Exponential Functions:

Base: positive real number

exponent: variable

Consider: \( f(x) = 2^x \)

<table>
<thead>
<tr>
<th>x</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>( \frac{1}{4} )</td>
</tr>
<tr>
<td>-1</td>
<td>( \frac{1}{2} )</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Parent graph of an exponential function:

Domain: \( (-\infty, \infty) \)

Range: \( (0, \infty) \)

Horizontal Asymptote: \( y = 0 \)

Graph:

\( f(x) = 3^{x-1} + 2 \rightarrow \) shift to the right \((+1)\)

\( \text{Vertical Asymptote: } x = 0 \)

\( \text{Intercept: } (0, 1) \)

\( \text{Points: } (1, 3) \)

\( \text{Horizontal Asymptote: } y = 2 \)

\( \text{Domain: } (-\infty, \infty) \)

\( \text{Range: } (2, \infty) \)
$F(x) = \left( \frac{1}{2} \right)^x \rightarrow$ Bases between zero and 1.

$F(x) = \left( \frac{1}{3} \right)^x = 2^{-x} \rightarrow$ reflection over y.

Natural Exponential Function.

$F(x) = e^x$

Exponential Function Applications

Growth and decay models at specific times.

$4000$ in account, increases $5\%$ every $6$ months.

How much money is in there after $6$ years.

growth: $P(1+r)^t$

decay: $P(1-r)^t$

$P =$ original.

$r =$ rate of change decimal.

t =$ amount of time.
\[ 4000 \left(1 + 0.0005\right)^{12} \approx 6400.00 \]

Continuous exponential model \( P_{\text{ext}} \).

\[ P = 1000 \text{,000} \]
\[ r = 17\% \rightarrow 0.17 \]
\[ t = 6 \text{ hours} \]

\[ P_{\text{ext}} = 1000 \text{,000} e^{0.17(6)} \]

Decreasing Continuous exponential model:

\[ P e^{-rt} \]