

## Quiz on Lesson 3

July 23, 2023

**Question 1.** Suppose that 10 replications of a particle filter, each using  $10^3$  particles, runs in 15 minutes with no parallelization. To look for a more precise likelihood evaluation, you consider running 20 replicates, each with  $10^4$  particles. How many minutes will this take, if you distribute the calculation across 4 cores?

- (A) 50
- (B) 60
- (C) 75
- (D) 120
- (E) 300

**Question 2.** A particle filter is repeated 5 times to evaluate the likelihood at a proposed maximum likelihood estimate, each time with  $10^4$  particles. Suppose the log likelihood estimates are  $-2446.0$ ,  $-2444.0$ ,  $-2443.0$ ,  $-2442.0$ ,  $-2440.0$ . Which of the following is an appropriate estimate for the log likelihood at this parameter value and its standard error.

- (A) Estimate =  $-2443.0$ , with standard error 1.0
- (B) Estimate =  $-2443.0$ , with standard error 2.2
- (C) Estimate =  $-2443.0$ , with standard error 5.0
- (D) Estimate =  $-2441.4$ , with standard error 2.2
- (E) Estimate =  $-2441.4$ , with standard error 1.4

**Question 3.** What is the log likelihood (to the nearest unit) of the Dacca cholera data for the POMP model constructed in pomp via

```
d <- dacca(deltaI=0.08)
```

with cholera mortality rate 8% per year, and other parameters fixed at the default values.

- (A) -3764
- (B) -3765
- (C) -3766
- (D) -3767
- (E) -3768

**Question 4.** Effective sample size (ESS) is one of the main tools for diagnosing the success of a particle filter. If you plot an object of class `pfilterd_pomp` (created by applying `pfilter` to a `pomp` object), the ESS is displayed. Suppose one or more time points have low ESS (say, less than 10) even when using a fairly large number of particles (say,  $10^4$ ). What is the proper interpretation?

- (A) There is a problem with data, perhaps an error recording an observation.
- (B) There is a problem with the model which means that it cannot explain something in the data.
- (C) The model and data have no major problems, but the model happens to be problematic for the particle filter algorithm.
- (D) At least one of `??`, `??` and `??`.
- (E) Either `??` or `??` or both, but not `??`. If the model fits the data well, the particle filter is guaranteed to work well.