

ResGeo 202 Reservoir Geomechanics  
Spring 2017, Stanford Online

Homework 3 – Estimating Rock Strength from Geophysical Logs  
**Due 2 May 2017, 07:30 UTC**

Please direct any questions to the Piazza discussion forum on the course website

Note that the deadline is in Coordinated Universal Time (UTC). If you want to see the current time in UTC, please google: “Current time in UTC.”

Background

In this assignment, you will be estimating the unconfined compressive strength (UCS) of rock as a function of depth using geophysical logs from a well in the Barnett Shale. The log data and information about the formation depths in the well can be downloaded from Stanford Lagunita by clicking the right-hand tab (the document icon) near the top of the page. Utilize a scientific computing program such as MATLAB or Microsoft Excel to follow the steps below. Then **answer the questions on the page below.**

Instructions

**Part 1: Estimating rock strength from geophysical logs**

- a. *Examine the log data.* The Excel file containing the log data has density in g/cc and compressional and shear velocities expressed as travel times in units of  $\mu\text{s}/\text{ft}$  for a section of the Barnett Shale well. In addition, the formation top depths of three lithological units are given.
- b. *Estimate UCS for the given depths using known empirical relations.* Use the empirical relationships given in Lecture 5, slides 33–36 to estimate UCS from the given sonic and density logs. The appropriate equations to apply for each of the three lithological units are given in the data spreadsheet. For each formation, you will use one method of estimating UCS from Young’s modulus ( $E$ , which is derived from sonic and density logs), and one method from porosity ( $\phi$ , which is derived from density logs). Make sure to pay attention to the units for these calculations, and be careful of imaginary components when exponentials are involved.
- c. *Plot UCS vs. depth.* It is conventional to put depth on an inverted y-axis and UCS on the x-axis. Compare your methods of estimating UCS for the different lithological units to answer the questions below.

**Part 2: Answer the questions on the page below**

Use the plots and calculations from Part 1 to answer the questions on the page below. The solutions will be posted after the due date. Numerical entry type responses have only a range of acceptable values and are graded electronically, so please adhere to the value of constants given here to prevent misgrading of your submissions.