Sheet 7

Prob1

Consider the design of the U.S. digital cellular equalizer [Pro91]. If f = 900 MHz and the mobile velocity v = 80 km/hr, determine the following:
(a) the maximum Doppler shift
(b) the coherence time of the channel
(c) the maximum number of symbols that could be transmitted without updating the equalizer, assuming that the symbol rate is 24.3 ksymbols/sec

Prob2

Consider a single branch Rayleigh fading signal has a 20% chance of being 6 dB below some mean SNR threshold.
(a) Determine the mean of the Rayleigh fading signal as referenced to the threshold.
(b) Find the likelihood that a two branch selection diversity receiver will be 6 dB below the mean SNR threshold.
(c) Find the likelihood that a three branch selection diversity receiver will be 6 dB below the mean SNR threshold.
(d) Find the likelihood that a four branch selection diversity receiver will be 6 dB below the mean SNR threshold.
(e) Based on your answers above, is there a law of diminishing returns when diversity is used?

Prob3

Assume four branch diversity is used, where each branch receives an independent Rayleigh fading signal. If the average *SNR* is 20 dB, determine the probability that the *SNR* will drop below 10 dB. Compare this with the case of a single receiver without diversity.

Prob4

Compare $\bar{\gamma}/\Gamma$ (selection diversity) with γ_M/Γ (maximal ratio combining) for 1 to 6 branches. Specifically, compare how the average SNR increases for each diversity scheme as a new branch is added. Does this make sense? What is the average SNR improvement offered by 6-branch maximal ratio combining as compared to 6-branch selection diversity? If $\gamma/\Gamma = 0.01$, determine the probability that the received signal will be below this threshold for maximal ratio combining and selection diversity (assume 6 branches are used). How does this compare with a single Rayleigh fading channel with the same threshold?