Name_____   Date_____

Financial Literacy
Unit 1 Line Master 3a

Calculating Interest with Coding

Part A: Simple Interest

Jamal has been given a lump sum of $2000 as part of a scholarship package from the college they will attend in the fall. Jamal would like to see how much interest the money could earn over 10 years. They use coding to calculate how much the money would be worth at different banks.

1. Jamal's current bank account, at **MA Bank**, offers 4.5% simple interest per year. Determine the value of the $2000 after each year for 10 years.

   The formula for calculating the amount of money the initial value will be worth after applying simple interest is:

   $A = (P \times r \times t) + P$, where

   A represents the future value of the money invested.
   P represents the principal, or present value, of the investment.
   r represents the annual interest rate, written in decimal form.
   t represents the time, in years, for which the money will be invested.

   Copy this exact code into a Python console, such as Google Colab or https://cscircles.cemc.uwaterloo.ca/console/ to calculate the amount of an investment using simple interest.

```
principal = 2000
rate = 0.045
time = 0

print ("Time(year)       Amount")

for i in range (0,10):
  time = time + 1
  amount = (principal * rate * time) + principal
  print (time, '\t\t', amount)
```

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About the Code:

In Python, an asterisk (*) is used for multiplication.

- The amount Jamal invests is $2000. The principal value is assigned 2000.
  ```
  principal = 2000
  ```

- The interest rate is 4.5%. The rate in decimal form is 0.045.
  ```
  rate = 0.045
  ```

- The time starts at 0.
  ```
  time = 0
  ```

- The headings for the columns of data are printed to the screen.
  ```
  print ("Time(year)        Amount")
  ```

- Since Jamal wants to invest for 10 years, the *for loop* starts and will repeat the indented code below it 10 times.
  ```
  for i in range (0,10):
  ```

- The time increases by one each time through the loop, representing years 1 through 10.
  ```
  time = time + 1
  ```

- The *amount* will be calculated each time through the loop.
  ```
  amount = (principal * rate * time) + principal
  ```

- The *time* and *amount* variables will be printed to the screen each time through the loop.
  ```
  print (time, '\t\t', amount)
  ```

Execute the code by running the application. What does the output look like?

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2. Jamal decides to see how much the $2000 would earn if it was moved to an account at **Bank EARN**, which is offering 6% simple interest per year.

   a) Alter the code to reflect this change.

   b) Execute the code. What does the output look like?

   c) How much more will Jamal earn by switching banks?
      Do you think it's worth it for this amount? Explain.

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Calculating Interest with Coding (cont'd)

Part B: Compound Interest

Savings accounts and other investment accounts often use compound interest, which means you will earn interest on the interest.

Jamal decides to compare the savings account options at the two banks. Both accounts use compound interest rates.

The formula for calculating the amount of money the initial value will be worth after applying compound interest is:

$A = P\left(1 + \frac{r}{n}\right)^{nt}$, where

A represents the future value of the money invested.
P represents the principal, or present value, of the investment.
r represents the annual interest rate, written in decimal form.
t represents the time, in years, for which the money will be invested.
n represents the number of compounding periods per year. This is usually daily (365), monthly (12), or quarterly (4).

3. How much would $2000 be worth if Jamal puts the money into a savings account at **MA Bank** that offers compound interest at a rate of 4.5 %, compounded monthly, over 10 years?

   Copy this exact code into a Python console, such as Google Colab or https://cscircles.cemc.uwaterloo.ca/console/ to calculate the amount of an investment using compound interest.

```
principal = 2000
rate = 0.045
compoundFrequency = 12
time = 0

print ("Time(year)    Total Amount")

for i in range (0,10):
  time = time + 1
  amount = principal * (1 +
  rate/compoundFrequency)**(compoundFrequency*time)
  amount = round(amount)
  print (time, '\t\t', amount)
```

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Calculating Interest with Coding (cont'd)

About the Code:

In Python, two asterisks (**) are used for an exponent.

Execute the code by running it. What does the output look like?

4. The account at **Bank EARN** offers compound interest at a rate of 6%, compounded monthly. How much would Jamal's $2000 be worth after 10 years at **Bank EARN**?

a) Alter the code in question 3 to reflect this new situation.

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b) Execute the code by running it. What does the output look like?

c) How much more would Jamal's money be worth in the savings account
at **Bank EARN**?

Part C: Credit Cards and Compound Interest

Credit card companies charge compound interest on money people borrow.
Many credit cards use daily compounding, so the amount you owe
increases quickly and can become very expensive. This is why it is important
to pay off credit cards right away!

Consider these two scenarios that involve credit cards and write code to reflect
each situation.

5. Farrah uses a credit card to pay for furniture for her new apartment. The total
    amount charged to the credit card is $10 976. If Farrah does not pay off the credit
    card right away, how much will they owe after 3 years, with an interest rate of 25%
    compounded daily?

    Copy this exact code into a Python console, such as Google Colab or
    https://cscircles.cemc.uwaterloo.ca/console/ to calculate the amount owing
    on the credit card using compound interest.

Calculating Interest with Coding (cont'd)

```python
principal = 10976
rate = 0.25
compoundFrequency = 365
time = 0

print ("Time(year)    Total Amount")

for i in range (0,3):
  time = time + 1
  amount = principal * (1 + rate/compoundFrequency)**(compoundFrequency*time)
  amount = round(amount)
  print (time, '\t\t', amount)
```

a) Execute the code by running it. What does the output look like?

b) How much money will Farrah owe after 3 years?

6. Maxwell uses a credit card to pay for some dental work, which costs $8000. The credit card company charges 22% interest, compounded daily. If Maxwell fails to pay the credit card balance right away, how much might they owe after 5 years?

a) Copy this exact code into a Python console, such as Google Colab or https://cscircles.cemc.uwaterloo.ca/console/ to calculate the amount owing on the credit card using compound interest.

```python
principal = 8000
rate = 0.22
compoundFrequency = 365
time = 0

print ("Time(year)    Total Amount")

for i in range (0,5):
  time = time + 1
  amount = principal * (1 + rate/compoundFrequency)**(compoundFrequency*time)
  amount = round(amount)
  print (time, '\t\t', amount)
```

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How much money will Maxwell owe after 5 years if they don't pay the balance on the credit card right away?

Reflect and Connect

7. How does using code to make interest calculations help you make financial decisions?

8. Alter the code to explore these investments and borrowing situations.

   a) A savings bond offers an annual interest rate of 2.85%, compounded monthly for 10 years. If the initial value invested, or principal, is $10 000, how much will the bond be worth after each year for 10 years?

   b) A bank offers an interest rate of 6%, compounded weekly for 10 years. If the initial loan amount is $100 000, how much will be owing after each year for 10 years?

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