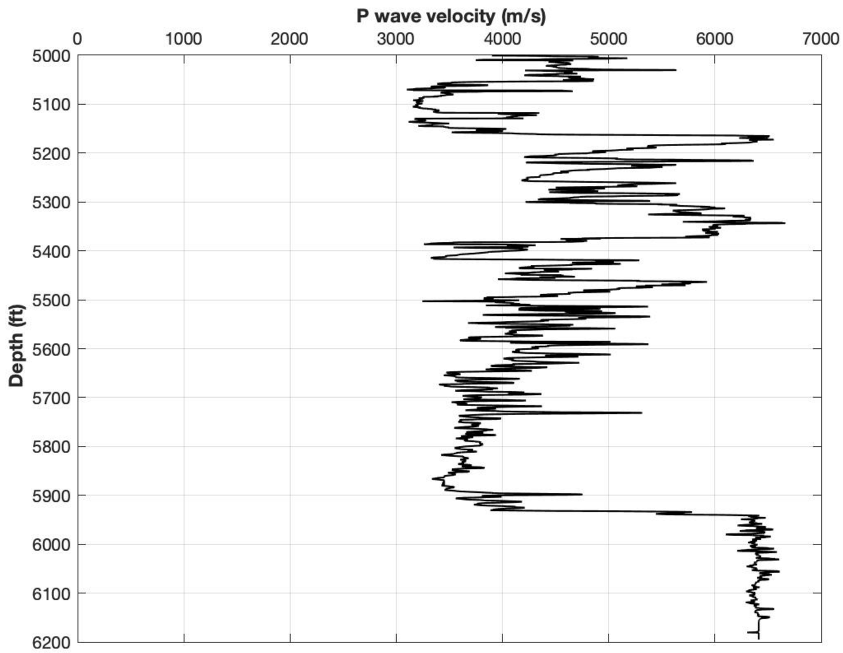
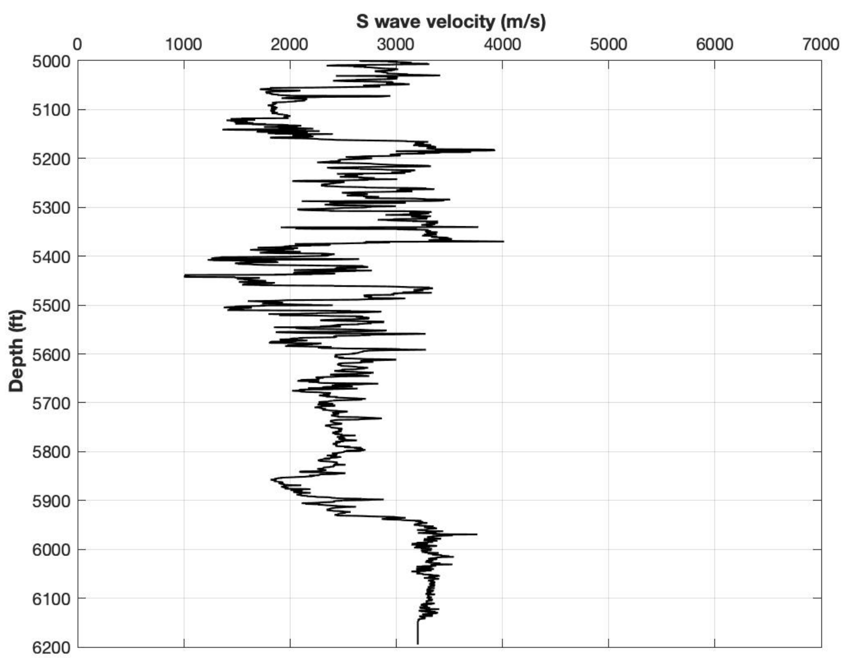
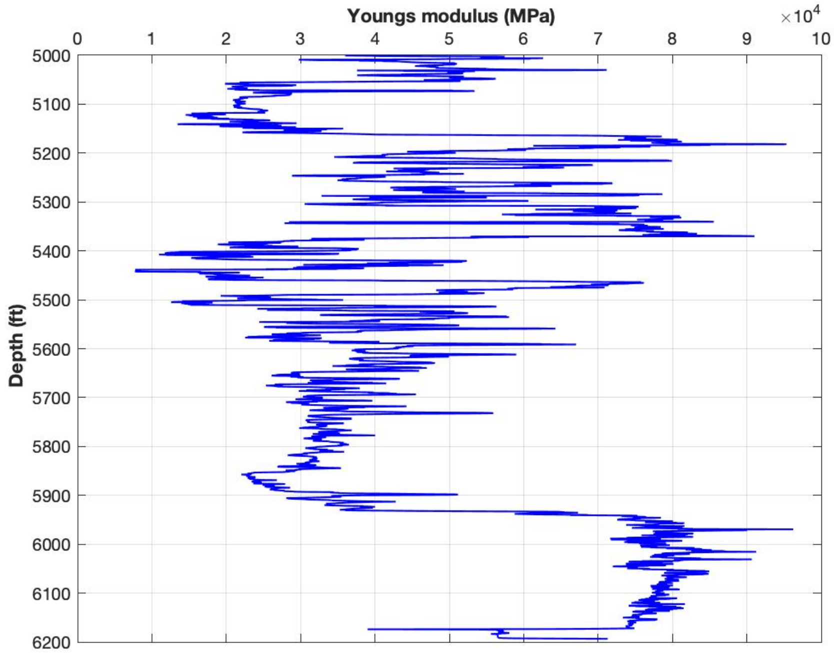
I. Estimate UCS for the given depths using known empirical relations

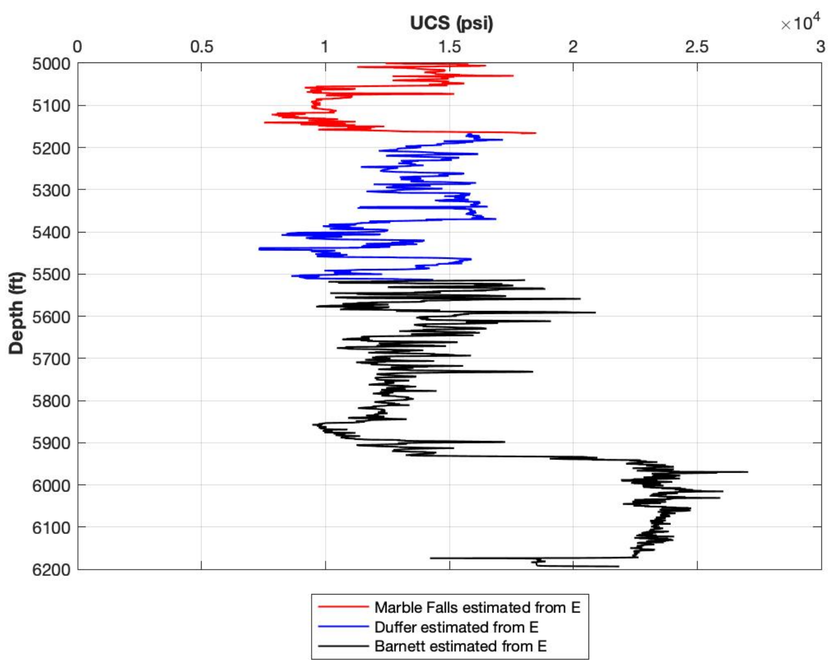
a. Examine log data.

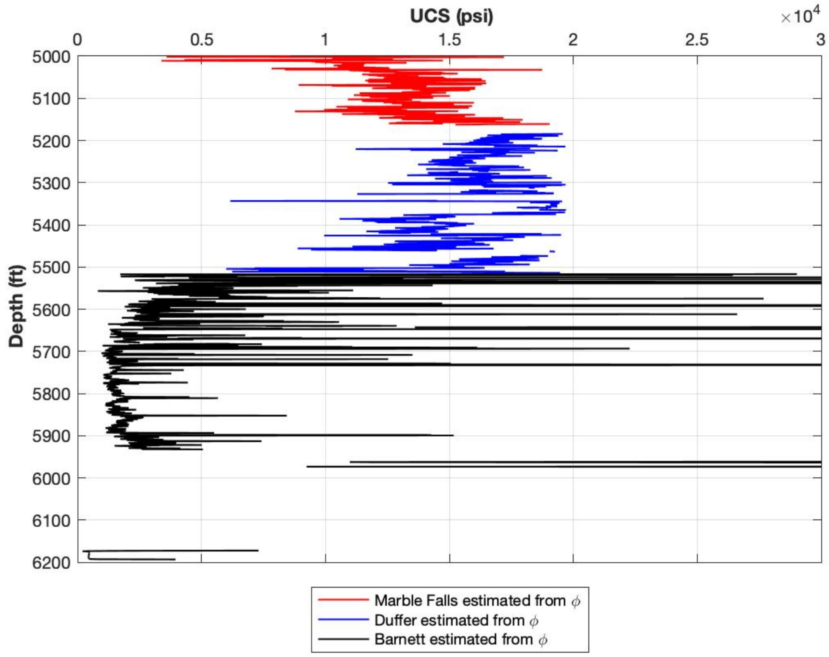






b. Estimate UCS for the given depths.





II. Answer questions

Question 1: Estimating a Unconfined Compressive Strength

a. What is a compressional wave velocity from sonic logs at a depth of 5080 feet in m/s?
   3540 +- 354

b. What is a shear wave velocity from sonic logs at a depth of 5465 feet in m/s?
   3280 +- 984

c. What is a Youngs modulus at a depth of 5800 feet in MPa?
   33390 +- 3339

d. What is the value of the unconfined compressive strength estimated from sonic logs for the Marble Falls Formation at 5080 feet depth in psi?
   11077 +- 1107.7

e. What is the value of the unconfined compressive strength estimated from density logs for the Marble Falls Formation at 5080 feet depth in psi?
   13987 +- 2797.4

f. What is the value of the unconfined compressive strength estimated from sonic logs for the Duffer Formation at 5465 feet depth in psi?
   15759 +- 3151.8

g. What is the value of the unconfined compressive strength estimated from density logs for the Duffer Formation at 5465 feet depth in psi?
22074 +- 8829.6

h. What is the value of the unconfined compressive strength estimated from sonic logs for the Barnett Formation at 5800 feet depth in psi?
12733 +- 1273.3

i. What is the value of the unconfined compressive strength estimated from density logs for the Barnett Formation at 5800 feet depth in psi?
1884 +- 565.2

Question 2.a:

>>As we <u> begin</u> to axially compress a cylindrical sample of rock, small cracks inside the rock begin to close and the stress-strain relation is :<<
( ) Linear and irreversible
( ) Linear and reversible
( ) Non-linear and irreversible
(x) Non-linear and reversible

[explanation]
In the beginning of an axial deformation experiment, small cracks in the rock will close as the applied stress increases. This appears as a non-linear strain response. However, once the sample is unloaded, the cracks will open again, so the effect is reversible.
[explanation]

Question 2.b:

>>How many elastic moduli (minimum number) are needed to completely describe a material that is isotropic and homogeneous?<<
( ) Four
( ) Three
(x)Two

[explanation]
For isotropic materials, there are 2 independent elastic moduli. If you know two elastic moduli, you can compute the others. Materials that are anisotropic have a larger number of independent stiffness coefficients depending on the degree of symmetry.
[explanation]

Question 2.c:

>> Assume that you are given values of an elastic moduli (or P wave velocity) for the same rock measured by a number of methods (at different scales). The "stiffest" value of the elastic moduli (or the fastest velocity) is likely to correspond to which of the following measurement/data type? Assume a constant fluid viscosity. <<
( ) Sesismic data with a frequency of 50 Hz
( ) Sonic log with a frequency of 20 kHZ (20000 Hz)
(x) Ultrasonic mesaurement with a velocity of 1 MHz (1000000 Hz)

[explanation]
High frequency data often give a higher stiffness value due to diespersion. Thus, high frequency measurement at the lab scale often give an anomalously high stifness value compared to insitu conditions as indicated by low frequency data such as a seismic survey. See the curves on slide 13 of the lecture 4 pdf.
[explanation]