## Real-Life Discovery of Mathematical Constant *e* by Bernoulli

The mathematician Jacob Bernoulli (1654-1705) tried to find out what happened if interest is compounded continuously for $P$ = \$1, $n$ = 1 year and $R$ = 100 (i.e., 100% annual interest). So the formula simplifies to:

$$A = \left(1 + \frac{1}{k}\right)^k$$

where $A$ is the amount at the end of one year and $k$ is the number of compounding intervals within the year.

1. Use a calculator to fill in the following table, leaving your answers to 5 decimal places where applicable.

| $k$ | $A = \left(1 + \frac{1}{k}\right)^k$ |
|---|---|
| 1 | $\left(1 + \frac{1}{1}\right)^1 = 2$ |
| 2 | $\left(1 + \frac{1}{2}\right)^2 =$ |
| 3 | $\left(1 + \frac{1}{3}\right)^3 =$ |
| 10 | $\left(1 + \frac{1}{10}\right)^{10} =$ |
| 100 | |

| $k$ | $A = \left(1 + \frac{1}{k}\right)^k$ |
|---|---|
| 1000 | |
| 10 000 | |
| 100 000 | |
| 1 000 000 | |
| 10 000 000 | |

2. What do you notice about the value of $A = \left(1 + \frac{1}{k}\right)^k$ as $k$ becomes very big? What is its *final* value correct to 5 decimal places?

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This is called the **mathematical constant *e***.

3. Is the final amount $A$ very big compared to $P$ = \$1 at 100% annual interest compounded continuously?

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4. Which one of the following has a greater effect: interest compounded continuously or a higher interest rate? Why?

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