Electrical and Computer Engineering **Dr. Mohamed N. Ahmed**
University of Louisville **Summer 2008**

ECE620: Hw # 2

Due date: June 12, 2008

1. N samples are drawn independently from a univariate normal density with unknown mean and variance. Obtain a maximum-likelihood estimate of the unknown parameters.

2. Repeat (1) for the case of 2D normal with unknown mean and covariance $\boldsymbol{\mu}, \boldsymbol{\Sigma}$.

3. Let x have an exponential density

$$p(x/\theta) = \begin{cases} \theta e^{-\theta x} & x \geq 0 \\ 0 & otherwise \end{cases}$$

Suppose that n samples $x_1, ..., x_n$ are drawn independently according to $p(x/\theta)$. Show that the maximum-likelihood estimate for θ is given by

$$\hat{\theta} = \frac{1}{\frac{1}{n}\sum_{k=1}^{n} x_k}$$

4. In the following HMM

$$A = [a_{ij}] = \begin{bmatrix} 0.8 & 0.1 & 0.1 \\ 0.4 & 0.2 & 0.4 \\ 0.6 & 0.1 & 0.3 \end{bmatrix} \text{ and } B = [b_{jk}] = \begin{bmatrix} 0.3 & 0.7 \\ 0.4 & 0.6 \\ 0.8 & 0.2 \end{bmatrix}$$

a) Draw the HMM Diagram.
b) Using the Forward HMM (trellis) algorithm, calculate $P(\mathbf{V}^T) = P(V_1 V_2 V_2 V_1 V_1)$ assuming that we started at state 1. Explain all steps.
c) What is the most likely sequence of states in (a)?