



PERSONAL FINANCE

Military Families Learning Network

The Time Value of Money

<https://learn.extension.org/events/2878>

U.S. DEPARTMENT
OF DEFENSE



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and Cooperative Extension professionals to research
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Today's Presenter

Barbara O'Neill, Ph.D

- Rutgers Cooperative Extension's Specialist in Financial Resource Management
- Outreach Coordinator for the Personal Finance concentration area of the Military Families Learning Network
- Author of over 1500 consumer newspaper articles, over 120 articles for professional publications and two books, *Saving on a Shoestring* and *Investing on a Shoestring*



Webinar Objectives

- Discuss basic time value of money concepts
- Apply time value of money concepts to real-life financial planning decisions
- Model “hands-on” calculations that participants can use with others



Question #1

What is the time value of money?



Key Time Value of Money Take-Away Message

Compound interest can be...

- Your **worst enemy** (minimum payments on credit card debt)
- Your **best friend** (5+ decades of growth on retirement savings for a 22 year old)



VIDEO: The Time Value of Money (Investopedia)

<https://www.youtube.com/watch?v=MdK-A1VQJIs>

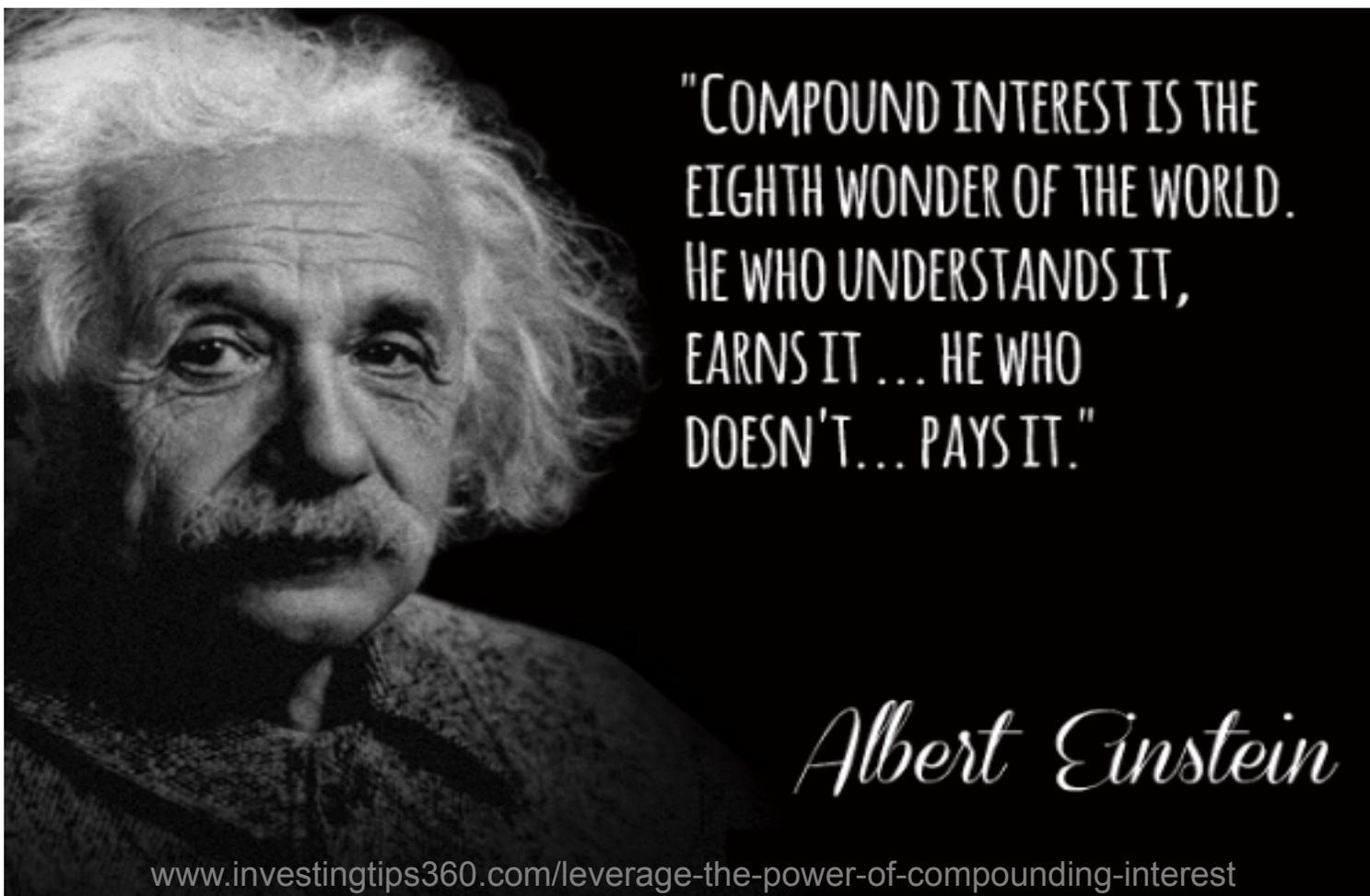


Key Video Take-Aways

- A dollar today is always worth more than a dollar tomorrow
- Money received today can be saved and will earn interest immediately
- No interest can be earned on money that is not received and saved



Compound Interest is Your Best Friend Forever (BFF)



"COMPOUND INTEREST IS THE EIGHTH WONDER OF THE WORLD. HE WHO UNDERSTANDS IT, EARNS IT ... HE WHO DOESN'T... PAYS IT."

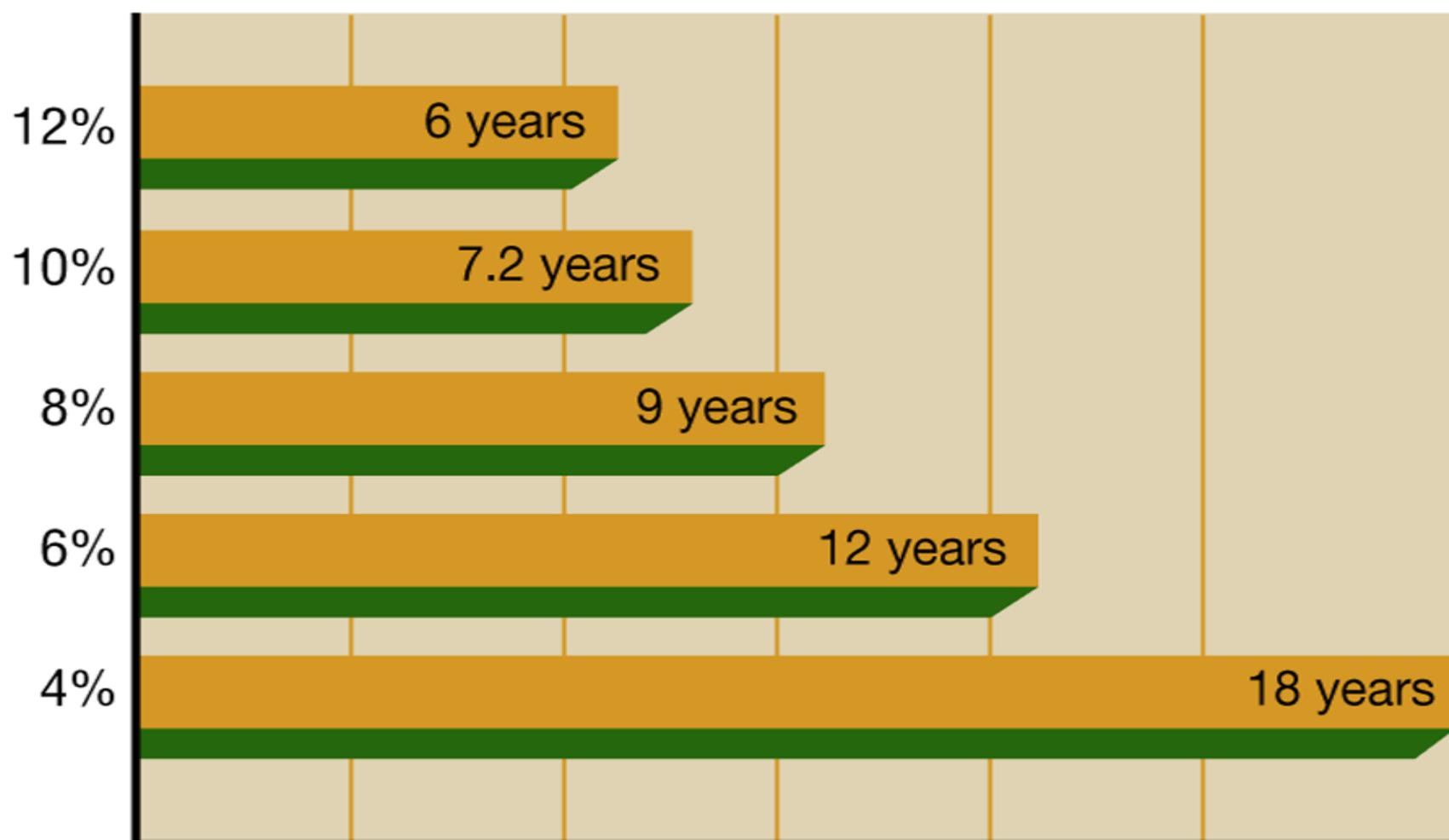
Albert Einstein

www.investingtips360.com/leverage-the-power-of-compounding-interest

Simple Time Value Example: The Rule of 72

- Calculates the **number of years** it takes for principal to double
 - Years = 72 divided by interest rate
 - **Example:** 72 divided by 8% = 9 years
- Calculates the **interest rate** it takes for principal to double
 - Interest rate = 72 divided by number of years
 - **Example:** 72 divided by 10 years = 7.2%

The Rule of 72 in Pictures



Source: Garman & Forgue (2008). *Personal Finance*

Question #2

How do you teach
the time value of money?



Rule of 72 Calculator

<http://www.moneychimp.com/features/rule72.htm>

The rule says that to find the number of years required to double your money at a given interest rate, you just divide the interest rate into 72. For example, if you want to know how long it will take to double your money at eight percent interest, divide 8 into 72 and get 9 years.

Interest Rate: %

Years Required for Principal to Double

Exact Answer:

Rule of 72 Estimate:

(We're assuming the interest is [annually compounded](#), by the way.)

As you can see, the "rule" is remarkably accurate, as long as the interest rate is less than about twenty percent; at higher rates the error starts to become significant.

You can also run it backwards: if you want to double your money in six years, just divide 6 into 72 to find that it will require an interest rate of about 12 percent.

Years to double
your investment

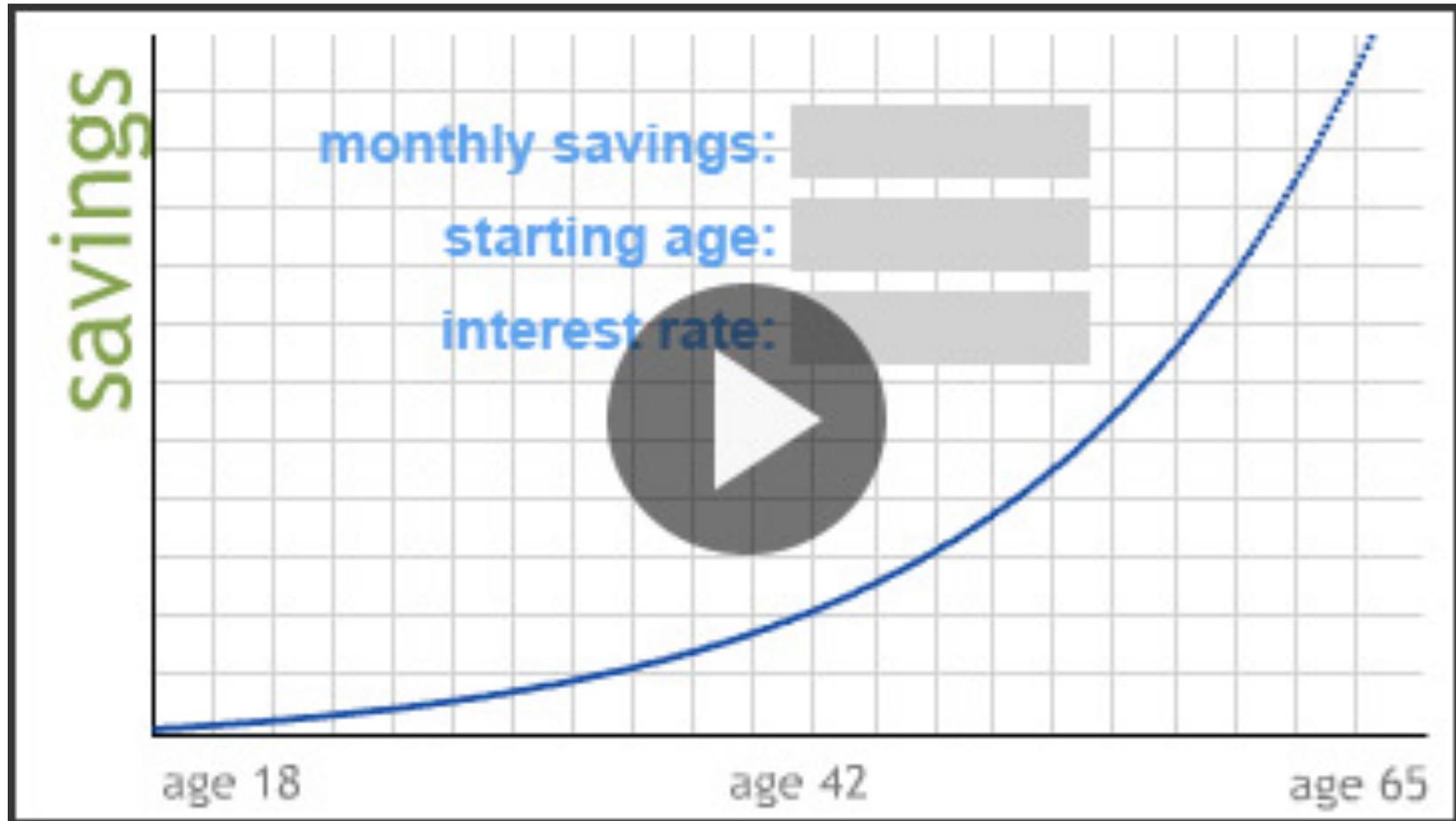
Required Interest Rate

Exact Answer: %

Rule of 72 Estimate: %

Compound Interest Calculator (Council for Economic Education)

<http://www.econedlink.org/tool/2/>



Time Value of Money Online Lesson (Study Finance)

<http://www.studyfinance.com/lessons/timevalue/>

TIME VALUE OF MONEY

Begin 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Time Value of Money

The time value of money impacts business finance, consumer finance, and government finance. Time value of money results from the concept of interest.

This overview covers an introduction to simple interest and compound interest, illustrates the use of time value of money tables, shows a matrix approach to solving time value of money problems, and introduces the concepts of intrayear compounding, annuities due, and perpetuities. A simple introduction to working time value of money problems on a financial calculator is included as well as additional resources to help understand time value of money.



Time Value of Money Lesson (Council for Economic Education)

<http://www.econedlink.org/lesson/37/Time-Value-Money>



COUNCIL FOR
**Economic
Education**

Teaching Opportunity™

Time Value of Money Course for Teachers and Students (Federal Reserve Bank of St. Louis)

<https://www.stlouisfed.org/education/time-value-of-money-online-course-for-teachers-and-students>



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Online Time Value of Money Calculator

<http://www.zenwealth.com/businessfinanceonline/TVM/TVMCalculator.html>

▶ The Time Value of Money

Concepts

▶ Future Value

▶ Present Value

▶ Cash Flow Streams

▶ Annuities

▶ Other Compounding Periods

▶ Equations

Tools & Problems

▶ TVM Calculator

▶ Cash Flow Calculator

▶ TVM Exercise

▶ Uneven Cash Flow Stream Exercise

Time Value of Money Calculator

TVM Calculator

PV: \$ Rate: %

PMT: \$ Periods:

FV: \$ ▼

Online Calculator Instructions

<http://www.zenwealth.com/businessfinanceonline/TVM/TVMCalcIntro.html>

- ▶ [The Time Value of Money](#)
- ▶ [Concepts](#)
- ▶ [Future Value](#)
- ▶ [Present Value](#)
- ▶ [Cash Flow Streams](#)
- ▶ [Annuities](#)
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- ▶ [Tools & Problems](#)
- ▶ [TVM Calculator](#)
- ▶ [Cash Flow Calculator](#)
- ▶ [TVM Exercise](#)
- ▶ [Uneven Cash Flow Stream Exercise](#)
- ▶ [Time Value of Money Quiz](#)

Time Value of Money Calculator: Introduction

The screenshot shows a web-based calculator interface. At the top, it says 'TVM Calculator'. Below that, there are seven numbered red arrows pointing to specific elements: 1. Points to the 'PV: \$' input field. 2. Points to the 'PMT: \$' input field. 3. Points to the 'FV: \$' input field. 4. Points to the 'Rate: [input field] %' field. 5. Points to the 'Periods: [input field]' field. 6. Points to a dropdown menu currently showing 'Annual'. 7. Points to a row of five buttons: 'PV', 'PMT', 'FV', 'Rate', and 'Periods'.

The [Time Value of Money Calculator](#) can be used to perform many time value of money related calculations including the calculation of the [Present Value](#) or [Future Value](#) of a single cash flow or annuity, the Annuity Payment given the Present or Future Value of the annuity, and the Nominal Rate which an investment must earn to grow to a Future Value in a specified number of Periods. The calculator works similarly to the Time Value of Money functions of the Texas Instruments BA II Plus calculator.

1. **Present Value Field** - The Present Value is displayed or entered in this field.
2. **Payment Field** - The Annuity Payment is displayed or entered in this field.
3. **Future Value Field** - The Future Value is displayed or entered in this field.
4. **Nominal Rate Field** - The Nominal Interest Rate is displayed or entered in this field.
5. **Periods Field** - The number of Periods is displayed or entered in this field. When the Future Value is non-zero the number displayed in this field represents the number of periods in the future in which the Future Value occurs. When the Payment Field is non-zero the number displayed in this field represents the number of annuity payments.
6. **Compounding Field** - The value selected in this pop-up represents the Compounding Frequency of the Nominal Interest Rate. For Annuities, it also represents the Frequency of the Annuity Payments.
7. **Buttons** - Press these buttons to calculate the corresponding value.
 - **PV Button** - Press to calculate the Present Value.
 - **PMT Button** - Press to calculate the Annuity Payment.
 - **FV Button** - Press to calculate the Future Value.
 - **Rate Button** - Press to calculate the Nominal Interest Rate.
 - **Periods Button** - Press to calculate the Number of Periods.

Now you are ready to use the [Time Value of Money Calculator](#).

Online Time Value of Money Quiz (10 Questions)

<http://www.zenwealth.com/businessfinanceonline/TVM/TVMQuiz.html>

Business Finance Online

Home Time Value of Money Bond Valuation Stock Valuation Capital Budgeting Risk and Return Ratio Analysis Financial Cash Flow Financial Forecasting

- ▶ The Time Value of Money
 - ▶ **Concepts**
 - ▶ Future Value
 - ▶ Present Value
 - ▶ Cash Flow Streams
 - ▶ Annuities
 - ▶ Other Compounding Periods
 - ▶ Equations
 - ▶ **Tools & Problems**
 - ▶ TVM Calculator
 - ▶ Cash Flow Calculator
 - ▶ TVM Exercise
 - ▶ Uneven Cash Flow Stream Exercise
 - ▶ Time Value of Money Quiz

Time Value of Money Quiz: Results

✗ 1. Find the present value of the following cash flow stream if the interest rate is 4 per cent.

0	1	2	3	4

	\$200	\$200	\$400	\$400

a. \$1074.74
b. \$1083.36
c. \$1092.18
d. \$1096.43

Your Answer:

Correct Answer: a

Explanation: To solve using the TI BAI Plus calculator:

```
[ CF ]      [ 2nd ][ CLR Work ]
  0  [ ENTER ][ DOWN ARROW ]
 200 [ ENTER ][ DOWN ARROW ]
  2  [ ENTER ][ DOWN ARROW ]
 400 [ ENTER ][ DOWN ARROW ]
  2  [ ENTER ][ DOWN ARROW ]
[ NPV ]
  4  [ ENTER ][ DOWN ARROW ]
```

Question #3

Other good time value of money resources?



Key Variables in TV of Money Calculations

- **N** Number of compounding periods
- **% i** Interest rate (for compounding FV interest or discounting PV interest)
- **PV** Present value
- **FV** Future value
- For annuity calculations, periodic payment or income receipt amount
 - Enter 3 known variables; solve for the 4th (unknown) variable

Four Types of Time Value of Money Calculations

- Future value of a single amount (lump sum)
- Future value of a series of deposits (annuity)
- Present value of a single amount (lump sum)
- Present value of a series of payments (annuity)

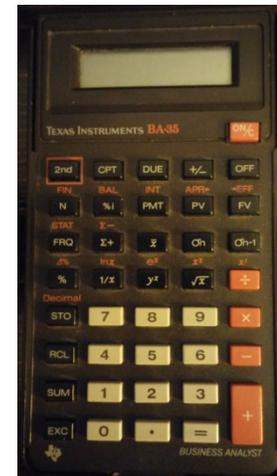


Ways to Calculate the Time Value of Money

- Mathematically using a formula:
- Computer spreadsheets with formulas
 - Example: Microsoft Excel
- Financial calculators
- TV of money interest factor tables

$$\text{Present Value} = \frac{FV}{(1 + i)^n}$$

$$\$ 258,419 = \frac{\$1,000,000}{(1 + .07)^{20}}$$



- See <http://www.retailinvestor.org/pdf/futurevaluetables.pdf>

Let's Start Simple: Time Value of Money Factor Tables

<http://www.retailinvestor.org/pdf/futurevaluetables.pdf>

riod	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	1.0100	1.0200	1.0300	1.0400	1.0500	1.0600	1.0700	1.0800	1.0900	1.1000
2	1.0201	1.0404	1.0609	1.0816	1.1025	1.1236	1.1449	1.1664	1.1881	1.2100
3	1.0303	1.0612	1.0927	1.1249	1.1576	1.1910	1.2250	1.2597	1.2950	1.3310
4	1.0406	1.0824	1.1255	1.1699	1.2155	1.2625	1.3108	1.3605	1.4116	1.4641
5	1.0510	1.1041	1.1593	1.2167	1.2763	1.3382	1.4026	1.4693	1.5386	1.6105
6	1.0615	1.1262	1.1941	1.2653	1.3401	1.4185	1.5007	1.5869	1.6771	1.7716
7	1.0721	1.1487	1.2299	1.3159	1.4071	1.5036	1.6058	1.7138	1.8280	1.9487
8	1.0829	1.1717	1.2668	1.3686	1.4775	1.5938	1.7182	1.8509	1.9926	2.1436
9	1.0937	1.1951	1.3048	1.4233	1.5513	1.6895	1.8385	1.9990	2.1719	2.3579
10	1.1046	1.2190	1.3439	1.4802	1.6289	1.7908	1.9672	2.1589	2.3674	2.5937
11	1.1157	1.2434	1.3842	1.5395	1.7103	1.8983	2.1049	2.3316	2.5804	2.8531
12	1.1268	1.2682	1.4258	1.6010	1.7959	2.0122	2.2522	2.5182	2.8127	3.1384
13	1.1381	1.2936	1.4685	1.6651	1.8856	2.1329	2.4098	2.7196	3.0658	3.4523
14	1.1495	1.3195	1.5126	1.7317	1.9799	2.2609	2.5785	2.9372	3.3417	3.7975
15	1.1610	1.3459	1.5580	1.8009	2.0789	2.3966	2.7590	3.1722	3.6425	4.1772
16	1.1726	1.3728	1.6047	1.8730	2.1829	2.5404	2.9522	3.4259	3.9703	4.5950
17	1.1843	1.4002	1.6528	1.9479	2.2920	2.6928	3.1588	3.7000	4.3276	5.0545
18	1.1961	1.4282	1.7024	2.0258	2.4066	2.8543	3.3799	3.9960	4.7171	5.5599
19	1.2081	1.4568	1.7535	2.1068	2.5270	3.0256	3.6165	4.3157	5.1417	6.1159
20	1.2202	1.4859	1.8061	2.1911	2.6533	3.2071	3.8697	4.6610	5.6044	6.7275
21	1.2324	1.5157	1.8603	2.2788	2.7860	3.3996	4.1406	5.0338	6.1088	7.4002
22	1.2447	1.5460	1.9161	2.3699	2.9253	3.6035	4.4304	5.4365	6.6586	8.1403
23	1.2572	1.5769	1.9736	2.4647	3.0715	3.8197	4.7405	5.8715	7.2579	8.9543
24	1.2697	1.6084	2.0328	2.5633	3.2251	4.0489	5.0724	6.3412	7.9111	9.8497
25	1.2824	1.6406	2.0938	2.6658	3.3864	4.2919	5.4274	6.8485	8.6231	10.835
30	1.3478	1.8114	2.4273	3.2434	4.3219	5.7435	7.6123	10.063	13.268	17.449
35	1.4166	1.9999	2.8139	3.9461	5.5160	7.6861	10.677	14.785	20.414	28.102
36	1.4308	2.0399	2.8983	4.1039	5.7918	8.1473	11.424	15.968	22.251	30.913
40	1.4889	2.2080	3.2620	4.8010	7.0400	10.286	14.974	21.725	31.409	45.259
50	1.6446	2.6916	4.3839	7.1067	11.467	18.420	29.457	46.902	74.358	117.391

Find Time Value of Money Factors to Do Calculations

- Read down columns for interest rate
- Read across rows for time period
- Find intersection of column and row to locate factor

Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	1.0100	1.0200	1.0300	1.0400	1.0500	1.0600	1.0700	1.0800	1.0900	1.1000
2	1.0201	1.0404	1.0609	1.0816	1.1025	1.1236	1.1449	1.1664	1.1881	1.2100
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13	1.1381	1.2936	1.4685	1.6651	1.8856	2.1329	2.4098	2.7196	3.0658	3.4523
14	1.1495	1.3195	1.5126	1.7317	1.9799	2.2609	2.5785	2.9372	3.3417	3.7975
15	1.1610	1.3459	1.5580	1.8009	2.0789	2.3966	2.7590	3.1722	3.6425	4.1772
16	1.1726	1.3728	1.6047	1.8730	2.1829	2.5404	2.9522	3.4259	3.9703	4.5950
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19	1.2081	1.4568	1.7535	2.1068	2.5270	3.0256	3.6165	4.3157	5.1417	6.1159
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22	1.2447	1.5460	1.9161	2.3699	2.9253	3.6035	4.4304	5.4365	6.6586	8.1403
23	1.2572	1.5769	1.9736	2.4647	3.0715	3.8197	4.7405	5.8715	7.2579	8.9543
24	1.2697	1.6084	2.0328	2.5633	3.2251	4.0489	5.0724	6.3412	7.9111	9.8497
25	1.2824	1.6406	2.0938	2.6658	3.3864	4.2919	5.4274	6.8485	8.6231	10.835
30	1.3478	1.8114	2.4273	3.2434	4.3219	5.7435	7.6123	10.063	13.268	17.449
35	1.4166	1.9999	2.8139	3.9461	5.5160	7.6861	10.677	14.785	20.414	28.102
36	1.4308	2.0399	2.8983	4.1039	5.7918	8.1473	11.424	15.968	22.251	30.913
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50	1.6446	2.6916	4.3839	7.1067	11.467	18.420	29.457	46.902	74.358	117.391

Future Value

- Future value is the amount to which current savings will increase based on interest rate and time period
- Future value is also called **compounding** - earning interest on previously earned interest
- Future value can be computed for a single amount or for a series of deposits



Simple Interest: The Building Block of the Future Value of Money

Amount in savings (principal) x annual interest rate x time period

Principal x Interest x Time

\$100 x 5% x 1 (1 year)

$$100 \times .05 \times 1 = \$5$$



In one year, you will have \$100 in principal plus \$5 in interest for a total of \$105 at the end of the year

Future Value of an Annuity Example

FV of an Annuity (FVOA)- What principal will grow to over time if a series of regular deposits are made

Example: \$2,000 annual deposits to a Roth IRA at 8% interest for 40 years from age 22 to 62 = \$518,114

FVOA (8%, 40 years) = 259.057

\$2,000 x 259.057



Present Value

- Current value for a future amount based on a certain interest rate and a certain time period
- Present value calculations are also called **discounting**
- The present value will always be **less than** the future value
- Present value can be computed for a lump sum amount or for a series of deposits



Present Value of a Lump Sum Example

Present/Discounted Value (PV)–Current value of an asset that will be received in the future.

Example: Today's value of a \$25,000 inheritance to be received in 10 years, assuming the principal earns an 8% average annual return

$$PV (8\%, 10 \text{ years}) = 0.4632$$

$$\$25,000 \times 0.4632 = \$11,580$$



Present Value of an Annuity Example

- **PV of an Annuity (PVOA)**- Present value of a stream of payments to be received in the future.

Example: The amount to have invested at retirement to provide \$30,000 of income per year for 20 years with a 7% return = \$317,820

$PVOA(7\%, 20 \text{ years}) = 10.594$

$\$30,000 \times 10.594$



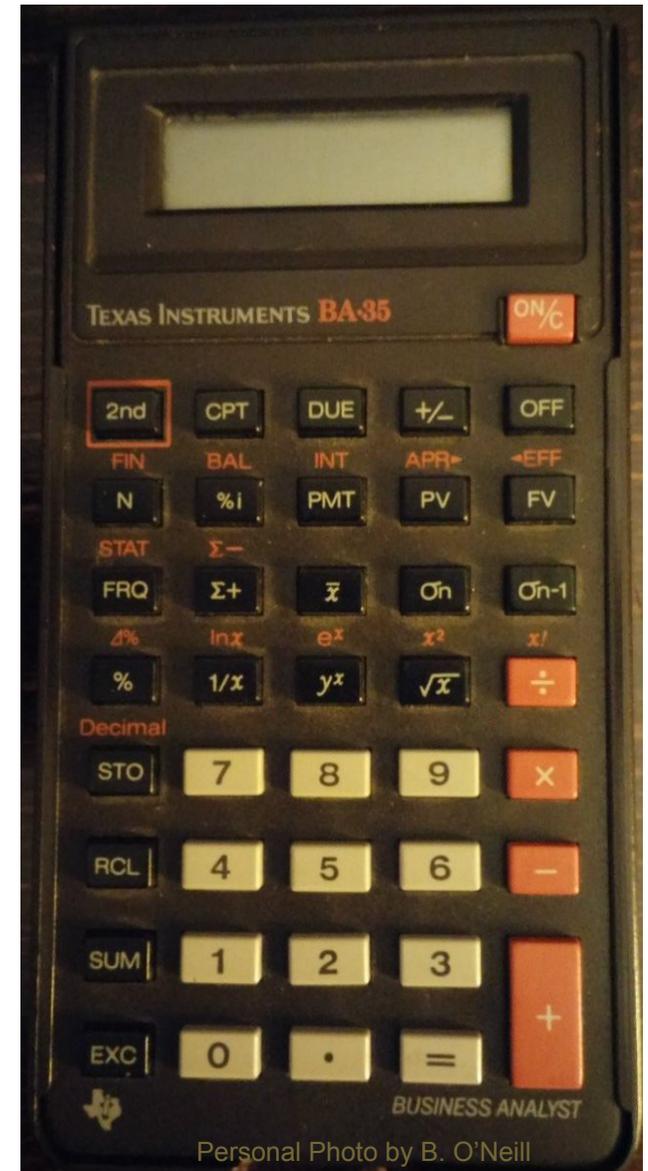
Question #4

Any questions so far?



Bring Out Your Calculator

- In real life, interest rates and time frames don't necessarily come in round numbers
 - Example: 2.76% (current interest rate on I bonds)
- Financial calculators provide a more accurate projection of time value
- Calculator should have buttons for financial calculations (PV, FV, N, %, PMT, etc.)



Plan B: Use an Online Time Value of Money Calculator

<http://www.zenwealth.com/businessfinanceonline/TVM/TVMCalculator.html>

- ▶ [The Time Value of Money](#)
 - Concepts**
 - ▶ [Future Value](#)
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 - ▶ [Cash Flow Streams](#)
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 - Tools & Problems**
 - ▶ [TVM Calculator](#)
 - ▶ [Cash Flow Calculator](#)
 - ▶ [TVM Exercise](#)
 - ▶ [Uneven Cash Flow Stream Exercise](#)

Time Value of Money Calculator

TVM Calculator

PV: \$ Rate: %

PMT: \$ Periods:

FV: \$

Problem #1

Your first “real” job pays \$32,000 a year to start. How much will you need to be earning in 20 years to maintain the *same* purchasing power if inflation averages

3%?

4%?

5%?



Question #5

What can people do to increase their future purchasing power?



Problem #2

Your grandparents (age 60 and 62) are about to retire next month with a monthly income of \$2,000. Assuming an annual inflation rate of 4%, how much will they need in 10 years to equal the purchasing power of \$2,000 today?

In 20 years?

In 30 years?



Question #6

What can your grandparents do to prevent inflation from eroding their purchasing power?



Problem #3

Your rich uncle has promised to give you \$25,000. The only “catch” is that you must graduate from college and get a “real job” before he gives it to you. Let’s assume that’s in 4 years. What is the value of his gift today if his money is earning 5%?

7%?

10%?



Question #7

What can your uncle do to try to earn a higher return on the money earmarked for the gift?



Problem #4

Kevin is 19 and wants to have \$10,000 saved by the time he's 25. Thanks to a generous gift from his grandparents, he currently has \$6,500 invested in a bond paying 5%. If he makes no further deposits, will he reach his goal?



Question #8

What can Kevin do to reach (or exceed) his goal?



Problem #5

Heather starts a Roth IRA at age 22. She plans to contribute \$3,000 at the end of each year for 45 years until age 67. How much will she have if her IRA investments earn 4% ?

7% ?

9% ?



Question #9

\$3,000 a year is about \$60 per week of savings. How can Heather “find” \$60 a week to invest in her Roth IRA?



Problem #6

Wendy and Sal just got married and want to save \$15,000 for a down payment and closing costs on their first house. They intend to save \$500 **per month** in CDs averaging a 4% annual return. How long will it take them to reach their goal?

Hint: Convert the annual interest rate into a monthly interest rate and solve for the time period (N)



Question #10

What can Wendy and Sal do to save money faster?



Problem #7

You quit smoking a pack a day of cigarettes and save \$2,550 a year (savings of \$7 per pack per day). You are 20. How much would you have if you invested the money in a stock index fund averaging a 10% return and don't touch it until age 55?



Question #11

What steps can people take to quit smoking?



Are Your Savings Going Up in Smoke?

<http://njaes.rutgers.edu/sshw/pdfs/upinsmoke.pdf>

Are YOUR Savings Going Up in Smoke?

If you cut out a half pack a day and invest what you save, in 20 years, you will have almost \$25,000

(calculated at 5% yield).



Small Steps to Health and Wealth™

Problem #8

Lucky you...you just won a state lottery prize. You have a choice between receiving \$1,000,000 as an annuity of \$50,000 a year over 20 years or taking \$500,000 as a lump sum payment today. Ignoring taxes for the moment and, assuming a discount rate of 6%, which option is the best deal?



Question #12

What factors- other than the time value of money- need to be considered in lottery and settlement money decisions?



Problem #9

You want to have \$1 million dollars when you retire and will average a 10% return. How much do you need to save per year if you have 40 years to save?

- 30 years to save?
- 20 years to save?
- 10 years to save?



Question #13

What do the Problem #9 answers for savings in 10 to 40 years of time tell you?



Problem #10

Your grandparents, both age 62, have a retirement fund of \$100,000 saved to supplement a pension and Social Security. Assuming an average annual interest rate of 7%, how long will their savings last if they withdraw \$750 per month?

Hint: Convert the annual interest rate into a monthly interest rate and solve for the time period (N)



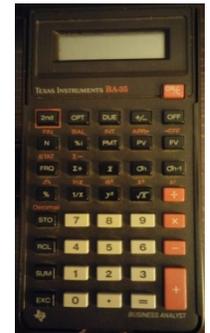
Question #14

What would you advise your grandparents to do to stretch their retirement savings?



Create a Personal Time Value of Money Calculation

- **N** Number of compounding periods
- **% i** Interest rate (for compounding FV interest or discounting PV interest)
- **PV** Present value
- **FV** Future value
- For annuity calculations, periodic payment or income receipt amount
 - Enter 3 known variables; solve for the 4th (unknown) variable



Question #15

Would anyone like to share their time value of money calculation?



Two Take-Away Messages

1. For every decade that you delay saving, the required investment **triples** (approximately)
2. Compound interest is NOT retroactive!
You can't earn interest on money that was not saved



**The Time Value of Money is Like
the Original Format of
Who Wants to Be a Millionaire?
(Television Game Show)**



<http://millionairetv.dadt.com/>

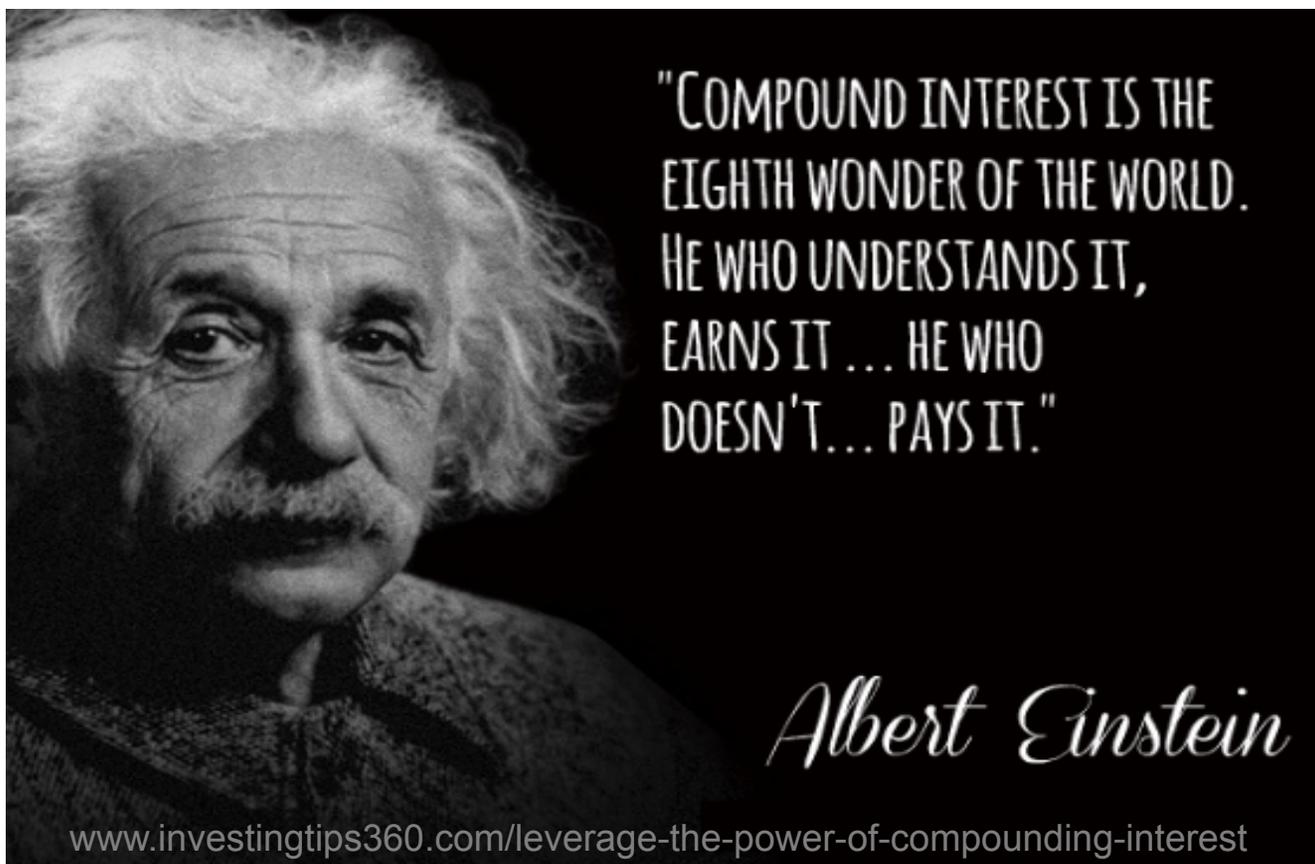
Similarities

- You start by doubling small dollar amounts
- You can't get to the later rounds of doubling money unless you go through the earlier rounds of doubling money
- The later part of the game (saving) is the most profitable because you double larger sums

One More Key Similarity

Knowledge is Power!

- About game questions and compound interest



Let's Grow Some Money!

15	●	\$1 Million
14	●	\$500,000
13	●	\$250,000
12	●	\$125,000
11	●	\$64,000
10	●	\$32,000
9	●	\$16,000
8	●	\$8,000
7	●	\$4,000
6	●	\$2,000
5	●	\$1,000
4	●	\$500
3	●	\$300
2	●	\$200
1	●	\$100

50:50



A: Answer A

B: Answer B

C: Answer C

D: Answer D





YOU WIN \$1

MILLION DOLLARS!

Financial Calculator and Time Value of Money Teaching Tips

- Introduce basic concepts first
- Illustrate concepts initially using time value of money factor tables
- Have participants use the SAME calculator
- Demonstrate the keystrokes step-by-step
- Give participants a handout with keystrokes and problem solutions



Questions and Comments?

Barbara O'Neill, Ph.D., CFP®, CRPC

Extension Specialist in Financial Resource Management
and Distinguished Professor, Rutgers University

Phone: 848-932-9126

E-mail: boneill@njaes.rutgers.edu

Internet: <http://njaes.rutgers.edu/money/>

Twitter: <http://twitter.com/moneytalk1>





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[Must pass post-test with an 80% or higher to receive certificate.]

Personal Finance Upcoming Event

Military Blended Retirement System

- Date: March 14, 2017
- Time: 11 a.m. Eastern
- Location: **[learn.extension.org/events/2835](https://militaryfamilies.extension.org/events/2835)**

For more information on MFLN Personal Finance go to:
<https://militaryfamilies.extension.org/personal-finance/>



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