# 10. Exercise: The mean-squared error

Exercises due Apr 8, 2020 05:29 IST *Completed*

## Exercise: The mean-squared error

1/1 point (graded)

In this exercise we want to understand a little better the formula

$$\frac{1}{\sum_{i=0}^{n} \frac{1}{\sigma_i^2}}$$

for the mean squared error by considering two alternative scenarios.

In the first scenario, $\Theta \sim N(0,1)$ and we observe $X = \Theta + W$, where $W \sim N(0,1)$ is independent of $\Theta$.

In the second scenario, the prior information on $\Theta$ is extremely inaccurate: $\Theta \sim N(0, \sigma_0^2)$, where $\sigma_0^2$ is so large that it can be treated as infinite. But in this second scenario we obtain two observations of the form $X_i = \Theta + W_i$, where the $W_i$ are standard normals, independent of each other and of $\Theta$.

The mean squared error is

- ○ smaller in the first scenario.
- ○ smaller in the second scenario.
- ◉ the same in both scenarios.

✔

**Solution:**

We use the formula for the mean squared error. For the second scenario, we set $\sigma_0^2 = \infty$. In the first scenario, we obtain

$$\frac{1}{\frac{1}{1}+\frac{1}{1}} = \frac{1}{2},$$

and in the second scenario, we obtain the same mean squared error:

$$\frac{1}{\frac{1}{\infty}+\frac{1}{1}+\frac{1}{1}} = \frac{1}{2}.$$

This suggests the following interpretation: the prior information on $\Theta$ in the first scenario is, in a loose sense, exactly as informative as having no useful prior information but one more observation, as in the second scenario.

Submit You have used 1 of 1 attempt

Answers are displayed within the problem

## Discussion

Hide Discussion

**Topic:** Unit 7: Bayesian inference:Lec. 15: Linear models with normal noise / 10. Exercise: The mean-squared error

Show all posts by recent activity

Questions like this I find are really counter productive to learning. 4

I've gone through it... obviously got it wrong and spent a lot of time on it. Finally, after reading the comm...

When would we be on the case when all variance for different observations remains the same? 2

I was very puzzled with the solution, I have to confess. I assumed we were on the special case described

argh :(
I assumed 2 trials for the first one as well
1

Hint
Note the Variances are **not** the same in the second scenario. Just try adding up the values of the vari...
1

Number of observations
In the first scenario, the language of the problem was unclear to me how many observations were being ...
3 new

Not that misleading
While I'd agree that there have been a number of misleading questions throughout these MITx courses, I...
1

[Staff] Is $\sigma_0$ a real number?
2

Problem with low number of observations in each case
If the number of observations made in each case is low and the noise is random, wouldn't that throw off...
2