Applied Geophysics – GEO 5660/6660
Lab Exercise # 4: Seismic Reflection
### *Due: Wednesday, March 18ᵗʰ, 5 PM*
(Email lab write-ups to rgmcdermott@aggiemail.usu.edu)

1.) The seismogram below is synthetic and generated from a model velocity structure. There are *four primary reflections* present in the data. *For 3 of these reflectors*, pick 10 travel times **each** at different distances (guess-timate as best you can). Plot x^2 vs. t^2, and estimate velocities and thicknesses from each reflector from the slope and y-intercepts, assuming each reflection is from a single-layer interface over a half-space.

For the line-fit regression estimate of slope/intercept, use Excel, or a software of your choice (Matlab, Python, etc.). You can even do this by hand calculator or on graph paper if you prefer. In the latter case, the most common approach (in the absence of measurement uncertainties) is the method of least-squared misfit of the measurements to the line. Given $y = mx + b$ with slope m and intercept b, the least-squares line fit is given by (for *n* measurements, denoted by subscript *i*):

$$ m = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{n\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2} \qquad b = \frac{\sum_{i=1}^{n} y_i - m\sum_{i=1}^{n} x_i}{n} $$
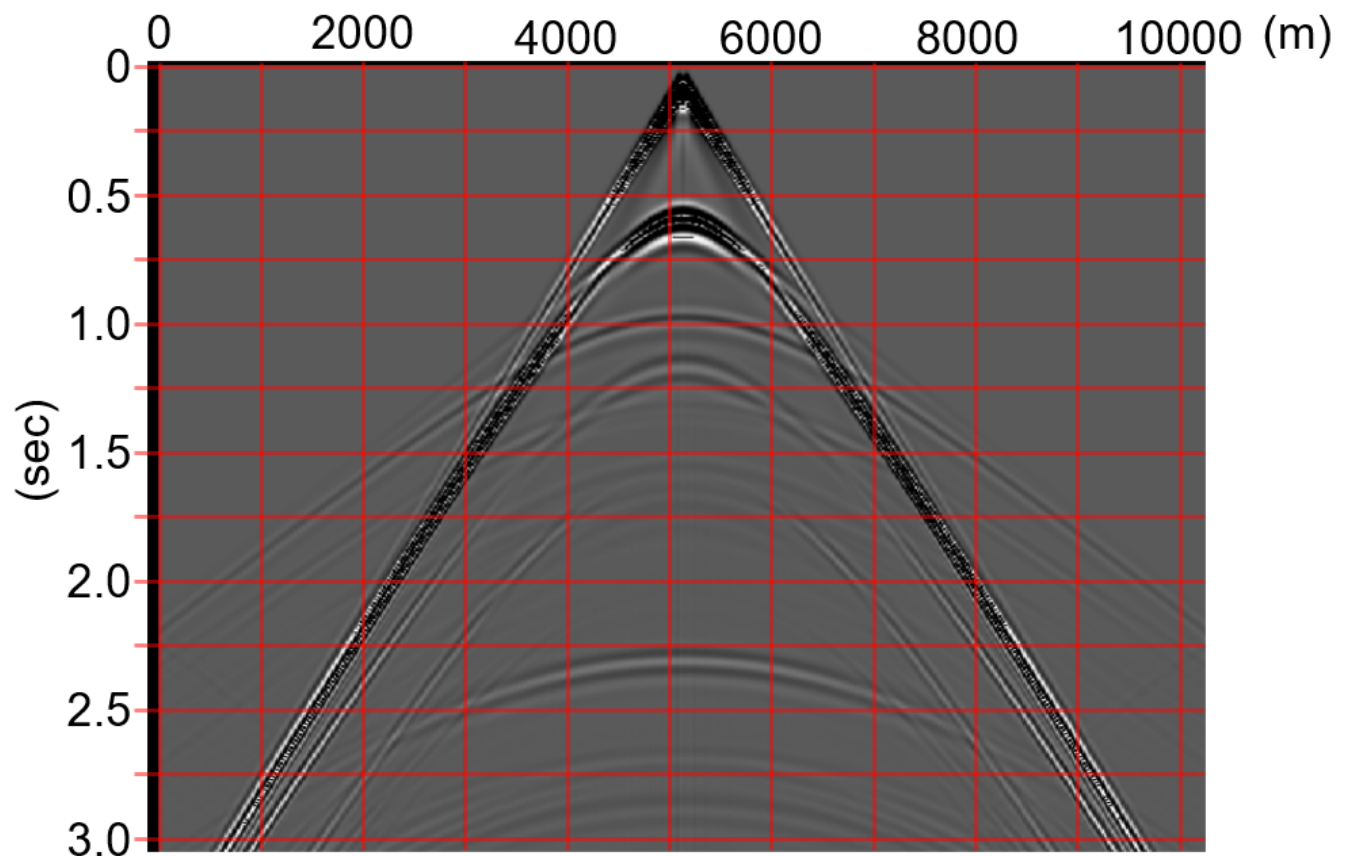
2. Repeat steps in question 1 above for **one** of the multiple reflections.

3. <u>Without using Reflect</u>, use the slopes and y-intercepts of your lines above with Dix equations to estimate the velocity and thickness of each layer.

4. Do similar calculations as in 3, but this time instead of using V^2_{rms} taken from the inverse slope of x^2-t^2, use the first order T_{NMO} relation (i.e., the inverse slope of a line fit to a plot of T_{NMO} versus $x^2/2t_0$). How does this change your inferred velocities and layer thicknesses? Which is likely to be more accurate and why?

(Notation note: V^2_{rms}=root mean squared velocity, T_{NMO}=normal move-out time, t0=travel time at x=0 (or square root of y-intercept on x^2-t^2 plot).

5. Now plug your travel-time picks into **_Reflect_** and calculate a model of velocities and thicknesses. How does this compare to your "hand-calculated" models?

6. Create a record-section plot for all of the arrivals using **_Reflect_** and compare/contrast with the synthetic record section from which you derived your travel-times. Why do you suppose they might be different?

REPORTS: Your reports should include any relevant plots, numerical data and short blurbs (nothing formal) for where you are asked to comment. Submit your assignment as a single document (Word, PDF, etc). **_Include your name in the filename._**