TIME VALUE OF MONEY

"Timing is Everything"

#10

Takin' Care of Business

CPA... Imagine the possibilities!

AICPA

Intro

Learning Activity

Financial Planning: *Students learn the time value of money by using future value and present value calculations.*

Learning Objectives

1. Understand the time value of money.
2. Calculate the present value and future value of lump-sum payments and annuities.
3. Understand the key variables in time value of money calculations: amount, term, and rate.

Assessment

Students will: (1) calculate the present value of an annuity, (2) calculate the present value of future cash flows, and (3) use the current stock quote of a publicly traded company to determine the "worth" of an individual based on stock holdings of that company.

Academic Standard

"Students analyze functions of one variable by investigating rates of change and compare properties of exponential and periodic functions." (NCTM)

"Students use mathematical procedures to analyze and solve business problems for areas such as savings and investment and cash management." (NBEA)

Business Skill

Financial Planning: CPAs provide a variety of services that utilize and interpret financial information. CPAs work with individuals, businesses, government, and not-for-profit agencies to maximize income and, with respect to taxes, minimize tax liabilities.

Procedure

- **Distribute a copy of the Overview to your students** and discuss the "time value of money" concept.
- **Use the future value and present value formulas** to illustrate the calculation for the future value and present value of a sum of money, as well as the present value of an annuity.
- **Provide each student with a copy of Activity #10** and assist them in calculating the present value of an annuity, the present value of future cash payments, and determining the value of Bill Gates' stock holdings in Microsoft Corporation.

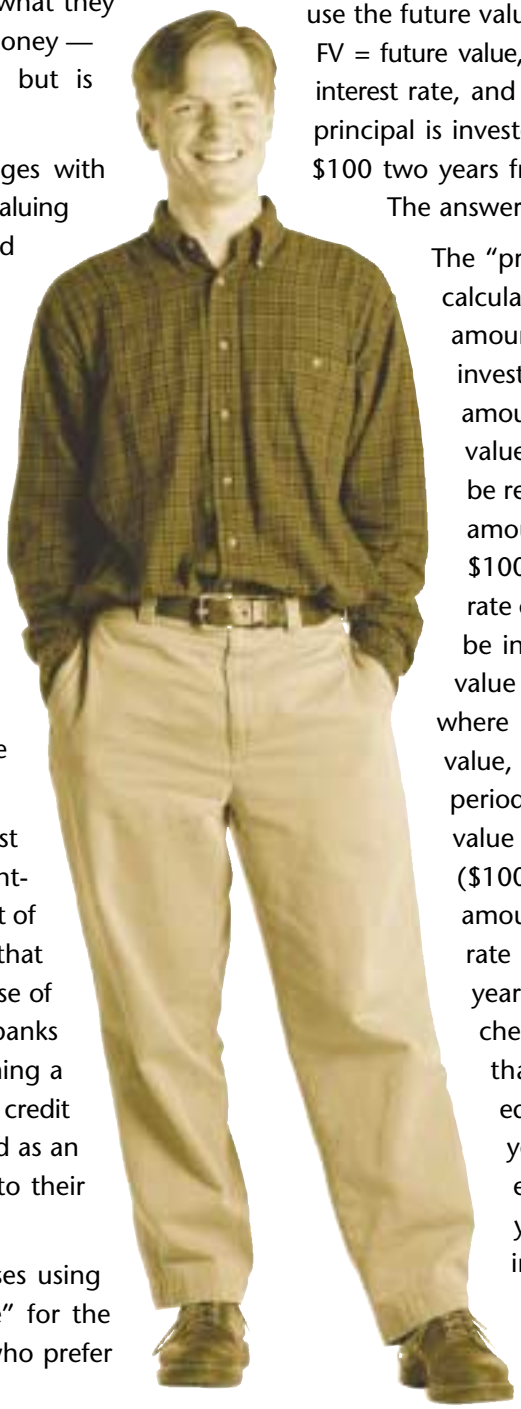
TEACHING-TIPS

For a related lesson plan that uses future value of an annuity calculations in conjunction with income tax calculations to discuss tax-deferred savings plans such as a 401(k) plan, see Activity #9, *Tax Laws Can Make You Rich.*

Overview

Money is valuable, but how is it valued? The value of money is measured in time, thus we use the phrase "time value of money" to assess how valuable money is.

Money by itself, without a measure with which to gauge its value, is worth little more than the paper it is printed on. In fact, "money" — the paper — is only a symbol. "Money" has no intrinsic value beyond its paper value. For instance, imagine if paper clips were "money." Would "paper clips" be worth more now? Yes, they would, despite the fact that they would be made no differently. Paper clips would be worth more to us because of what they represent, not what they are. The same is true with money. Money — the paper — by itself has no value, but is valued because of what it represents.



The value of money, however, changes with time. The most basic "time" frame for valuing the dollar is one year. To understand time as it relates to money, consider a brand name piece of clothing that sells for $75. Is $75 expensive? The answer depends on your "time value of money." If you have a job that pays $7.50 per hour, you will need to work at least 10 hours (remember to deduct taxes!) to purchase that item. In comparison, if you earn $25 per hour, you need only work 3 hours to purchase the item. Therefore, the "value" of an item and the "expensiveness" of an item can be measured in terms of time.

Time value of money, however, is most commonly expressed using a percentage, or interest rate. Interest is the cost of money, expressed as a percentage that the lender charges the borrower for use of his or her money. For instance, banks charge customers a "price" for obtaining a loan and for making purchases using a credit card. The "price" charged is expressed as an interest rate. Banks also pay interest to their depositors for the use of their funds.

People obtain loans or make purchases using credit because of a "time preference" for the item they wish to purchase. People who prefer to make purchases now, rather than later, and borrow money to do so, incur a cost. The cost is expressed as a percentage or interest rate, and represents the interest that must be paid in addition to the amount borrowed.

Money, therefore, has more value the earlier it is received. For example, if you had the option of receiving a dollar today or a dollar next year, your preference is to receive it today so that you can invest it and earn interest.

To determine the future value of a sum of money, we need to know the interest (rate) it will earn and the length of time (years) it will be invested. For example, use the future value formula: $FV = p \bullet (1 + i)^n$, where FV = future value, p = principal amount invested, i = interest rate, and n = number of periods (years) the principal is invested, to calculate the future value of $100 two years from now using a 6% interest rate. The answer is $112.36 ($100 x 1.1236).

The "present value" of money can also be calculated. Present value refers to the amount of money that, if received or invested today, will equal a stated future amount. For example, what is the present value — the value today — of $100 to be received in three years? That is, what amount must you invest today to have $100 in three years? Assume an interest rate of 8% (the rate at which money can be invested today) and use the present value formula: $PV = FV \bullet 1/(1 + i)^n$, where PV = present value, FV = future value, i = interest rate, and n = number of periods (years), to calculate the present value of $100. The answer is $79.38 ($100 x .79383), which means that this amount, invested today at an interest rate of 8%, will yield $100 in three years. (Use the future value formula to check the calculation.) This also means that receiving $100 today is the equivalent of receiving $79.38 three years from now. Therefore, the present value of $100 received three years hence, discounted at an 8% interest rate, is $79.83.

Activities

You Just Inherited $500 million! What are You Going to do Now?!

Your great, great, great-aunt has left you with her life savings of $500 million. Half a ***BILLION*** dollars! According to your aunt, you have the option to receive your $500 million in periodic, equal installments over the next 10 years, or the "present value equivalent" of $500 million now.

If you choose to accept your inheritance over the next 10 years, you will receive $50 million a year for the next 10 years.

Use the chart below to determine the amount you could receive today that is the equivalent of receiving $50 million a year for the next 10 years. (Use an interest rate of 7% for your calculation.)

Based on your calculation, would you elect to receive a lump-sum payment today or 10 annual payments?

Year & Amount	Factor (7%)	Present Value
1 $50,000,000	0.935	$46,750,000
2 $50,000,000		$
3 $50,000,000		$
4 $50,000,000		$
5 $50,000,000		$
6 $50,000,000		$
7 $50,000,000		$
8 $50,000,000		$
9 $50,000,000		$
10 $50,000,000		$
Total		$

CPA and Financial Consultant

Derek Singletary and Alex Doubleday, two highly successful baseball players, have signed 10-year contracts with the teams they play for. Derek signed for $200 million over 10 years and Alex signed for $225 million over ten years. The national and local media have assumed that Alex has signed the "bigger" contract, which includes a payment of $50 million in the final year of the contract.

You, as a CPA, however, have been asked to determine the "real" value of each player's contract.

As part of your analysis, you have determined that a 6% interest rate is appropriate to use in the calculation of the time value of each player's yearly payments. You have also obtained the yearly payments of each player, which are stated in the table below.

Calculate the present value factors and complete the chart below to determine who has the bigger contract.

		Derek Singletary		Alex Doubleday	
Year	Factor	Payment (millions)	Present Value	Payment (Millions)	Present Value
1	0.943	$ 25.00	$	$ 5.00	$
2		$ 25.00	$	$ 10.00	$
3		$ 25.00	$	$ 10.00	$
4		$ 22.50	$	$ 20.00	$
5		$ 22.50	$	$ 20.00	$
6		$ 20.00	$	$ 20.00	$
7		$ 15.00	$	$ 25.00	$
8		$ 15.00	$	$ 30.00	$
9		$ 15.00	$	$ 35.00	$
10		$ 15.00	$	$ 50.00	$
		$ 200.00	**$**	**$ 225.00**	**$**

Based on your calculations, did Alex really get the "bigger" contract? Why? _____

_____

_____

Use the present value of the players' payments in year 6—the present values are the same in year 6!—to answer the following:

1. If each player plays 162 games in one season, how much do they earn per game? _____
2. Based on playing 162 games and 9 innings per game, how much does each player earn per inning? _____

The Bill Gates Watch...

As of September 2003, Bill Gates owned 1.164 ***billion*** shares of Microsoft Corporation. Visit the Microsoft Investor Relations page at **www.microsoft.com** to locate the company's Proxy Statement, which will report Bill's most current stock holdings. Use this information and the most current stock quote for one share of common stock of Microsoft Corporation to answer the following questions:

1. How much is Bill Gates worth based on the number of shares of Microsoft that he currently holds and the most current market price of a share of common stock of Microsoft? _____
2. Based on Bill Gates worth (Question #1), if Bill wanted to build a $50 million house, how many could he build?

   _____

   If he wanted to build an equal number of $50 million houses in each of the 50 United States, how many could he build in each state? _____
3. Suppose Bill was paid his net worth as calculated in Question #1 in equal installments over 50 weeks, how much would he receive each week? _____

   If Bill works 5 days a week, how much is he receiving per day? _____

   If he works 8 hours per day, how much is he receiving per hour? _____

Answers

You Just Inherited $500 million! What are You Going to do Now?!

Year & Amount	Factor (7%)	Present Value
1 $50,000,000	0.935	$46,750,000
2 $50,000,000	0.873	$43,650,000
3 $50,000,000	0.816	$40,800,000
4 $50,000,000	0.763	$38,150,000
5 $50,000,000	0.713	$35,650,000
6 $50,000,000	0.666	$33,300,000
7 $50,000,000	0.623	$31,150,000
8 $50,000,000	0.582	$29,100,000
9 $50,000,000	0.544	$27,200,000
10 $50,000,000	0.508	$25,400,000
Total		**$351,150,000**

CPA and Financial Consultant

		Derek Singletary		Alex Doubleday	
Year	Factor	Payment (millions)	Present Value	Payment (Millions)	Present Value
1	0.943	$ 25.00	$ 23.58	$ 5.00	$ 4.72
2	0.890	$ 25.00	$ 22.25	$ 10.00	$ 8.90
3	0.840	$ 25.00	$ 21.00	$ 10.00	$ 8.40
4	0.792	$ 22.50	$ 17.82	$ 20.00	$ 15.84
5	0.747	$ 22.50	$ 16.81	$ 20.00	$ 14.94
6	0.705	$ 20.00	$ 14.10	$ 20.00	$ 14.10
7	0.665	$ 15.00	$ 9.98	$ 25.00	$ 16.63
8	0.627	$ 15.00	$ 9.41	$ 30.00	$ 18.81
9	0.592	$ 15.00	$ 8.88	$ 35.00	$ 20.72
10	0.558	$ 15.00	$ 8.37	$ 50.00	$ 27.90
		$ 200.00	**$ 152.20**	**$ 225.00**	**$ 150.96**

Based on your calculations, did Alex really get the "bigger" contract? Why? No. Derek received the "bigger" contract based on present value calculations. Derek will receive larger payments than Alex earlier in the life of the contract.

Use the present value of the players' payments in year 6—the present values are the same in year 6!—to answer the following:

1. If each player plays 162 games in one season, how much do they earn per game? $87,037

2. Based on playing 162 games and 9 innings per game, how much does each player earn per inning? $9,670