

## Statistical Modelling Exercises

The following exercises should be performed in Matlab.

### Trajectory Generation

Generate an ideal deterministic (without any noise disturbances) constant velocity trajectory in two dimensions with position and velocity components ( $\mathbf{x}_k = (x, y, \dot{x}, \dot{y})$ ). Use discrete time steps of  $T = 1$  second for a total of 60 seconds. Start at the origin with a y velocity of 10.

1. Make a plot of the trajectory.

Generate a nearly constant velocity trajectory (with noise disturbances – continuous white noise acceleration) with a process noise intensity of  $\tilde{q} = 0.1$  using the same state vector and starting state as the previous exercise.

**HINT:** To generate a random vector from a multivariate normal distribution using `mvnrnd`

2. Generate four random trajectories and add them to the plot from (1) of the deterministic trajectory.

For a single trajectory from exercise 2, generate a measurement of the object at each time step.

Measurements are positions  $\mathbf{z}_k = (x, y)'$ , measurement error standard deviation  $\sigma_x = \sigma_y = 5$  and so

$$\mathbf{R} = \begin{bmatrix} \sigma_x^2 & 0 \\ 0 & \sigma_y^2 \end{bmatrix}$$

3. Produce a plot showing a single trajectory from 2 as well as measurements