Homework 3 Petroleum Seismology 2010 Due Date: march 1

Purpose:

Examine Elastic Constants

Verify wave equation for several cases

Review Complex Number Mathematics

Q. 1 (a) Find or derive the relationship between Poisson's ratio and Vp, and Vs

(If you do not derive this relationship, reference your source and verify that it holds true.)

(b) Plot Poisson's ratio versus Vp/Vs ratio for Vp/Vs ratios extending from -5 to +5
(c) Indicate the location of an ideal Poisson solid and a liquid.

(d) Explain the existence of the asymptotes.

(e) What is Poisson's ratio for shale in the Gulf of Mexico

(use Matlab, Excel or Mathematica and cite your sources)

Q 2. Substitute the following equations back into the wave equation to show that they are indeed valid solutions to the wave equation:

$$V_P = \sqrt{\frac{k + \frac{4}{3}\mu}{\rho}}\,,\; V_S = \sqrt{\frac{\mu}{\rho}}$$

Hint: Substitute these equations into the following versions of the elastic wave equation, which we have already seen:

$$\begin{aligned}\rho\frac{\partial^2\Omega}{\partial t^2} &= -\mu\nabla\times\left(\nabla\times\vec{\Omega}\right)\\ &= -\mu\left\{\nabla\left(\nabla\bullet\left[\left(\nabla\times\vec{\Omega}\right)\right]\right)\right\}+\nabla^2\vec{\Omega}\\ &= -\frac{\mu}{\rho}\vec{\Omega}\end{aligned}$$

(for Vshear)

$$\frac{\rho}{\lambda + 2\mu}\ddot{\Theta} = \nabla^2\Theta$$

(for V acoustic)

Q. 3 Show the following is true algebraically and graphically using an Argand diagram

$$\frac{e^{i\theta} + e^{-i\theta}}{2} = cos\,\theta$$

$$\frac{e^{i\theta} - e^{-i\theta}}{2} = sin\,\theta$$