Archives of Business Research – Vol. 12, No. 12
Publication Date: December 25, 2024
DOI:10.14738/abr.1212.17994.
Kohli, R. K., & Pant, A. (2024). Some Guidelines to Publish Open Education Resource (OER) Materials for ADA Auditory Compliance in a Business Class. Archives of Business Research, 12(12). 51-68.

SERVICES FOR SCIENCE AND EDUCATION

Some Guidelines to Publish Open Education Resource (OER) Materials for ADA Auditory Compliance in a Business Class

Raj K Kohli
Judd Leighton School of Business and Economics
Indiana University South Bend, South Bend, IN 46634

Anurag Pant
Judd Leighton School of Business and Economics
Indiana University South Bend, South Bend, IN 46634

ABSTRACT

The number of persons with disabilities in the US has steadily increased to more than one in four today. Such disabilities have impaired both physical and cognitive functioning in human beings. Educational designers have suggested using a universal approach to designing courses and their materials such that all students could potentially benefit from such accommodations. Visual disability in particular has caused persons to be unable to grasp materials fully due to their dependence on text to speech software. Persons with disability have lagged the rest of the population in employability because of their lack of access to proper materials. In business education, finance classes have a particular problem of being able to depict tabular information to those with visual disability. This paper provides one method of how text-to-speech options can be used to suitably modify teaching materials and enable better learning among those with visual challenges.

28.7% of the US population has some form of disability. There are different disabilities in the US population including vision (5.5%), hearing (6.2%), mobility (12.2%) and cognition (13.9%) (CDC 2024). A disability is best understood in the modern context as anything that impairs the normal functioning of the body or mind (CDC definition). People with disabilities are disadvantaged in learning, hiring, and promotion processes on account of the accommodations sought by them as well as the lack of proper assistive technologies. Consequently, 22.5% of people with a disability were employed in USA compared to 65.8% of those without disability (BLS 2023). Persons 65 and over accounted for over half the persons with disability. But even in the 16 to 64 group, persons with disabilities had a 37.1% employment ratio compared to the 75% ratio for those without disability. These persistent lower levels of employment underline how much work there remains to be done to level the playing field for those with disabilities.

Difficulties in providing accessible materials to the differently abled continue to be bottlenecks to their growth. Lack of professional business curricula and other academic resources is an important contributor to the unemployment problem faced by persons with disability (Cranna and McKinnon 2022). These authors not only underlined the need for more disability inclusive business education but also proposed a full course in business that dealt with educating all students about such adversity. One challenging example of how basic assumptions were reexamined for the betterment of the programs comes from the case of a paraplegic student

who successfully graduated from a nursing program and went on to become a registered nurse, despite initial discomfort of many of the instructors (Evans 2005).

Other educators have recommended becoming familiar with disabilities and getting educated on the specific needs of the differently abled students (Myers 2009). They have recommended using Universal Design techniques in developing course curriculum that would benefit all students and not just those with disabilities. Such universal instructional design modifies curricula, program, student services, and even learning outcomes in a way to benefit all students including those with disability. The so-called accommodations for disabled students become something that improves the pedagogy and learning outcomes for all students. These then form the basis of best teaching practices without being seen as a burden imposed by students with disabilities. These recommendations are also consistent and well-founded in the Universal Design of Instruction framework which subsumes prior approaches of instructional development (Burgstahler). Amongst other suggestions, it is recommended that faculty use a 'equitable use' paradigm in making their courses inclusive. For example, faculty can make their website so well-designed that the captions and text-to-speech help not only the visually challenged but all other students as well. Our paper addresses one such problem of those with visual disability who are unable to interpret business data represented in tables. For those with impaired vision, getting access to verbal information in audio format depends on how the metadata in tables are encoded. This paper outlines the process to make such data available and accessible to persons with such disabilities. Organizations with limited resources can also use this method to make their materials more accessible to the students with visual disability.

THE OER IMPERATIVE

Considering the high cost of college textbooks, a few universities have started an initiative to provide free textbook materials to students under the Open Education Resources (OER). For example, OpenStax was initiated by an organization from Rice University. Indiana University, also encourages its faculty to adopt, modify, or create OER materials with compensated proposals. Open Education Resources is the start of a rapidly growing trend in higher education that is aiming to lower the cost of education for students and thus lower educational barriers for all students. Hence it is critical to have its material designed using the UDI principles mentioned above so that it remains inclusive even as it grows in popularity.

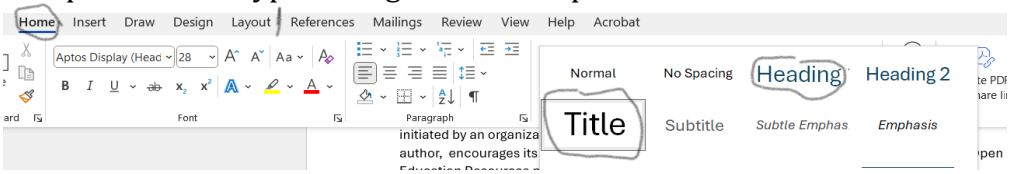
This article shows a non-comprehensive and brief description of steps needed to easily prepare MS Word or Excel files suitable to students needing help due to visual reasons. In particular, the examples chosen are from the finance field which offer very specific problems to the visually challenged due to their use of tables and financial formulae. Even though Microsoft and others have provided features to aid faculty in creating materials for students with visual disability, these are very often not used. This is either because faculty do not believe there is a workaround or that such workarounds are cumbersome, or they lack in confidence in their ability to apply universal design principles (West, Novak and Mueller 2016). Hence, we provide this step-by-step guideline to faculty who may be seeking help with developing their materials. If these can be done in classical finance problems, then all other areas of business would confidently be able to address their curriculum as well. We have used classical finance problems like estimating future and present value of a stream of cash flows. If these financial concepts can be successfully communicated to students with visual disabilities, then all other business materials can also be

easily modified. Specifically, the article demonstrates how to edit tables and pictures compatible with the "Read Aloud" feature in MS word files. The paper also demonstrates how to add various heading levels in the files to make the learning materials clearer to students with visual disabilities.

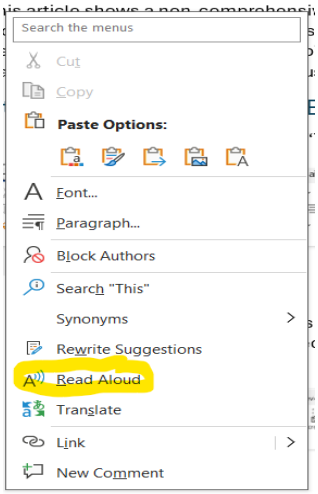
Future research in this area is continuing and recommended as visual and other disabilities continue to increase in numbers. New universal design strategies are also being developed by faculty across all academic areas and universities. The implementation of the current paper will be studied in future terms for effectiveness of learning among those with visual disabilities. In keeping with the simplicity and ease of availability requirement of the UDI, we also recommend that such implementations and others be assembled in a best practices handbook for ease of access to whoever needs such assistance.

STEP BY STEP SUGGESTIONS FOR OER MATERIAL COMPLETION IN MS WORD

1. The chapter shall be typed using the "Title" option shown below.

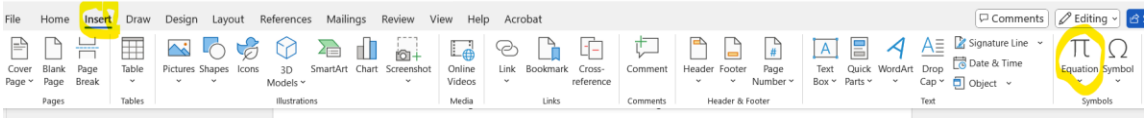


2. The next topic may be listed as Heading 2
3. "Read Aloud" features in MS Word.



If you right click anywhere in the text and then select Read Aloud, a voice starts reading the text from that location onward until you stop read aloud.

4. Formulas must be written as equations so the students can use "read aloud" feature of the MS Word file.



FV formula = FV = $PV * (1 + i)^n$

5. The contents of any Table, Figure or Graph shall be explained in the "view alt text" feature of the MS word. For example, see the following Excel table from a finance

chapter of the OER text materials. To complete "View Alt Text" details, right click at the bottom right corner of the table to see another figure

	B	C	D	E	F	G	H	I	J	K	L
15	Example 2-Timeline diagram in excel- Shown as Example 2 in excel (ChapterTMV.xlsx)										
16	Table 1 in the Chapter's text shows working details for excel input entries.										
17	Find FV (future value) of $100 deposit after 5 years with 6 % nominal interest rate compounded annually.										
18	0	1	2	3	4	5					
19	($100)					X(unknown value)					
20	interest rate	6%	annual			FV_5=	$133.82				
21	periods	5	years				=+FV(C20,C21,0,B19)				
22	FV Formula in excel										
23	FV(rate,nper,pmt,[pv],[type]										
24	where rate= interest rate			nper= number of periods			pmt = annuity payments-discussed later				

Figure 1: Excel Table from OER Chapter Text

5b. To complete "View Alt Text" details, right click at the bottom right corner of Figure 1 to see Figure 1a.

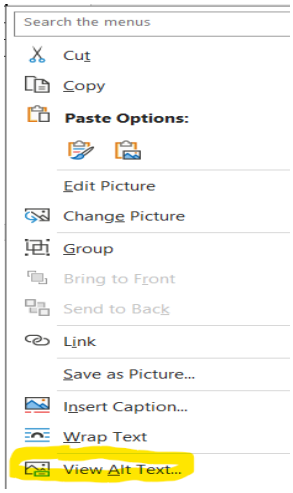


Figure 1a: To Access "View Alt Text" for Figure 1

5c. Click on "View Alt Text" to go to another window as below:

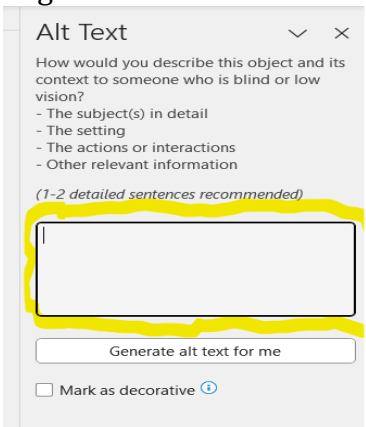


Figure 1b: To Insert the needed information in "View Alt Text" for Figure 1

5d. Now write the contents explaining the details of "Figure 1" in the "Highlighted Box" of "Figure 1b." As an illustration, the following text is inserted for reference"

inserted in Use FV formula in Excel = FV(rate,nper,pmt,[pv],type]) rate = interest rate = 6% nper = number of periods = 5 pmt = annuity payments =discussed later pv = present value =-$100 type = annuity type = discussed later Excel gives you an answer $133.82 Please note to enter PV as a negative number to get positive answer. Alternatively, if you enter PV as a positive number, the answer will be negative

Now, the students can access OER text materials as a text, and use "Read Aloud Feature" for the chapter materials and a "Screen Reader" to hear the contents of Figures/Tables.

STEP BY STEP SUGGESTIONS FOR OER MATERIAL COMPLETION IN EXCEL Spreadsheet

1. Complete the required works and solve problems in Excel. As an illustration, see Figure 2 (Example 2) below and steps 1 through 5 to make the Excel contents easily accessible to students with visual disabilities:

	B	C	D	E	F	G	H	I	J	K	L
15	**Example 2-Solution Timeline diagram in excel- Shown as Example 2 in excel (ChapterTMV.xlsx)**										
16	Table 1 in the Chapter's text shows working details for excel input entries.										
17	Find FV (future value) of $100 deposit after 5 years with 6 % nominal interest rate compounded annually.										
18	0	1	2	3	4	5					
19	($100)					X(unknown value)					
20	interest rate	6%	annual			FV_5=	$133.82				
21	periods	5	years				=+FV(C20,C21,0,B19)				
22	FV Formula in excel										
23	FV(rate,nper,pmt,[pv],[type]										
24	where rate= interest rate			nper= number of periods			pmt = annuity payments-discussed later				
25	[pv] = present value			[type] =type-discussed later							

Figure 2: A simple problem and its solution

2. Highlight the entire range (B15:L25) and click formulas in Excel.

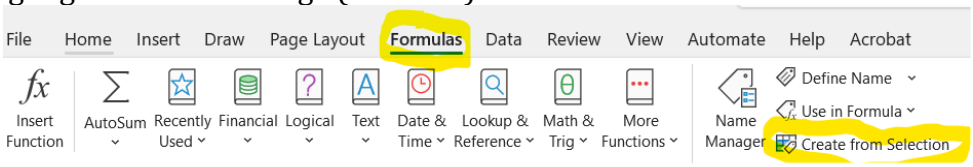
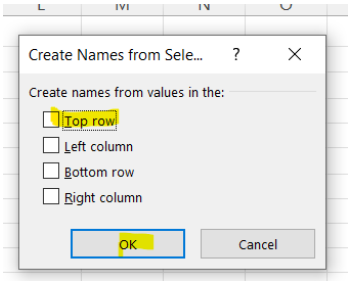


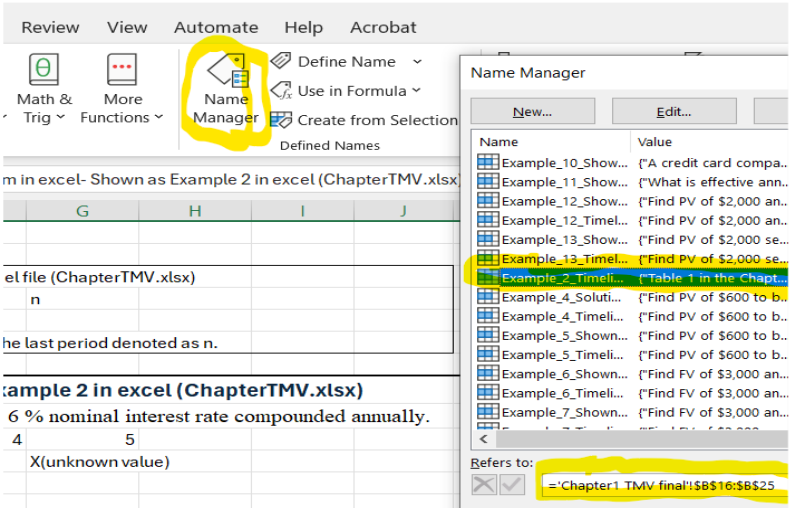
Figure 2a: Create the Formula Selection Range

3. Select Top row and OK.

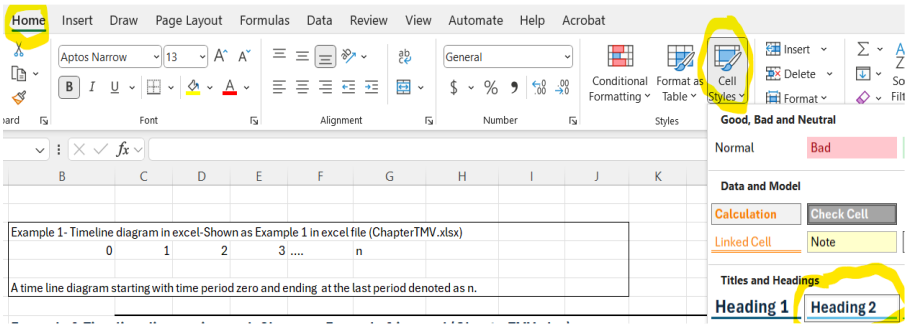


URL: http://doi.org/10.14738/abr.1212.17994

4. Use Name Manager for the range. For example, EXAMPLE 2.



5. Highlight cell for Example 2 and create Heading 2. Home – Cell Style-Heading 2



APPENDIX A: A COMPLETED OER CHAPTER IN MS WORD

Chapter: Time Value of Money (TVM) Concepts. TVM is also called as Discounted Cash Flow

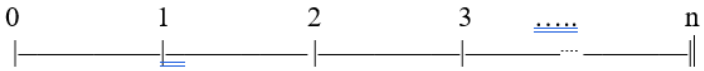
Time Value of Money Concepts with Emphasis on Timeline Diagram:

The following notations and equations are used in this chapter.

- I = Interest Rate
- n = Time Periods
- FV = Future Value $\quad FV = PV * (1+i)^n$
- PV = Present Value $\quad PV = FV * \frac{1}{(1+i)^n}$
- FVA = Future Value of regular (deferred) annuity $FVA = A * \frac{(1+i)^n - 1}{i}$
- FVA_{due} = Future Value of annuity due = multiply FVA with (1+i)
- PVA = Present Value of regular (deferred) annuity $PVA = A * \frac{1-\frac{1}{(1+i)^n}}{i}$
- PVA_{due} = Present Value of annuity due = multiply PVA with (1+i)
- EAR = Effective Annual Rate$= \left(1+\frac{i}{m}\right)^m - 1$
- m = Compounding frequency of interest rate in one year

Discounted cash Flows (DCF) or Time Value of Money is one the most important concepts in Finance. Valuation is extremely important in finance and is easily understood with a timeline diagram. I recommend starting any time value problem with a timeline diagram. A timeline diagram generally starts with period zero and ends at the last period with notation n as shown in the image below:

Example 1- TimeLine Diagrams. Also shown as Example 1 in Excel file(ChapterTVM.xlsx)



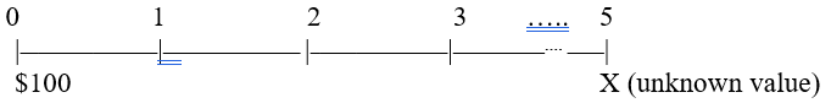
Concepts Involving Time Value of Money

Concept 1: FV (Future Value) of a PV (Present Value) Amount – Examples 2 and 3:

Example 2- FV of a single amount using annual periods. Also see – Example 2 in Excel file (ChapterTVM.xlsx):

Find FV (future value) of $100 deposit for after 5 years with 6 % nominal interest rate compounded annually.

Start with a timeline diagram.



Solution:

a. Using formula FV = $\$100 * (1 + .06)^5 = \$133.82$
b. Using calculator N=5, I/Y =6, PV = -$100, PMT= 0, CPT FV = $133.82
c. Using Excel -Shown as Example 2 solution in Excel (ChapterTVM.xlsx)

	B	C	D	E	F	G	H	I	J	K	L
15	Example 2-Timeline diagram in excel- Shown as Example 2 in excel (ChapterTMV.xlsx)										
16	Table 1 in the Chapter's text shows working details for excel input entries.										
17	Find FV (future value) of $100 deposit after 5 years with 6 % nominal interest rate compounded annually.										
18	0	1	2	3	4	5					
19	($100)					X(unknown value)					
20	interest rate	6%	annual			FV_5=	$133.82				
21	periods	5	years				=+FV(C20,C21,0,B19)				
22	FV Formula in excel										
23	FV(rate,nper,pmt,[pv],[type]										
24	where rate= interest rate			nper= number of periods			pmt = annuity payments-discussed later				

Table 1

Use FV formula in Excel = FV(rate,nper,pmt,[pv],type])
rate = interest rate = 6%
nper = number of periods = 5
pmt = annuity payments =discussed later
pv = present value =-$100

URL: http://doi.org/10.14738/abr.1212.17994

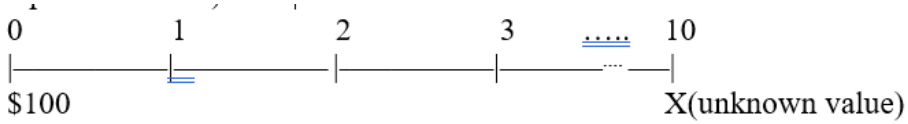
type = annuity type = discussed later
Excel gives you an answer $133.82
Please note to enter PV as a negative number to get positive answer.
Alternatively, if you enter PV as a positive number, the answer will be negative

Example 3: FV of a Single Amount Using Semiannual Periods. - Also See – Example 3 in Excel File (ChapterTVM.xlsx):

Find FV (future value) of $100 deposit for after 5 years with 6 % nominal interest rate compounded semi-annually.

First change interest rate i to semi-annual period by dividing with 2 and multiply time period n with 2 to make i and n to semi-annual terms.

Start with a timeline diagram.



Solution:

a. Using formula FV $= \$100 * (1 + .03)^{10}$ = $134.39
b. Using calculator N=10, I/Y =3, PV = -$100, PMT= 0, CPT FV = $134.39
c. Using Excel -Shown as Example 3 solution in Excel (ChapterTVM.xlsx)

	B	C	D	E	F	G	H	I	J	K	L
34	Example 3-Timeline diagram in excel- Shown as Example 3 in excel (ChapterTMV.xlsx)										
35	Table 2 in the Chapter's text shows working details for excel input entries.										
36	Find FV (future value) of $100 deposit after 5 years with 6 % nominal interest rate compounded annually.										
37	0	1	2	3	…	10					
38	($100)					X(unknown value)					
39	interest rate	3%	semiannual periods			FV_5=	$134.39				
40	periods	10	semi-annual				=+FV(C39,C40,0,B38)				
41	FV Formula in excel										
42	FV(rate,nper,pmt,[pv],[type]										
43	where rate= interest rate			nper= number of periods			pmt = annuity payments-discussed later				
44	[pv] = present value			[type] =type-discussed later							

Table 2

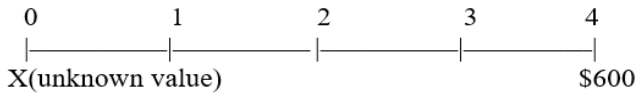
Use FV formula in Excel = FV(rate,nper,pmt,[pv],type])
rate = interest rate = 3%
nper = number of periods = 10
pmt = annuity payments =discussed later
pv = present value =-$100
type = annuity type = discussed later
Excel gives you an answer $134.39
Please note to enter PV as a negative number to get positive answer.
Alternatively, if you enter PV as a positive number, the answer will be negative.

Concept 2: PV (Present Value) of a FV (Future Value) Single Amount:

Example 4: PV of a Single Amount Using Annual Compounding. Also See – Example 4 in Excel File (ChapterTVM.xlsx):

Find PV of $600 to be received after 4 years with 8% nominal rate compounded annually. Start with a timeline diagram.

Example 4- TimeLine Diagrams. Also shown as Example 4 in Excel file (ChapterTVM.xlsx)



Solution:

a. Using formula $PV = \$600 * \frac{1}{(1+0.08)^4} = \$441.02$
b. Using calculator N=4, I/Y =8, FV = -$600, PMT= 0, CPT PV = $441.02
c. Using Excel

	B	C	D	E	F	G	H	I	J	K	L
53	Example 4-Shown as Example 4 in excel (ChapterTMV.xlsx)										
54	Find PV of $600 to be received after 4 years with 8% nominal rate compounded annually										
55	0	1	2	3	4						
56	x (unknown value)				$600						
57	interest rate		8%	annual		PV	($441.02)				
58	periods		4	years			=+PV(D57,D58,0,F56,0)				
59	PV Formula in excel										
60	PV(rate,nper,pmt,[fv],[type]										
61	where rate= interest rate			nper= number of periods			pmt = annuity payments-discussed later				
62	[fv] = future value			[type] =type-discussed later							

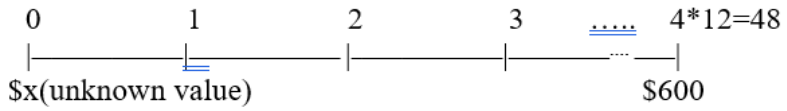
Table 3

Use PV formula in Excel = PV(rate,nper,pmt,[fv],type])
rate = interest rate = 8%
nper = number of periods = 4
pmt = annuity payments =discussed later
fv = future value =-$600
type = annuity type = discussed later
Excel gives you an answer $441.02
Please note to enter FV as a negative number to get positive answer.
Alternatively, if you enter FV as a positive number, the answer will be negative

Example 5: PV of a Single Amount Using Monthly Compounding. Also See – Example 5 in Excel File (ChapterTVM.xlsx):

Find PV of $600 to be received after 4 years with 8% nominal rate compounded monthly. Start with a timeline diagram.

Example 5: TimeLine Diagrams. Also shown as Example 5 in Excel file (ChapterTVM.xlsx)



Solution:

a. Using formula $PV = \$600 * \frac{1}{(1+0.08/12)^{4*12}} = \$436.15$

b. Using calculator N=4*12, I/Y =8/12, FV = -$600, PMT= 0, CPT PV = $436.15

c. Using Excel.

	B	C	D	E	F	G	H	I	J	K	L
73	Example 5-Shown as Example 5 in excel (ChapterTMV.xlsx)										
74	Find PV of $600 to be received after 4 years with 8% nominal rate compounded monthly										
75	0	1	2	3	…	4*12					
76	x (unknown value)					$600					
77	interest rate		0.67%	annual		PV	($436.15)				
78	periods		48	years			=+PV(D77,D78,0,G76,0)				
79	PV Formula in excel										
80	PV(rate,nper,pmt,[fv],[type]										
81	where rate= interest rate			nper= number of periods			pmt = annuity payments-discussed later				
82	[fv] = future value			[type] =type-discussed later							

Table 4

Use PV formula in Excel = PV(rate,nper,pmt,[fv],type])
rate = interest rate = 8%/12
nper = number of periods = 4*12
pmt = annuity payments =discussed later
fv = future value =-$600
type = annuity type = discussed later
Excel gives you an answer $436.15
Please note to enter FV as a negative number to get positive answer.
Alternatively, if you enter FV as a positive number, the answer will be negative.

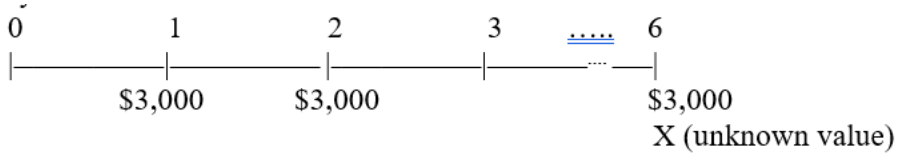
Concept 3: FV (Future Value) of An Annuity:

- Annuity: An annuity is a series of equal payments at an equal interval of time for a specified time.
- Regular Annuity: the first payment starts at end of the 1st period (Home mortgage payment is an example).
- Annuity Due: the first payment starts at beginning of the first period. (Car Lease payment is an example).

Example 6:

Find FV of $3,000 annual payments for 6 years at 8.4 % nominal rate compounded annually. Start with a timeline diagram

Example 6- TimeLine Diagrams. Also shown as Example 6 in Excel file (ChapterTVM.xlsx)



Solution:

a. Using formula $= FVA = \$3{,}000 * \frac{(1+0.084)^6-1}{0.084} = \$22{,}231$
b. Solution (calculator) N=6, I/Y =8.4, PV = 0, PMT= 3,000, CPT FV = $22,231
c. Solution (using Excel)

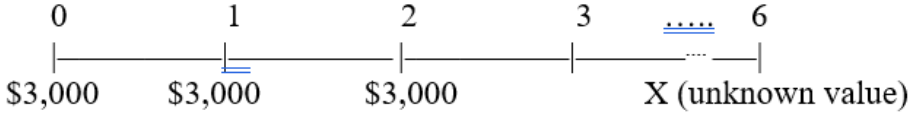
	B	C	D	E	F	G	H	I	J	K	L
91	Example 6-Shown as Example 6 in excel (ChapterTMV.xlsx)										
92	Find FV of $3,000 annual payments for 6 years at 8.4 % nominal rate compounded annually.										
93	0	1	2	3	…	6					
94	$x(unknown value)	$3,000	$3,000	$3,000		$3,000					
95	interest rate		8.40%	monthly		FV_A	($22,230.94)				
96	periods		6	months							
97	FV Formula in excel										
98	FV(rate,nper,pmt,[pv],[type]										
99	where rate= interest rate			nper= number of periods			pmt = annuity payments-discussed later				
100	[fv] = future value			[type] =type-discussed later							

Table 5

Use FV formula in Excel = FV(rate,nper,pmt,[pv],type])
rate = interest rate = 8.4%
nper = number of periods = 6
pmt = annuity payments =$3,000
pv = present value = 0
type = annuity type = 0 or nothing for regular annuity
Excel gives you an answer =-$22,230.94
Please note to enter FV as a negative number to get positive answer.
Alternatively, if you enter FV as a positive number, the answer will be negative.

Example 7: Find FV of $3,000 Annual Payments For 6 Years At 8.4 % Nominal Rate Compounded Annually Assuming Annuity Due:
Start with a timeline diagram

Example 7- TimeLine Diagrams. Also shown as Example 7 in Excel file (ChapterTVM.xlsx)



Solution:

a. Using formula = $FVA = \$3{,}000 * \frac{(1+0.084)^6-1}{0.084} * 1.084 = \$24{,}098$
b. Solution (calculator) N=6, I/Y =8.4, PV = 0, PMT= 3,000, change PMT from the default setting of 'end' to 'bgn', CPT FV = $24,098

c. Solution (using Excel)

Example 7-Shown as Example 7 in excel (ChapterTMV.xlsx)								
Find FV of $3,000 annual payments for 6 years at 8.4 % nominal rate compounded annually.								
0	1	2	3	…	6			
$x(unknown value)	$3,000	$3,000	$3,000		$3,000			
interest rate		8.40%	annual		FV_A	($24,098.34)		
periods		6	years					
FV Formula in excel								
FV(rate,nper,pmt,[pv],[type]								
where rate=interest rate			nper=number of periods			pmt = annuity payments-discussed later		
[fv] = future value			[type] =type-discussed later					

Table 6

Use FV formula in Excel = FV(rate,nper,pmt,[pv],type])
rate = interest rate = 8.4%
nper = number of periods = 6
pmt = annuity payments =$3,000
pv = present value = 0
type = annuity type = 1 to make it annuity due
Excel gives you an answer =-$24,098.34
Please note to enter FV as a negative number to get positive answer.
Alternatively, if you enter FV as a positive number, the answer will be negative.

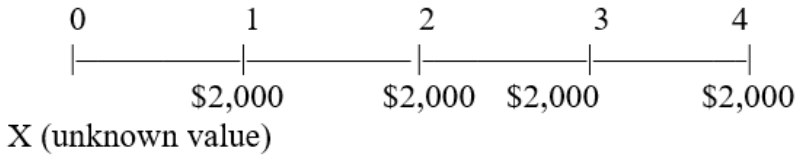
Concept 4: PV (Present Value) of An Annuity:

Example 8:

Find PV of $2,000 annual payments for 4 years at 9 % nominal rate compounded annually assuming regular annuity.

Start with a timeline diagram.

Example 8- TimeLine Diagrams. Also shown as Example 8 in Excel file (ChapterTVM.xlsx)



Solution:

a. Using formula) $= PVA = \$2{,}000 * \frac{[1-1/(1+0.09)^4]}{0.09} = \$6{,}479.44$
b. Using calculator N=4, I/Y =9, FV = 0, PMT= 2,000, CPT PV = $6,479.44
c. Using Excel.

	B	C	D	E	F	G	H	I	J	K	L
127	Example 8-Shown as Example 8 in excel (ChapterTMV.xlsx)										
128	Find PV of $2,000 annual payments for 4 years at 9% nominal rate compounded annually assuming regular annuity										
129	0	1	2	3	4						
130	$x(unknown value)	$2,000	$2,000	$2,000	$2,000						
131	interest rate		9.00%	annual		PV_A	($6,479.44)				
132	periods		4	Years							
133	PV Formula in excel										
134	PV(rate,nper,pmt,[fv],[type]										
135	where rate= interest rate			nper= number of periods			pmt = annuity payments				
136	[fv] = future value			type = 0 for regularannuity and 1 for annuity due							

Table 7

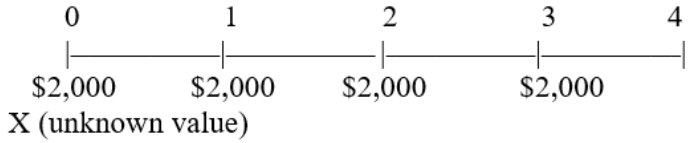
Use PV formula in Excel = PV(rate,nper,pmt,[fv],type])
rate = interest rate = 9%
nper = number of periods = 4
pmt = annuity payments =$2,000
fv = present value = 0
type = annuity type = 0 to make it regular annuity
Excel gives you an answer =-$6,479.44
Please note to enter FV as a negative number to get positive answer.
Alternatively, if you enter FV as a positive number, the answer will be negative.

Example 9:

Find FV of $2,000 annual payments for 4 years at 9 % nominal rate compounded annually assuming annuity due.

Start with a timeline diagram.

Example 9: TimeLine Diagrams. Also shown as Example 9 in Excel file (ChapterTVM.xlsx)



Solution:

a. Using formula = $PVA = \$2{,}000 * \frac{[1-1/(1+0.09)^4]}{0.09} * 1.09 = \$7{,}062.59$
b. Using calculator N=4, I/Y =9, FV = 0, PMT= 2,000, change to bgn, CPT PV = $7,062.59
c. Using Excel.

	B	C	D	E	F	G	H	I	J	K	L
145	Example 9-Shown as Example 9 in excel (ChapterTMV.xlsx)										
146	Find PV of $2,000 annual payments for 4 years at 9% nominal rate compounded annually assuming regular annuity										
147	0	1	2	3	4						
148	$x(unknown value)	$2,000	$2,000	$2,000	$2,000						
149	interest rate		9.00%	annual		PV_A	($7,062.59)				
150	periods		4	Years							
151	PV Formula in excel										
152	PV(rate,nper,pmt,[fv],[type]										
153	where rate= interest rate			nper= number of periods			pmt = annuity payments				
154	[fv] = future value			type = 0 for regularannuity and 1 for annuity due							

URL: http://doi.org/10.14738/abr.1212.17994

Table 8

Use PV formula in Excel = PV(rate,nper,pmt,[fv],type])
rate = interest rate = 9%
nper = number of periods = 4
pmt = annuity payments =$2,000
fv = present value = 0
type = annuity type = 1 to make it annuity due
Excel gives you an answer =-$7,062.59
Please note to enter FV as a negative number to get positive answer.
Alternatively, if you enter FV as a positive number, the answer will be negative.

Concept 5: Effective Annual Interest Rate (EAR) or EFF (Which Is A Common Acronym Used for EAR in Calculators and Textbook):

Effective annual rate is the applicable interest per annum under different compounding periods per annum are used.

- i_{nom} = Nominal interest rate
- m = compounding frequency per year
- EAR = Effective Annual Rate per year
- EAR = $\left(1 + \frac{i\,nom}{m}\right)^{m} - 1$ = EAR in percent

Example 10:

A credit card company charges an 18% annual interest rate on the monthly unpaid balance amount. What is Effective Annual rate in this case? (Hint- compute EAR with monthly compounding)

Solution:

a. Using formula

$$\text{EAR} = \left(1 + \frac{0.18}{12}\right)^{12} - 1 = 19.56\%$$

b. Using Excel.

	B	C	D	E	F	G	H	I	J	K	L
156	Example 10-Shown as Example 10 in excel (ChapterTMV.xlsx)										
157	A credit card company charges an 18% annual interest rate on the monthly unpaid balance amount.										
158	What is Effective Annual rate in this case? (Hint- compute EAR with monthly compounding)										
159	i_{nom} =	18.00%	m=	12	compounding frequency per year						
160	EAR	19.56%									
161	Excel formula=	=+EFFECT(C159,E159)									

Table 9

Excel formula is +EFFECT (nominal-rate, npery)
Nominal_rate = 18%
npery = 12= compounding frequency is 12 per year or monthly compounding
The Excel will give you an answer 19.56%

Concept 6: Continuous Compounding:

Until now, we have worked on annual compounding, semi-annual compounding, monthly compounding, and so on. These are examples of discrete compounding implying break in compounding period as per a specified period. Suppose there is continuous compounding implying compounding frequency is continuous and does not break by year, month, day, hour or even second. The formula for continuous compounding is EAR with continuous compounding $e^{i*n} - 1$

Where; e ≈=2.7183

- i=nominal annual interest rate
- n= time period compounding

Example 11:

What is effective annual rate using continuous compounding when the annual interest rate is 12 percent?

Solution:

a. Using formula $e^{\cdot 12*1} - 1 = 12.75\%$
b. Using Excel.

	B	C	D	E	F	G	H	I	J	K	L
163	Example 11-Shown as Example 11 in excel (ChapterTMV.xlsx)										
164	What is effective annual rate using continuous compounding when the annual interest rate is 12 percent?										
165	i=	12.00%	n=	1		i*n =	12.00%				
166	EAR using continuous compounding =			12.75%							
167	Excel formula =			=+EXP(H165)-1							

Table 10

Excel formula is expi*n -1; where exp e is 2.7183
i = Nominal_rate = 12%
n = 1
i*n = 12%*1 =12%
exp0.12 -1 = 12.75%

Concept 7: Treatment of Issues When the Given Time Period and Interest Rate Are Not Synchronized:

Sometime in TVM issues are complicated with different units of i and n. For example, annual cash flows with semi-annual compounding. In such case, we need to synchronize the units of i and n. Since we cannot change the timing of cash flow, we have to synchronize interest rate units with cash flow timing.

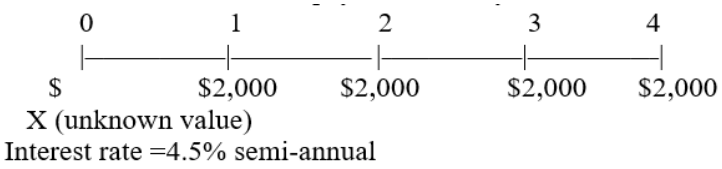
Example 12:

Find PV of $2,000 annual payments for 4 years at 4.5% semi-annual interest rate.

Start with a timeline diagram.

Example 12- TimeLine Diagrams. Also shown as Example 12 in Excel file (ChapterTVM.xlsx)

URL: http://doi.org/10.14738/abr.1212.17994



Solution:

First find EAR when semi annual interest rate is 4.5%

$$1.045 * 1.045 - 1 = 1.092 - 1 = 0.092 = 9.2\%$$

Now solve the problem

a. Using formula $= PVA = \$2{,}000 * \frac{[1-1/(1+0.092)^4]}{0.092} = \$6{,}451.10$
b. Using calculator N=4, I/Y =9.2, FV = 0, PMT= 2,000, CPT PV = $6,451.10
c. Using Excel.

	B	C	D	E	F	G	H	I	J	K	L
176	Example 12-Shown as Example 12 in excel (ChapterTMV.xlsx)										
177	Find PV of $2,000 annual payments for 4 years with 4.5% semi-annual interest rate.										
178	0	1	2	3	4						
179	$x(unknown value)	$2,000	$2,000	$2,000	$2,000						
180	interest rate		4.50%	semi-annual annual							
181	First we need to find EAR from semi-annual interest rate using concept 5, EAR concept of this chapter.										
182		Effective Annual Rate			(1+i)* (1+i) -1=		1.045*1.045 -1 = 1.092-1 = 9.2%				
183		EAR	9.20%								
184	periods		4	Years							
185					PV_A	($6,451.10)					
186	PV Formula in excel										
187	PV(rate,nper,pmt,[fv],[type]										
188	where rate= interest rate			nper= number of periods			pmt = annuity payments				
189	[fv] = future value			type = 0 for regular annuity and 1 for annuity due							

Table 11

Use PV formula in Excel = PV(rate,nper,pmt,[fv],type])
rate = interest rate = 9.2% (EAR = 1.045*1.045-1 = 0.092 = 9.2%)
nper = number of periods = 4
pmt = annuity payments =$2,000
fv = present value = 0
type = annuity type = 0
Excel gives you an answer =-$6,451.10
Please note to enter pmt as a negative number to get positive answer.
Alternatively, if you enter FV as a positive number, the answer will be negative.

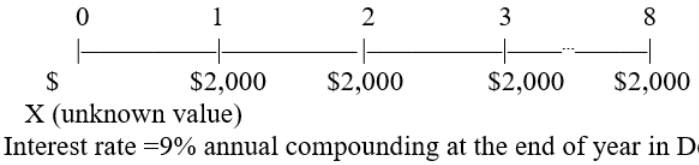
Example 13:

Example 13: Also see Example 13 – Excel file (ChapterTVM.xlsx)

Find PV of $2,000 semi-annual payments for 4 years with an annual compounding of 9%.

Start with a timeline diagram.

Example 13- TimeLine Diagrams. Also shown as Example 13 in Excel file (ChapterTVM.xlsx)



Interest rate =9% annual compounding at the end of year in December

Solution:

First find semiannual rate which makes EAR of 9%.

$(1+\text{semi-annual rate})^2 = 1.09$

1=semi-annual rate = Square root of 1.09 = 1.04403

Thus, semi-annual rate = 4.403%

Now solve the problem

a. Using formula $= PVA = \$2{,}000 * \frac{[1-1/(1+0.04403)^8]}{0.04403} = \$13{,}224.01$
b. Using calculator N=8, I/Y =4.4403, FV = 0, PMT= 2,000, CPT PV = $13,224.01
c. Using Excel.

	B	C	D	E	F	G	H	I	J	K	L
199	Example 13-Shown as Example 13 in excel (ChapterTMV.xlsx)										
200	Find PV of $2,000 semi-annual payments for 4 years with an annual compounding of 9%.										
201	0	1	2	3	…	8					
202	$x(unknown value)	$2,000	$2,000	$2,000		$2,000					
203	interest rate		9.00%	annual compounding							
204	First we need to find unknown semi-annual rate which will produce EAR of 9%.										
205			EAR = 9% = (1+semi annual rate)^2			1.09					
206			semi annual rate = Square root of 1.09 -1 = .04403=								
207	rate to be used		4.4403%	semi annual							
208	periods		8	semi-annual							
209											
210					PV_A	($13,224.01)					
211	PV Formula in excel										
212	PV(rate,nper,pmt,[fv],[type]										
213	where rate= interest rate			nper= number of periods			pmt = annuity payments				
214	[fv] = future value			type = 0 for regular annuity and 1 for annuity due							

Table 12

Use PV formula in Excel = PV (rate, nper, pmt,[fv],type])
Semi-annual rate = interest rate = (1+semi-annual rate)2 =1.09
Thus, semi-annual rate = 4.403%
nper = number of periods = 8
pmt = annuity payments =$2,000
fv = present value = 0
type = annuity type = 0
Excel gives you an answer =-$13,224
Please note to enter pmt as a negative number to get positive answer.
Alternatively, if you enter pmt as a positive number, the answer will be negative.

Important Statements About TVM Concepts

1. PV of a single amount concept and FV of a single amount concept are inverse of each other.

   PV formula = $(\frac{1}{(1+i)^n})$ while FV formula is $(1+i)^n$

2. FV of annuity due is always greater than FV of regular annuity.

   FV of annuity due = FV of regular annuity *(1+i)

3. PV of annuity due is always greater than PV of regular annuity.

   PV of annuity due = PV of regular annuity *(1+i)

4. Ceteris paribus (If all other factors are the same), PV will always be smaller than FV so far as both I and n are positive.
5. While solving any TVM problem, make sure that the units of time period (n) and interest rate (i) are synchronized. For example, if n is annual then i must be annual.

References

BLS (2024) https://www.bls.gov/news.release/disabl.nr0.htm

Burgstahler, Sheryl (n.d.). Universal design in instruction (UDI): Definition, principles, guidelines, and examples. DO-IT (Disabilities, Opportunities, Internetworking, and Technology), University of Washington. https://www.washington.edu/doit/universal-design-instruction-udi-definition-principles-guidelines-and-examples

Centers for Disease Control and Prevention. Disability and Health Data System (DHDS) [Internet]. [updated 2024 July]. Available from: http://dhds.cdc.gov

Centers for Disease Control and Prevention. (n.d.). Disability and health. Centers for Disease Control and Prevention. https://www.cdc.gov/ncbddd/disabilityandhealth/disability.html.

Crnna, Whitney McWherter and Sarah McKinnon (2022). Everybody Works: A Post-Secondary Business Course for Disability Inclusion Practices, Business Education Innovation Journal 14(1): pp148-155

Evans, Bronwynne C. (2005). Nursing Education for Students with Disabilities: Our Students, Our Teachers, Annual Review of Nursing Education 3: pp 3-22.

Myers, Karen A. 2009. A new vision for disability education: Moving on from the Add-on. Published online in Wiley Interscience (www.interscience.wiley.com) pp15-21.

Open Educational Resource: Stax Materials Open Stax

Open Educational Resource: Textbook Library Open Textbook Library

West, Elizabeth A., Novak, Daniel, and Mueller, Carlyn (2016). Inclusive Instructional Practices Used and Their Perceived Importance by Instructors. Journal of Postsecondary Education & Disability, 29(4): pp363-374.