Unit 7 Review: Financial Literacy
ApexMath

This review covers all six lessons in Unit 7. For each problem, show all of your work clearly and label every value you identify.

Formula Sheet

Simple Interest: $I = Prt$ and $A = P(1 + rt)$

Compound Interest: $A = P\left(1 + \dfrac{r}{n}\right)^{nt}$

Solve for t: $t = \dfrac{\ln(A/P)}{n \cdot \ln(1 + r/n)}$

Solve for r $(n = 1)$: $r = \left(\dfrac{A}{P}\right)^{1/t} - 1$

Annuity — Future Value: $FV = R \cdot \dfrac{(1+i)^n - 1}{i}$

Annuity — Present Value: $PV = R \cdot \dfrac{1 - (1+i)^{-n}}{i}$

Loan Payment: $R = PV \cdot \dfrac{i}{1 - (1+i)^{-n}}$

where $i = r \div n_{\text{freq}}$ and $n = n_{\text{freq}} \times t$.

Section 1: Simple Interest

1. You invest \$4,000 in a savings account at a simple interest rate of 3% per year for 5 years. Find the interest earned and the total amount in the account.

2. After 5 years at a simple interest rate of 4% per year, a bank account contains \$2,340. What was the original amount deposited?

3. (Real Life) Emma lends her friend \$6,000. Four years later, her friend repays \$6,720 in total. What simple interest rate did Emma charge per year?

Section 2: Compound Interest

4. (Real Life) You open a Tax-Free Savings Account (TFSA) with \$5,000 at 6% per year, compounded monthly. How much is in the account after 4 years?

5. A \$8,000 investment earns 5% per year, compounded quarterly, for 6 years. What is the total amount?

6. (Real Life) A college fund currently holds \$2,000. It grows at 5% per year, compounded annually. How long until it reaches \$3,000?

7. \$4,000 grows to \$6,000 over 8 years, compounded annually. What annual interest rate was applied?

Section 3: Annuities — Future Value

8. (Real Life) Starting at age 22, Maya deposits \$150 per month into a retirement savings account earning 6% per year, compounded monthly. How much will she have after 5 years? How much of that came from interest?

9. (Real Life) A business owner sets aside \$400 every quarter into an account earning 8% per year, compounded quarterly, for 6 years. What is the future value?

Section 4: Annuities — Present Value

10. (Real Life) A lottery prize pays \$600 per month for 4 years. If money earns 7% per year, compounded monthly, what is the prize worth in today's dollars?

11. (Real Life) You take out a \$22,000 student loan at 6% per year, compounded monthly, to be repaid over 5 years. What is your monthly payment? How much total interest will you pay over the life of the loan?

Section 5: Mortgages and Loans

12. (Real Life) A family takes out a \$280,000 mortgage at 4.5% per year, compounded monthly, amortized over 25 years. Find the monthly payment and the total interest paid over the life of the mortgage.

13. (Real Life) Using the same \$280,000 mortgage at 4.5%, calculate the monthly payment and total interest for a 20-year amortization. How much interest is saved by choosing 20 years over 25 years?

14. (Real Life) Sam and Priya are shopping for a home. They can afford monthly mortgage payments of \$1,400. The bank offers 4% per year, compounded monthly, over 25 years. What is the maximum mortgage they can qualify for?

15. (Real Life — Rent vs. Buy) A couple is deciding whether to rent or buy. Renting costs \$1,800 per month. Buying requires a \$320,000 mortgage at 4.5% per year, compounded monthly, amortized over 25 years.

- Find the monthly mortgage payment.
- Find the total interest paid on the mortgage over 25 years.

- Find the total rent paid over 25 years.
- Which option costs more over 25 years in interest or rent alone?

16. **(Challenge — Real Life)** A homeowner has a \$380,000 mortgage at 5% per year, compounded monthly, amortized over 25 years. They decide to pay an extra \$300 per month on top of the regular payment.

    - Find the regular monthly payment.
    - Approximately how many years early will the mortgage be paid off?
    - How much total interest is saved?

    (Use: $n = \dfrac{-\ln\left(1 - \dfrac{PV \cdot i}{R_{new}}\right)}{\ln(1+i)}$*)*

Answer Key

1. $P = \$4{,}000$, $r = 3\% = 0.03$, $t = 5$ years.

Step 1: Find the interest.

$$I = Prt = 4000 \times 0.03 \times 5 = 600$$

Step 2: Find the total amount.

$$A = P + I = 4000 + 600$$

$$\boxed{I = \$600, \quad A = \$4{,}600}$$

2. $A = \$2{,}340$, $r = 4\% = 0.04$, $t = 5$ years. Find P.

Step 1: Find $1 + rt$.

$$1 + rt = 1 + 0.04 \times 5 = 1.20$$

Step 2: Divide A by $1 + rt$.

$$P = \frac{A}{1 + rt} = \frac{2340}{1.20}$$

$$\boxed{P = \$1{,}950}$$

3. $P = \$6{,}000$, $A = \$6{,}720$, $t = 4$ years. Find r.

Step 1: Divide A by P.

$$\frac{A}{P} = \frac{6720}{6000} = 1.12$$

Step 2: Subtract 1 and divide by t.

$$rt = 1.12 - 1 = 0.12 \qquad \Longrightarrow \qquad r = \frac{0.12}{4} = 0.03$$

$$\boxed{r = 3\% \text{ per year}}$$

4. $P = \$5{,}000$, $r = 0.06$, $n = 12$, $t = 4$ years.

Step 1: Find i and nt.

$$i = \frac{0.06}{12} = 0.005 \qquad \text{and} \qquad nt = 12 \times 4 = 48$$

Step 2: Substitute into the compound interest formula.

$$A = 5000\,(1.005)^{48}$$

Step 3: Evaluate.

$$(1.005)^{48} \approx 1.270489$$

$$A = 5000 \times 1.270489$$

$$\boxed{A \approx \$6{,}352.45}$$

5. $P = \$8{,}000$, $r = 0.05$, $n = 4$, $t = 6$ years.

Step 1: Find i and nt.

$$i = \frac{0.05}{4} = 0.0125 \qquad \text{and} \qquad nt = 4 \times 6 = 24$$

Step 2: Substitute.

$$A = 8000\,(1.0125)^{24}$$

Step 3: Evaluate.

$$(1.0125)^{24} \approx 1.347351$$

$$A = 8000 \times 1.347351$$

$$\boxed{A \approx \$10{,}778.81}$$

6. $P = \$2{,}000$, $A = \$3{,}000$, $r = 0.05$, $n = 1$. Find t.

Step 1: Compute numerator and denominator of the t formula.

$$\text{Numerator: } \ln\left(\frac{3000}{2000}\right) = \ln(1.5) \approx 0.405465$$

$$\text{Denominator: } 1 \times \ln(1.05) \approx 0.048790$$

Step 2: Divide.

$$t = \frac{0.405465}{0.048790}$$

$$\boxed{t \approx 8.31 \text{ years}}$$

7. $P = \$4{,}000$, $A = \$6{,}000$, $n = 1$, $t = 8$ years. Find r.

Step 1: Compute A/P.

$$\frac{A}{P} = \frac{6000}{4000} = 1.5$$

Step 2: Raise to the power $1/t = 1/8 = 0.125$.

$$r = (1.5)^{0.125} - 1 \approx 1.051990 - 1$$

$$\boxed{r \approx 5.20\% \text{ per year}}$$

8. $R = \$150$, $r = 0.06$, $n_{\text{freq}} = 12$, $t = 5$ years.

Step 1: Find i and n.

$$i = \frac{0.06}{12} = 0.005 \qquad \text{and} \qquad n = 12 \times 5 = 60$$

Step 2: Substitute into the FV formula.

$$FV = 150 \cdot \frac{(1.005)^{60} - 1}{0.005}$$

Step 3: Evaluate.

$$(1.005)^{60} \approx 1.348850$$

$$FV = 150 \cdot \frac{0.348850}{0.005} = 150 \times 69.770$$

$$FV \approx \$10{,}465.50$$

Step 4: Find total deposited and interest earned.

$$\text{Total deposited} = 150 \times 60 = \$9{,}000$$

$$\text{Interest earned} = 10{,}465.50 - 9{,}000$$

$$\boxed{FV \approx \$10{,}465.50, \quad \text{Interest earned} \approx \$1{,}465.50}$$

9. $R = \$400$, $r = 0.08$, $n_{\text{freq}} = 4$, $t = 6$ years.

Step 1: Find i and n.

$$i = \frac{0.08}{4} = 0.02 \qquad \text{and} \qquad n = 4 \times 6 = 24$$

Step 2: Substitute.

$$FV = 400 \cdot \frac{(1.02)^{24} - 1}{0.02}$$

Step 3: Evaluate.

$$(1.02)^{24} \approx 1.608437$$

$$FV = 400 \cdot \frac{0.608437}{0.02} = 400 \times 30.422$$

$$\boxed{FV \approx \$12{,}168.74}$$

10. $R = \$600$, $r = 0.07$, $n_{\text{freq}} = 12$, $t = 4$ years.

Step 1: Find i and n.

$$i = \frac{0.07}{12} \approx 0.005833 \qquad \text{and} \qquad n = 12 \times 4 = 48$$

Step 2: Compute $(1.005833)^{-48}$.

$$(1.005833)^{-48} \approx 0.758680$$

Step 3: Substitute.

$$PV = 600 \cdot \frac{1 - 0.758680}{0.005833} = 600 \cdot \frac{0.241320}{0.005833} = 600 \times 41.370$$

$$\boxed{PV \approx \$25{,}056.12}$$

11. $PV = \$22{,}000$, $r = 0.06$, $n_{\text{freq}} = 12$, $t = 5$ years. Find R.

Step 1: Find i and n.

$$i = \frac{0.06}{12} = 0.005 \qquad \text{and} \qquad n = 12 \times 5 = 60$$

Step 2: Compute $(1.005)^{-60}$.

$$(1.005)^{-60} \approx 0.741372$$

Step 3: Find the payment.

$$R = 22000 \cdot \frac{0.005}{1 - 0.741372} = 22000 \cdot \frac{0.005}{0.258628} = \frac{110}{0.258628}$$

$$R \approx \$425.32/\text{mo}$$

Step 4: Find total interest.

$$\text{Total paid} = 425.32 \times 60 = \$25{,}519.20$$

$$\text{Total interest} = 25{,}519.20 - 22{,}000$$

$$\boxed{R \approx \$425.32/\text{mo}, \quad \text{Total interest} \approx \$3{,}519.30}$$

12. $PV = \$280{,}000$, $r = 0.045$, $t = 25$ years.

Step 1: Find i and n.

$$i = \frac{0.045}{12} = 0.00375 \qquad \text{and} \qquad n = 12 \times 25 = 300$$

Step 2: Compute $(1.00375)^{-300}$.

$$(1.00375)^{-300} \approx 0.323560$$

Step 3: Find the monthly payment.

$$R = 280000 \cdot \frac{0.00375}{1 - 0.323560} = 280000 \cdot \frac{0.00375}{0.676440} \approx \$1{,}556.33/\text{mo}$$

Step 4: Find total interest.

$$\text{Total paid} = 1556.33 \times 300 = \$466{,}899.00$$

$$\text{Total interest} = 466{,}899.00 - 280{,}000$$

$$\boxed{R \approx \$1{,}556.33/\text{mo}, \quad \text{Total interest} \approx \$186{,}899.28}$$

13. Same mortgage, 20-year amortization. $PV = \$280{,}000$, $i = 0.00375$, $n = 240$.

Step 1: Compute $(1.00375)^{-240}$.

$$(1.00375)^{-240} \approx 0.406928$$

Step 2: Find the monthly payment.

$$R = 280000 \cdot \frac{0.00375}{1 - 0.406928} = 280000 \cdot \frac{0.00375}{0.593072} \approx \$1{,}771.42/\text{mo}$$

Step 3: Find total interest.

$$\text{Total paid} = 1771.42 \times 240 = \$425{,}140.80$$

$$\text{Total interest} = 425{,}140.80 - 280{,}000 \approx \$145{,}140.38$$

Step 4: Find the interest saved versus the 25-year plan.

$$186{,}899.28 - 145{,}140.38 = \$41{,}758.90$$

$$\boxed{R \approx \$1{,}771.42/\text{mo}, \quad \text{Interest saved} \approx \$41{,}758.90}$$

14. $R = \$1{,}400$, $r = 0.04$, $t = 25$ years. Find PV.

Step 1: Find i and n.

$$i = \frac{0.04}{12} \approx 0.003333 \qquad \text{and} \qquad n = 12 \times 25 = 300$$

Step 2: Compute $(1.003333)^{-300}$.

$$(1.003333)^{-300} \approx 0.368940$$

Step 3: Substitute into the PV formula.

$$PV = 1400 \cdot \frac{1 - 0.368940}{0.003333} = 1400 \cdot \frac{0.631060}{0.003333} = 1400 \times 189.330$$

$$\boxed{PV \approx \$265{,}233.48}$$

15. $PV = \$320{,}000$, $r = 0.045$, $t = 25$ years. Rent $= \$1{,}800$/month.

Step 1: Find the monthly mortgage payment.

$$i = \frac{0.045}{12} = 0.00375, \qquad n = 300$$

$$(1.00375)^{-300} \approx 0.323560$$

$$R = 320000 \cdot \frac{0.00375}{0.676440} \approx \$1{,}778.66/\text{mo}$$

Step 2: Find total mortgage interest over 25 years.

$$\text{Total paid} = 1778.66 \times 300 = \$533{,}598.00$$

$$\text{Total interest} = 533{,}598.00 - 320{,}000 \approx \$213{,}599.18$$

Step 3: Find total rent paid over 25 years.

$$\text{Total rent} = 1800 \times 300 = \$540{,}000$$

Step 4: Compare.

$$\$540{,}000 - \$213{,}599.18 = \$326{,}400.82$$

$$\boxed{Mortgage interest \approx \$213{,}599. \quad Total rent = \$540{,}000. \quad Renting costs \approx \$326{,}401 \text{ more in pure cash out}}$$

16. (Challenge) $PV = \$380{,}000$, $r = 0.05$, $t = 25$ years, extra \$300/month.

Step 1: Find i, n, and the standard payment.

$$i = \frac{0.05}{12} \approx 0.004167, \qquad n = 300$$

$$(1.004167)^{-300} \approx 0.287942$$

$$R = 380000 \cdot \frac{0.004167}{0.712058} \approx \$2{,}221.44/\text{mo}$$

$$\text{Standard interest} = (2221.44 \times 300) - 380000 \approx \$286{,}432.65$$

Step 2: Find the new number of months with the extra payment.

$$R_{\text{new}} = 2221.44 + 300 = \$2{,}521.44/\text{mo}$$

$$n_{\text{new}} = \frac{-\ln\left(1 - \dfrac{380000 \times 0.004167}{2521.44}\right)}{\ln(1.004167)} = \frac{-\ln\left(1 - \dfrac{1583.46}{2521.44}\right)}{0.004158}$$

$$= \frac{-\ln(0.371904)}{0.004158} \approx \frac{0.988898}{0.004158} \approx 237.8 \text{ months}$$

Step 3: Convert and find interest saved.

$$\frac{237.8}{12} \approx 19.82 \text{ years} \qquad \Longrightarrow \qquad \text{paid off about 5.18 years early}$$

$$\text{New total interest} = (2521.44 \times 237.8) - 380000 \approx \$219{,}565.91$$

$$\text{Interest saved} = 286{,}432.65 - 219{,}565.91$$

$$\boxed{\text{Paid off} \approx 5.2 \text{ years early.} \quad \text{Interest saved} \approx \$66{,}866.73}$$

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End of Unit 7 Review • ApexMath
