derivative_rules_brief.doc created 4/4/02 update/print 9/9/06 12:22 PM

Average Rate of Change (slope of a line between two points on a curve)

$$\frac{f(b)-f(a)}{b-a}$$

Velocity (speed) over a trip

Average Value of a Function

$$\frac{1}{b-a}\int_a^b f(x)dx$$

ex) Average

1st Derivative

(slope at a point on a curve); **Instantaneous Rate of Change**

$$f'(x)=\lim_{\Delta x\to 0}\frac{f(x+h)-f(x)}{\Delta x}=\frac{dy}{dx}=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

ex) Instantaneous Velocity at a given moment

Derivatives

1) Derivative of Constant $d(c)/dx = 0$ ex) If $y = 5$, then $y' = 0$

2a) Simple Power Rule $d(x^n)/dx = nx^{n-1}$ ex) If $y = x^5$, then $y' = 5x^4$

2b) General Power Rule $d(u^n)/dx = nu^{n-1}u'$ ex) If $y = (x^2+3)^5$, then $y' = 5(x^2+3)^4(2x) = 10x(x^2+3)^4$

3) Derivative of x $d(x)/dx = 1$

4) Constant Multiple $d(cu)/dx = cu'$

5) Sum and Difference $d(u \pm v)/dx = u' \pm v'$

6) Product $d(uv)/dx = u'v + uv'$

7) Quotient $d(u/v)/dx = (u'v - uv')/v^2,\ v \neq 0$

8) Chain Rule $\frac{dy}{dx}=\frac{dy}{du}\cdot\frac{du}{dx}$ ex) If $y = (x^2+3)^5$, then $y' = 5(x^2+3)^4(2x)$ (simplify)

note: $y = u^5$ $u = x^2+3$ $dy/du = 5u^4 = 5(x^2+3)^4$ $du/dx = 2x$

9) Exponential e $d(e^u)/dx = e^u u'$

10) Exponential any base $d(a^u)/dx = a^u u' \ln a$

11) Natural Log $d(\ln u)/dx = u'/u$

12) Log any base $d(\log_a u)/dx = u'/(u \ln a)$

13) Absolute value $\frac{d(|u|)}{dx}=\frac{u}{|u|}\cdot u'$

The formulas below do *not* apply to the Applied Calculus courses. (Trig is not covered in most of those courses.)

14) Sine $\frac{d(\sin u)}{dx}=\cos u\cdot u'$

15) Cosine $\frac{d(\cos u)}{dx}=-\sin u\cdot u'$

16) Tangent $\frac{d(\tan u)}{dx}=\sec^2 u\cdot u'$

17) Cotangent $\frac{d(\cot u)}{dx}=-\csc^2 u\cdot u'$

18) Secant $\frac{d(\sec u)}{dx}=\sec u\tan u\cdot u'$

19) Cosecant $\frac{d(\csc u)}{dx}=-\csc u\cot u\cdot u'$

20) Arcsine $\frac{d(\arcsin u)}{dx}=\frac{u'}{\sqrt{1-u^2}}$

21) Arccosine $\frac{d(\arccos u)}{dx}=\frac{-u'}{\sqrt{1-u^2}}$

22) Arctangent $\frac{d(\arctan u)}{dx}=\frac{u'}{1+u^2}$

23) Arccotangent $\frac{d(arc\cot u)}{dx}=\frac{-u'}{1+u^2}$

24) Arcsecant $\frac{d(arc\sec u)}{dx}=\frac{u'}{|u|\sqrt{u^2-1}}$

25) Arccosecant $\frac{d(arc\csc u)}{dx}=\frac{-u'}{|u|\sqrt{u^2-1}}$