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Functions and Models

1. Precalculus review
   (a) Adding fractions. Laws of exponents. Graphs of basic functions.
   (b) Working with functions algebraically, graphically and numerically.
   (c) Plugging a function into another function and simplifying.
   (d) Piecewise functions, the vertical line test, and reading domains/ranges from graphs.
   (e) Defining functions from a word problem.
2. Applications to Economics
   (a) Cost, Revenue, and Profit: breaking even, maximizing, and minimizing.
   (b) Supply and demand: finding equilibrium points.
   (c) Studying revenue when price is a function of # units.
3. Know the regular and continuous compound interest formulas. Be able to
   (a) Explain where the formula comes from (its derivation).
   (b) Find the future value given the initial value and time elapsed,
   (c) find the present value given a desired future value and time elapsed, and
   (d) find the time elapsed given present and future value.
   (e) Find the effective annual interest rate using both its definition,
   and using the laws of exponents.
4. Logarithms
   (a) Know the Laws of Logarithms
   (b) Compute exact values of a mix of logarithms and exponentials.
   (c) Solving equations of logarithms and exponentials for x.
   (d) Applications of logarithms to the compound interest formula.
   (e) Rewriting an exponential of any base to have the form $F(t) = P \cdot e^{k \cdot t}$

Rates of Change and the Derivative

1. Limits
   (a) Know the definition of the limit.
   (b) Be able to find the limit of a function from its graph.
   (c) Find limits that arise from the limit definition of the derivative.
   (d) ((Other limit problems omitted because we missed this day of class)).

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2. Rates of Change
   (a) Compute the average rate of change on an interval from a graph or from an equation.
   (b) Know that "instantaneous rate of change of $f(x)$ at a" = "slope of $f(x)$ at a" = $f'(a)$.
   (c) Know that $f'(a)$ is called the derivative of $f(x)$ at a.
   (d) Given a graph of $f(x)$,
      i. be able to sketch the tangent line to $f(x)$ at different numbers a.
      ii. be able to compute $f'(a)$ for different values of a.
3. Defining the derivative:
   (a) Know the limit definition of the derivative. Be able to use it to find $f'(x)$.
   (b) Remember $f'(a)$ = "slope of the tangent to f at a"
   = "instantaneous rate of change at a of f"

Computing Derivatives Quickly

1. Rules for Computing Derivatives Quickly
   (a) Basic derivatives: powers, exponentials, logs, sums, coefficients, and constant terms.
   (b) The product and quotient rule.
   (c) The chain rule.
   (d) Some multi-step computations require you to use several different rules.
   Showing your work helps you keep track of what you've done, and what remains.
2. Applications: Tangent Lines are Linear Approximations
   (a) $f'(a)$ is the slope of the line tangent to $f(x)$ at a.
   (b) The equation of the line tangent to $f(x)$ at a is $y = f'(a)\Big(x - a\Big) + f(a)$.
   (c) If you graph $f(x)$ and zoom in enough around the point $(a, f(a))$,
   the graph looks more and more like the tangent line.
   (d) The tangent line to f at a is the line that approximates $f(x)$ near a point $(a, f(a))$
   (e) In other words: $L(x) = f'(a)\Big(x - a\Big) + f(a)$ = "the linear approximation of $f(x)$ at a."
3. Applications: Marginal Cost/Revenue/Profit
   (a) If $C(x)$ is the cost, then the marginal cost is $C'(x) = \dfrac{d}{dx}\Big[C(x)\Big]$
   (b) If the cost function is *linear*, then "the cost of 1 more" is exactly equal to "the slope of $C(x)$," which is exactly equal to $C'(x)$.

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(c) Because "zooming in" makes any function C appear linear,
$C'(x) \approx$ "the cost of the $(x+1)^{st}$ unit" $= C(x+1) - C(x)$.

This can also be written $C'(x-1) \approx$ the cost of the x^{th} unit.

(d) the units of $C'(x)$ are (units of cost)/(units of x).

4. Applications: The Chain Rule

(a) Know the "business meaning" of the chain rule. For example, the Revenue R depends on the price p, and the price p depends on the quantity q. Therefore, $\frac{dR}{dq} = \frac{dR}{dp} \cdot \frac{dp}{dq}$

(b) For continuously compounded interest, be able to find $F'(t)$.

(c) For other compounding intervals, be able to find $F'(t)$.

(d) Notice that $F'(t) \approx$ amount gained/lost in the $(t+1)^{st}$ year $= F(t+1) - F(t)$.