Department of Electrical & Computer Engineering
University of California, Santa Barbara

ECE 240A
Winter 2010
Shynk
H.O. #2

ECE 240A OPTIMAL ESTIMATION AND FILTERING

TENTATIVE COURSE OUTLINE

LINEAR MODEL (Lesson 2)

- State-space formulation
- Random and deterministic signals
- Autoregressive model
- Moving average model
- Filtering, smoothing, and prediction

LEAST-SQUARES ESTIMATION (Lessons 3, 4, and 5)

- Batch processing
- Orthogonality condition
- Singular value decomposition
- Recursive processing
- Information and covariance forms
- Initial conditions

PROPERTIES OF ESTIMATORS (Lessons 6, 7, 8, and 9)

- Small-sample properties
- Unbiasedness and efficiency
- Cramer-Rao inequality and Fisher's information
- Large-sample properties
- Stochastic convergence and consistency
- Properties of least-squares estimators
- Best linear unbiased estimation

SUFFICIENT STATISTICS (Lesson A)

- Factorization theorem
- Exponential families of distributions
- Complete and sufficient statistics
- Uniformly minimum-variance unbiased estimation

MAXIMUM LIKELIHOOD (ML) ESTIMATION (Lessons 10, 11, and 12)

Likelihood ratio
Multiple hypotheses
Maximum-likelihood method
Log-likelihood function
Multivariate Gaussian random variables

MEAN-SQUARED (MS) ESTIMATION (Lesson 13)

Mean-square error
Orthogonality principle
Conditional mean estimator
Nonlinear estimation

MAXIMUM A POSTERIORI (MAP) ESTIMATION (Lesson 14)

Bayesian estimation
Conditional likelihood function
Detection theory
Comparison of ML, MS, and MAP estimation

STATE ESTIMATION (Lessons 15 and 16)

Gauss-Markov random sequences
State-variable model
Single-stage predictor
Innovations process
State prediction, filtering, and smoothing

KALMAN FILTER (Lessons 17, 18, 19, 20, and 21)

Recursive estimation
Properties of Kalman filter
Whitening filter
Steady-state Kalman filter
Relationship to Wiener filter
Smoothing: fixed interval, fixed point, and fixed lag