Statistics:

* Sample mean and variance

Let , be a i.i.d., random sample.

1. The sample mean: is an unbiased estimator of . We should remember is A RANDOM VARIABLE.

1.1 The mean of , sample mean

which implies, the sample mean is unbiased.

1.2 The variance of , the sample mean:

which implies, the number of sampling is large, the variance of the sample mean, the

uncertainty, is converge to zero.

1. Let’s define a Random variable as the sample variance,

Again is A RANDOM VARIABLE.

* 1. The mean of

Remember, by definition,

It is useful to know in equation (2)

,

implies:

And

Calculation: we need calculation the following equation

To simplify to calculate, first

Now

The (3) is

Together with (4), the mean of the sample variance is

In conclusion, the estimator of the sample variance is unbiased

Remark: the scale is not but

* The mean of the unbiased sample variance is

where

n =# of measurements, p = the number of unknown parameters. Why the scale is , rather

than or . We call “p” as a degree of freedom, The idea is let’s see the following

The number of unknown is two. If we have two measurements, and , we may have the exact estimator of . If the number of measurements is larger than two, we may have a regression equation but, two of three errors should be zeros, hence

The scale