Time Value of Money

Learning Problems

**Problem: Future Value at Hamilton**

Hamilton Ltd. bought a CAD 100,000 bank deposit that matures in three years. The interest rate is 2.0%, compounded annually and principal and interest are paid at maturity.

**REQUIRED:**

1. How much will Hamilton receive when the deposit matures in three years? How much of that amount is interest?
2. Re-do Part 1 assuming the investment matures in five years.
3. Re-do Part 1 assuming the interest rate is 2.0%, compounded monthly. Explain the difference in interest between Part 1 and 3.

**Problem: Future Value at Sproule**

Aggie Jenkins is the CFO of Sproule Industries and is considering providing a three-year loan to a supplier to finance a major expansion. The CAD 10,000 loan has an interest rate of 6.10%, compounded annually. All principal plus interest is paid at maturity.

**REQUIRED:**

1. How much will Sproule Industries receive when the loan matures in three years?
2. How much interest revenue will the company earn? How much of that interest revenue will be due to compounding over the life of the loan and in each of the three years?
3. How would the answer to Part 1 change if the interest rate were 6.10%, compounded semi-annually?

**Problem:** **APR versus EAR at Tyson**

Joe Tyson was quoted the following annual percentage rates (APR) by four financial institutions:

8%, compounded monthly

8%, compounded quarterly

8%, compounded semi-annually

8%, compounded annually

**REQUIRED:**

1. What is the effective annual rate (EAR) for each investment?

**Problem: Present Value at Tribeca**

Walter Gordon is the CEO of Tribeca Ltd. The company is expanding, and Tribeca needs to buy a machine costing CAD 150,000 in three years. Funds can be invested at 2.5%, compounded annually.

**REQUIRED:**

1. How much must Tribeca invest now to reach its goal?
2. If Tribeca only had CAD 120,000 to invest, how long would it take to reach its goal?
3. If Tribeca only had CAD 120,000 to invest and needed to begin the expansion in three years, what interest rate must they earn?

**Problem: Present Value at Sol**

Sol Enterprises is examining a capital project. It requires an initial investment of CAD 75,000 and generates CAD 45,000 in cash flows at the end of each of the next three years. At the end of the project, the assets can be sold for CAD 25,000. The interest rate is 7.0%, compounded annually.

**REQUIRED:**

1. Should Sol undertake this project?

**Problem: Future Value of an Annuity at Cartlidge**

Rita Cartlidge has just received a large inheritance that she plans to use to fund her retirement in 25 years. A financial planner has presented her with two options:

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| --- | --- |
| Option 1 | Invest CAD 50,000 today. |
| Option 2 | Invest CAD 3,500 at the end of each year for the next 25 years. |

Funds invested in both options will earn 3.55%, compounded annually.

**REQUIRED:**

1. Which option will generate the largest retirement savings in 25 years?
2. Would the decision change if the investments in Option 2 were made at the beginning of the year?
3. Why may Option 1 be preferred?

**Problem: Present Value of an Annuity at Edwards**

Jim Edwards was awarded a settlement for an injury he received at work. The insurance company offers him two payout options:

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| --- | --- |
| Option 1 | Receive CAD 500,000 at the end of five years and another CAD 500,000 at the end of ten years. |
| Option 2 | Receive CAD 90,000 at the end of each of the next ten years. |

The interest rate is 4.0%, compounded annually.

**REQUIRED:**

1. Which option should Edwards select?
2. Would the decision change if the payments in Option 2 are received at the beginning of the year?

**Problem: Present Value of an Annuity at Wellington**

Wellington Inc., a technology company, is considering selling the rights to one of its products. The company has received the following two bids:

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| --- | --- |
| Bid 1 | Payment of CAD 20,000 at the end of Year 1, CAD 15,000 at the end of Year 2, and CAD 10,000 at the end of each of Years 3 through 10 |
| Bid 2 | Payment of CAD 12,000 at the beginning of each of the next 8 years. |

The interest rate is 5.0%, compounded annually.

**REQUIRED:**

1. Which bid should Wellington select?

**Problem: Present Value of an Annuity at Wilson**

Jane Wilson won a lottery. The British Columbia Lottery Commission offers her three payout options to receive her prize:

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| --- | --- |
| Option 1 | Receive CAD 140,000 at the end of 10 years. |
| Option 2 | Receive CAD 12,000 at the end of each of the next ten years. |
| Option 3 | Receive CAD 5,000 at the end of each of the next ten years plus CAD 10,000 at the end of each of the ten subsequent years.  |

The interest rate is 5.0%, compounded annually.

**REQUIRED:**

1. Which option should Jane select?

**Problem: Present Value of an Annuity at Harte**

Harte Systems Ltd., a maker of electronic surveillance equipment, is considering selling the rights to one of its home security systems. The company has received offers from two companies with the following payment patterns:

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| --- | --- |
| Offer 1: Innovative Products | Payment of CAD 30,000 at the end of Year 1, CAD 25,000 at the end of Year 2, and CAD 17,000 at the end of each of Years 3 through 10. |
| Offer 2: Morden Industries | A one-time payment of CAD 145,000 paid immediately |

The interest rate is 4.0%, compounded annually.

**REQUIRED:**

1. Which option should Harte Systems select?

**Problem: Present Value of a Perpetuity at Wexler**

John Wexler purchased a preferred share with a fixed annual dividend of CAD 5.20 that is paid in quarterly installments. The interest rate is 5.0%, compounded quarterly.

**REQUIRED:**

1. What is the value of the preferred share?

**Problem:** **Present Value of a Perpetuity with Growth at Jenkins**

Mary Jenkins purchased a common share that currently pays an annual dividend of CAD 5.20 that is paid out annually. The interest rate is 5.0, compounded annually. The dividend is expected to grow at 3.0% per annum in perpetuity.

**REQUIRED:**

1. What is the value of the common share?
2. What if the dividend was expected to grow at 8.0% per annum for the first three years and then at 3.0% per annum in perpetuity?

**Problem:** **Present Value of an Annuity with Growth at Harrison**

Harrison Industries is undertaking a capital project. The project requires an initial investment of CAD 250,000 and is expected to generate CAD 65,000 in cash inflows that will grow at 5.0% over the project’s five-year life. The interest rate is 6.0%, compounded annually.

**REQUIRED:**

1. Should Harrison undertake this project?

**Problem:** **Blended, Equal Monthly Loan Payment at Jones**

Edna Jones wants to purchase a new home for CAD 450,000. The bank requires a 20.0% down payment and charges an interest rate of 4.5%, compounded monthly. Payments will be made at the end of each month for the next 20 years.

**REQUIRED:**

1. What is Jones’ monthly loan payment?
2. Prepare an amortization table for the first two payments.

**Problem:** **Interest Rate at Wilson**

Bank of Montreal has agreed to lend Stan Wilson CAD 250,000. The loan will be paid back in equal monthly installments of CAD 1,700 at the end of each month over the next 25 years.

**REQUIRED:**

1. What is the APR and EAR for this loan?

**Problem:** **Number of Payments at Allison**

Toronto Dominion Bank has agreed to lend Sally Allison CAD 350,000. Sally can afford monthly payments at the end of each month of CAD 1,500 at an interest rate of 3.5%, compounded monthly.

**REQUIRED:**

1. How many years will it take to pay off this loan?

**Problem:** **Customized Loan Schedule at Hastings**

Hastings negotiated a loan with the Bank of Nova Scotia. It had the following features:

 Amount: CAD 5,500,000

 Signed: July 1, 2018

 Due: December 31, 2020

 Interest rate: 8%, payable quarterly

 Repayment terms: Interest only in 2018

Principal payments of CAD 500,000 at the end of each quarter plus interest in 2019 and CAD 750,000 plus interest in 2020

 Balloon payment at the end of the loan

 Accounting Period: Calendar year

**REQUIRED:**

1. Calculate the amounts of principal and interest that must be paid at the end of each quarter over the life of the loan.
2. Describe the principal repayment methods used.

**Problem: Time Value of Money Applications**

1. What is the present value of a single payment of CAD 45,000 at the end of Year 4 at an interest rate of 3.20%, compounded yearly?
2. What is the present value of a string of CAD 5,500 payments at the end of each year that go on forever at an interest rate of 4.00%, compounded annually?
3. How much interest will be earned over three years on a one-time investment of CAD 8,000 at an interest rate of 3.25%, compounded yearly?
4. How much interest will be earned over eight years on a one-time investment of 5,500 at a simple interest rate of 3.80% per annum?
5. What is the future value of a string of CAD 3,500 payments at the beginning of each year for the next six years at an interest rate of 3.25%, compounded annually?
6. If a company negotiates a one-year CAD 45,000 discount loan at an interest rate of 8.00%, compounded monthly, how much will it receive today?
7. What is the present value of a string of CAD 4,350 payments at the end of the year that go on forever growing at 3.00% per year at an interest rate of 8.00%, compounded annually?
8. What is the present value of a string of CAD 4,200 payments at the end of each year for the next five years at an interest rate of 3.65%, compounded annually?
9. What is the EAR of an APR of 3.50%, compounded continuously?
10. What is the EAR of an APR of 6.00%, compounded quarterly?

**Problem:** **Predefined FV and PV Functions in Excel**

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| --- | --- |
| Case 1 | How much will a client accumulate in 25 years if they invest CAD 250 at the end of each month at an interest rate of 3.2%, compounded monthly? What if the investment occurs at the beginning of the month? |
| Case 2 | What is a receivable worth today if a customer must pay CAD 5,000 at the end of every six-month period for the next three years at an interest rate of 4.5%, compounded semi-annually? What if the payment occurs at the beginning of each six-month period? |
| Case 3 | How long will it take for an investor who can invest CAD 2,000 at the end of each month at an interest rate of 3.5%, compounded monthly to accumulate 50,000? |
| Case 4 | What annual interest rate compounded monthly is needed to save CAD 100,000 if an individual can invest CAD 2,000 each month for four years? |
| Case 5 | An annual percentage rate (APR) of 5.3%, compounded quarterly is equal to what effective annual rate (EAR)? |
| Case 6 | An effective interest rate (EAR) of 8.5% per annum is equal to what annual percentage rate (APR), compounded semi-annually? |

**REQUIRED:**

1. Answer the questions in each of the above cases using the FV, PV, RATE, NPER, EFFECT, and NOMINAL Excel functions.

**Problem:** **Blended, Equal Monthly Loan Payments at Flynn**

Maggie Flynn wants to purchase a new home for CAD 390,000. The bank requires a 25.0% down payment and charges an interest rate of 5.5%, compounded monthly. Payments will be made at the end of each month for the next 25 years.

**REQUIRED:**

1. What is Flynn’s monthly loan payment? Use the PMT function in Excel.
2. Prepare an amortization table for the first two payments. Use the IPMT and PPMT functions in Excel.