

**(13) Bayesian filtering**

## STUDY QUESTIONS

1. Write down the definition of a probabilistic state space model.
2. Write down the definitions of the predicted, filtered, and smoothed distributions for a probabilistic state space model.
3. Write down the prediction and filtering equations for a probabilistic state space model.
4. Write down the smoothing equation for a probabilistic state space model.
5. Write down the definition of a linear Gaussian state space model.
6. Write down the definition of the Kalman filter.
7. Write down the definition of the Rauch-Tung-Striebel smoother.

## EXERCISES (THEORY)

1. Derive the parameters of the predicted distributions of the Kalman filter ([Lecture slides](#)).
2. Derive the parameters of the filtered distributions of the Kalman filter ([Lecture slides](#)).
3. Derive the parameters of the smoothed distributions of the RTS smoother ([Lecture slides](#)).

## EXERCISES (PROGRAMMING)

1. Evaluate the sum of squared deviations of the filtered distribution expectation parameters from the true, but unknown, state values as a function of the transition and observation variance parameters, respectively, for the latent Gaussian walk model using the exemplary code provided with the lecture.
2. Using the exemplary code provided with the lecture, evaluate the variance parameters of the filtered and smoothed distributions as functions of the transition and observation variance parameters, respectively, for the latent Gaussian walk model using the exemplary code provided with the lecture.