

Guide for MMA (STS) - Winter 2020

1. Introduction

- (a) Basic information about the subject
- (b) Probability notions
Random variable, vector; Distribution (joint, marginal, conditional); Independence; Basic characteristics; Random process; Categorical, normal distribution
- (c) System - model
- (d) Differential equations
First and second order equation; Solution; Discretization

2. Model

- (a) Regression model
Equation; Normal regression model
- (b) Regression model in a state form
- (c) Discrete model
Definition; Model matrix; Examples of discrete model; Generation in Scilab
- (d) Logistic model
Definition; Logistic function

3. Estimation (I)

- (a) Bayes rule
Basic notions; Types of distributions (prior, posterior, model)
- (b) Application of Bayes rule
Remarks to estimation: Natural conditions of control; Batch estimation; Self-reproducing prior; Results of estimation

4. Estimation (II)

- (a) Regression model
Model; Prior pdf; Posterior; Statistics; Recursion for statistics; Results of estimation
- (b) Batch estimation of regression model

5. Estimation (III)

- (a) Categorical (discrete) model
Model; Prior pdf; Posterior; Statistics; Recursion for statistics; Results of estimation
- (b) Logistic regression
Model; Likelihood

6. Prediction (I)

- (a) Definition of k -step prediction

(b) Prediction with regression model

Zero step prediction

Predictive pdf; Point prediction

One step prediction

Predictive pdf - construction

7. Prediction (II)

Multi step point prediction

Full prediction with normal regression model

(a) Prediction with discrete model

Zero step prediction

Multi step prediction for model with square matrix

8. State estimation (I)

(a) State-space model

Model in pdf; Model equations

(b) State estimation in pdf

State description; Evolution of state description

(c) Kalman filter

9. State estimation (II)

(a) Nonlinear state-space model

Linearization; Parameter matrices of linearized model

(b) Model with unknown parameter

10. Control (I)

(a) Control interval

(b) Criterion on control interval

Penalization of y^2 , only; One step control; Penalization $y_t^2 + \omega u_t^2$ or $y_t^2 + \lambda (u_t - u_{t-1})^2$;

Multi step control

(c) Bellman equations

11. Control (II)

(a) Control algorithm for regression model

(b) Control with categorical model

12. Adaptive control

Optimality; Receding horizon