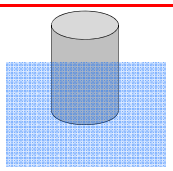
Class 2 Business

1. Prayer
2. Joke
3. Homework Due
4. Info Sheets Due
5. Review of Professional Program deadline
   - **April 15**
6. Class Web Page
   - Homework Hints (2 for this HW assignment)
   - Class Notes
   - U. Colorado tutorials
   - Hedengren videos

HW Review

- Archimedes principle
  - $m_{obj} = m_{water\ displaced}$
  - $m = \rho \cdot V$
  - $\rho_{water} V_w = \rho_{wood} V_{wood}$



  - How many of you looked at the homework hint?

- Weight
  - What is weight of 180 lb person on moon ($g = 5.26\ ft/s^2$)

Next HW Assignment

- Please look at homework hints
  - 2-31
  - 2-40
    - Work two ways:
      (1) Linearize (see the workbook for help), and
      (2) Minimization of sum-square error
    - Note that we will use the solver in Excel instead of the E-Z Solve program
- All workbook problems will be required on a workbook sheet for full credit

Class 2 Outline

(much of this should be a review)

- Estimation ☑
- Dimensional consistency
- Equation of a line
  - Slope, intercept
  - Interpolation
- Curve-fitting
  - (i.e., interpolation- known model)
- Linearization and data fitting

Estimation

- Are your calculations reasonable?
  - How many gallons in a liter?
- How many seconds in 25 years?

$$(25\ yrs)\left(\frac{365\ days}{yr}\right)\left(\frac{24\ hrs}{day}\right)\left(\frac{60\ min}{hr}\right)\left(\frac{60\ s}{min}\right)$$

$$(3\times10^1)\quad(4\times10^2)\quad(2\times10^1)\quad(4\times10^3)$$

3*4*2*4=12*8=96 times 10^7

9.6×10^8 s

Exact answer: 7.9×10^8 s

Units

FACTORS FOR UNIT CONVERSIONS

Quantity	Equivalent Values
Mass	1 kg = 1000 g = 0.001 metric ton = 2.20462 lb_m = 35.27392 oz 1 lb_m = 16 oz = 5×10^{-4} ton = 453.593 g = 0.453593 kg
Length	1 m = 100 cm = 1000 mm = 10^6 microns (μm) = 10^{10} angstroms (Å) = 39.37 in. = 3.2808 ft = 1.0936 yd = 0.0006214 mile 1 ft = 12 in. = 1/3 yd = 0.3048 m = 30.48 cm
Volume	1 m^3 = 1000 L = 10^6 cm^3 = 10^6 mL = 35.3145 ft^3 = 219.97 imperial gallons = 264.17 gal = 1056.68 qt 1 ft^3 = 1728 $in.^3$ = 7.4805 gal = 0.028317 m^3 = 28.317 L = 28,317 cm^3
Force	1 N = 1 kg·m/s^2 = 10^5 dynes = 10^5 g·cm/s^2 = 0.22481 lb_f 1 lb_f = 32.174 lb_m·ft/s^2 = 4.4482 N = 4.4482×10^5 dynes
Pressure	1 atm = 1.01325×10^5 N/m^2 (Pa) = 101.325 kPa = 1.01325 bar = 1.01325×10^6 dynes/cm^2 = 760 mm Hg at 0°C (torr) = 10.333 m H_2O at 4°C = 14.696 $lb_f/in.^2$ (psi) = 33.9 ft H_2O at 4°C = 29.921 in. Hg at 0°C
Energy	1 J = 1 N·m = 10^7 ergs = 10^7 dyne·cm = 2.778×10^{-7} kW·h = 0.23901 cal = 0.7376 ft·lb_f = 9.486×10^{-4} Btu
Power	1 W = 1 J/s = 0.23901 cal/s = 0.7376 ft·lb/s = 9.486×10^{-4} Btu/s = 1.341×10^{-3} hp

Example: The factor to convert grams to lb_m is $\left(\frac{2.20462\ lb_m}{1000\ g}\right)$.

- Gas bottle reads 1300 psi
  - ✓ Pounds per square inch
  - ✓ lb_f/in^2
- How many atm?
- $1300\ psi \cdot \left(\frac{1\ atm}{14.696\ psi}\right)$
  $= 88.46\ atm$
- How many mm Hg?
- $1300\ psi \cdot \left(\frac{760\ mm\ Hg}{14.696\ psi}\right)$
  $= 6.723 \times 10^4\ mm\ Hg$

Interpolation

- Density of water at different temperatures

T (°F)	ρ (kg/m^3)
60	998.6
70	997.4

- What is the density of water at 64°F?

Curve-Fitting

- Curve fit (i.e., trendline)
- Sum square errors (Appendix A.1)
- (Excel files with examples)

Linearizatoin

- Idea: Manipulate the equation so that the constants are in the form:

$$y^* = m \cdot x^* + b$$

- Where y* and x* are rearranged variables which may be combinations of x and y
- Example:

$$xy^2 = a \cdot \frac{x}{y} + \frac{b}{a}$$

- Let y* = xy^2 and x* = x/y
- Plot y* vs. x*
  - slope = a and intercept = b/a