
First Name

Last Name

CE 80N Lab 2, Due April 12, 2016

Question 2 requires using the Excel spreadsheet.

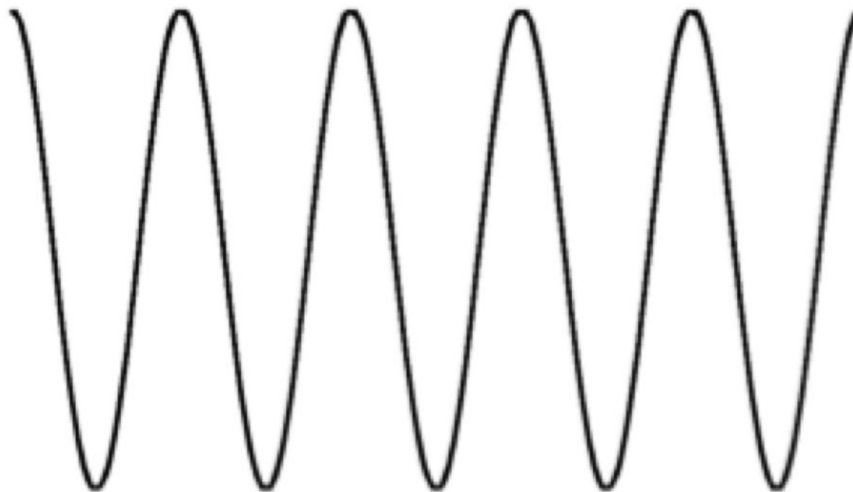
1. (5 point) **Sampling and Quantization Basics** Standard terminology and understanding
 - (a) *Frequency* is expressed in what terms? (give name) _____
 - (b) The Nyquist sample rate is at **what multiple** of a signal's frequency? _____
 - (c) What is the minimum sampling rate required to replicate a signal of 2500Hz? _____
 - (d) If a signal range is -5v to 5v, with a resolution of 0.5v, how many levels are represented?

 - (e) For above, with a signal range of -5v to 5v, with a resolution of 0.5v, how many **bits, not levels** are needed to represent this range? _____

2. (10 points) **Nyquist frequency** - Use the EXCEL spreadsheet for this!

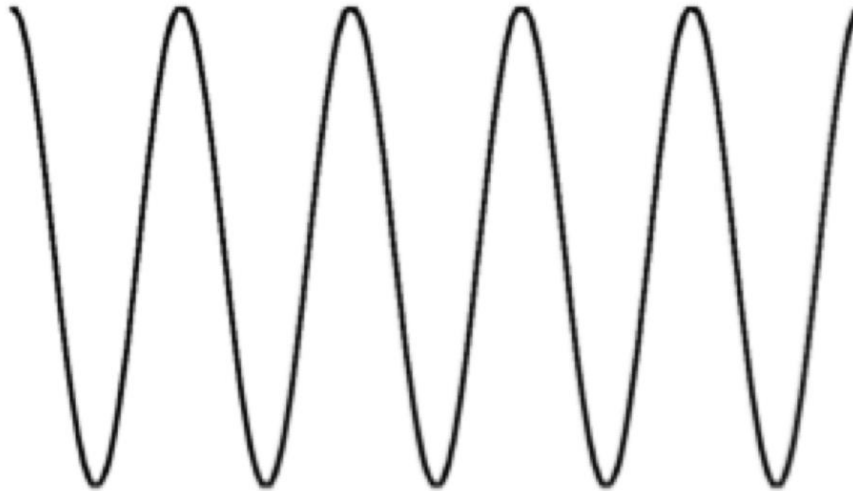
You have just been hired by 'wesayso' corporation. Your new boss (any resemblance to the pointy haired boss in dilbert is purely coincidental ...) wants to start a phone service on the internet, and puts you in charge (aka to take the blame if it fails). To save bandwidth and maximize profits, he wants you to sample a 500 Hz signal.

- (a) He suggest you sample the waveform at 500 samples per second. **In the spreadsheet, enter 500 in the green box that is next to *signal frequency*, and enter 500 in the green box that is next to sample rate. Mark the waveform below with the resulting samples (red dots) and the red square wave shown in the Excel file.**

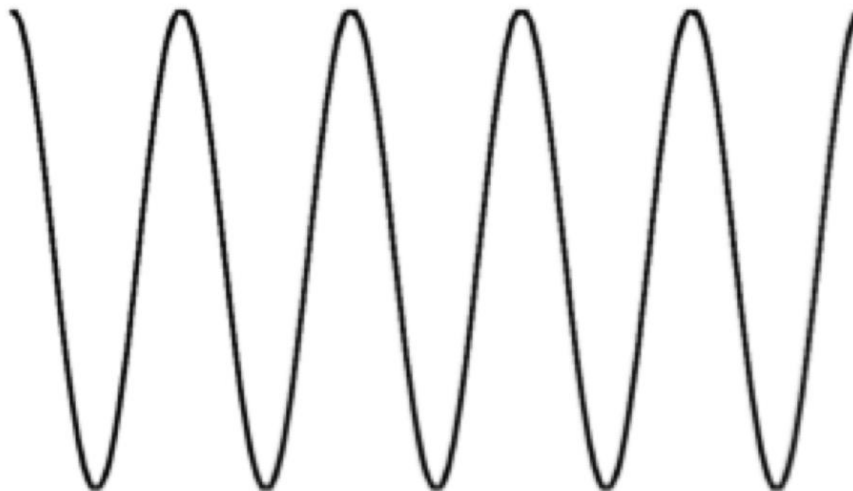


(b) Is the sampling rate sufficient to reproduce the main frequency of the signal?

(c) Try the Nyquist sampling rate, leaving the *signal frequency* as 500 Hz, but enter the Nyquist rate in the green box next to *sample rate*. Mark the waveform below with the samples (red dots) and the red wave as shown in the Excel file.



(d) Obviously, your boss is smarter than you, otherwise he wouldn't be the boss! He decides to save money by using 900 samples per second, as it is 'close enough'. **Change the sampling to 900 per second.** Mark the waveform below with the samples (red dots) and the red wave, as shown by the Excel file.



(e) Is your boss' idea to use 900 samples per second sufficient to reproduce the original signal? What do you see?

3. (5 points) Quantization: ADC

Below is a signal that is varying over time, from -1.0 volts to 1.0 volts. Using a resolution of 200mv quantization, and a sampling interval of 1 millisecond (ms), draw a digitized (square wave) version of the signal below.

