Concepts to Know #1

Math 141
1.1-1.5, 2.1-2.7

- **1.1 - The Cartesian Coordinate System**

  x and y axis (label your scales on graphs)

  Ordered pairs (points): (x, y)

  Origin: (0,0)

- **1.2 - Straight Lines**

  Slope $= m = \frac{y_2 - y_1}{x_2 - x_1}$

  Positive slope: line rises from lft to rt
  Negative slope: line falls from lft to rt
  Zero slope: Horizontal line
  Undefined Slope: Vertical line

  Equations of Lines

  Pt-Slope Form: $y - y_1 = m(x - x_1)$
  Slope-Int Form: $y = mx + b$
  General Form: $Ax + By + C = 0$
  Horizontal line: $y = a$
  Vertical line: $x = b$

  Intercepts

  x-intercept = point where line crosses x-axis: (#,0)
  y-intercept = point where line crosses y-axis: (0,#)

  Parallel Lines $\Longrightarrow m_1 = m_2$
  (same slopes/diff. y-int)

  Perpendicular Lines $\Longrightarrow m_1 m_2 = -1$
  (neg. reciprocal slopes)

- **1.3 - Linear Functions and Math. Models**

  Functions

  Domain
  Range
  Independent Variable
  Dependent Variable

  Linear Functions

  Linear Depreciation: $V(t) = mt + b$
  m = rate of depreciation
  b = value of asset at time = 0
  Scrap Value = lowest value asset attains

  Linear Cost, Revenue and Profit

  Cost: $C(x) = cx + F$ where c is the cost to produce each unit and F is the fixed costs
  Revenue: $R(x) = sx$ where s is the selling price of each unit
  Profit: $P(x) = R(x) - C(x)$

  Linear Supply and Demand

  $S(x) = p = mx + b$
  $D(x) = p = mx + b$
  All points on supply and demand curves are of the form (x, p) = (quantity, price)!!

- **1.4 - Intersection of Straight Lines**

  Break-Even Point

  $R(x) = C(x)$ (or $P(x) = 0$ to find quantity)
  x = break-even quantity
  y = break-even revenue/cost

  Equilibrium Point

  Supply = Demand
  x = equilibrium quantity
  y = equilibrium price

- **1.5 - The Method of Least Squares/Linear Regression**

  Be able to use LinReg on your calculator to find the least-sq. line

  Correlation coefficient (r) - determines the amount of the data explained by the line
  (Want $|r|$ close to 1)

  Be able to predict values, using the least-sq. line

- **2.1 - Systems of Linear Equations**

  Two linear eqns $\Longrightarrow$ three cases

  Unique Soln (intersecting lines $\Longrightarrow m_1 \neq m_2$)

  No Soln (parallel lines $\Longrightarrow$ $m_1 = m_2$ and $b_1 \neq b_2$)

  Infinitely Many Solns (same line $\Longrightarrow$ $m_1 = m_2$ and $b_1 = b_2$)

  General soln (parametric soln)

  Specific solns

  Setting up systems of equations

  DEFINE YOUR VARIABLES!

- **2.4 - Matrices**

  Size (dimension): mxn (m = # rows, n = # columns)

  Matrix elements: a_{ij} (element in row i and col j)

  Equality $\Longrightarrow$ all corresponding entries equal

  Addition/Subtraction (matrices must be the same size)

  Matrix Transpose (A^T): switch rows and cols

  Scalar Multiplication: multiply every entry by the scalar

- **2.2/2.3 - Solving System of Equations**

  Gauss-Jordan (GJ) Elimination (Row Operations)

  Interchange any two equations

  Multiply an eqn by a non-zero constant

  Add a multiple of one eqn to another

  Row-Reduced Echelon Form

  All zero rows must be below all non-zero rows

  The first non-zero entry in each row is 1 (leading 1)

  In any two successive (non-zero) rows, the leading 1 in the lower row lies to the right of the leading 1 in the upper row

  If a column contains a leading 1, then the other entries in that column are zeros

  RREF on your calculator

  Solving a system

  Put system in "nice" form

  Place "nice" system in an augmented matrix

  Use RREF on your calculator to reduce your system

  Read system (eqns) from reduced system

  Find soln

- **2.5 - Multiplication of Matrices**

  The # of cols in the left matrix must equal the # of rows in the right matrix. (Inner dimensions equal.)

  If A is (mxn) and B is (nxp), then AB is (mxp). (Outer dimensions give answer size.)

  ORDER IS IMPORTANT!

  Know how to multiply matrices by hand.

  Identity Matrix: Square matrix (# rows = # cols) with 1's along the diagonal (from upper lft to lower right) and 0's elsewhere

  Be able to represent a system of eqns as a matrix eqn: $AX = B$

  Put system in "nice"form

  A = coefficient matrix

  X = variable matrix

  B = constant matrix

- **2.6 - Inverse of a Square Matrix**

  Matrix must be square

  Not all matrices have an inverse ("singular" means no inverse)

  Inverse of $A = A^{-1}$

  $AA^{-1} = A^{-1}A = I$

  A system in form $AX = B \Longrightarrow X = A^{-1}B$ if the inverse exists (know how to solve a matrix equation)

- **2.7 - Leontief Input-Output Model**

  Be able to set-up the input-output matrix, A

  Understand how to read each element in the input-output matrix

  Know how to find how much of each product/service should be produced to satisfy demand (Be able to solve $X = AX + D$ for X, knowing what each of these matrices means)

  Know how to find how much of each product/service is consumed internally by an economy while meeting demand