

GEO 5500 Numerical Methods in the Geosciences
Midterm Quiz
February 27, 2003

Matrices

- a. What is the *condition* of a matrix? Describe the term both verbally and mathematically. (10 points)
- b. Would you expect the matrix of these equations to be well or poorly conditioned? Why? (10 points)

$$5x + 10y = 0$$

$$5x + 9y = 0$$

- b. If you were to find a solution to a poorly conditioned matrix, what numerical technique might you use? (10 points)

Roots of equations

The circulation of an asteroid and a planet can be described as an ellipse and a circle:

$$0.8x^2 + 1.2y^2 = 1 \text{ (ellipse)}$$

$$x^2 + y^2 = 1 \text{ (circle)}$$

The simultaneous solution to these equations can be determined using Newton-Raphson techniques.

- a. Calculate the Jacobian matrix of these two equations (15 points)
- b. Make an initial guess of the intersection of these orbits. (10 points)
- c. Use the initial guess to write out the first iteration of a Newton-Raphson solution. (15 points)

Numerical integration

Consider the equation $y = x^2$ in the interval $-1 \leq x \leq 1$.

- a. Solve the integral using the trapezoidal rule with 4 panels and equally spaced Δx . (20 points)
- b. Solve the integral analytically and determine the error of the trapezoidal rule. (20 points)