3.1 Compound Interest & e

$$e = 1 + \frac{1}{1} + \frac{1}{1 \cdot 2} + \frac{1}{1 \cdot 2 \cdot 3} + \frac{1}{1 \cdot 2 \cdot 3 \cdot 4} + \dots + \frac{1}{1 \cdot 2 \cdot 3 \cdot \dots \cdot n}$$

= 1 + 1 + $\frac{1}{2} + \frac{1}{6} + \frac{1}{24} + \dots$
\$\approx 2.71828182846

 $\mathbf{y} = e^{\mathbf{x}}$





• \$1,000, 5%, monthly, 5 years

A = _____

 $A = Pe^{rt}$

♦ \$1,000, 5%, 5 years, continuously

A = ___

Example: \$500, 3%, 4 years yearly (n =)	A =
<i>quarterly</i> (n =)	A =
<i>monthly</i> (n =)	A =
weekly (n =)	A =
<i>daily</i> (n =)	A =
continuously (e)	A =

Applications:

- Determine how much money your parents would have needed to invest at the time of your birth in order for you to have \$30,000 when you turn 18? (The investment would be compounded semi-annually at a 2.75% interest rate).
- 2. Will Mike have enough money to buy a used car costing \$3000 with the \$1000 investment his grandparents made for him 16 years ago if the rate is 6.8% compounded continuously?
- 3. Determine the principal P that must be invested at a 6.25% rate, compounded continuously, so that \$450,000 will be available upon retirement in 35 years?

<u>Annuity</u>: a fixed sum of money paid to someone/bank each year.

• Examples: Retirement Plans, Mortgage Loans, Student Loans, and Car Payments

• <u>Investment/Borrowing Terms</u>: IRA (Individual Retirement Account): 401K, 403B; Mortgage Loan **Types of Annuities**:

- <u>Present Value</u>: You are borrowing money now and paying it back over time later.
- <u>Future Value</u>: You are putting money away now and saving it for a later use.

Present Value:
$$P_n = P\left[\frac{1-(1+i)^{-n}}{i}\right]$$

 $P_n = presentvalueofmoneyloanedout $P = futurepaymentsamount(fixedoverlifeofloan)$
 $i = yearlyinterestatedividedoynumberofpaymentsperyear$
 $n = numberofpaymentsoverthelifeoftheloan$$

A monthly mortgage payment consists of an amount paid towards the principal (loan balance) and the interest on the loan. It
may also contain an amount for the property taxes (school, county, municipality) that the mortgage holder will pay from an
escrow (A financial document held by a third party on behalf of the other two parties in a transaction) and an amount for
insurance that protects the mortgage holder in case of default on the loan. Jeremy purchased a house for \$157,000. He paid an
18% down payment. He gets a 25 year mortgage with an interest rate of 8.9%.

a. How much was his down payment?

- b. How much of the house is financed?
- c. What will his monthly payment for principal and interest be?

- d. How much will he pay in total interest over the life of the loan?
- e. How much did the house cost him in total?

- 2. When she purchased her house in 2011, Mary took out a 30-year mortgage for \$230,000 with a fixed interest rate of 6.375%.
 - a. What will be the monthly payment for the principal and interest?

b. After 30 years, how much money will Mary have paid to her mortgage lender?

c. How much interest did she end up paying her mortgage lender?