

A process for assessing Excel skills using a capital budgeting analysis

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ABSTRACT

Many institutions have technology mastery as one of their stated learning goals. Accreditation increasingly requires more robust assessment of stated goals. However, assessing Excel skills separate from understanding new concepts or problem-solving skills can be difficult. This paper presents one method for assessing Excel skills within a simple capital budgeting analysis. The paper includes a practice problem and a timed exercise used in this process. The practice problem is completed in class or through video capture to help students understand the capital budgeting concepts. The students can then focus on utilizing Excel to evaluate substantially similar problems during a timed exercise. The paper also includes information regarding the skills that are evaluated along with a rubric that can be used for assurance of learning and grading.

Keywords: business education, assessment, information technology, finance

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INTRODUCTION

Accreditation standards often encourage undergraduate business programs to include information technology mastery as a stated learning goal. For example, AACSB International Standard 9 states that the undergraduate business curriculum would normally include learning experiences that enable students to use current technologies in business and management contexts (AACSB, 2013, pp. 30-1). Although limited in scope, information technology skills are frequently assessed by evaluating students' proficiency with using Excel to solve business problems. Capital budgeting is a common topic in an introductory finance course (Bianco & Bosco, 2011) and provides an opportunity to embed this type of skills assessment into a related spreadsheet assignment. However, assessing technology skills through a capital budgeting analysis can be confounded with evaluating problem solving or topic knowledge. While these confounding factors cannot be eliminated from a technology skills assessment within a business context, their influence can be reduced through a carefully designed assessment process.

This paper describes a process for assessing student proficiency with technology in a capital budgeting context that may be incorporated in an introductory finance or accounting course. The process emphasizes technology skill assessment while reducing the focus on problem solving ability related to capital budgeting and promotes consistent student preparation and measurement of learning outcomes across multiple sections of a course. The process begins with a practice problem in which students learn (reinforce) Excel skills including organization and presentation of information, cell referencing, construction and use of formulas, and the application of Excel functions. The practice problem may be completed in class as an instructor-led exercise or outside of class with the aid of a demonstration video using video capture software. After experience with the practice problem, students are required to complete an Excel project (the assessment instrument) that is a simplified version of the practice problem. Measurement of learning outcomes is based on a rubric that separately evaluates each trait of the assignment.

The assessment instrument is useful for measuring proficiency with Excel because it may be individually assigned and completed in a timed setting, either in class during a single class period (in one hour or less), at a campus testing center, or through a learning management system (e.g., Blackboard) for online and hybrid courses. Completing the project in a timed setting simulates the time pressure often found in a work environment. A timed and controlled setting also reduces opportunities for file sharing or collaboration among students and allows a more accurate assessment of individual skills.

The organization of the paper is as follows: the assessment project is described along with simple ways to vary the project to reduce incidences of academic dishonesty as well as to add difficulty, if desired. The skills being assessed are discussed and an assessment rubric is provided that can be used for an assurance of learning report and for grading. One practice problem is discussed, including guidelines for using video capture software to create a demonstration video. Solutions are provided for the assessment instrument and the practice problem.

ASSESSMENT INSTRUMENT DESCRIPTION

The assessment instrument is a simple capital budgeting project entitled, "Cupcake Bakery" that is completed in Excel. This project is similar to an example in Ross, Westerfield,

and Jordan (2011). The assessment instrument and its solution (containing numerical values, formulas, and functions) are provided in Appendix A. The primary assignment objectives are for students to demonstrate the skills of professional organization of information and the efficient use of Excel formulas, functions, and cell referencing.

In the project scenario, the student desires to bake and sell cupcakes on evenings and weekends. The student has a full time job (being a student!) and lives in an apartment. The student must rent bakery space and purchase special equipment to pursue this project. The project has a three year expected life and a stated required return on investment. Unit sales, price, and cost data are given. The project entails an annual fixed cost (bakery rent), and a one-time equipment purchase at the beginning of year 1. The project requires an infusion of net working capital at the beginning of year 1 that is maintained in the intervening years and withdrawn at the end of the project's life. A tax rate is also given. To simplify the problem, the equipment has a \$0 salvage value and straight-line annual depreciation. While MACRS depreciation is most commonly used in capital budgeting, straight-line depreciation reduces the complexity of the problem to focus more on Excel skills.

Students are provided a written set of instructions that include the project description and assigned tasks. Students must complete the assignment using a blank Excel workbook. Students must type in all inputs to the problem, create pro forma income statements for three years, calculate each year's pro forma free cash flow, NPV, IRR, and apply a decision rule to accept or reject the project. Pro forma statements require the application of formulas, the sum function, and cell references for efficient copying to complete the problem. NPV and IRR are calculated using Excel functions with cell referencing. The decision to accept or reject the project is stated in a text box.

The assignment assumes that students are familiar with capital budgeting concepts, creating pro forma statements, and using the required Excel formulas, functions, and cell referencing. To shift the emphasis of the assessment away from problem solving and toward Excel skills, students complete a similar but more challenging practice problem to learn how to construct a capital budgeting analysis in Excel. To further reduce the emphasis on problem solving and knowledge of the capital budgeting process, the assignment also includes a basic income statement and formula hints for calculating free cash flow. These hints may be omitted to add difficulty to the assignment.

Students are able to complete the assessment project in one hour or less after they have worked the practice problem. Therefore, the assessment project is ideally administered as a timed assignment, either in class or through the learning management system. The timed aspect simulates time pressure in the workplace and emphasizes the need to know the technology well enough that it doesn't interfere with completing the primary task of analysis. Timed, in-class assignments also deter collaboration between students which is helpful for assessing individual learning. To further reduce the possibility of collaboration, the instructor may assign variations of the base assignment by changing the business description and input values. The authors assign two variations, "Art Gallery" and "Dance Studio" that contain different numerical inputs and lead to different project selection decisions (problems and solutions available from the authors).

ASSURANCE OF LEARNING AND GRADING

A detailed rubric facilitates consistent evaluation across students, sections, and multiple instructors. The authors use the Excel skills assessment rubric in Table A1 (Appendix A) to

measure learning outcomes for the project. The rubric is designed to assess Excel skills only. The rubric features the following four Excel skills:

1. Organization and presentation (creation of an input area, titles, spacing, spelling, text box)
2. Application of Excel formulas (add, multiply, subtract)
3. Application of Excel functions (NPV, IRR, sum)
4. Use of cell references (absolute, relative)

The rubric classifies performance on each trait as does not meet expectations, meets expectations, or exceeds expectations. These classifications are compatible with a scoring system for measuring learning outcomes for assessment as well as grading. Classifying a student's work as meeting expectations (or not) depends on institutional or departmental standards. For example, a student may be classified as meeting expectations if he or she achieves this classification on at least three traits. The instructor may desire to include additional traits for grading knowledge of concepts and accuracy of the solution. Given the general nature of the traits, the rubric may be adapted to assess Excel skills in multiple classes and a variety of projects.

Students at the authors' institution submit their completed Excel files to the learning management system. Spreadsheets are reviewed in electronic format. The use of formulas, functions, and cell references traits are graded by toggling to "show formulas" in Excel's "formulas" ribbon. For each trait, a student's work is scored based on percentages of 60%, 75%, and 100% for does not meet, meets, and exceeds expectations, respectively. A total percentage score is calculated as the arithmetic average of the four traits given in the rubric. For assurance of learning, a total score of 100% exceeds expectations, a score from 70% to 99% meets expectations, and a score below 70% do not meet expectations. Based on these scoring intervals, 35% of the authors' students exceed, 61% meet, and 4% do not meet expectations.

Assessment notes for each trait are presented below Table A1 (Appendix A). The assessment notes discuss typical errors made by the authors' students and how the errors are treated according to the rubric. While conceptual errors related to capital budgeting are not entirely separable, the assessment notes focus on errors in Excel usage.

PRACTICE PROBLEM

Giving students the opportunity to practice using Excel in the context of capital budgeting is essential to their successful completion of the assessment project. Assigning several practice or end of chapter problems using Excel will help accomplish this task. However, the instructor should provide students with guidance on how to use Excel effectively by working at least one practice problem. In addition to homework problems related to capital budgeting, students at the authors' institution prepare for the assessment project by completing an instructor-led practice problem given in Appendix B. The solution to the practice problem appears in Figure B1 (Appendix B). The practice problem is from Ross, et al. (2011, pp. 271-4) and is similar in scope but slightly more challenging than the assessment instrument. The problem in Ross, et al. is modified for minor changes in wording.

The practice problem provides a scenario based on development of a product called "shark attractant". The format for the basic inputs is similar to the assessment instrument. The project life is three years, and the project description includes a required return, unit sales and cost estimates, an annual fixed cost, a one-time equipment charge, annual depreciation expense,

and a tax rate. Like the assessment instrument, students are asked to prepare pro forma income and free cash flow statements for three years. However, the practice problem also requires students to determine year zero capital spending and the change in net working capital over the three year period. The assessment instrument provides this information to reduce the need to understand cash flow determination and to focus on Excel skills. Additionally, the practice problem asks students to calculate the project's NPV by first calculating each period's discounted total free cash flow, and then applying a formula to find NPV. The discounted cash flow approach gives students a method for checking the accuracy of the NPV calculation via the Excel function. This step may be omitted to reduce confusion for students regarding the required calculations in the assessment instrument.

The practice problem may be completed in class, preferably with students following along in Excel on lab computers or laptops. An in-class demonstration allows students to ask the instructor questions when they do not understand a concept or miss a step in Excel. However, some students have difficulty keeping up in class and may learn better by listening first and then completing the practice problem on their own.

Video screen capture software can be used to record a demonstration of the practice problem in Excel. A video demonstration provides an out-of-class resource to help students prepare for the assessment problem or may be an alternative delivery method for an online or hybrid course or if the instructor does not have the time or equipment for an in-class demonstration. A video demonstration allows students to view the practice problem multiple times and review any missed steps or techniques. However, instructors do not always anticipate what students do not know. The best process is to create and post a video demonstration following an in-class demonstration. If this is not possible, then student questions may also be addressed through the learning management system discussion forum or chat.

CREATING A VIDEO DEMONSTRATION

A number of software products will capture what is being done on the screen along with audio input. Jing is a product for Windows operating systems that is available for free download. Quicktime is standard, preloaded software on Mac computers. Other video capture software products with more sophisticated editing features are available for both Macs and PCs but require license purchases (e.g., Snagit, Camtasia). The campus educational technology department can help instructors discover currently purchased video capture software licenses or the software may be purchased at an educational discount if desired.

While Jing is available for free, it is limited to five-minute videos that may result in multiple "episodes" of the demonstration problem. Dividing the demonstration into sections could be a strategy to individually present the basic problem set-up, pro forma income statements, calculation of cash flows/NPV/IRR, and recommendations. Shorter videos also increase upload and download speeds. However, recording the exercise in multiple segments increases the instructor's time to ensure that the exercise is fully captured and may require students to toggle between multiple videos. Online tutorials are available to help instructors use Jing. Guidance for using Quicktime is available through its help menu.

General guidelines for using screen capture software with Excel are described in Appendix C. The guidelines address how to begin recording in Excel, including background noise considerations. While working in Excel, the guidelines suggest that the instructor explain every step in Excel including any error correction and addressing anticipated student questions

while recording. The guidelines conclude with simple reminders about ending the recording. Because the video file sizes can be large, the file may need to be uploaded to cloud storage or a private YouTube account with a link in the learning management system. The campus educational technology department can provide information on the best way to make the video available to students.

CONCLUSION

This paper describes a process for assessing technology mastery in the context of a capital budgeting analysis that is completed in Excel. The process minimizes the influences of knowledge of business concepts or problem solving skills to focus the assessment primarily on Excel skills. The process includes working through a practice problem that is similar to the assessment instrument, assigning the assessment instrument in a timed setting, and using a detailed rubric to evaluate learning outcomes. Ideally, the instructor will work the practice problem in class and provide a video demonstration online of either the same problem or another one that is essentially the same in format. Administering the assessment instrument in a timed setting discourages collaboration between students. The assessment rubric promotes focus on Excel skills and helps to ensure consistent evaluation of learning outcomes across multiple sections of a course. Although a capital budgeting analysis is featured in this paper, the Excel skills and assessment process are general enough to apply to other topics in an introductory business course, such as time value of money or basic statistical analysis.

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APPENDIX A

Cupcake Bakery Project

You have a full-time job, but want to bake and sell cupcakes on evenings and weekends. You live in an apartment, so you will need to rent a bakery space and spend some money up front for special equipment. You want to know if this idea is worth pursuing. You estimate the following items related to the project:

Cupcake bakery project description	
Project life (years)	3
Required return	20%

Sales data	
Unit Sales (annual)	8,650
Unit Price	\$2.50
Cost data	
Unit cost	\$1.00
Bakery rent (annual)	\$12,000
Equipment cost (one-time purchase)	\$900
After-tax equipment salvage (Year 3)	\$0
Depreciation expense (annual)	\$300
Tax rate	35%
Year 0 total capital spending - equipment	\$900
Change in net working capital	
Year 0	-\$1,500
Year 1	\$0
Year 2	\$0
Year 3	\$1,500

Tasks to complete: use Excel to

1. Prepare pro forma income statements for three years
2. Prepare pro forma cash flows from assets (free cash flow) for three years
3. Calculate the project's NPV (use Excel function)
4. Calculate the project's IRR (use Excel function)
5. In your spreadsheet, use a text box and state whether you accept or reject this project, and briefly explain your rationale.

Income statement

Sales

Cost of Goods

Gross Profit

Fixed Costs

Depreciation

EBIT=Gross profit – fixed costs – depreciation

Tax Expense=EBIT*tax rate

Net Income

Total project free cash flow

Operating cash flow=EBIT+ depreciation – tax expense

Change in NWC (see project description)

Capital spending

Figure A1 Cupcake Bakery Project Solution with Excel Formulas and Functions

	A	B	C	D	E	F	G	H	I	J
1	Cupcake bakery project description									
2	Inputs			Pro forma income statement						
3	Project life (years)	3				Years				
4	Required return	20%			0	1	2	3	Year 3	
5				Sales		\$21,625	\$21,625	\$21,625	=B\$7*B\$8	
6	Sales data			Cost of goods		\$8,650	\$8,650	\$8,650	=B\$7*B\$11	
7	Unit sales (annual)	8,650		Gross profit		\$12,975	\$12,975	\$12,975	=H5-H6	
8	Unit price	\$2.50		Fixed costs		\$12,000	\$12,000	\$12,000	=B\$12	
9				Depreciation		\$300	\$300	\$300	=B\$15	
10	Cost data			EBIT		\$675	\$675	\$675	=H7-H8-H9	
11	Unit cost	\$1.00		Tax expense		\$236	\$236	\$236	=H10*B\$16	
12	Bakery rent (annual)	\$12,000		Net income		\$439	\$439	\$439	=H10-H11	
13	Equipment cost (one-time purchase)	\$900								
14	After-tax equipment salvage (Year 3)	\$0		Pro forma cash flows						
15	Depreciation expense (annual)	\$300				Years				
16	Tax rate	35%			0	1	2	3	Year 3	
17				Operating cash flow		\$739	\$739	\$739	=H10+H9-H11	
18	Year 0 total capital spending-equipment	\$900		Change in NWC	-\$1,500	\$0	\$0	\$1,500	\$1,500 given in problem	
19				Capital spending	-\$900					
20				Total project free cash flow	-\$2,400	\$739	\$739	\$2,239	=SUM(H17:H19)	
21										
22				NPV	\$24.22	=NPV(B4,F20:H20)+E20			Accept project, NPV>0, IRR>required return	
23				IRR	21%	=IRR(E20:H20)				



Table A1 Excel Skills Assessment Rubric

Trait	Does not meet expectations	Meets expectations	Exceeds expectations
Organization and presentation	Does not present relevant information and results in a clear and professional format with multiple spelling errors or failure to create an input area, titles, appropriate spacing, a text box for the discussion, or does not complete the problem	Presents relevant information and results in a relatively clear and professional format with at most one spelling error and creates an input area, titles, appropriate spacing, and a text box for the discussion with only minor deficiencies	Presents relevant information and results in a clear and professional format with no spelling errors and creates an input area, uses appropriate titles, spacing, and a text box for the discussion with no deficiencies
Application of Excel formulas	Errors in formula input in two or more formulas or does not utilize Excel for all basic calculations – enters results calculated by hand	Uses formulas in Excel for all basic calculations with errors in formula input in at most one formula	Uses formulas in Excel for all basic calculations with no errors when inputting the formulas
Application of Excel functions	Does not apply appropriate Excel functions such as NPV, IRR, sum, etc. where needed or used incorrectly	Applies appropriate Excel functions such as NPV, IRR, sum, etc. where needed to achieve an accurate answer but not as efficiently as possible, or missing at most one function	Applies appropriate Excel functions such as NPV, IRR, sum etc. efficiently and accurately where needed (i.e. uses ranges instead of individual cell references)
Use of cell references	Does not use cell references for two or more calculations	Uses cell references for all calculations including Excel functions but does not use relative and absolute references appropriately in all cases to allow for efficient copy/paste	Uses cell references for all calculations and uses relative and absolute references appropriately to allow for efficient copy/paste

Assessment notes

1. Organization and presentation

- a. “#####” in a cell is usually caused by a zoom level difference between the student’s and instructor’s monitor. Students are not penalized for this type of presentation problem.
- b. Text boxes should be sized to fit the discussion. If the text boxes do not show all of the text or are excessively large, then students should not exceed expectations.

2. Application of Excel formulas
 - a. Errors in formulas most commonly result from incorrect cell referencing and choice of incorrect mathematical operator (e.g., addition instead of subtraction).
3. Application of Excel functions
 - a. Some students do not know how to apply the NPV and IRR functions because they have not completed the practice problem. In these cases, students do not meet expectations. Students who do not know to subtract the year 0 cash flow from the NPV function, but correctly apply the sum and IRR functions do not meet expectations.
 - b. A few students will correctly use the sum and IRR functions, but neglect to include the NPV function and instead calculate NPV by summing the annual discounted cash flows as in the practice problem. Students in this latter case meet expectations.
 - c. A few students will add a string of referenced cells to sum a column instead of using the sum function (e.g., =+B1+B2+...). These students meet expectations provided all other functions are applied appropriately, but do not exceed expectations due to inefficient use of Excel functions.
 - d. Students should not use the sum function to subtract, e.g., =SUM(B13-B12). A student could at most meet expectations if they incorrectly use the sum function.
4. Use of cell references
 - a. In rare cases, students will correctly identify functions, but type in numbers instead of using cell references. These students do not meet expectations even if cell references are used correctly elsewhere.
 - b. Students may use absolute and relative references inefficiently. In order to exceed expectations, the students must use the appropriate type of cell reference in the year one pro forma so that correct pro formas will be created in later years by using copy/paste.

APPENDIX B

Shark Attractant Project

You have an idea for a new product called Shark Attractant, a “perfume” that attracts sharks. You want to know if producing and selling this product will add value to your firm. You estimate the following items related to the project:

Shark attractant project description	
Project life (years)	3
Required return	20%
Sales Data	
Unit Sales (annual)	50,000
Unit Price	\$4

Cost Data

Unit cost	\$2.50
Production facility rent (annual)	\$12,000
Equipment cost (one-time purchase)	\$90,000
Depreciation expense (annual)	\$30,000
Tax rate	34%
Net working capital investment (annual)*	\$20,000

*Assume NWC is recovered in Year 3

Use Excel to

1. Prepare pro forma income statements for three years
2. Prepare pro forma capital requirements for three years
3. Prepare pro forma free cash flow for three years
4. Calculate the project's NPV using a formula
5. Calculate the project's NPV using an Excel function
6. Calculate the project's IRR using an Excel function

Insert a text box into your worksheet and answer the following questions based on your work:

1. Does the NPV method recommend selecting this project if it is independent? Briefly explain your answer.
2. Does the IRR method recommend selecting this project if it is independent? Briefly explain your answer.

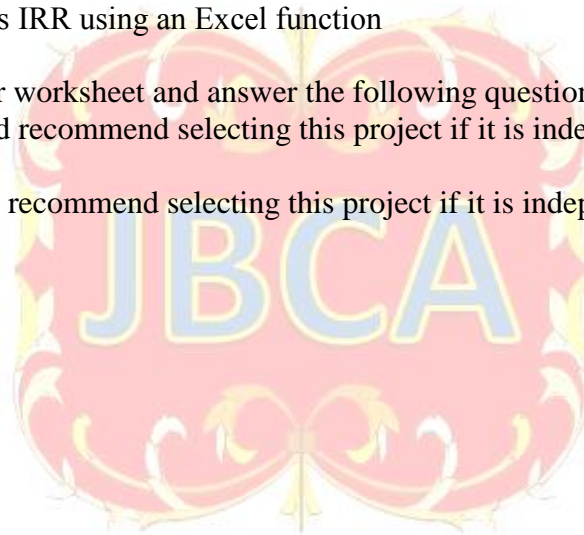


Figure B1 Shark Attractant Project Solution with Excel Formulas and Functions

	A	B	C	D	E	F	G	H	I	J	K
1	Shark attractant project description										
2	Inputs										
3	Project life (years)	3	Pro forma income statement								
4	Required return	20%	Years								
5				0	1	2	3	Year 3			
6	Sales Data		Sales		\$200,000	\$200,000	\$200,000	=\$B\$7*\$B\$8			
7	Unit sales (annual)	50,000	Cost of goods		\$125,000	\$125,000	\$125,000	=\$B\$7*\$B\$11			
8	Unit price	\$4	Gross profit		\$75,000	\$75,000	\$75,000	=H5-H6			
9			Fixed costs		\$12,000	\$12,000	\$12,000	=\$B\$12			
10	Cost Data		Depreciation		\$30,000	\$30,000	\$30,000	=\$B\$14			
11	Unit cost	\$2.50	EBIT		\$33,000	\$33,000	\$33,000	=H7-H8-H9			
12	Production facility rent(annual)	\$12,000	Tax expense		\$11,220	\$11,220	\$11,220	=H10*\$B\$16			
13	Equipment cost (one-time purchase)	\$90,000	Net income		\$21,780	\$21,780	\$21,780	=H10-H11			
14	Depreciation expense (annual)	\$30,000	Pro forma capital requirements								
15	Net working capital (annual)	\$20,000	Years								
16	Tax rate	34%		0	1	2	3	Year 3			
17			Net working capital	\$20,000	\$20,000	\$20,000	\$20,000	=\$B\$15			
18			Net fixed assets	\$90,000	\$60,000	\$30,000	\$0	=G18-\$B\$14			
19			Total investment	\$110,000	\$80,000	\$50,000	\$20,000	=SUM(H17:H18)			
20			Pro forma cash flows								
21			Years								
22				0	1	2	3	Year 3			
23			Operating cash flow		\$51,780	\$51,780	\$51,780	=H10+H9-H11			
24			Change in NWC	-\$20,000	\$0	\$0	\$20,000	=-SUM(E25:G25)			
25			Capital spending	-\$90,000							
26			Total project cash flow	-\$110,000	\$51,780	\$51,780	\$71,780	=SUM(H24:H26)			
27			Discounted cash flows								
28			Years								
29				0	1	2	3	Year 3			
30				-\$110,000	\$43,150	\$35,958	\$41,539	=H27/(1+\$B\$4)^H31			
31											
32			NPV (formula)	\$10,648	=SUM(E32:H32)						
33			NPV (function)	\$10,648	=NPV(B4,F27:H27)+E27						
34			IRR	26%	=IRR(E27:H27)						
35								NPV: accept project since NPV>0			
36								IRR: accept project since IRR>20%			
37											

APPENDIX C

Guidelines for Using Video Capture Software with Excel

Getting started

- Have Excel open with the starting worksheet before opening the screen capture software.
- Choose to create a new screen recording.
- Choose the type of microphone that will be used
 - If creating the video during the in-class demonstration, then use the computer's built in microphone if possible. This will capture student questions as well.
 - If creating the video outside of class, it is recommended to find a quiet location and use a headset microphone to minimize background noise. Students have indicated that background noise from pets, children, music, etc. is distracting.
- Choose to start the recording and begin working in Excel. A controller bar will appear that allows the instructor to pause and stop recording if needed.

Within Excel

- Speak slower and more carefully than normal, avoiding monotone speech or students will lose interest.

- Explain everything that is done. Don't assume that students watching the video will understand why each step is important.
- Read through the problem and pause as each piece of information is entered. This helps students break what appears to be an overwhelming amount of information into manageable pieces.
- Don't edit out minor input errors. Correct any errors while recording and move on. Correcting errors in the video helps students understand that they don't have to start over if they make a mistake.
- Excel often "guesses" incorrectly at the cell format that is desired. Explain that to the students as corrections are made.
- Try to anticipate questions students have or what they don't know and address these items proactively in the video. For example, explain why formatting the years horizontally and using absolute and relative references allows the user to create pro forma statements in year one and then copy the remaining years to reduce the amount of work required and reduce the probability of input errors.

Making the video available

- Choose to stop recording when the problem is completed.
- Save the video.
- Watch the entire video to make sure that it recorded as intended and that major edits are not needed.

