

# CPSC 532W - Homework 6

Xiaoxuan Liang - 48131163

## 1. Code snippets:

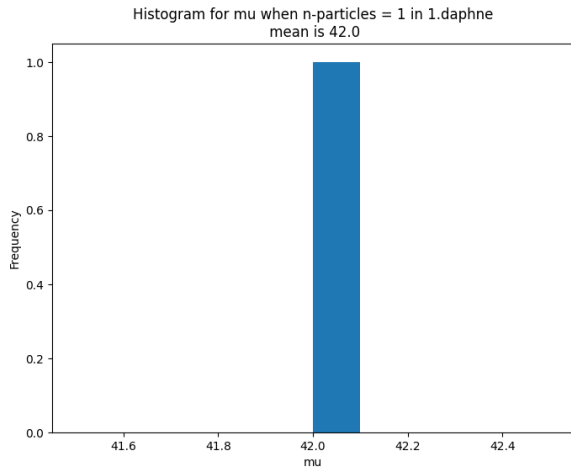
```
if type(exp) is list:
    op, *args = exp
    if op == 'sample':
        alpha = evaluate(args[0], env=env)
        d = evaluate(args[1], env=env)
        s = d.sample()
        k = evaluate(args[2], env=env)
        sigma = {'type': 'sample',
                 #TODO: put any other stuff you need here
                 'addr': alpha
                 }
        return k, [s], sigma
    elif op == 'observe':
        alpha = evaluate(args[0], env=env)
        d = evaluate(args[1], env=env)
        c = evaluate(args[2], env=env)
        k = evaluate(args[3], env=env)
        sigma = {'type': 'observe',
                 #TODO: put any other stuff you need here
                 'logW': d.log_prob(c),
                 'addr': alpha
                 }
        return k, [c], sigma

def resample_particles(particles, log_weights):
    new_particles = []
    weights = torch.exp(torch.FloatTensor(log_weights))
    normalization_weights = weights / torch.sum(weights)
    samples = torch.multinomial(normalization_weights, len(particles), True)
    for sample in samples:
        new_particles.append(particles[sample])
    logZ = torch.log(torch.mean(weights))

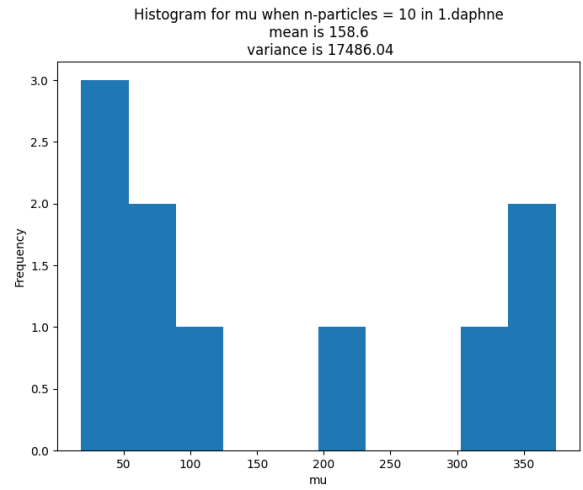
    return logZ, new_particles

else:
    #TODO: check particle addresses, and get weights and continuations
    particles[i] = res
    if i == 0:
        address = res[2]['addr']
    else:
        test_address = res[2]['addr']
        if test_address != address:
            raise RuntimeError("Failed SMC, different addresses")
    logW = res[2]['logW']
    weights[i] = logW
```

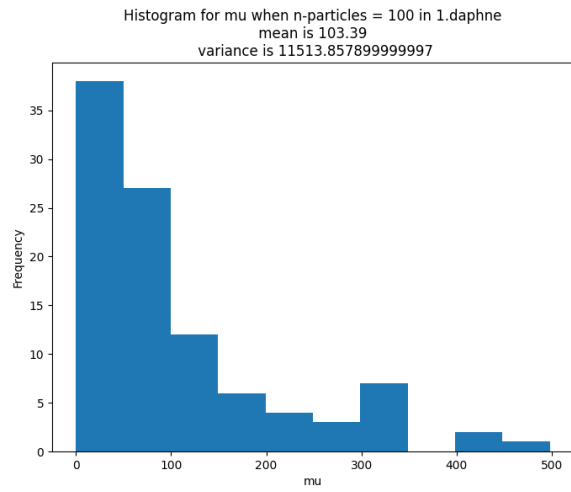
## 2. Program 1



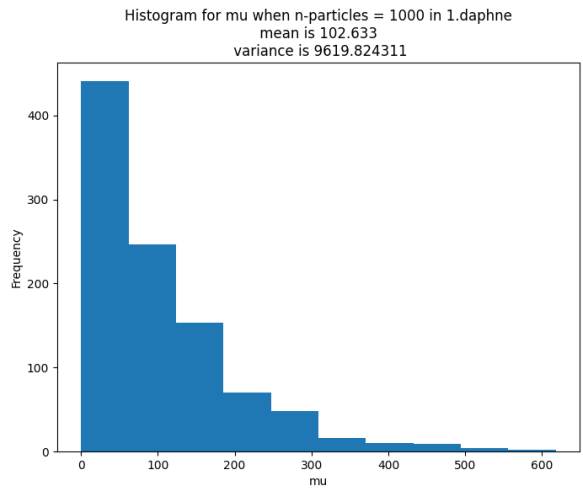
(a) Samples from the posterior for mu



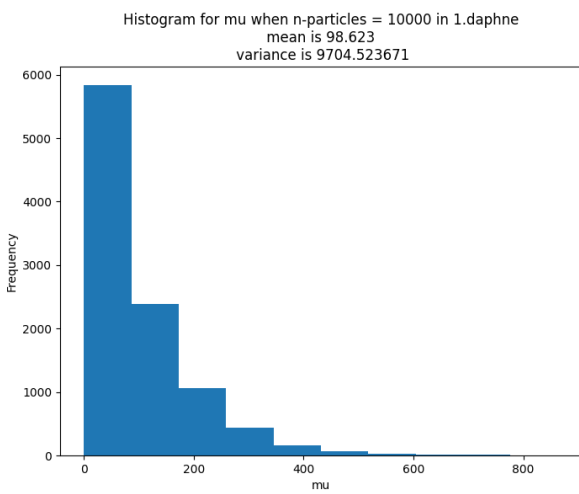
(b) Samples from the posterior for mu



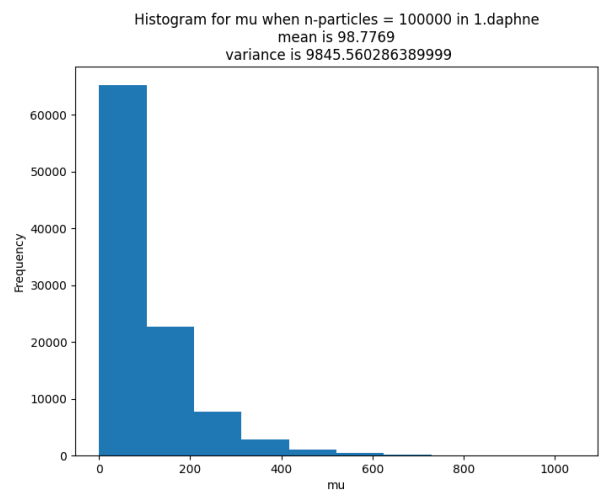
(c) Samples from the posterior for mu



(d) Samples from the posterior for mu



(e) Samples from the posterior for mu



(f) Samples from the posterior for mu

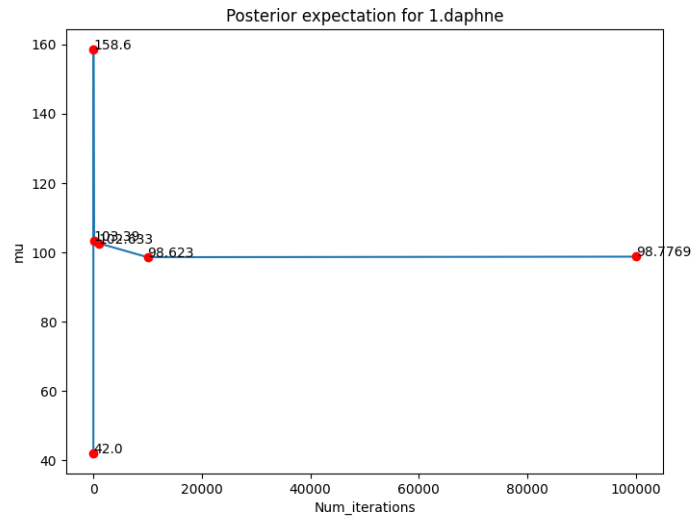
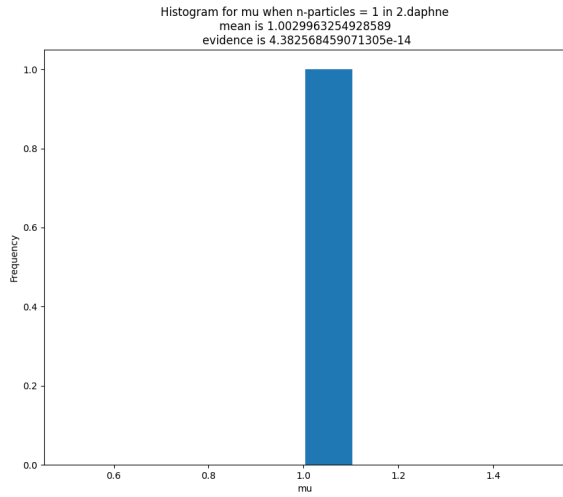
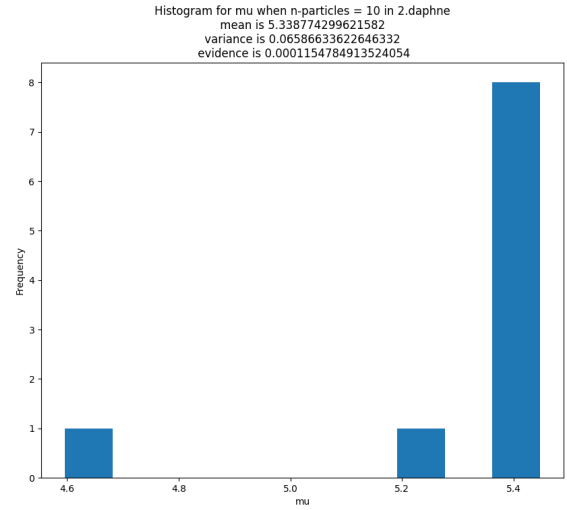


Figure 1: Trace plot for posterior expectations

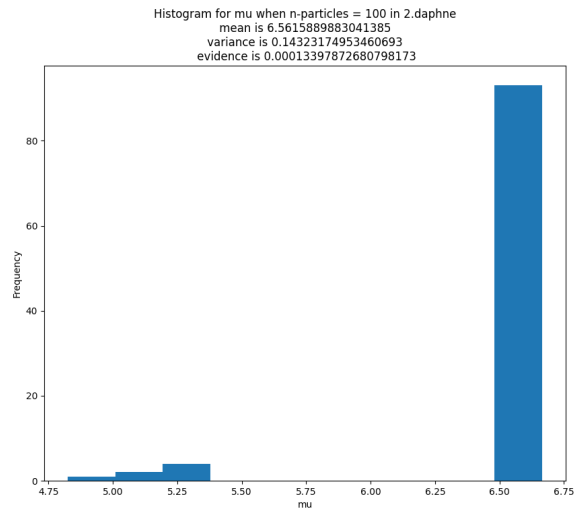
### 3. Program 2



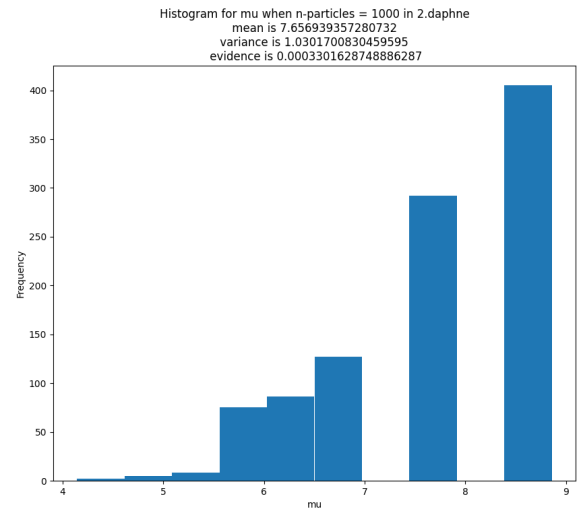
(a) Samples from the posterior for mu



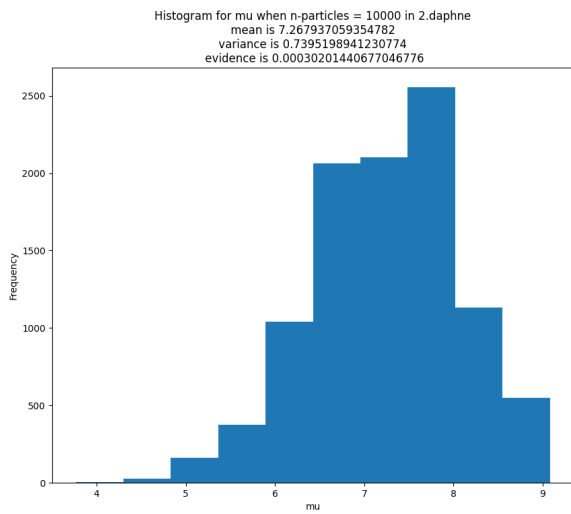
(b) Samples from the posterior for mu



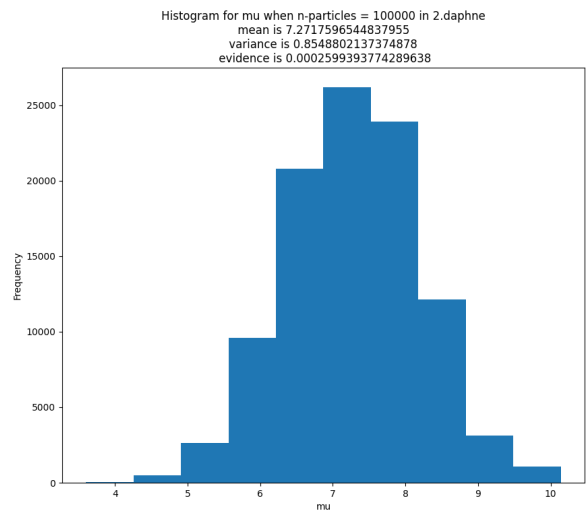
(c) Samples from the posterior for mu



(d) Samples from the posterior for mu



(e) Samples from the posterior for mu



(f) Samples from the posterior for mu

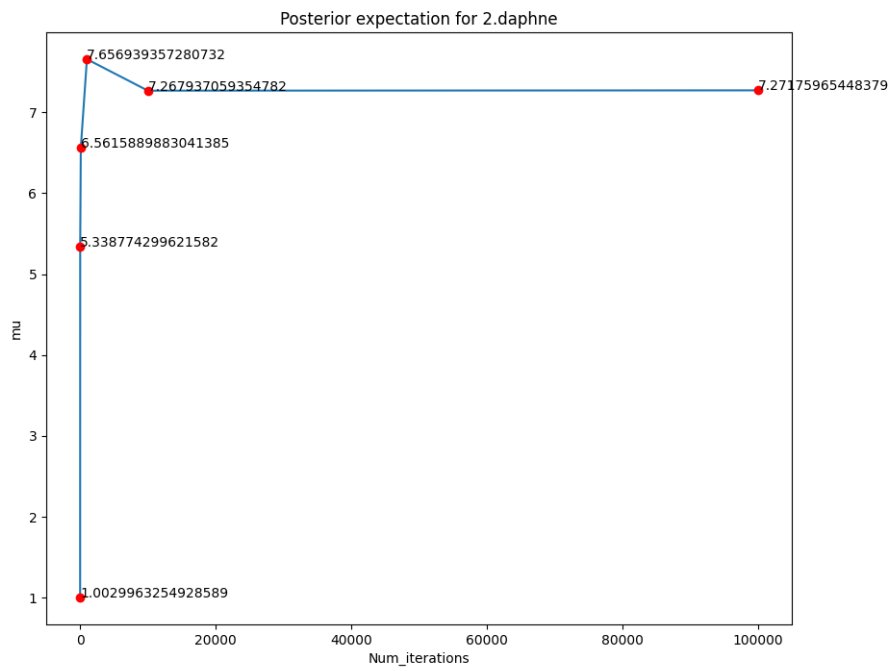


Figure 2: Trace plot for posterior expectations

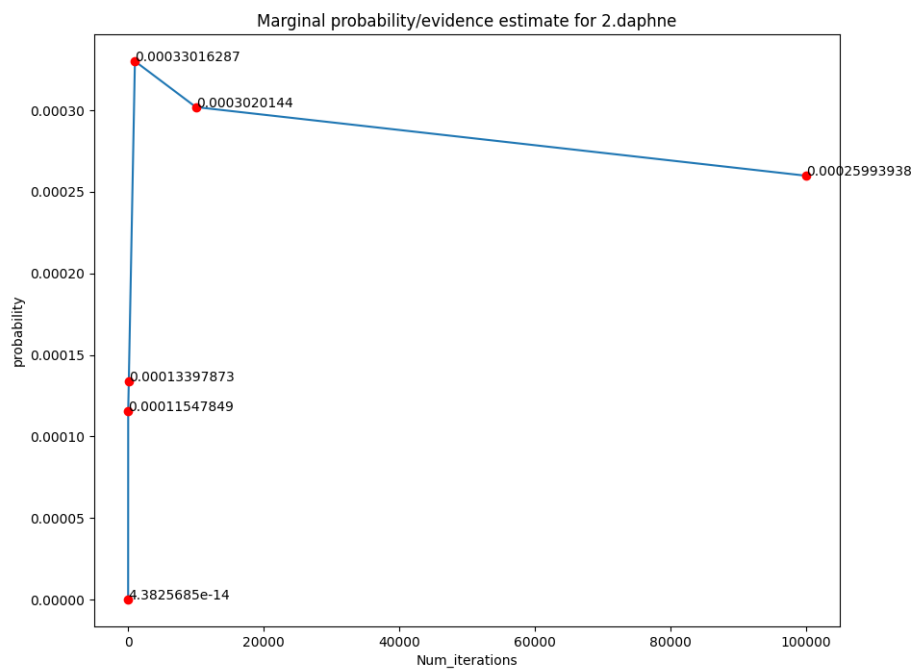
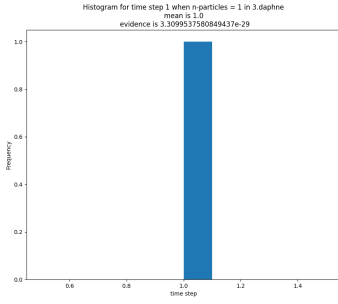


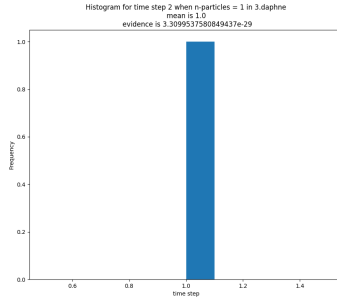
Figure 3: evidence plot

#### 4. Program 3

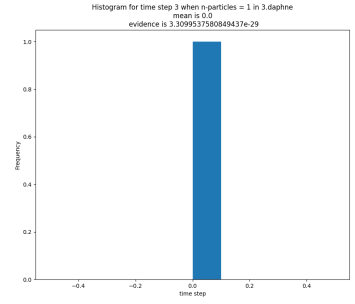
- when n-particles = 1:



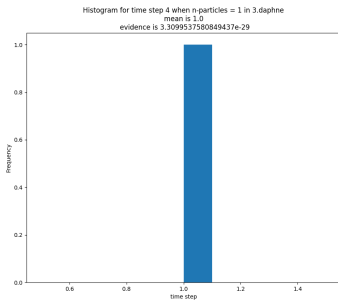
(a) Samples from the posterior for time step



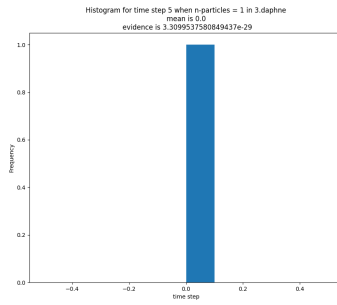
(b) Samples from the posterior for time step



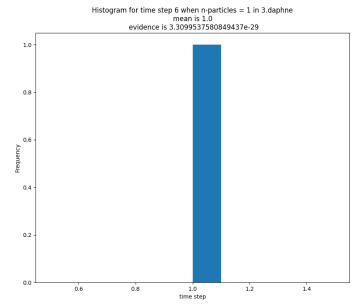
(c) Samples from the posterior for time step



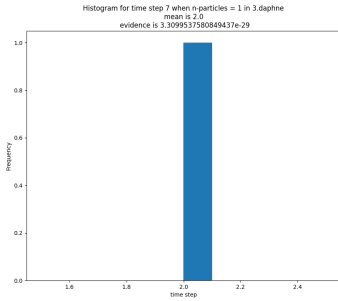
(d) Samples from the posterior for time step



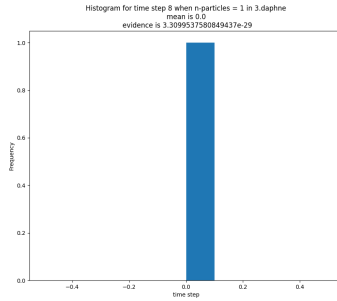
(e) Samples from the posterior for time step



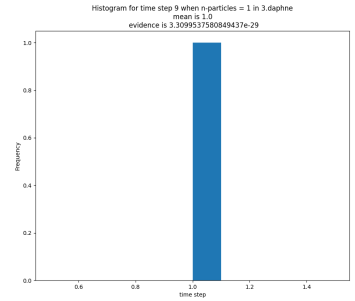
(f) Samples from the posterior for time step



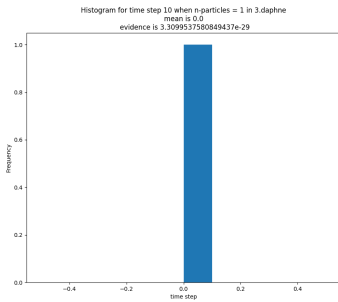
(g) Samples from the posterior for time step



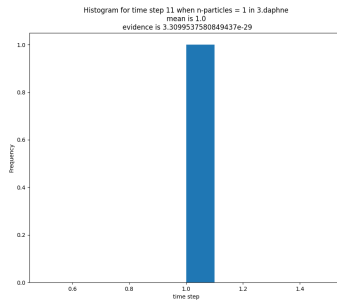
(h) Samples from the posterior for time step



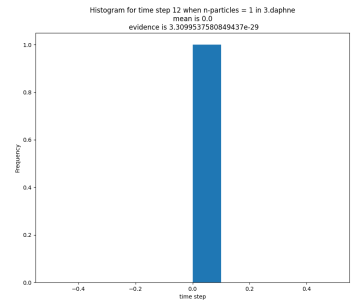
(i) Samples from the posterior for time step



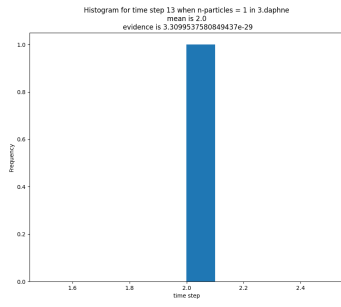
(j) Samples from the posterior for time step



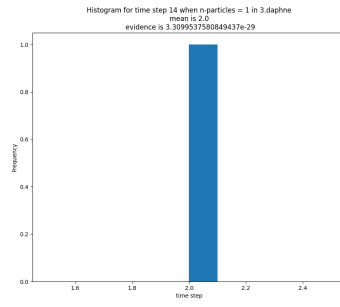
(k) Samples from the posterior for time step



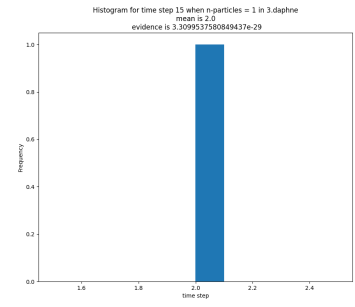
(l) Samples from the posterior for time step



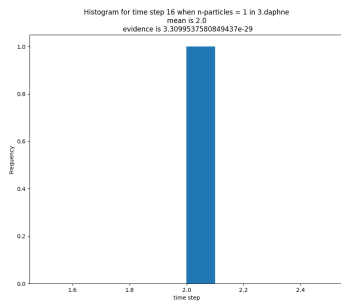
(a) Samples from the posterior for time step



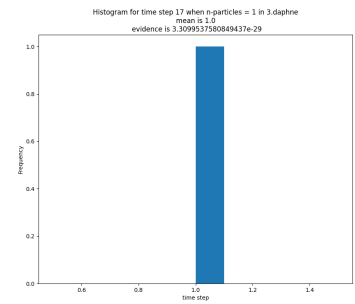
(b) Samples from the posterior for time step



(c) Samples from the posterior for time step

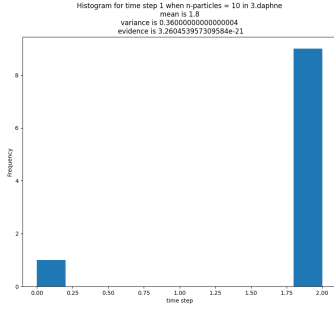


(d) Samples from the posterior for time step

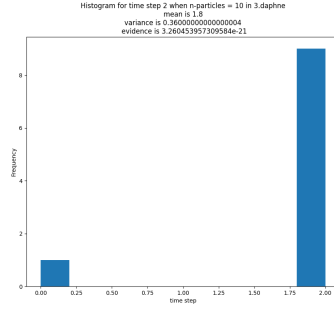


(e) Samples from the posterior for time step

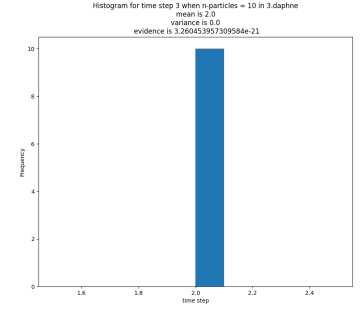
- n-particles = 10



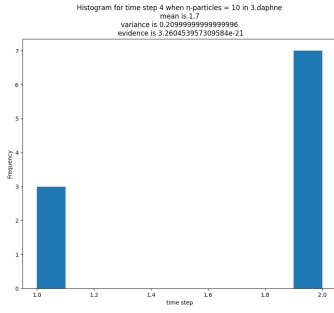
(a) Samples from the posterior for time step



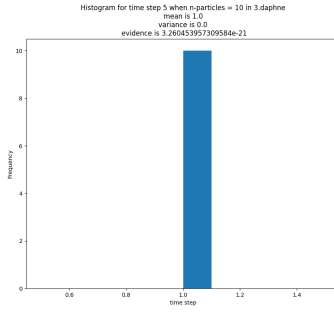
(b) Samples from the posterior for time step



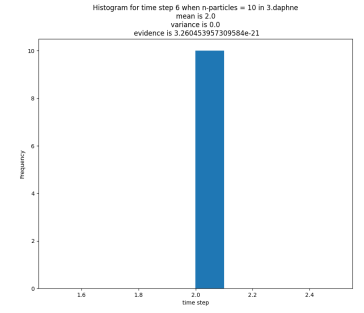
(c) Samples from the posterior for time step



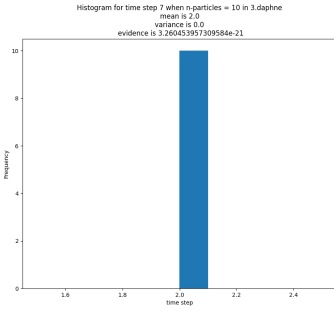
(d) Samples from the posterior for time step



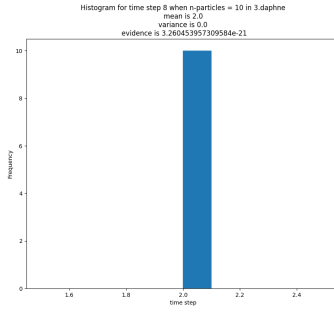
(e) Samples from the posterior for time step



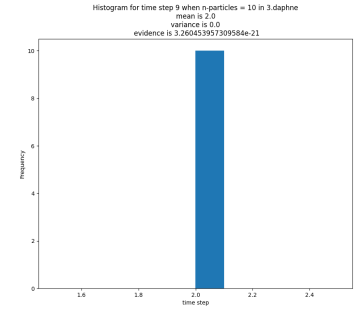
(f) Samples from the posterior for time step



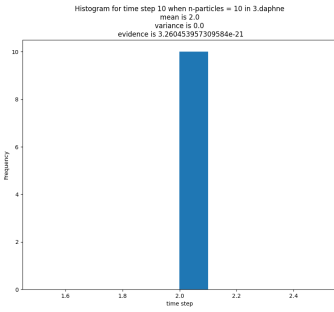
(g) Samples from the posterior for time step



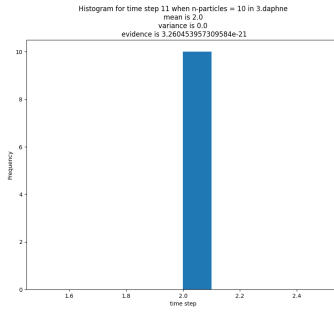
(h) Samples from the posterior for time step



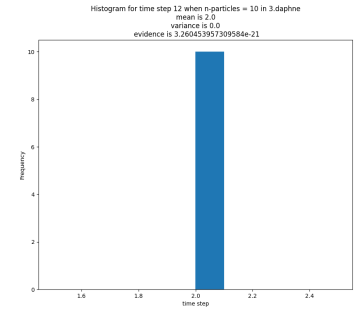
(i) Samples from the posterior for time step



(j) Samples from the posterior for time step

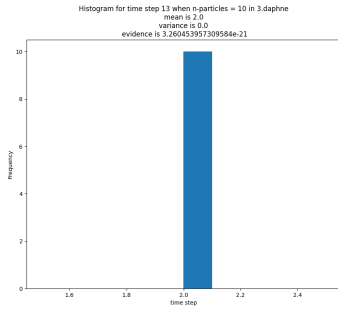


(k) Samples from the posterior for time step

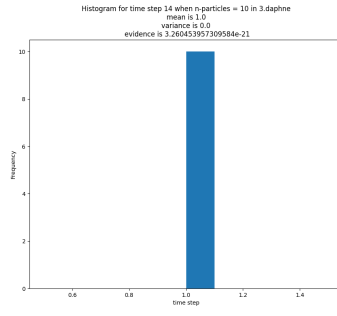


(l) Samples from the posterior for time step

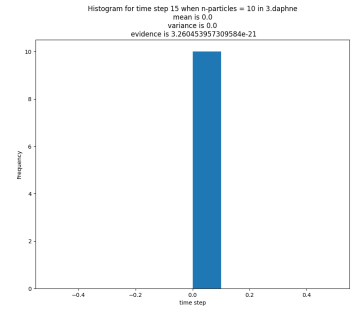




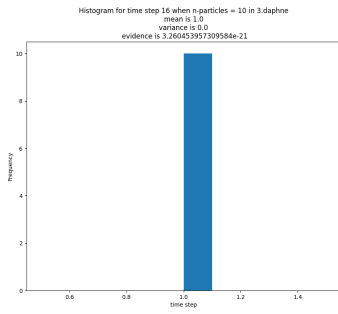
(a) Samples from the posterior for time step



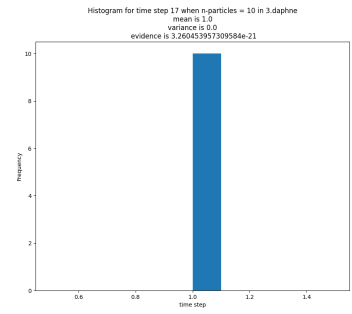
(b) Samples from the posterior for time step



(c) Samples from the posterior for time step

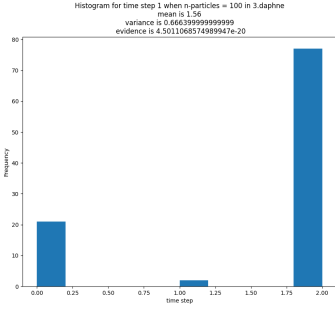


(d) Samples from the posterior for time step

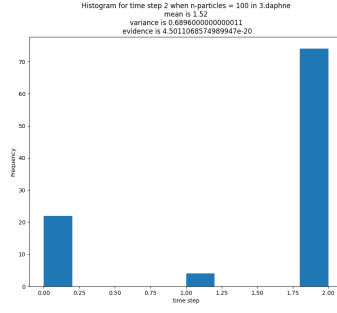


(e) Samples from the posterior for time step

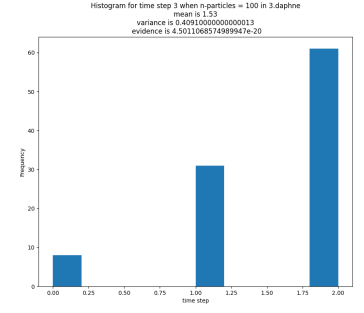
n-particles = 100



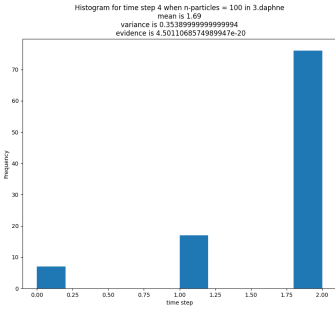
(a) Samples from the posterior for time step



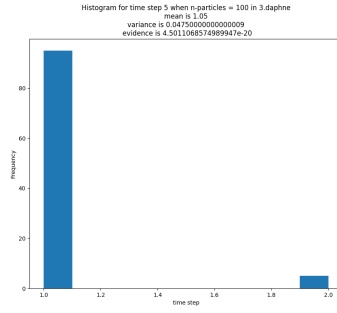
(b) Samples from the posterior for time step



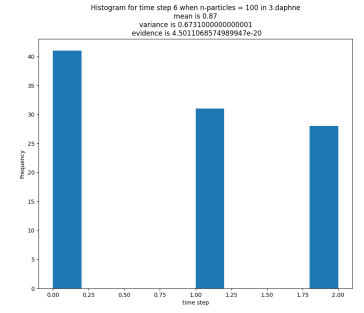
(c) Samples from the posterior for time step



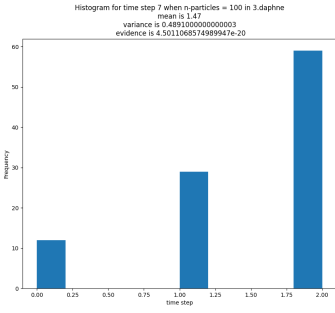
(d) Samples from the posterior for time step



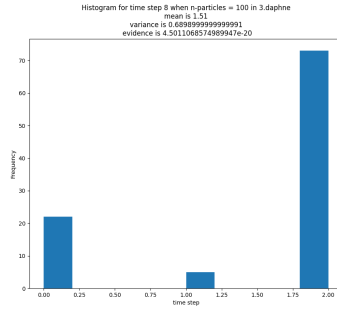
(e) Samples from the posterior for time step



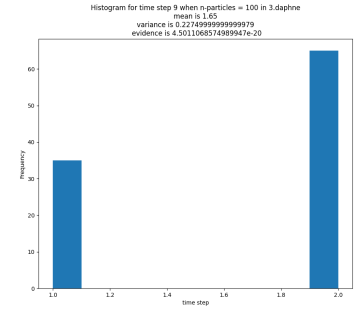
(f) Samples from the posterior for time step



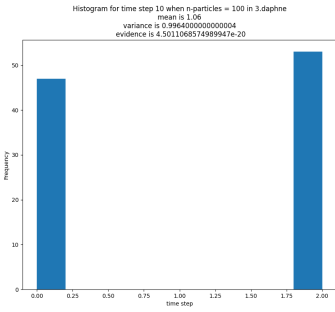
(g) Samples from the posterior for time step



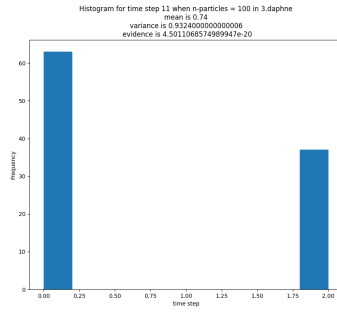
(h) Samples from the posterior for time step



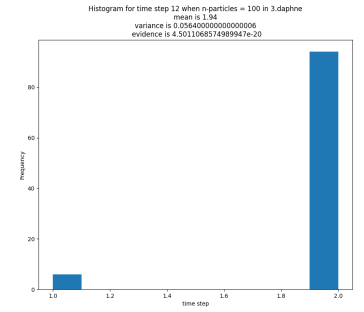
(i) Samples from the posterior for time step



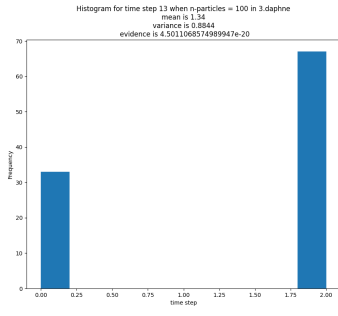
(j) Samples from the posterior for time step



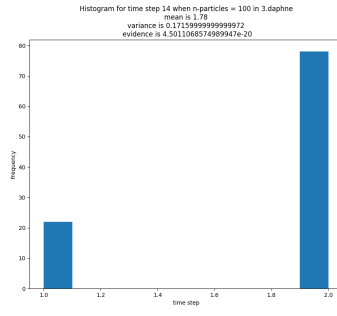
(k) Samples from the posterior for time step



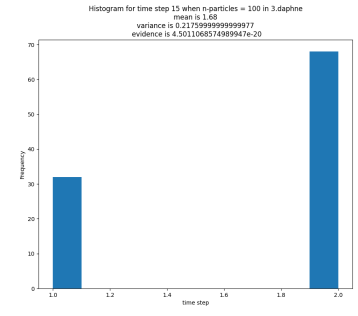
(l) Samples from the posterior for time step



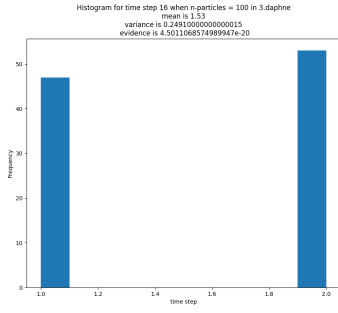
(a) Samples from the posterior for time step



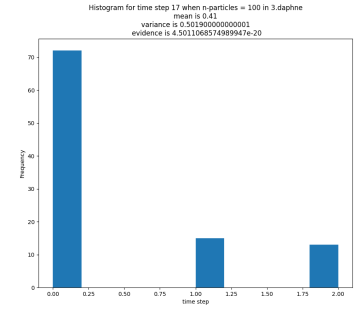
(b) Samples from the posterior for time step



(c) Samples from the posterior for time step

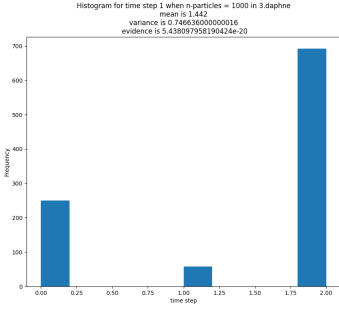


(d) Samples from the posterior for time step

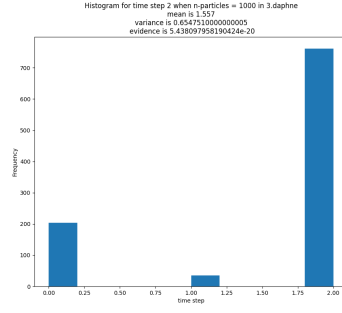


(e) Samples from the posterior for time step

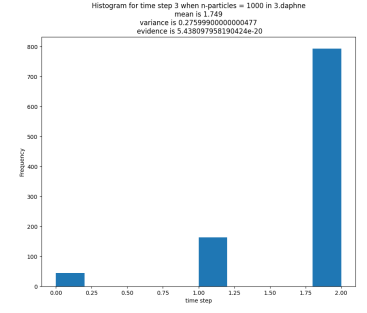
- n-particles = 1000



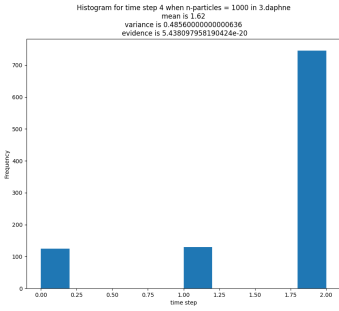
(a) Samples from the posterior for time step



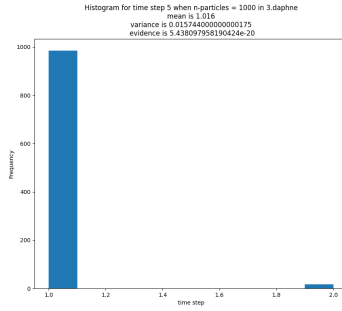
(b) Samples from the posterior for time step



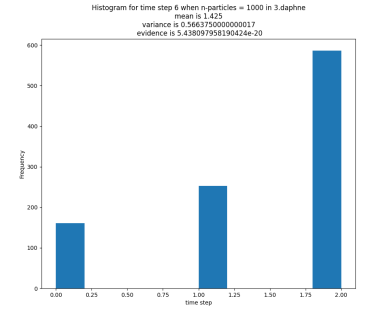
(c) Samples from the posterior for time step



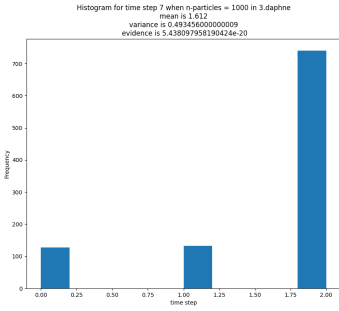
(d) Samples from the posterior for time step



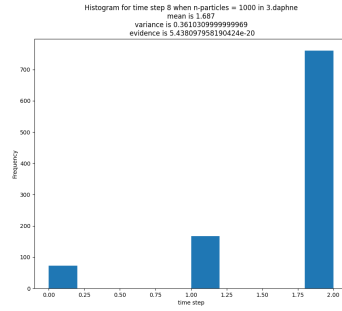
(e) Samples from the posterior for time step



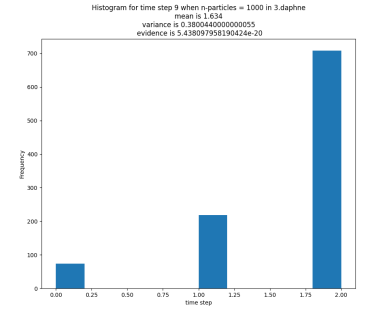
(f) Samples from the posterior for time step



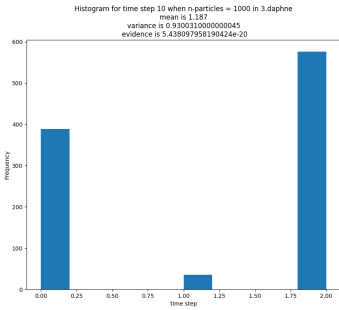
(g) Samples from the posterior for time step



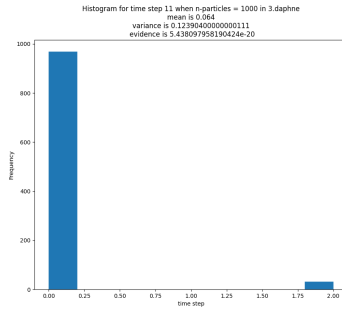
(h) Samples from the posterior for time step



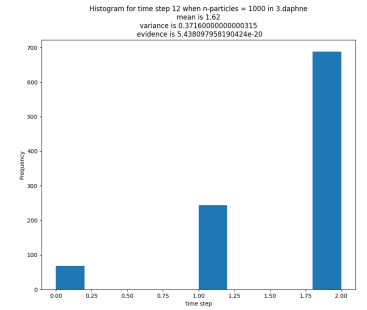
(i) Samples from the posterior for time step



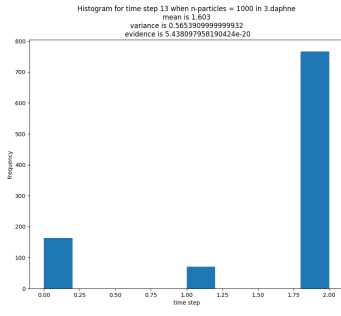
(j) Samples from the posterior for time step



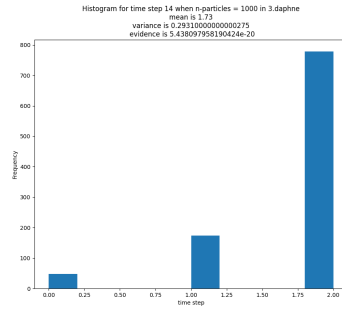
(k) Samples from the posterior for time step



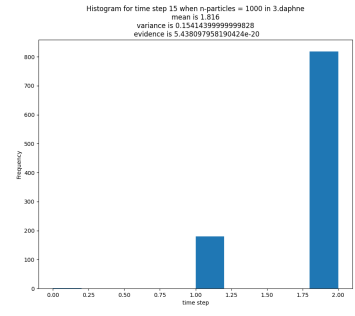
(l) Samples from the posterior for time step



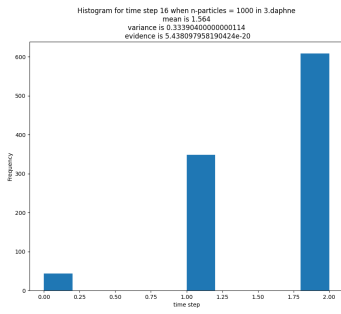
(a) Samples from the posterior for time step



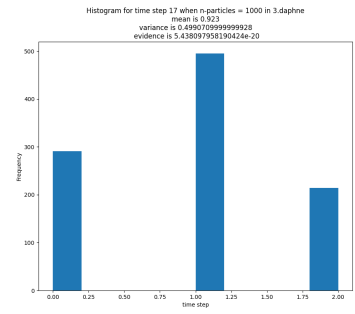
(b) Samples from the posterior for time step



(c) Samples from the posterior for time step

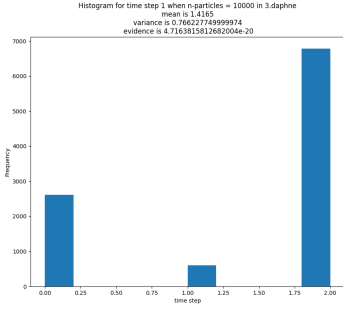


(d) Samples from the posterior for time step

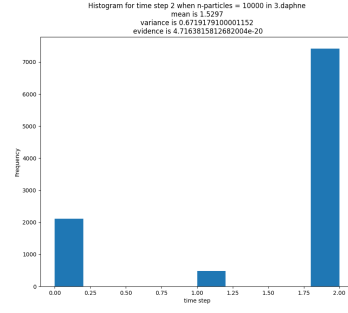


(e) Samples from the posterior for time step

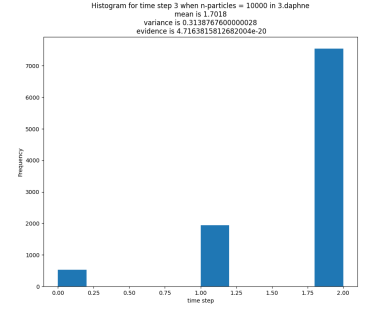
- n-particles = 10000



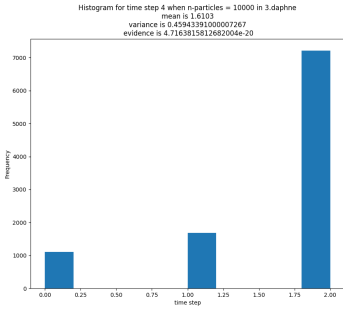
(a) Samples from the posterior for time step



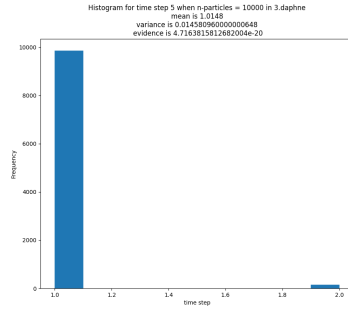
(b) Samples from the posterior for time step



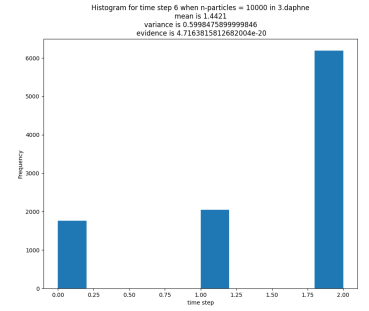
(c) Samples from the posterior for time step



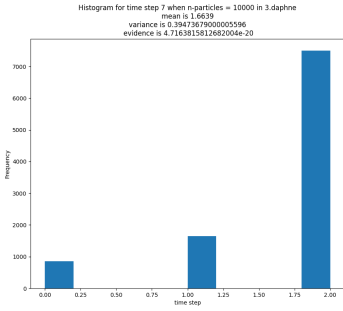
(d) Samples from the posterior for time step



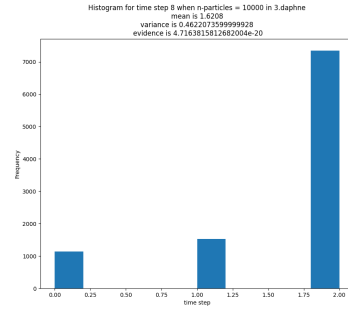
(e) Samples from the posterior for time step



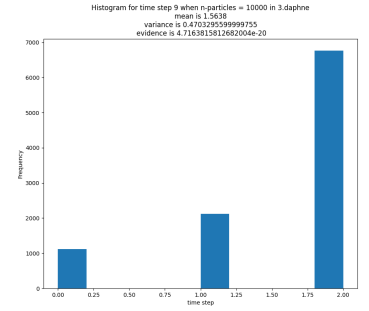
(f) Samples from the posterior for time step



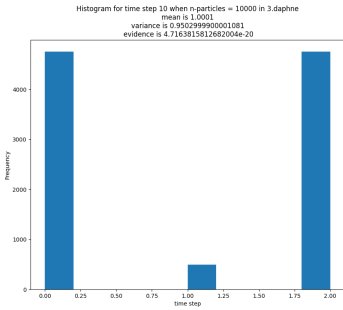
(g) Samples from the posterior for time step



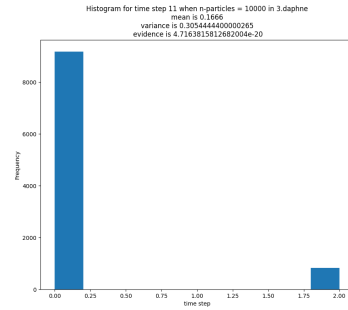
(h) Samples from the posterior for time step



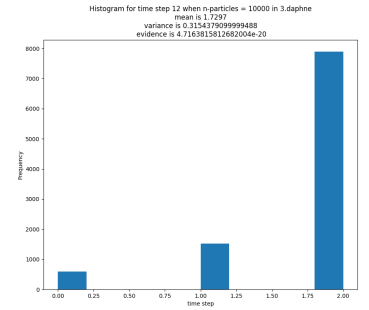
(i) Samples from the posterior for time step



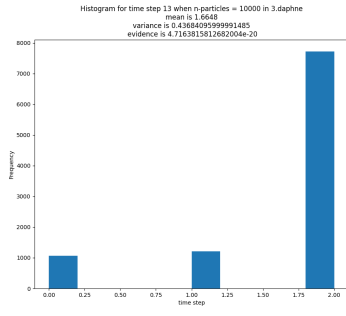
(j) Samples from the posterior for time step



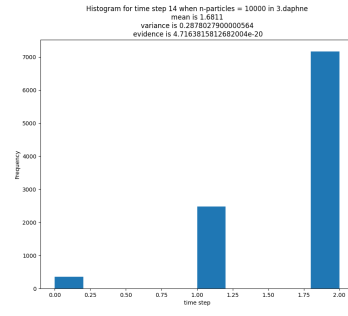
(k) Samples from the posterior for time step



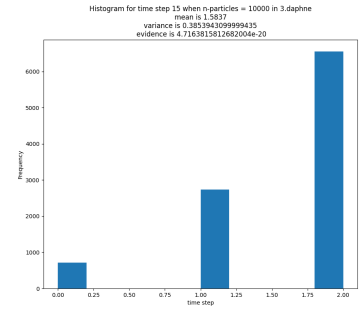
(l) Samples from the posterior for time step



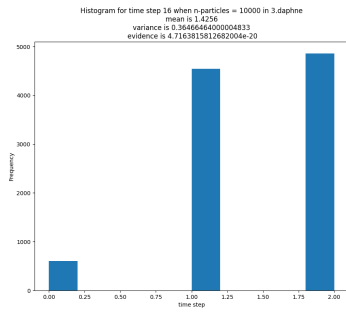
(a) Samples from the posterior for time step



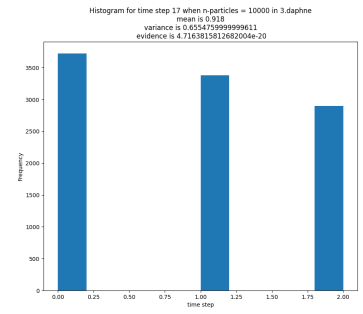
(b) Samples from the posterior for time step



(c) Samples from the posterior for time step

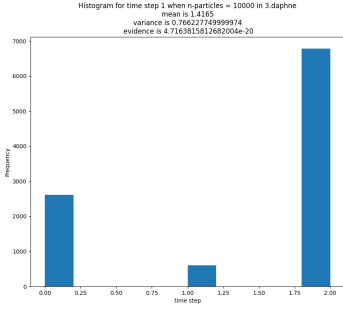


(d) Samples from the posterior for time step

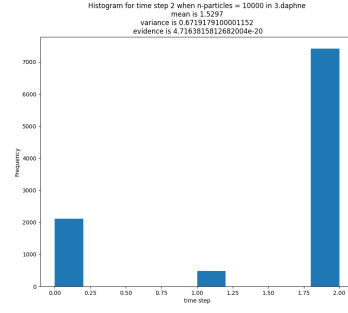


(e) Samples from the posterior for time step

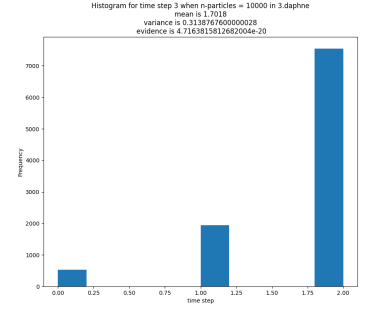
- n-particles = 10000



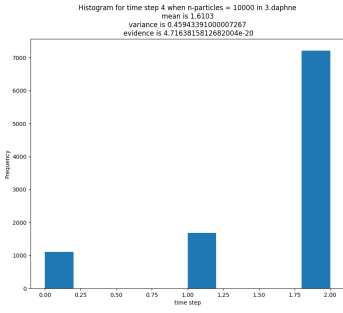
(a) Samples from the posterior for time step



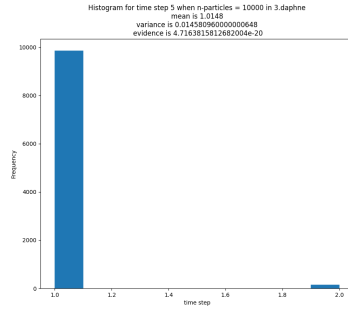
(b) Samples from the posterior for time step



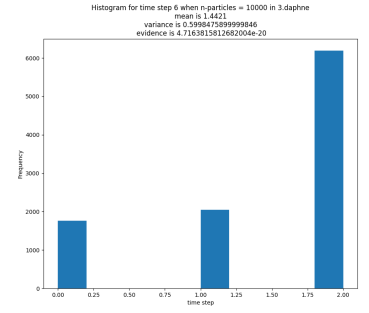
(c) Samples from the posterior for time step



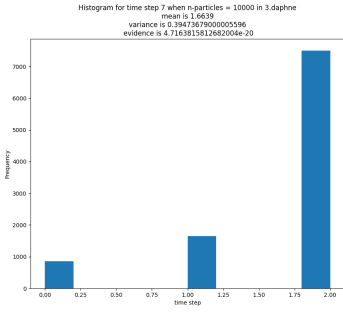
(d) Samples from the posterior for time step



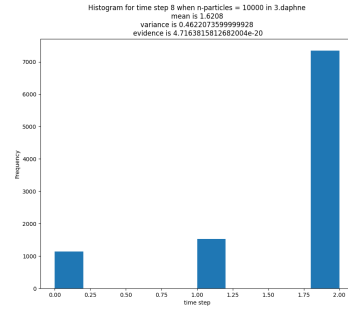
(e) Samples from the posterior for time step



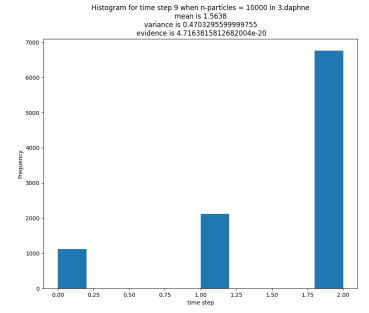
(f) Samples from the posterior for time step



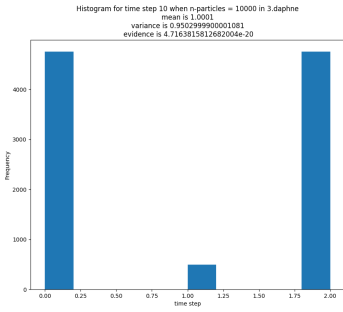
(g) Samples from the posterior for time step



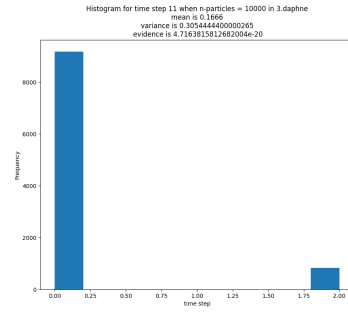
(h) Samples from the posterior for time step



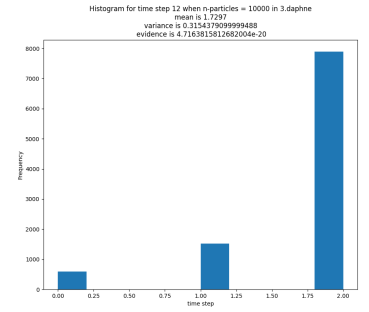
(i) Samples from the posterior for time step



(j) Samples from the posterior for time step

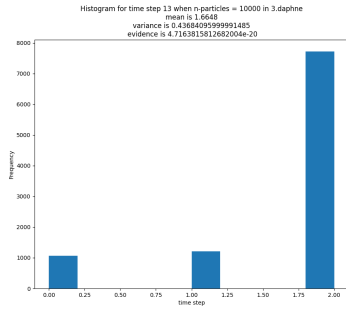


(k) Samples from the posterior for time step

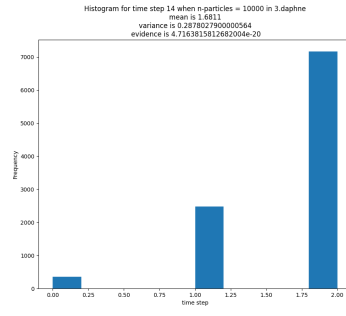


(l) Samples from the posterior for time step

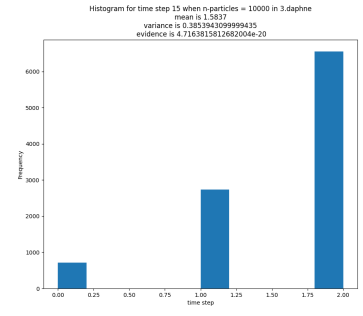




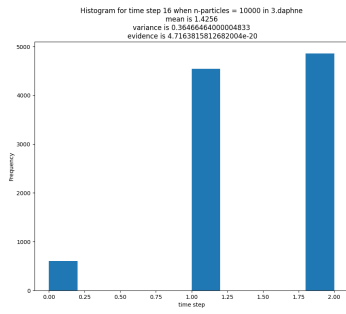
(a) Samples from the posterior for time step



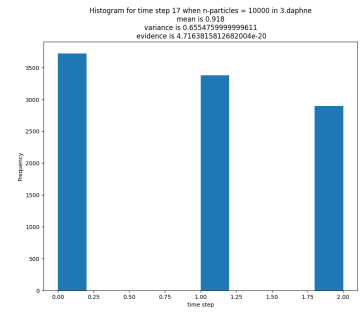
(b) Samples from the posterior for time step



(c) Samples from the posterior for time step

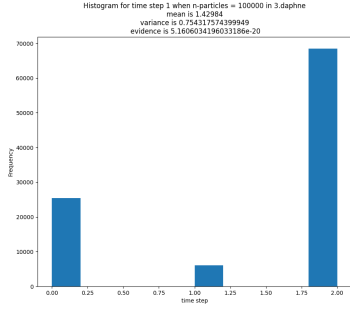


(d) Samples from the posterior for time step

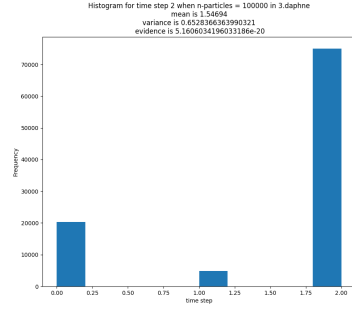


(e) Samples from the posterior for time step

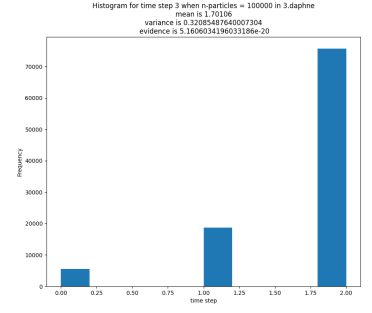
- n-particles = 100000



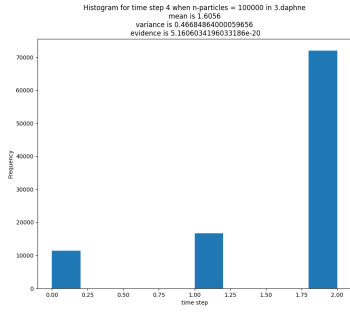
(a) Samples from the posterior for time step



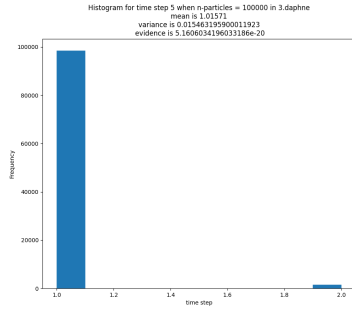
(b) Samples from the posterior for time step



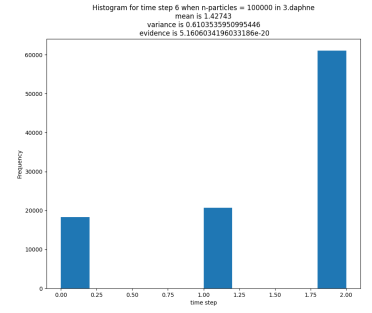
(c) Samples from the posterior for time step



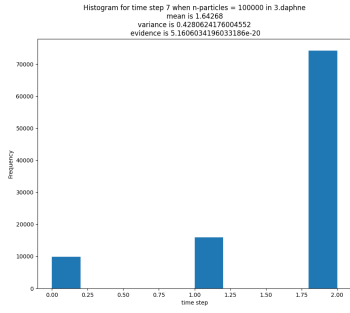
(d) Samples from the posterior for time step



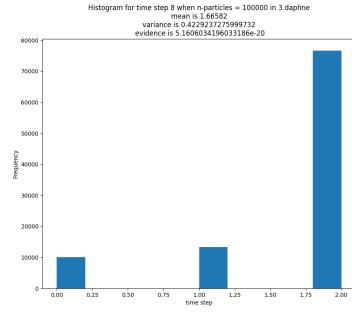
(e) Samples from the posterior for time step



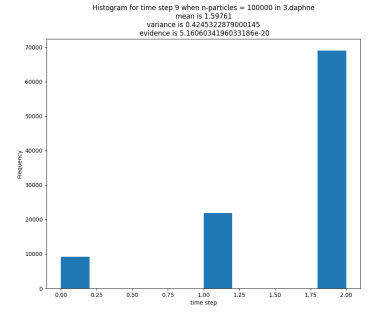
(f) Samples from the posterior for time step



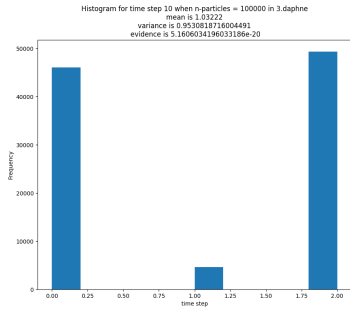
(g) Samples from the posterior for time step



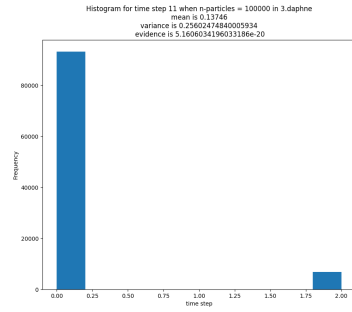
(h) Samples from the posterior for time step



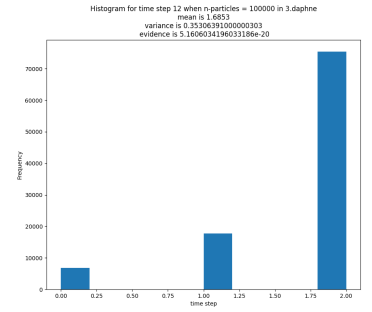
(i) Samples from the posterior for time step



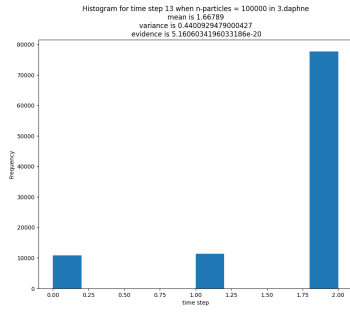
(j) Samples from the posterior for time step



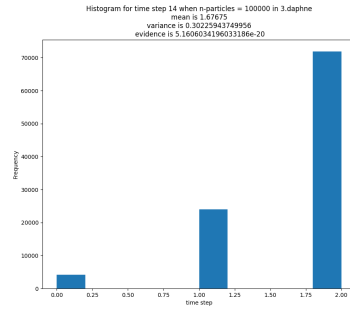
(k) Samples from the posterior for time step



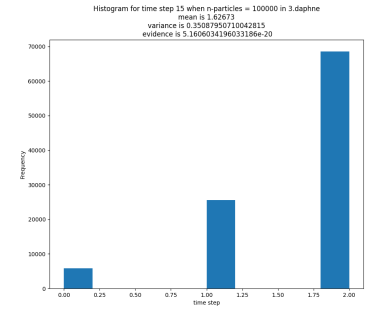
(l) Samples from the posterior for time step



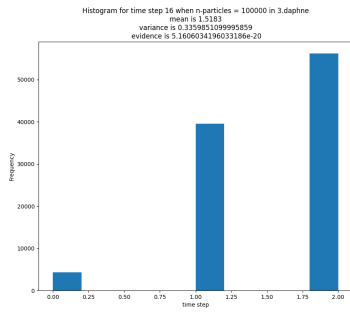
(a) Samples from the posterior for time step



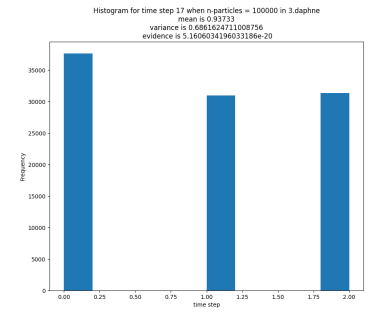
(b) Samples from the posterior for time step



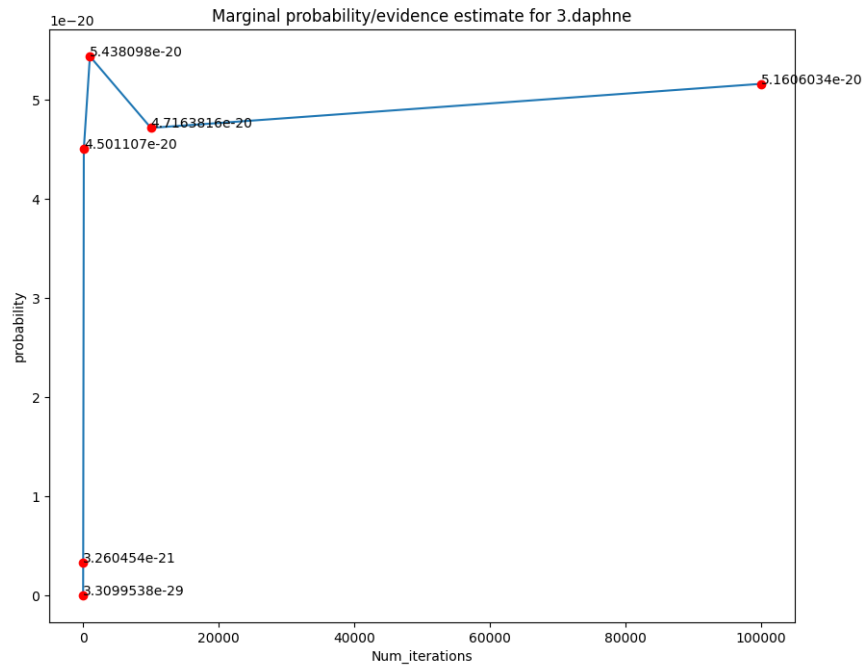
(c) Samples from the posterior for time step



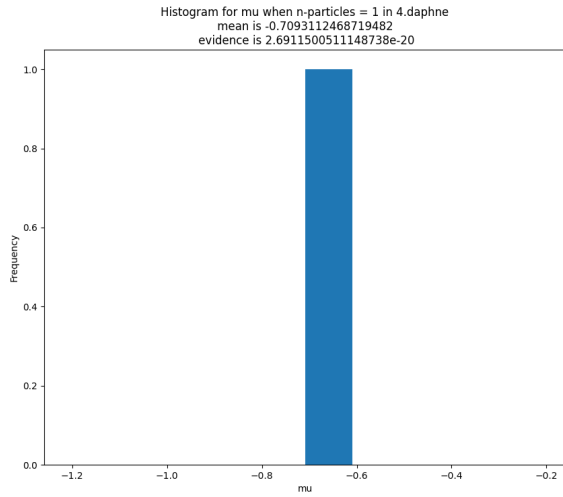
(d) Samples from the posterior for time step



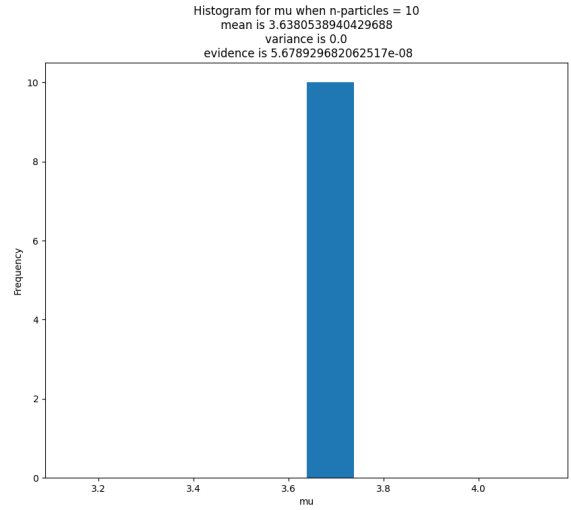
(e) Samples from the posterior for time step



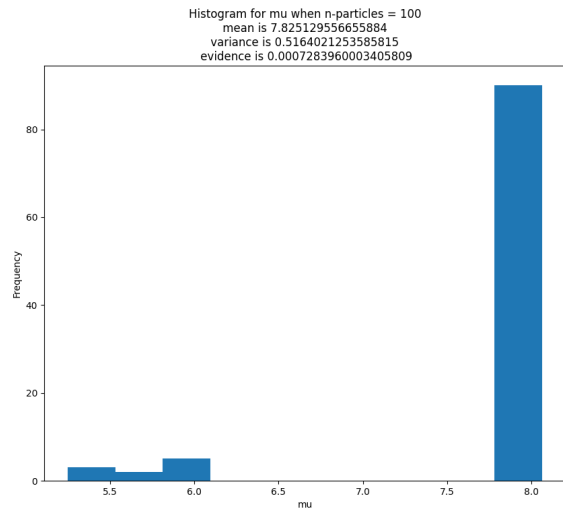
## 5. Program 4



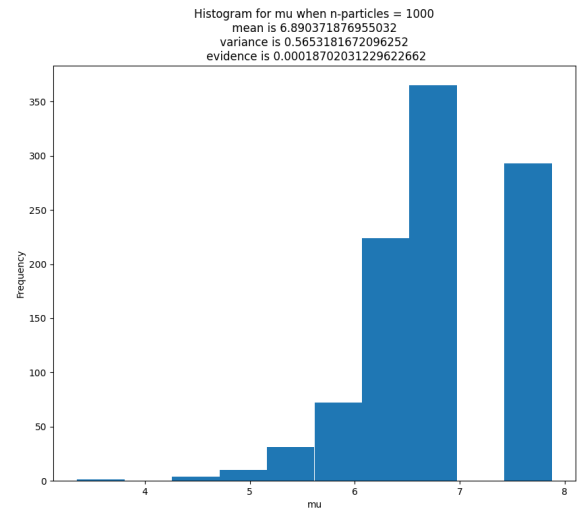
(a) Samples from the posterior for mu



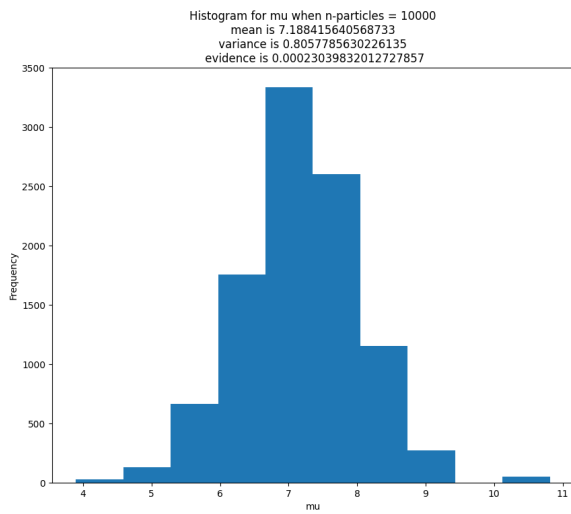
(b) Samples from the posterior for mu



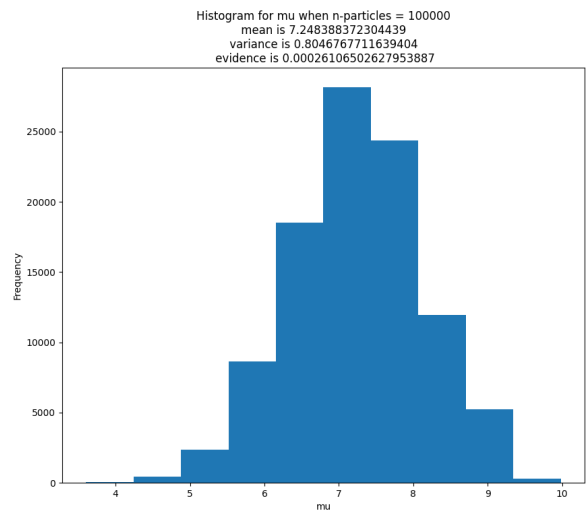
(c) Samples from the posterior for mu



(d) Samples from the posterior for mu



(e) Samples from the posterior for mu



(f) Samples from the posterior for mu

