Biofilm Example

In engineering and manufacturing processes, it is very important to maintain a small variability in the process outcome, and so estimating σ or σ^2 with confidence is important. The parameter σ, which quantifies the run-to-run variability of the process, is called the **repeatability standard deviation.** A process is said to be **repeatable** if σ is small.

For example, at the Center for Biofilm Engineering on MSU's campus, a laboratory method consists of growing a bacterial biofilm on a surface in a reactor system which provides a nutrient rich solution across the surface on which the bacteria grow.

After three experiments, the log(number of organisms / cm^2) of organisms on the surface is estimated to be: 7.13, 7.40, and 7.21.

a) Find the sample mean and sample standard deviation.

```
> ld=c(7.13,7.4,7.21)
> mean(ld)
[1] 7.246667
> sd(ld)
[1] 0.1386843
```

The **mean log density** of organisms per cm^2 on the surface is estimated to be 7.25.

The **repeatability standard deviation** is estimated to be 0.1387.

b) Find A 95% confidence interval for the true repeatability standard deviation.

```
# In R
> .1387*sqrt(c(2/qchisq(.975,2),2/qchisq(.025,2)))
[1] 0.0722153 0.8716927

# These critical values ought to agree with the chi-square table used in the textbook:
> qchisq(.025,2)
[1] 0.05063562

> qchisq(.975,2)
[1] 7.377759
```

c) Give a conclusion in terms of the problem.
We're 95% confident that the true repeatability standard deviation for the log density of biofilm bacteria for this laboratory method is between 0.07 and 0.87.