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Investing in Your Future

ACTIVITY OVERVIEW

This activity provides students the opportunity to apply the concept of compound interest to make financial decisions based on different investment scenarios. Students will use the spreadsheet application of the TI-Nspire calculator to compare the results of investing in a certificate of deposit (a "CD") or a Money Market Account. Students are asked to predict which investment scenario would produce the greater return on their investment. Students are required to manipulate the formula to be used in the spreadsheet application to determine the total amount of each investment over a given period of time. Follow-up questions and extended thinking tasks are provided to allow students to investigate these concepts further and to deepen their understanding.

CONCEPTS

- Compound interest
- Recursive formulas
- Data analysis

OBJECTIVES

- Pre-Calculus
  - Express sequences and series using recursive and explicit formulas. (DOK 2)
- Statistics
  - Make inferences and predictions from charts, tables, and graphs that summarize data. (DOK 3)
- Survey of Mathematical Topics
  - Use information and data to make sound decisions regarding personal savings. (DOK 3)
  - Identify and apply appropriate algebraic formulas to personal finance situations. (DOK 2)
  - Identify and apply appropriate algebraic formulas to personal and business investments. (DOK 2)

(Taken from the *2007 Mississippi Mathematics Framework Revised*)

STANDARDS

- National Council for Teachers of Mathematics
  - Process Standards – Problem Solving, Communication, Representation, Connections, Reasoning & Proof
  - Content Standards – Algebra for Grades 9-12
  - Technology Principle
- International Society for Technology Education
  - National Technology Education Standards for Students

TEACHER PREPARATION

Banks offer multiple opportunities for their customers to make money by investing money into the bank's financial reserves. A Certificate of Deposit (or "CD") allows a customer to invest a particular amount of money for a predetermined period of time and receive interest on that amount; but the customer cannot withdraw any of that money for the duration of the time period without paying a penalty fee. A Money Market Account also allows a customer to invest a particular amount of money for a predetermined period of time, but the customer can make withdrawals and contributions to that amount throughout the time period without penalty. However, the interest rates for Money Market Accounts tend to be lower than the rates for CDs.

This activity allows students to apply mathematical concepts to real-world financial decisions. For this reason, teachers may want to adjust the task to reflect current interest rates and terms of investments. Teachers can access up-to-date information from websites, such as www.bankrate.com. This activity is not intended to be an introductory activity, but rather an investigation of compound interest. Therefore, prior to this activity students should possess the abilities to:

- Evaluate expressions
- Create algebraic expressions to represent a given situation
- Use spreadsheets to determine values for created or given formulas
- Manipulate formulas to obtain missing values

This activity is designed to take place over 2 – 3 class meetings. Suggested extension activities have been included or could be developed to extend this activity even further. Although this activity was created to be used with the TI-Nspire handheld, any spreadsheet application can be used for this investigation.

CLASSROOM MANAGEMENT

This activity is intended to be a student-centered investigation. Students should be placed into groups of two or three with one TI-Nspire or other spreadsheet application per group. The student worksheet *Investing in Your Future* is designed to provide students with the information needed to complete the task. Keystroke sequences are not included on the student worksheet; therefore, students should be familiar with the use of the TI-Nspire handheld. Step-by-step instructions are included in these teacher notes for your convenience but are not intended to be given to students.

Following the initial investigation and creation of the spreadsheets, students should be given the *Investing in Your Future—Follow Up Questions*. This could be distributed as groups complete the initial task in order to accommodate groups finishing *Investing in Your Future* at different paces or distributed to all students as a separate task following a whole-class discussion of the results of the initial task.

It is recommended that the teacher invite questions and extensions from the students that could lead to deeper discussion and further extensions of the activity. The document titled *Investing in Your Future—Extended Thinking* is available to provide extensions to this investigation. Another option for extending this activity is to have each

group develop a “What if…” scenario. For example, “What if you withdrew $250.00 each December from the money market account in order to purchase gifts for family and friends? How would this affect the results of the investigation? Explain.” Each group could investigate another group’s scenario.

TI-Nspire APPLICATIONS
Calculator, Lists & Spreadsheets

REFERENCES

Bankrate, Inc. (2008). Retrieved on August 1, 2008, from http://www.bankrate.com

International Society for Technology Education (2007). *NETS for Students 2007.* Retrieved August 10, 2008, from http://www.iste.org

Mississippi Department of Education (2007). *2007 Mississippi Mathematics Framework Revised.* Jackson, MS: MDE.

National Council for Teachers of Mathematics (2000). *Principles and Standards for School Mathematics.* Reston, VA: NCTM.

Texas Instruments (2008). *Technology Education*. Retrieved on August 1, 2008, from http://education.ti.com

Watson, A. and Mason, J. (1998). *Questions and Prompts for Mathematical Thinking.* Derby: Association of Teachers of Mathematics.

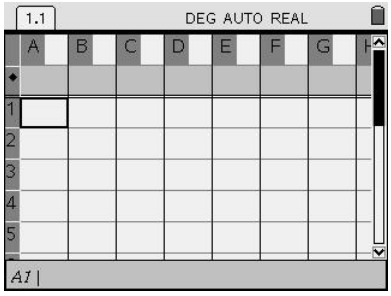
STUDENT WORKSHEET

Following a brief description of certificates of deposit and money market accounts, students are given the following task:

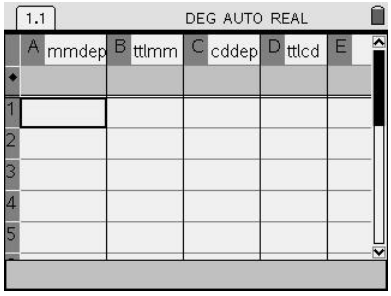
> Your task is to decide which investment scenario will result in the greatest return over a five-year period. You may choose to deposit $5000.00 into the CD or you may choose to deposit $100.00 each month for 5 years into the Money Market account.
>
> A. Predict which scenario would be the better investment. Justify your reasoning.
>
> B. Using the Lists & Spreadsheets application of your TI-Nspire handheld, compare the monthly balances for each type of investment. Was your prediction correct? Explain why or why not, using the data from the spreadsheet to support your explanation.

Students should open a new List & Spreadsheets page.

(⌂ > 3: Lists & Spreadsheets)



Students should decide what information would be important for completing the task. The goal is for students to compare the total balance of each type of investment at monthly intervals. Therefore, we have chosen the following categories of data: Month, Money Market Deposit Amount, Total Money Market Value, CD Deposit Amount, and Total CD Value. If students choose to use more categories, use this as an opportunity for discussion. Due to space limitations on the screen, we have chosen to let the row reference numbers indicate the month and to abbreviate the other categories. Label each column with the value it represents.



(▲▲ MMDEP enter, ▶▲ TTLMM enter,
▶▲ CDDEP enter, ▶ ▲ TTLCD enter)

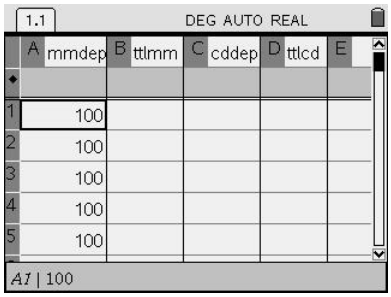
Students may need to increase the width of each column in order to see the category labels.

(▲ ▲ menu > 1: Actions > 2: Resize enter ▶ ▶ ▶ enter ▼)

Keystroke notations have been entered using the *TINspireKeys* font downloaded from
http://education.ti.com/educationportal/downloadcenter/SoftwareDetail.do?website=US&tabId=1&appId=6661

Students will enter the amount of the monthly money market investment ($100.00) and use the fill option to enter this amount into the table for a total of 60 months.

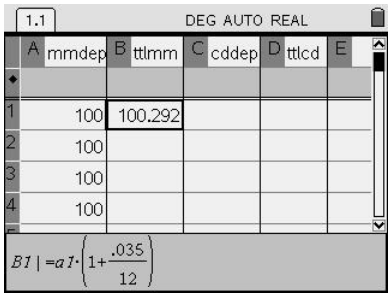
(1 0 0 menu > 3: Data > 3: Fill Down ▼ ▼ … enter)



Students should determine the formula to find the total value of the money market account at any month. The formula for compound interest is $A = P\left(1+\frac{r}{n}\right)^{nt}$, where *A* is the total amount in the account, *P* is the principal, *r* is the interest rate (APR) in decimal form, *n* is the number of times interest is compounded per year, and *t* is the number of years. Since the spreadsheet is set up to compute the total value of the account on a monthly basis, students will need to adjust this formula accordingly. This process of figuring out how to adjust the formula is intended to be part of the learning task.

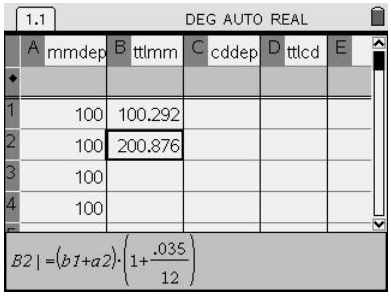
Students should compute the total amount of the money market account for the first month by using the appropriate formula in cell "*ttlmm*1".

(= A 1 × (1 + (0 . 0 3 5 ÷ 1 2)) enter)



Students should compute the following months' totals using the previous month's total. They should be sure to create their formula so that the monthly deposit is included.

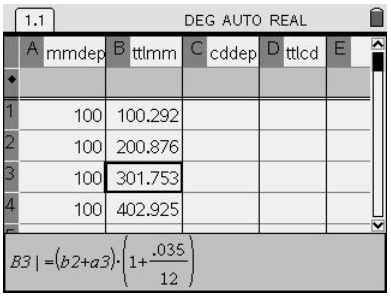
(= (B 1 + A 2) × (1 + (0 . 0 3 5 ÷ 1 2)) enter)



Keystroke notations have been entered using the *TINspireKeys* font downloaded from http://education.ti.com/educationportal/downloadcenter/SoftwareDetail.do?website=US&tabId=1&appId=6661

Students can then use this formula for the rest of this column using the fill option.

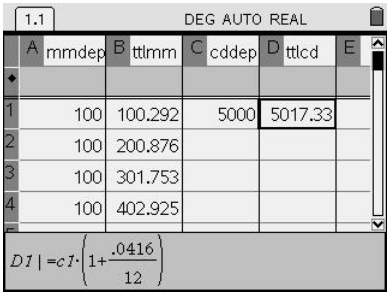
(menu > 3: Data > 3: Fill Down ▼ ▼ … enter)



Students should enter the amount of the CD investment ($5000.00) into cell "*cddep*1". Since this is a lump sum investment without an option for additional deposits, this will be the only value in this column. This fact should be left as part of the investigation for students to discover and may need to be a point of discussion when the lesson is debriefed.

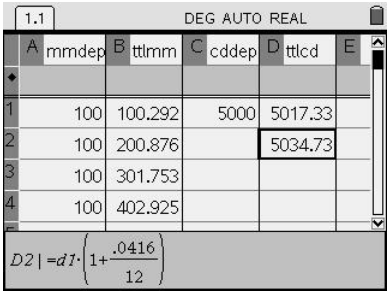
Students should compute the total amount of the CD for the first month by using the appropriate formula in cell "*ttlcd*1".

(= C 1 (1 + (0 . 0 4 1 6 ÷ 1 2)) enter)



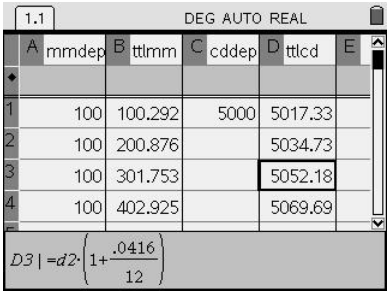
Students should compute the following months' totals using the previous month's total.

(= D 1 (1 + (0 . 0 4 1 6 ÷ 1 2)) enter)



Students can then use this formula for the rest of this column using the fill option.

(menu > 3: Data > 3: Fill Down ▼ ▼ … enter)



Students now have the information they will need to compare the rates and answer the questions on the student worksheet.

Keystroke notations have been entered using the *TINspireKeys* font downloaded from
http://education.ti.com/educationportal/downloadcenter/SoftwareDetail.do?website=US&tabId=1&appId=6661

FOLLOW-UP QUESTIONS

These questions are designed to guide students' reflection about the task. This could be distributed as groups complete the initial task in order to accommodate groups finishing *Investing in Your Future* at different paces or distributed to all students as a separate task following a whole-class discussion of the results of the initial task.

Below each question are main ideas that should be addressed as students reflect on the task. They are provided here as examples of student responses, but do not represent all acceptable responses.

Use the information in your spreadsheet to answer each question.

1. After how many months does the Money Market account produce a greater total profit than the CD produces? Why do you think this happens?

   56 months; The money market account has more principal invested after the 50th month. The lower interest rate on the money market account causes the profit to grow more slowly than the CD.

2. Compare and contrast the Money Market and CD investment scenarios. How are they alike and how are they different?

   The principal amount in the money market account can increase over time, whereas the principal amount of the CD never changes. Interest rates are different for each account. Both accounts compound monthly.

3. Is it always true, sometimes true, or never true that a Money Market account will produce a greater financial profit than a CD? Create an investment scenario to justify your statement. You may want to include references to time, interest rates, and investment amounts in your description.

   Sometimes true; The amount of profit depends on the interest rate, amount of initial investment, time period, etc.

4. If you were to visit a bank today to decide whether to invest your money in a CD or Money Market account, what questions would you ask the investment officer? Explain why asking these questions would help you make your decision.

   What is the interest rate? How often is the interest compounded? What are the rules for deposits and withdrawals?

EXTENDED THINKING

These tasks are designed to serve as further investigation of the concept of compound interest. Since development over time increases the depth of learning, we suggest using these tasks to extend student thinking beyond the day of the initial task. These tasks allow students to apply prior knowledge in deeper and more creative ways.

PROBLEM EXTENSION 1

Consider the original Money Market account that offered a 3.5% APR that compounded monthly. If you continue to invest $100.00 each month, predict how long it will take for the balance of your account to reach $1,000,000.00. Justify your prediction.

Use the TI-Nspire handheld Lists & Spreadsheets application to investigate your prediction.

PROBLEM EXTENSION 2

Consider the original Money Market account that offered a 3.5% APR that compounded monthly. You have set a goal of saving $1,000,000.00 in the next 15 years. How much money would you need to invest each month in order to reach this goal?

Use your solution from the investigation above to predict the amount your monthly investment should be in order reach this goal in 30 years. Justify your prediction.

Use the TI-Nspire handheld Lists & Spreadsheets application to investigate your prediction.