ECE 371 **Spring 2001**

Handout # 6 April 3, 2001

HOMEWORK ASSIGNMENT 4

Reading: Class notes pages 79-126, and papers referenced in notes.

Due Date: Tuesday, April 10, 2001 (in class)

1. *CDMA forward link capacity analysis.* Derive the expressions for $E[X]$ and $\mathrm{Var}(X)$ given on page 91 (slide 26) of the notes.

2. *Other-cell interference on CDMA forward link.* Describe how you might estimate m_y and σ_y^2 via simulation.

3. *Lognormal approximation in CDMA capacity-coverage analysis.* Consider the information bit SIR equation from page 96 of the notes:

$$\gamma_{\mathrm{b},1}^{\star} = \frac{\frac{S_1^{\star}}{R}}{\sum_{i=2}^{k} \frac{\nu_i S_i^{\star}}{W} + N_0 + I}$$

   Assume that $\{S_j^{\star}\}_{j=1}^{k}$ are i.i.d. lognormal random variables, and further assume that these random variables are mutually independent of $\gamma_{\mathrm{b},1}^{\star}$. We can rewrite the above equation as

$$\gamma_{\mathrm{b},1}^{\star} \left[\sum_{i=2}^{k} \frac{\nu_i S_i^{\star}}{W} + N_0 + I \right] = \frac{S_1^{\star}}{R} \,. \tag{1}$$

   Taking expectations on both sides of (1), derive the expression for $m_S(k)$ given on page 100 of the notes. Then, square both sides of (1), and take expectations to obtain the expression for $\delta_S(k)$.

4. Explain how you might use the CDMA capacity-coverage analysis to design an admission policy for CDMA systems.

5. Derive the expressions for $\mathrm{E}[X_{k+1}^{(i)}|I_k]$ and $\mathrm{Var}[X_{k+1}^{(i)}|I_k]$ given on page 111 (handoff slide 13) of the notes. You may want to use the fact that

$$Z_{k+1}^{(i)} = a Z_k^{(i)} + \sigma_Z \sqrt{1-a^2}\, W_{k+1}^{(i)} \,, \quad \text{with } Z_0^{(i)} = \sigma_Z W_0^{(i)}$$

   where $\{W_k^{(i)}\}$ is a sequence of i.i.d. $\mathcal{N}(0,1)$ random variables.

6. Set up the soft handoff tradeoff problem in a manner similar to how we set up the hard handoff tradeoff problem in class, clearly indicating your reasons for choosing the various cost functions.

7. Consider a CDMA cell with 30 users. Suppose the voice activity factor equals 0.5 for each user. Further assume that for all users, $\Gamma_{i,\mathrm{th}} = -14$ dB (this corresponds to an $\mathcal{E}_\mathrm{b}/I_0$ of 7 dB for $W/R = 128$). Is the power control problem feasible? If your answer is yes, find the received powers $Y_i^{\star}$ that achieve $\Gamma_{i,\mathrm{th}}$. Assume that $\psi = 10^{-5}$ mW.