MATH 1100---Chapter 1 Formulas

<table>
<thead>
<tr>
<th>Name of Rule</th>
<th>( f(x) )</th>
<th>( f'(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Rule</td>
<td>( x^k )</td>
<td>( k \cdot x^{k-1} )</td>
</tr>
<tr>
<td>Product Rule</td>
<td>( g(x) \cdot h(x) )</td>
<td>( g'(x) \cdot h(x) + h'(x) \cdot g(x) )</td>
</tr>
<tr>
<td>Quotient Rule</td>
<td>( \frac{N(x)}{D(x)} )</td>
<td>( \frac{N'(x) \cdot D(x) - D'(x) \cdot N(x)}{</td>
</tr>
<tr>
<td>Chain Rule</td>
<td>( g[h(x)] )</td>
<td>( g'[h(x)] \cdot h'(x) )</td>
</tr>
</tbody>
</table>

MATH 1100---Chapter 2 Formulas

Definitions: \( f(x) \) is **increasing** when \( f'(x) > 0 \) and **decreasing** when \( f'(x) < 0 \)

\( f(x) \) is **concave up** when \( f''(x) > 0 \) and **concave down** when \( f''(x) < 0 \)

**Extreme Value Theorem**: If \( f \) is continuous over \([a,b]\), then \( f \) will have both an absolute maximum and an absolute minimum over this interval. These extrema occur at critical points and/or interval endpoints.

\( \Delta x = x_2 - x_1 \), \( \Delta y = y_2 - y_1 \), \( dx = \Delta x \), \( dy = f'(x) \, dx \). If \( \Delta x \) is small, then \( dy \approx \Delta y \)

**Elasticity of Demand**

\[
E(x) = -\frac{x \cdot D'(x)}{D(x)}
\]

MATH 1100---Chapter 3 Formulas

**Properties of Logarithms**

\[
\log_b(AB) = \log_b A + \log_b B \\
\log_b(A^k) = k \log_b A \\
\log_b(x^n) = n \log_b x
\]

**Base Conversion Formula**

\[
\log_b(x) = \frac{\log x}{\log b} = \frac{\ln x}{\ln b}
\]

**Compound Interest**

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

**Continuous Compounding**

\[
A = Pe^{rt}
\]

**Doubling Time** for Continuous Compounding

\[
T_2 = \frac{\ln 2}{r}
\]

**Exponential Growth and Decay**

Given: \( \frac{dN}{dt} = kN \)

\[
N = N_0 e^{kr}
\]

**Amortization Formula**

\[
L = \text{loan amount}, \ r = \text{interest rate} \\
\text{n = number of compoundings per year}, \ p = \text{payment}, \ t = \text{time} \\
L \left(1 + \frac{r}{n}\right)^{nt} = \frac{p \left(1 + \frac{r}{n}\right)^{nt} - 1}{\frac{r}{n}}
\]

**Newton's Law of Cooling**

\[
T(t) = a \cdot e^{kt} + C \quad (C = \text{Surrounding Temperature})
\]

**Monthly Loan Payment**

\[
p = \frac{r \cdot L}{1 - \left(1 + \frac{r}{12}\right)^{-12t}}
\]

**Derivatives**

<table>
<thead>
<tr>
<th>( f(x) )</th>
<th>( e^{kt} )</th>
<th>( \ln x )</th>
<th>( a^x )</th>
<th>( \log_a x )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f'(x) )</td>
<td>( ke^{kt} )</td>
<td>( \frac{1}{x} )</td>
<td>( (\ln a)a^x )</td>
<td>( \frac{1}{\ln a} \cdot \frac{1}{x} )</td>
</tr>
</tbody>
</table>
MATH 1100—Chapter 4 Formulas

If \( \frac{d}{dx} F(x) = f(x) \), then \( F(x) \) is called the antiderivative of \( f(x) \).

Integrating involves finding the antiderivative: \( \int f(x) \, dx = F(x) + C \)

Rules of Antidifferentiation:

\[
\begin{align*}
\int k \, dx &= kx + C \\
\int x^n \, dx &= \frac{1}{n+1} x^{n+1} + C \quad (n \neq -1) \\
\int \frac{1}{x} \, dx &= \ln |x| + C \\
\int e^{ax} \, dx &= \frac{1}{a} e^{ax} + C \\
\int f(x) \, dx + \int_c^b f(x) \, dx &= \int_c^b f(x) \, dx
\end{align*}
\]

Average Value of a Function

\[
y_{\text{ave}} = \frac{1}{b-a} \int_a^b f(x) \, dx
\]

Integration-by-Parts

\[
\int u \, dv = uv - \int v \, du
\]

MATH 1100—Chapter 5 Formulas

\( p = D(x) \) is the Demand Function, \( p = S(x) \) is the Supply Function.

The Equilibrium Point \((Q, P)\) is where \( D(Q) = S(Q) = P \)

Consumer Surplus: \( \int_0^Q D(x) \, dx - QP \)
Producer Surplus: \( QP - \int_0^Q S(x) \, dx \)

With continuous compounding, \( P_0 = \text{Present Value}, \) and \( P = \text{Future Value} \)

\( A = \int_0^T R(t) e^{(t-a)} \, dt = e^{RT} \int_0^T R(t) e^{-kt} \, dt \)

\( B = \int_0^T R(t) e^{-kt} \, dt \)

If \( R \) is constant, then \( A = \frac{R(t)}{k} (e^{kT} - 1) \)

If \( R \) is constant, then \( B = \frac{R(t)}{k} (1 - e^{-kT}) \)

Consumption of a natural resource can be modeled by:

\( \int_0^T P_0 e^{kt} \, dt = \frac{P_0}{k} (e^{kT} - 1) \)

\( \int_0^T P e^{-kt} \, dt = \frac{P}{k} \)

Accumulated Present Value of a continuous money flow of \( P \) dollars per year perpetually:

\( E(x) = \mu = \int x \cdot f(x) \, dx \), Therefore: \( E(x^2) = \int x^2 \cdot f(x) \, dx \)

Expected Value = \( E(x) \), Mean = \( \mu \)

Variance = \( \sigma^2 = E(x^2) - \mu^2 \)

Standard Deviations = \( \sigma = \sqrt{\sigma^2} \)

\( z \)-scores

\( z = \frac{x - \mu}{\sigma} \)

MATH 1100—Chapter 6 Formulas

Finding the Relative Extrema of a function \( z = f(x,y) \)

First find all critical points of \( f(x,y) \) \([\text{This is a point } (a,b) \text{ where } f_x(a,b) = 0 \text{ and } f_y(a,b) = 0]\)

Use the D-Test to find \( D = f_{xx}(a,b) \cdot f_{yy}(a,b) - [f_{xy}(a,b)]^2 \)

For each critical point, there are 4 possibilities:

1. If \( D > 0 \) and \( f_{xx}(a,b) < 0 \), Then \( f \) has a maximum at \((a,b)\).
2. If \( D > 0 \) and \( f_{xx}(a,b) > 0 \), Then \( f \) has a minimum at \((a,b)\).
3. If \( D < 0 \), then \( f \) has a saddle point at \((a,b)\).
4. If \( D = 0 \), then the D-Test is not applicable.