18.310 Homework # 4 **Due Wednesday, October 1, 2008**

(Spreadsheet homework problems should be sent electronically
Other homework problems can be turned in either electronically (best) or should
be turned in to the UMO by 4pm on the due date. Don't forget to point out where
everything is at the top of the spreadsheet.

1: Write a one to two page essay explaining Shannon's first and second
theorems (coding for efficiency and coding for error correction). What do they
have in common?
There should be a brief introduction, and it should be typeset or word processed.
Equations should either be typeset in LaTeX or composed using an equation
editor (one is included with Word and with OpenOffice) or with other
mathematical typesetting software.

2a: Suppose you have a coin which has probability p of heads and probability 1-p
of tails. You toss it N times, independently. Give a formula for the probability that
there are exactly Nq heads (and therefore N(1-q) tails).
2b: Take the above expression and use Stirling's formula to approximate it into
as simple a formula as you can find.
2c: For N = 100, substitute p = 0:55 and q = 0:5; 0:55; 0:6; 0:65, into the above
expression
(or estimate their values from a plot). Do the same thing for N = 10,000, and the
values p = 0:55 and q = 0:55; 0:555; 0:56; 0:57. What is the expectation and
mean square deviation of the number of heads for a coin with probability of
heads 0:55 and for the number of coin is N = 100 and 10; 000?

3a: Using a spreadsheet, construct a Hamming code that encodes 11 bits into 15
and corrects one error.
3b: On the spreadsheet, construct an encoder for your code.
3c: On the spreadsheet, construct a decoder for your code. This should allow you
to input any message with a single error, and output the message with the error
corrected.