Accelerated Returns

ID: 12279

Time Required
15–20 minutes

Activity Overview

In this activity, students will compare periodic and continuous compounding and apply continuous compounding to a variety of problem situations.

Topic: Continuous Compounding of Interest

- *Nominal Rate vs. Effective Rate*
- *Natural Logarithm Base, e*
- *Periodic vs. Continuous Compounding of Interest*

Teacher Preparation and Notes

- *This activity was designed for use with TI-Nspire technology.*
- *The TI-Nspire document engages students in a graphing activity to explore periodic compounding as $n \to \infty$. Students then compare the continuous and periodic compounding formulas graphically. It may be helpful to review with students the periodic compounding formula, $B = P(1 + \frac{r}{n})^{nt}$, prior to the start of this activity.*
- *Extension problems are provided on the student worksheet. These problems involve real-world problem applications of continuous compounding. Some basic review of solving exponential equations may be helpful.*
- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "12279" in the quick search box.***

Associated Materials

- *PrecalcWeek23_Continuous_Worksheet_TINspire.doc*
- *PrecalcWeek23_Continuous.tns*
- *PrecalcWeek23_Continuous_Soln.tns*

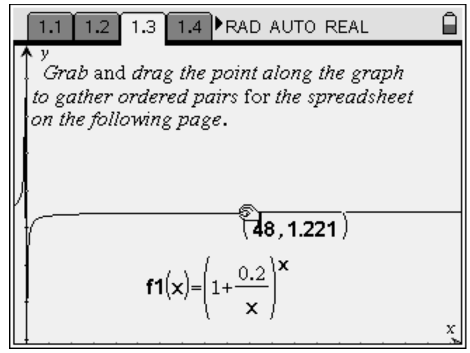
Suggested Related Activities

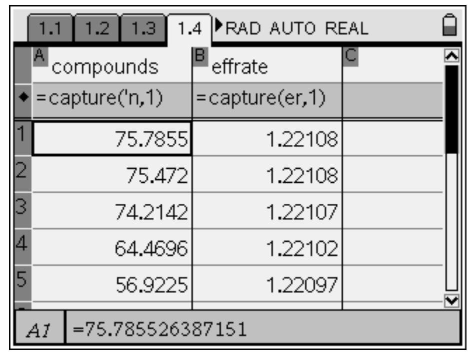
To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box. The activities below approach the concept of optimization via use of derivatives.

- *Financial Futures (TI-Nspire technology) — 10133*
- *Deposit and Forget It (TI-Nspire technology) — 9635*
- *Very Interesting… (TI-Nspire technology) — 12239*

Problem 1 – Periodic Versus Continuous Compounding

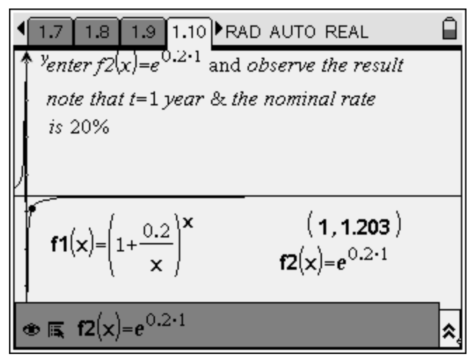
In this problem, students first explore the issue of compounding as $n \to \infty$. This is done by exploring $(1+\frac{r}{n})^{nt}$ with a 20% interest rate, time of 1 year, and letting $x = n$ and graphing this expression as the equation, $\mathbf{f1}(x) = (1+\frac{0.2}{x})^{x}$. Students will drag a point along this graph. As the point is dragged, a spreadsheet on the following page will be populated with the number of times compounded in a year and the effective interest rate. Students should observe the pattern that results both on the graph and spreadsheet.





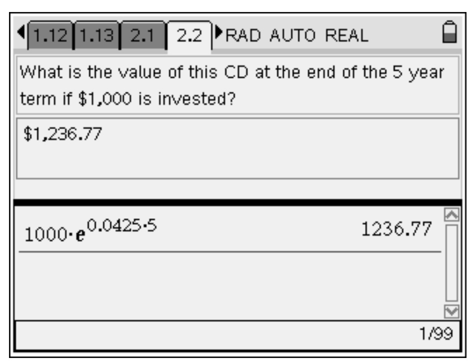
It may be helpful to review with students the meanings of *r*, *n*, and *t* as well as the related terminology (nominal rate, effective rate).

Students then make a comparison to continuous compounding by inserting a second function, $\mathbf{f2}(x) = e^{rt}$, with $r = 0.2$ substituted into the equation.



Note that students must use the special characters available in the character map (ctrl +) in order to obtain the mathematical constant *e*.

This activity topic provides a great opportunity to teach students mathematics related to finance. Unfortunately, many students learn the impact of buying using credit by making some serious financial mistakes at times when they really cannot afford to be making these mistakes.



If time allows, consider providing students with an assignment involving searching newspaper and internet advertisements for "buy now, pay later" arrangements and have students find the cost to the consumer should the payment terms of the agreement not be met.

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Student Solutions

1. 20%

2. 21.6%

3. 22.1%

4. The function reaches a point at which no further increases will occur—it “levels out” and has a maximum value that will not be exceeded no matter how large *n* is.

5. the values appear to be the same

6. After about 12 compounding periods, there isn't much difference between periodic and continuous compounding. (*Answers will vary*)

7. **a.** $1,236.77

b. about 16 years (16.3 years)

c. about 26 years (25.85 years)

8. **a.** $485.15 interest will be added (total amount due with interest added is $2,945.14)

b. Stores are hoping that consumers will take advantage of the special financing offers. They also offer special pricing to attract people to buy on credit, knowing that a number of consumers will not be able to pay in full within the interest-free period. As a result, consumers will pay significant amounts of interest. In this case, the consumer would end up paying nearly $500 more than was initially intended.

9. 13.24%