

Annuity Compounded Periodically - Yearly Investments

For an annuity due—where deposits are made at the beginning of each period—the future value is given by:

$$S_n = \frac{Ar(1 - r^n)}{1 - r}$$

- Where A is the periodic deposit,
- r is the growth rate per period, and
- n is the number of periods.

1. You deposit \$1000 at the beginning of each year into an account earning 6% per annum. Determine the future value of your investment after **10 years** using the formula.
2. Sherry invests 15% of her annual income of \$85,000 each year into a mutual fund that earns an average return of 6% annually.
 - a) How much will she have in her investment have after 20 years?
 - b) How much will she have in her investment after 40 years?
 - c) After how many years will she have over \$1,000,000 in her investment?
3. Marko starts by investing \$8000 every year into a self-directed plan earning an average annual return of 10.5% with no management fee. Suppose Marko increases the amount he invests into each plan by \$5000 every 5 years, how much will he have in each plan after 25 years?
4. You deposit \$1000 annually at the beginning of each year at a nominal interest rate of 6% for 10 years. However, assume the inflation rate is 2% per year.
 - a) First, compute the future nominal value using the annuity due formula.
 - b) Then, determine its real value in today's dollars by adjusting for inflation over 10 years by dividing by 1.02^{10} .
5. A student plans to save for college by making deposits at the beginning of each year. She aims to have \$50,000 in 15 years and expects an annual return of 7%. Calculate the required annual deposit using the annuity due formula
6. Marko plans to invest \$8000 every year into two investment plans.
 - a. The first is a self-directed plan earning an average annual return of 10.5% with no management fee. How much is it worth after 25 years?
 - b. The second plan is a mutual fund that purchases an index fund that earns an average annual return of 10.5% but charges a management fee of 3% each year. How much is it worth after 25 years?
 - c. What is the difference in value of the two investment plans after 25 years?
7. Melody's invests \$10,000 into her RRSP each year. In 2015 her portfolio was worth \$10,000. In 2023 [8years later] her portfolio grew to 130,210.36. What is her average annual rate of return?

Annuity Compounded Periodically - Monthly Investments

For an annuity due—where deposits are made at the beginning of each period—the future value is given by:

$$S_n = \frac{Ar(1 - r^n)}{1 - r}$$

- A is the monthly deposit,
- r is the growth rate per period, and
- n is the number of months.

1. You deposit \$200 at the beginning of each month for **6 months** at a monthly interest rate of 0.5%. Compute the future value.
2. Given an annual nominal interest rate of 8% compounded monthly:
 - a. Determine the **monthly interest rate**.
 - b. You deposit \$500 at the beginning of each month. Calculate the **future value after 12 months** using the annuity due formula.
3. Given an annual nominal interest rate of **8%** compounded monthly, determine the monthly interest rate. Then, with **\$500** deposited at the **beginning** of each month, calculate the future value after **12 months** using the annuity due formula.
4. Determine the monthly deposit required to accumulate **\$20,000** in **36 months**, given that deposits are made at the **beginning** of each month and the account earns a monthly interest rate of **0.5%**.
5. For **\$300** deposited at the **beginning** of each month at a monthly interest rate of **0.5%**, determine the minimum number of months required for the account's future value to exceed **\$10,000**. (Set up and solve the appropriate inequality.)
6. For **\$350** deposited at the **beginning** of each month for **36 months**, if the future value is **\$13,500**, determine the monthly interest rate.
7. Compare these two investment strategies:
 - Strategy A:** Deposit **\$300** at the **beginning** of each month for **36 months** in an account earning a monthly interest rate of **0.5%** (using the annuity due formula).
 - Strategy B:** Invest a single lump sum of **\$9,000** at the **beginning** of the period at the same monthly interest rate for **36 months** (using the compound interest formula)..Calculate the future value for both strategies and verify that they are approximately equal.