Math 150, Section 4.1

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Purpose of this section

In this section we define exponential functions and study their properties. We also learn how to calculate compounded interest and continuously compounded interests.

Definition of Exponential function

The **exponential function with base** a is defined for all real numbers x by

$$f(x) = a^x$$

where $a > 0$ and $a \neq 1$. The number a is called the **base** of the exponential function.

For example the functions 3^x, and 3^{-x} are exponential functions where as x^3 or $\sqrt{x^2+1}$ are not exponential functions.

Evaluating Exponential Functions and Graphing

The graph of the exponential function $f(x) = a^x$ will be increasing or decreasing depending on whether a is more than 1 or less than 1. You must know how the graphs of basic exponential functions look like (Page 336). Also familiarize yourself with how to evaluate exponential functions using calculator.

Natural Exponential Function

The **natural exponential function** is the exponential function

$$f(x) = e^x$$

with base e.
The exponential functions that come up in real life situations are often the natural exponential function and hence the name.

Compound Interest

Compound interest is calculated using the formula

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

where

$$\begin{aligned} A(t) &= \text{amount after } t \text{ years} \\ P &= \text{principal or initial deposit} \\ r &= \text{interest rate per year} \\ n &= \text{number of times interest is compounded per year} \\ t &= \text{number of years} \end{aligned}$$

Continuously compounded Interest

When n becomes ∞ the compound interest becomes continuously compounded interest.

Continuously compounded Interest is calculated by the formula

$$A(t) = Pe^{rt}$$

where

$$\begin{aligned} A(t) &= \text{amount after } t \text{ years} \\ P &= \text{principal or initial deposit} \\ r &= \text{interest rate per year} \\ t &= \text{number of years} \end{aligned}$$