1. First
2. Second
3. Sum of the RVs

3.1 Since are independent,

3.2 Differentiate w.r.t “a”

Hence

3.3 Since

3.4 Likewise

3.5 Since

Hence the gain

The Kalman gain is by the formula

Which is equivalent to the (1)

1. Conditional

4.1 Since

4.1

4.2 marginal

4.3 Since

And if

hence

4.4 Since

And