also requested comments from a tax partner in a local accounting firm, and the feedback was very positive. The tax partner noted,

This is a great example of the type of planning exercise we see throughout the year. It may not always be these specific credits but the type of analysis that involves a ‘baseline’ scenario and then builds off it is exactly what tax planning is about. In reality, this specific type of analysis (education credits) can be handled by specific software that most CPA firms have, but having the analytical background is truly important because it can be used to explain the results to a real-life client.

Practical Case Validation in a University-Sponsored VITA Program

In the Spring of 2022, the strategies applied in this case were also implemented in a university-sponsored VITA program. Of the roughly 201 student returns that were prepared, 90 would have likely missed the credit due to grants received that exceeded tuition. These 90 students received roughly \$108,000 of additional tax refunds by applying the strategies learned in this case. The Spring of 2023 saw even more success, with roughly 245 student returns prepared receiving \$245,000 in education credits. Of this \$245,000 total, we tracked that roughly 114 students would have missed \$107,000 due to grants received that exceeded tuition. VITA program implementation recommendations are provided in the Teaching Notes.

In combination, the mapping of the results to the learning objectives, the comparison of the pre-case and post-case survey results, as well as the post-case student experiential feedback and written responses demonstrate the effectiveness of this teaching case. The desired learning objectives have all been met. It has shown effectiveness in teaching students complicated and useful Excel functions and data analytic tools that are useful for tax minimization and planning. In addition, positive feedback from nonauthor instructors and tax practitioners demonstrates how the project benefits students academically, professionally, and personally.

TEACHING NOTES

Teaching Notes are available only to full-member subscribers to the *Issues in Accounting Education* through the American Accounting Association’s electronic publications system at <https://publications.aaahq.org>. Full-member subscribers can use their usernames and passwords for entry into the system where the Teaching Notes can be reviewed and printed. Please do not make the Teaching Notes available to students or post them on websites.

If you are a full member of AAA with a subscription to *Issues in Accounting Education* and have any trouble accessing this material, please contact the AAA headquarters office at info@aaahq.org or (941) 921-7747.

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