CPSC532W: Probabilistic Programming, Homework 6

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Code for this assignment can be found here: https://github.com/namratadeka/cpsc532W/tree/main/CS532-HW6.

```
            raise RuntimeError('Failed SMC, finished one calculation before the other')
else:
    #TODO: check particle addresses, and get weights and continuations
    particles[i] = res
    if i == 0:
        current_addr = res[2]['addr']
    else:
        addr = res[2]['addr']
        if not current_addr == addr:
            raise RuntimeError('Failed SMC, address mismatch. Expected {} but got {}.'.format(current_addr, addr))
    logW = res[2]['logW']
    weights[i] += logW

not done:
```

Figure 1: SMC: Address checks and weight updates.

```
def resample_particles(particles, log_weights):
    #TODO
    new_particles = []

    weights = torch.exp(torch.FloatTensor(log_weights))
    normalized_weights = weights + 1e-5 / (weights + 1e-5).sum()
    logZ = torch.log(weights.mean())

    particle_indices = torch.multinomial(normalized_weights, len(particles), True)
    for idx in particle_indices:
        new_particles.append(particles[idx])

    return logZ, new_particles
```

Figure 2: Resample particles function.

```
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',
             'addr' : alpha
             #TODO: put any other stuff you need here
             }
    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
```

Figure 3: Sample and Observe cases in the evaluator.

1 Program 1

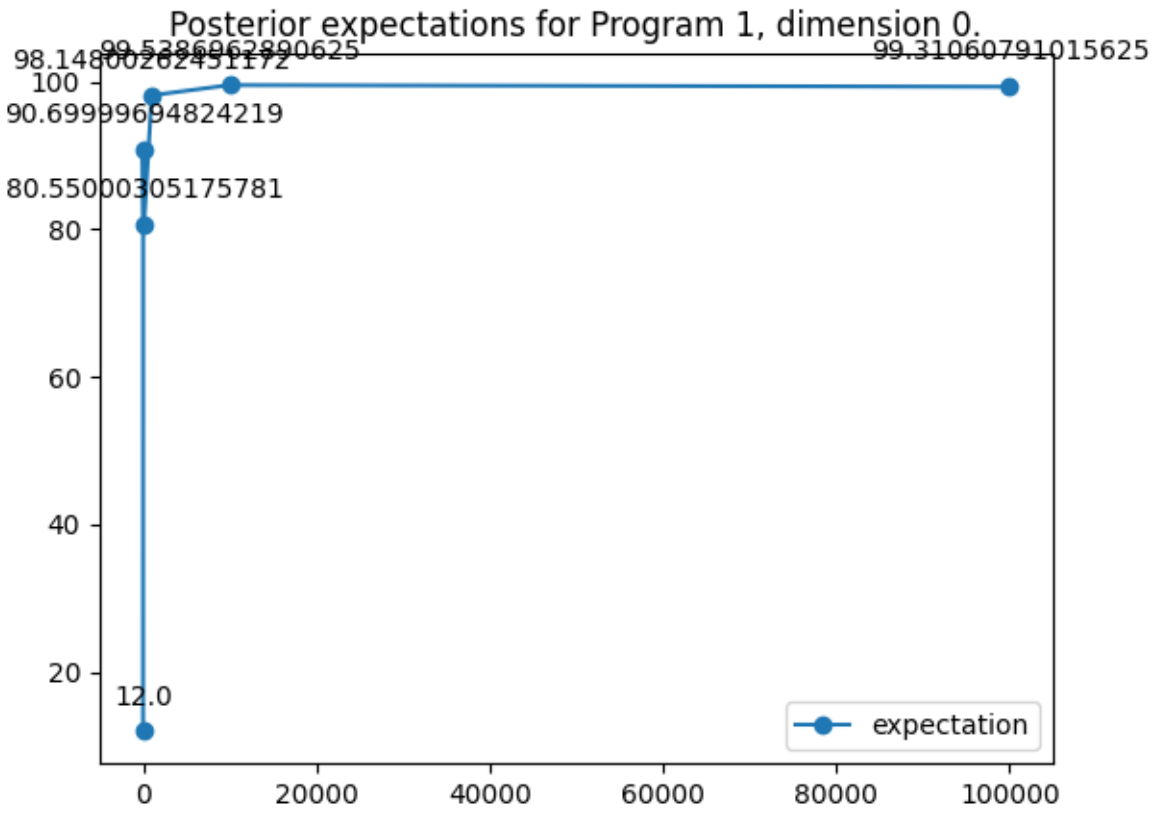

Figure 4: Posterior Means vs number of particles

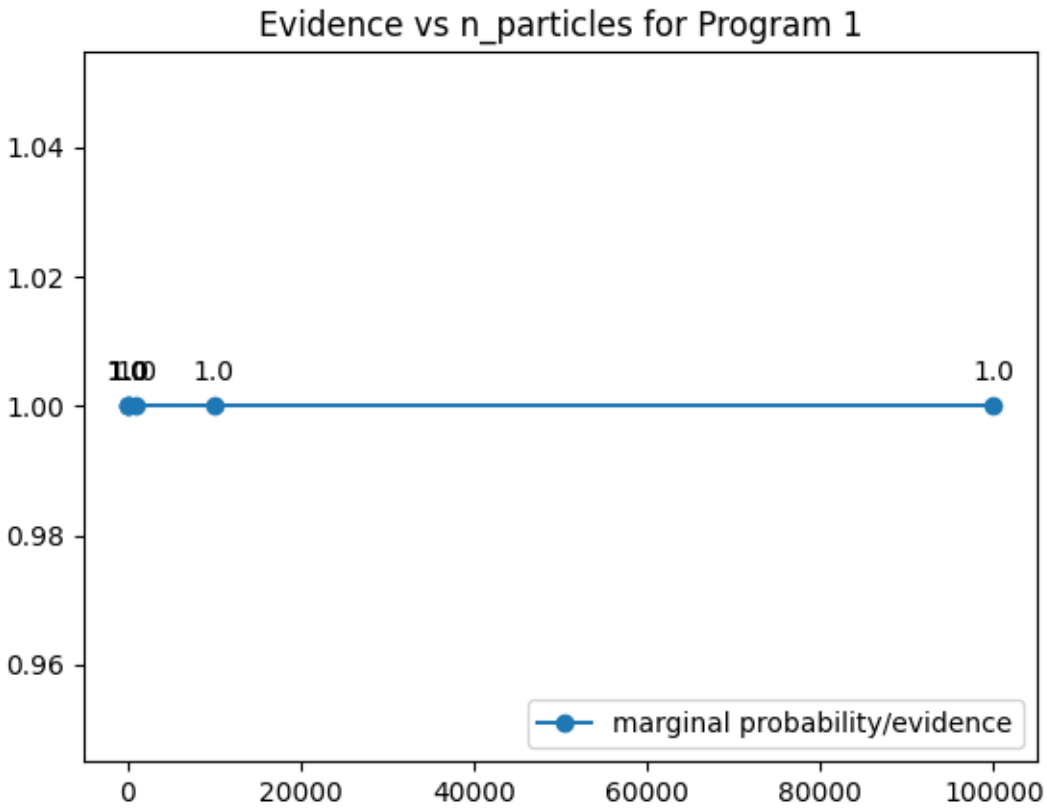

Figure 5: Marginal probability vs number of particles

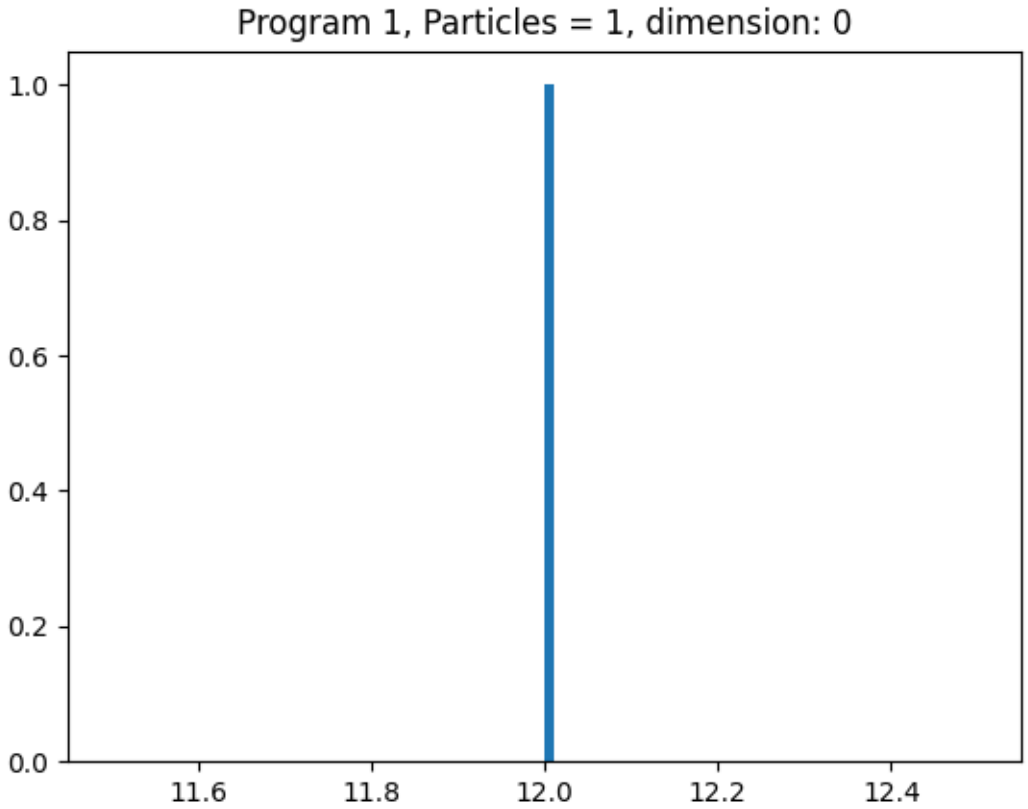

Figure 6: P1 Histogram: 1 particles

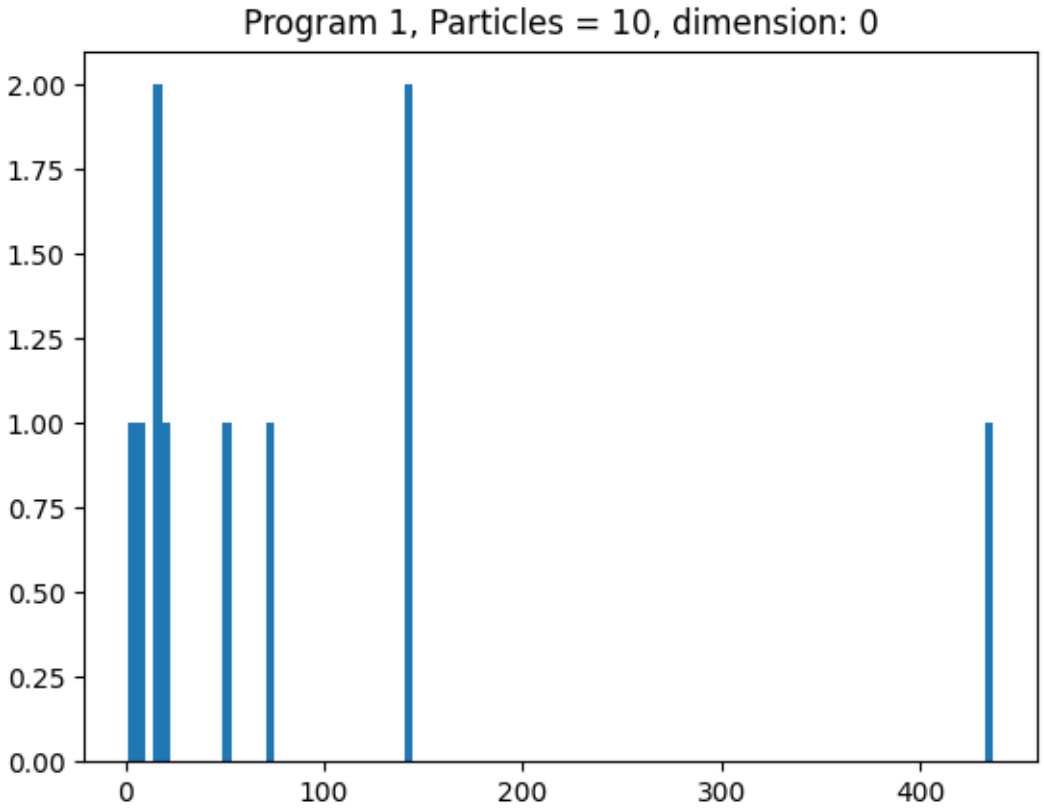

Figure 7: P1 Histogram: 10 particles

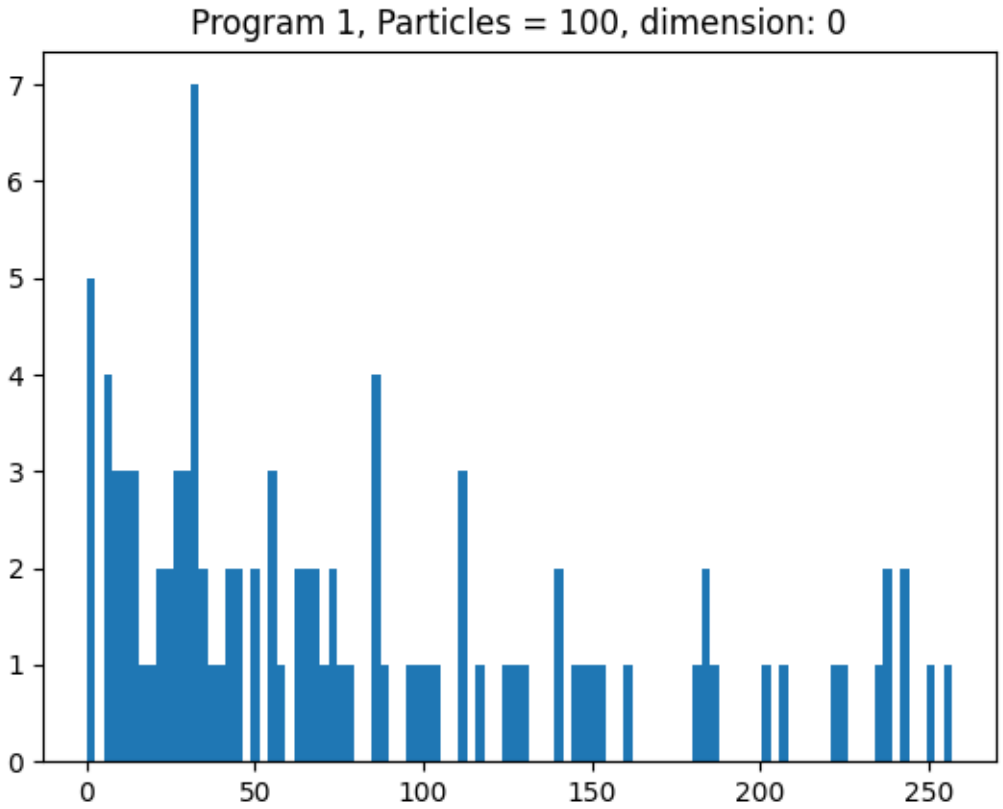

Figure 8: P1 Histogram: 100 particles

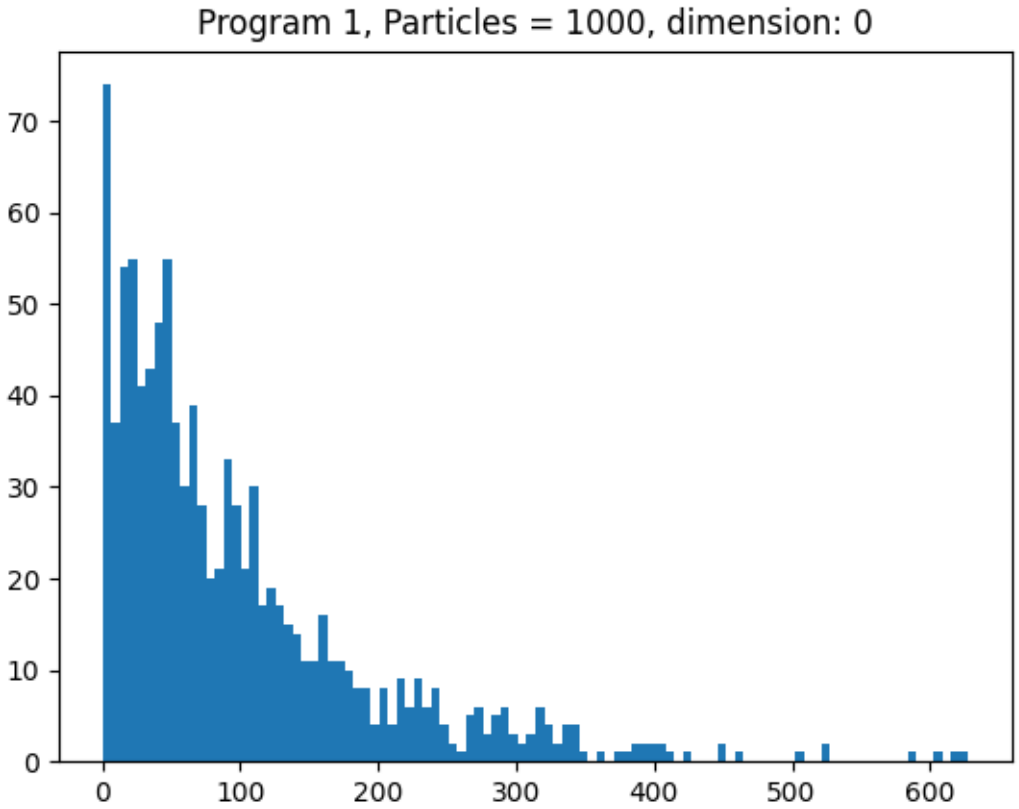

Figure 9: P1 Histogram: 1000 particles

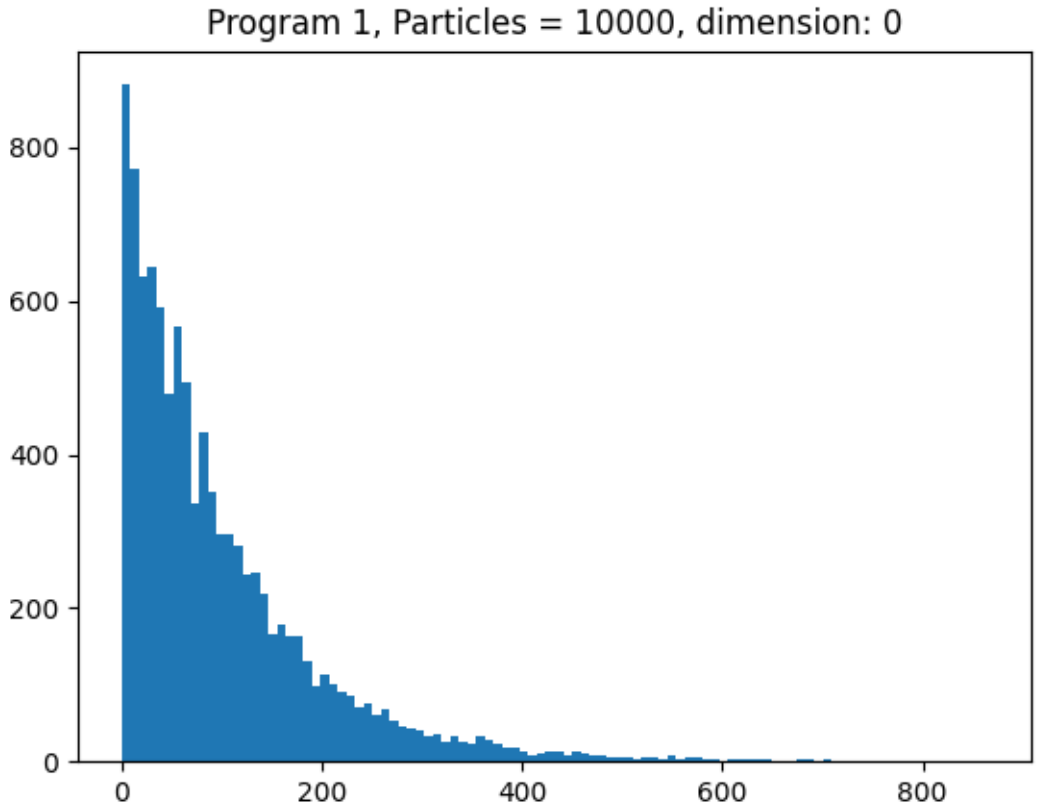

Figure 10: P1 Histogram: 10000 particles

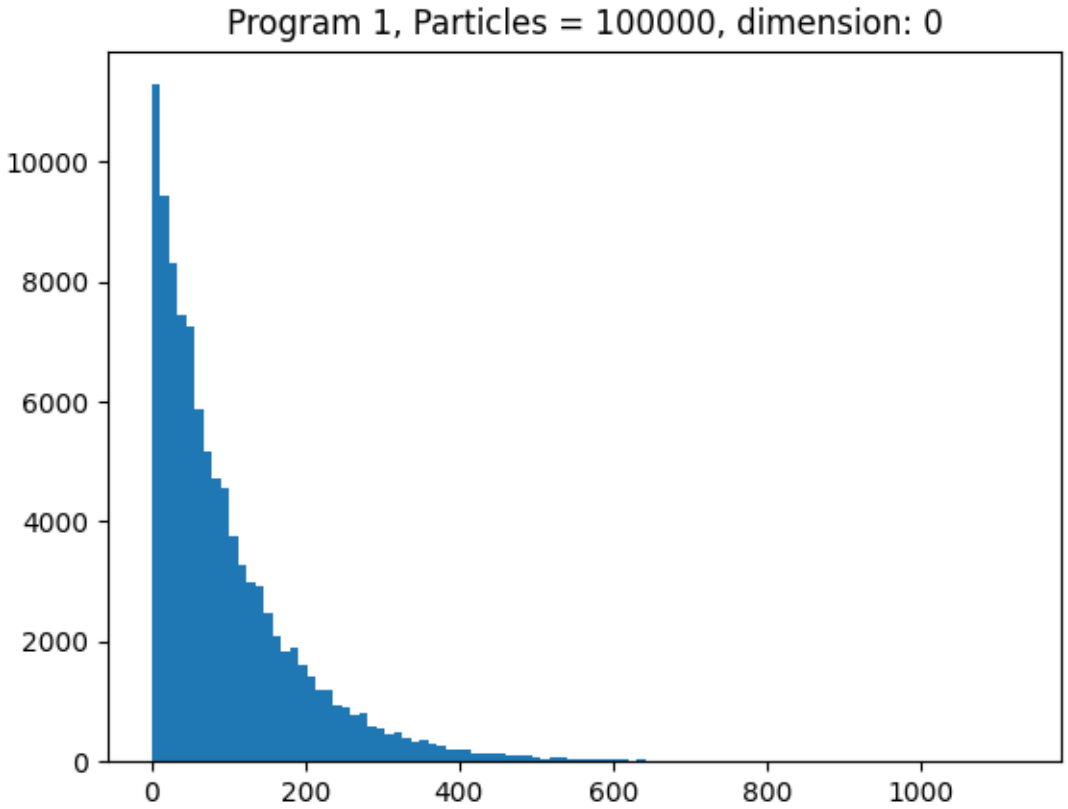

Figure 11: P1 Histogram: 100000 particles

2 Program 2

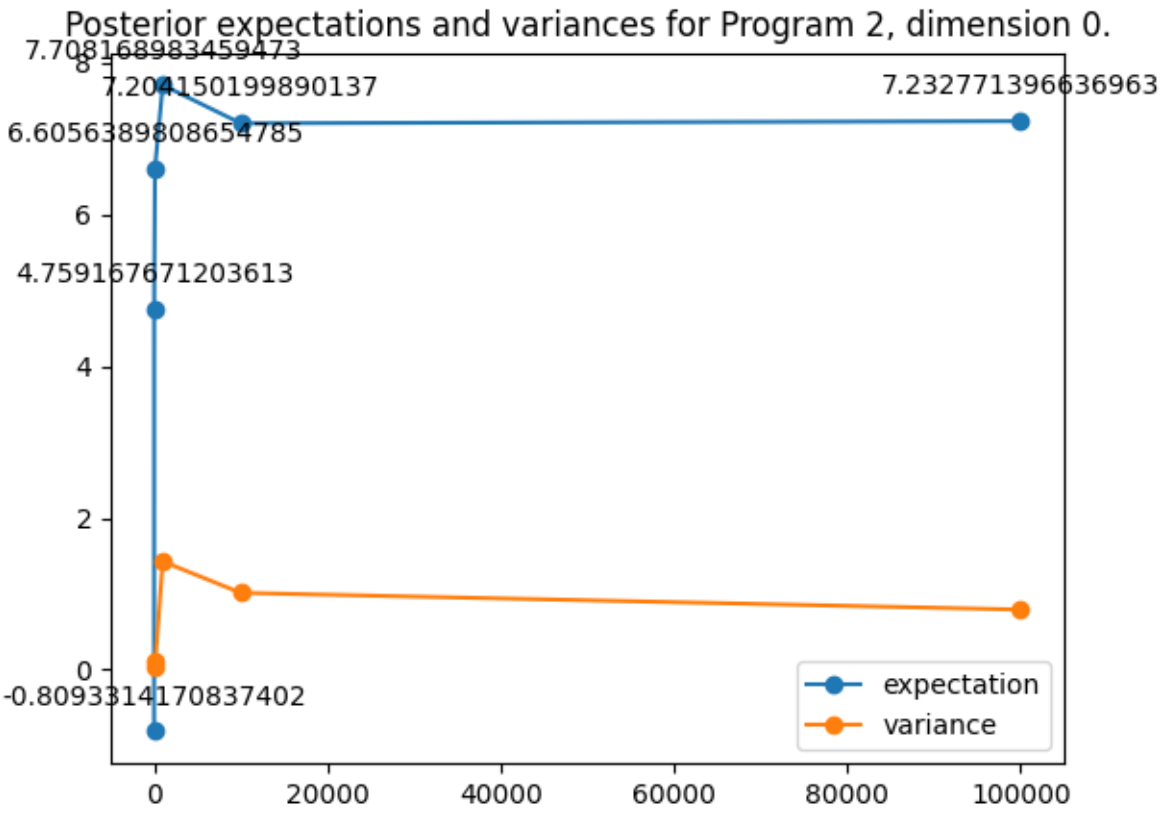

Figure 12: Posterior Means and Variances vs number of particles

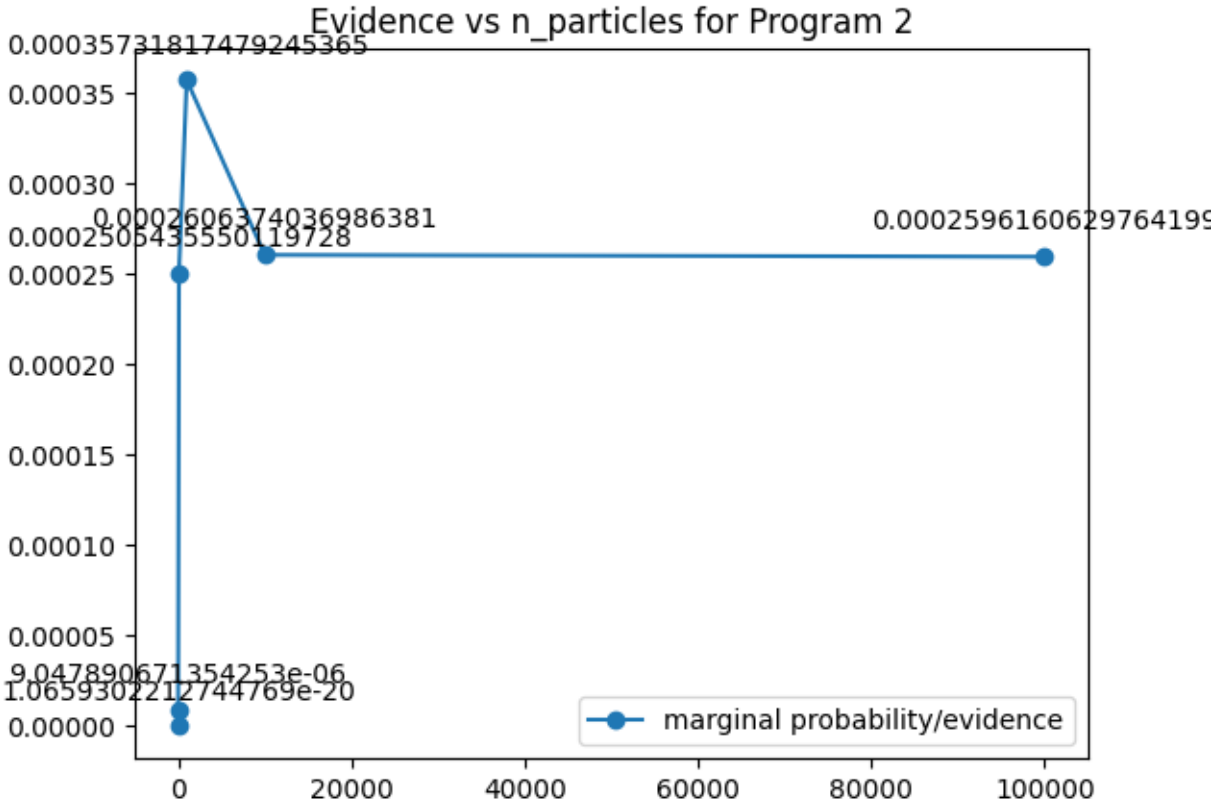

Figure 13: Marginal probability vs number of particles

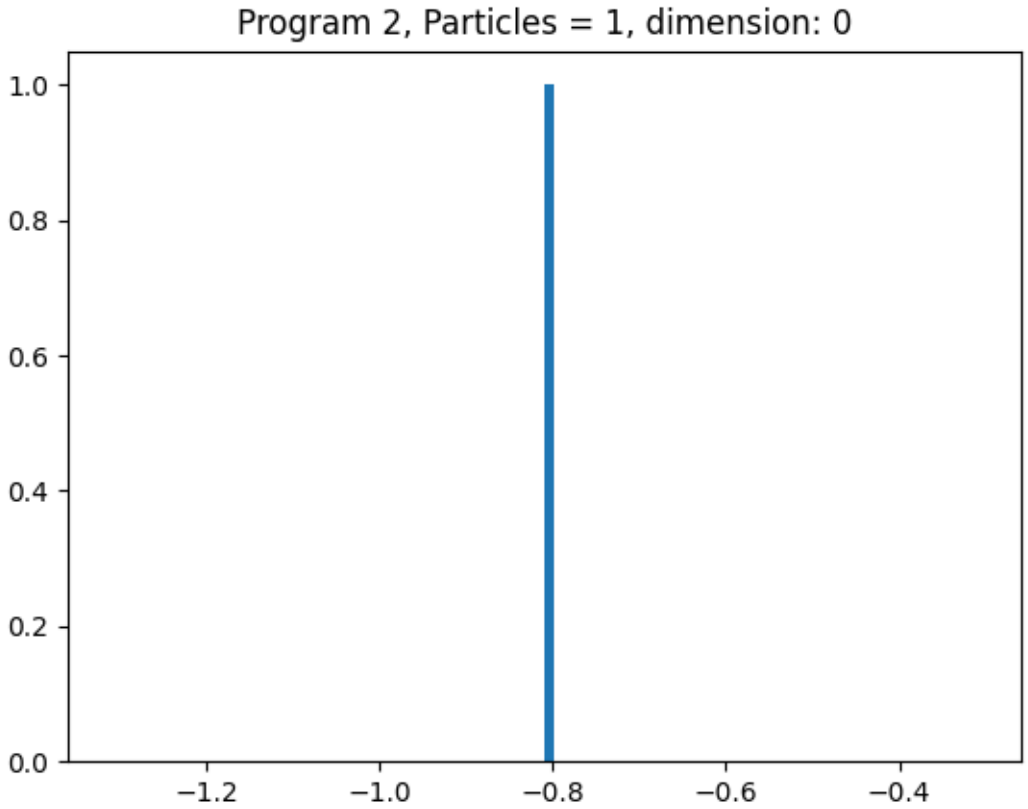

Figure 14: P2 Histogram: 1 particles

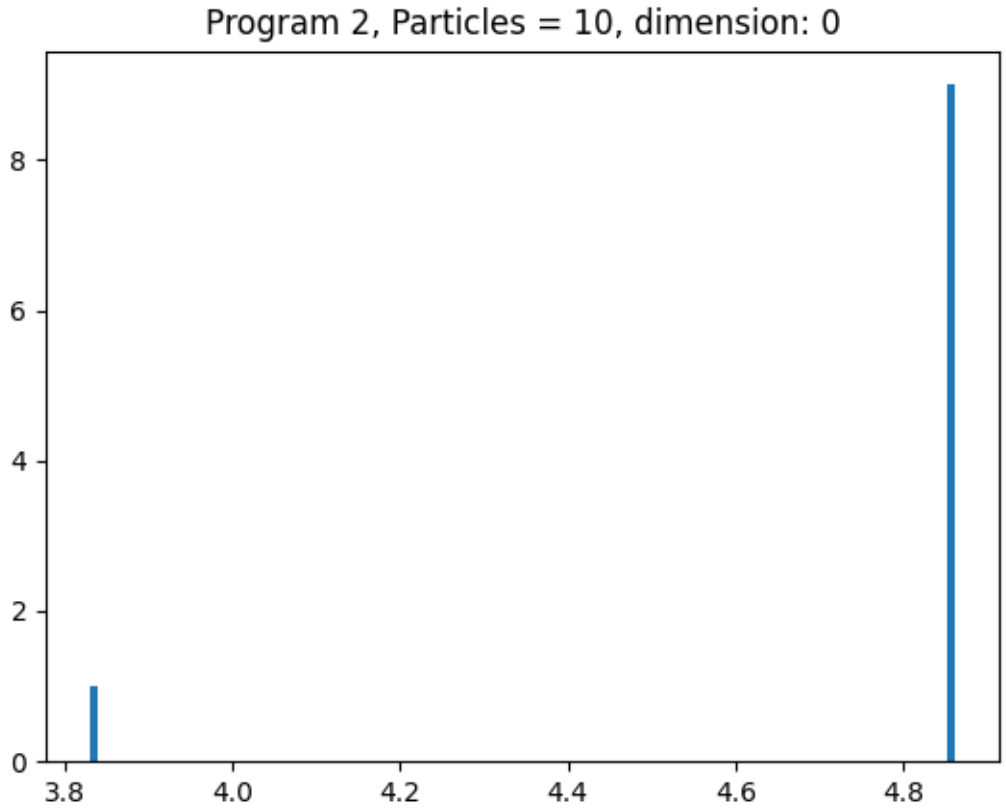

Figure 15: P2 Histogram: 10 particles

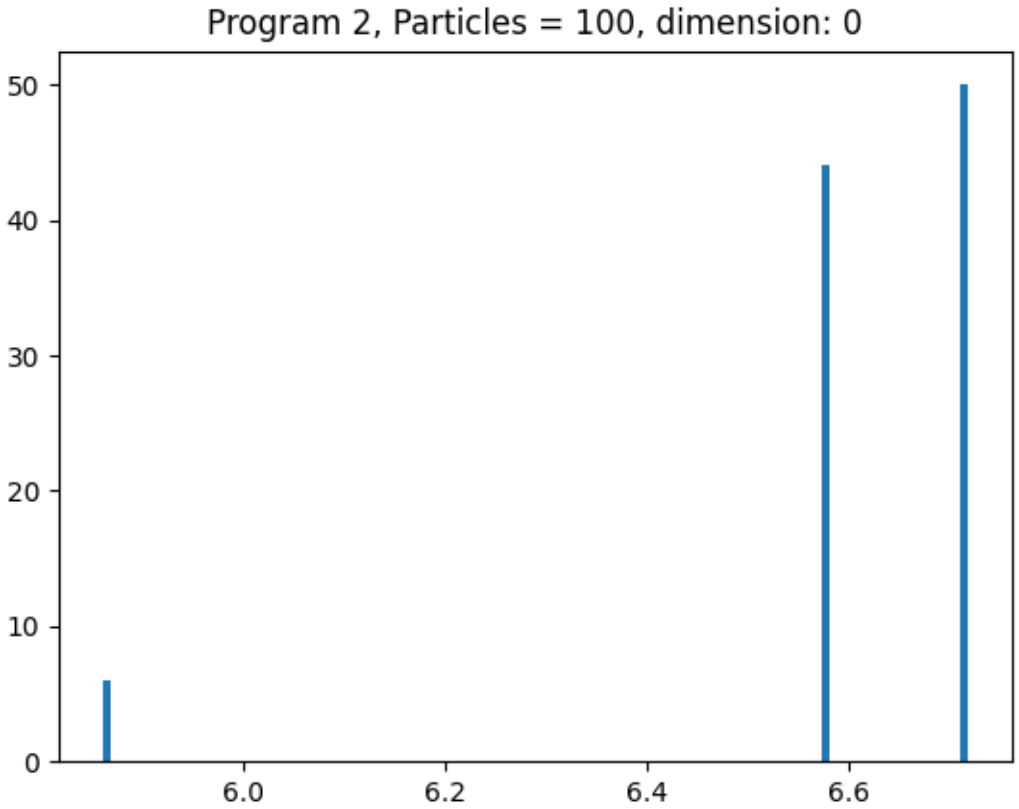

Figure 16: P2 Histogram: 100 particles

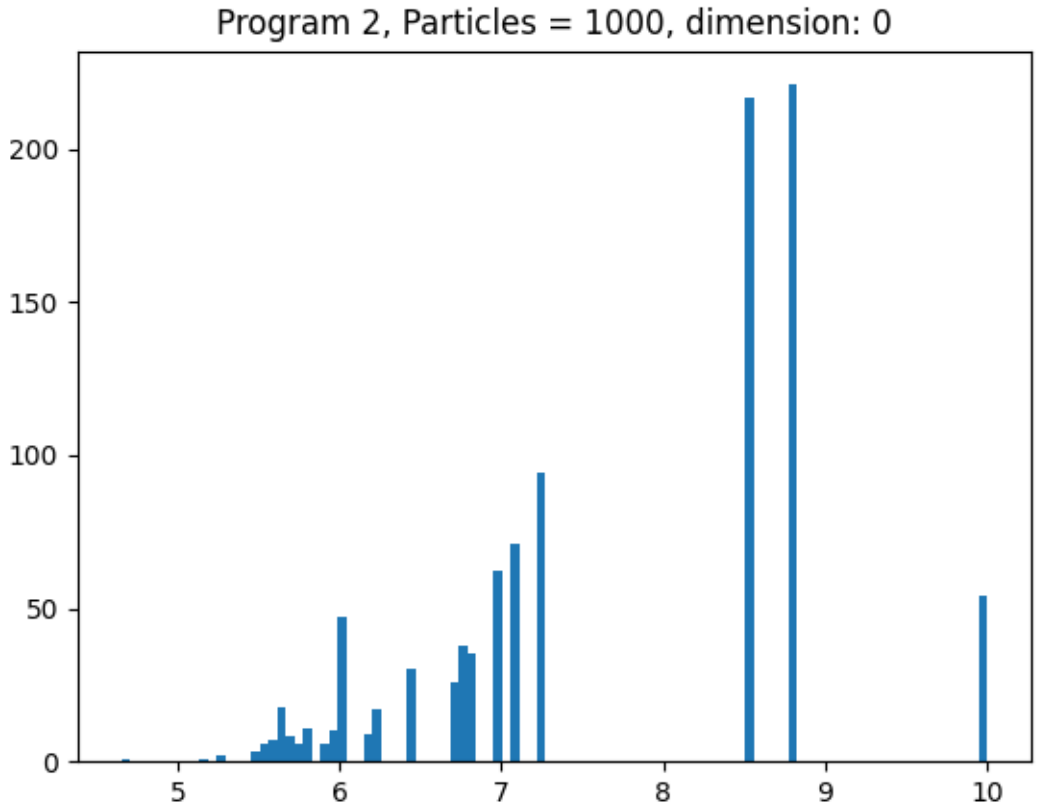

Figure 17: P2 Histogram: 1000 particles

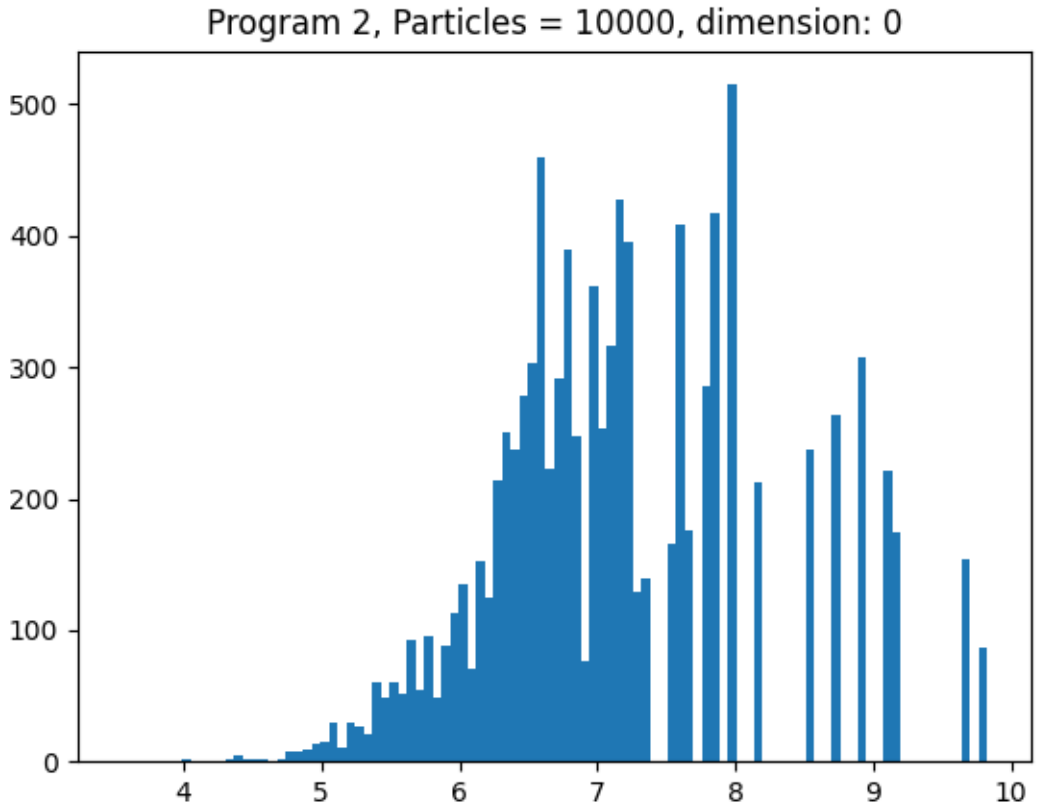

Figure 18: P2 Histogram: 10000 particles

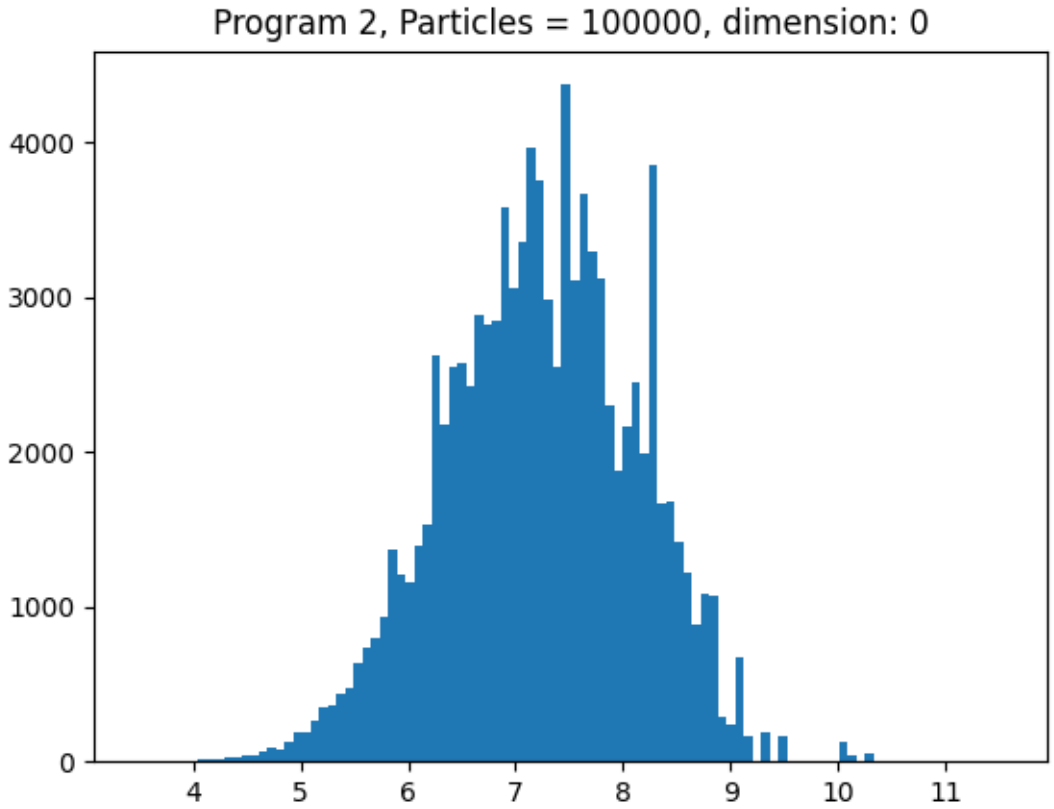

Figure 19: P2 Histogram: 100000 particles

3 Program 3

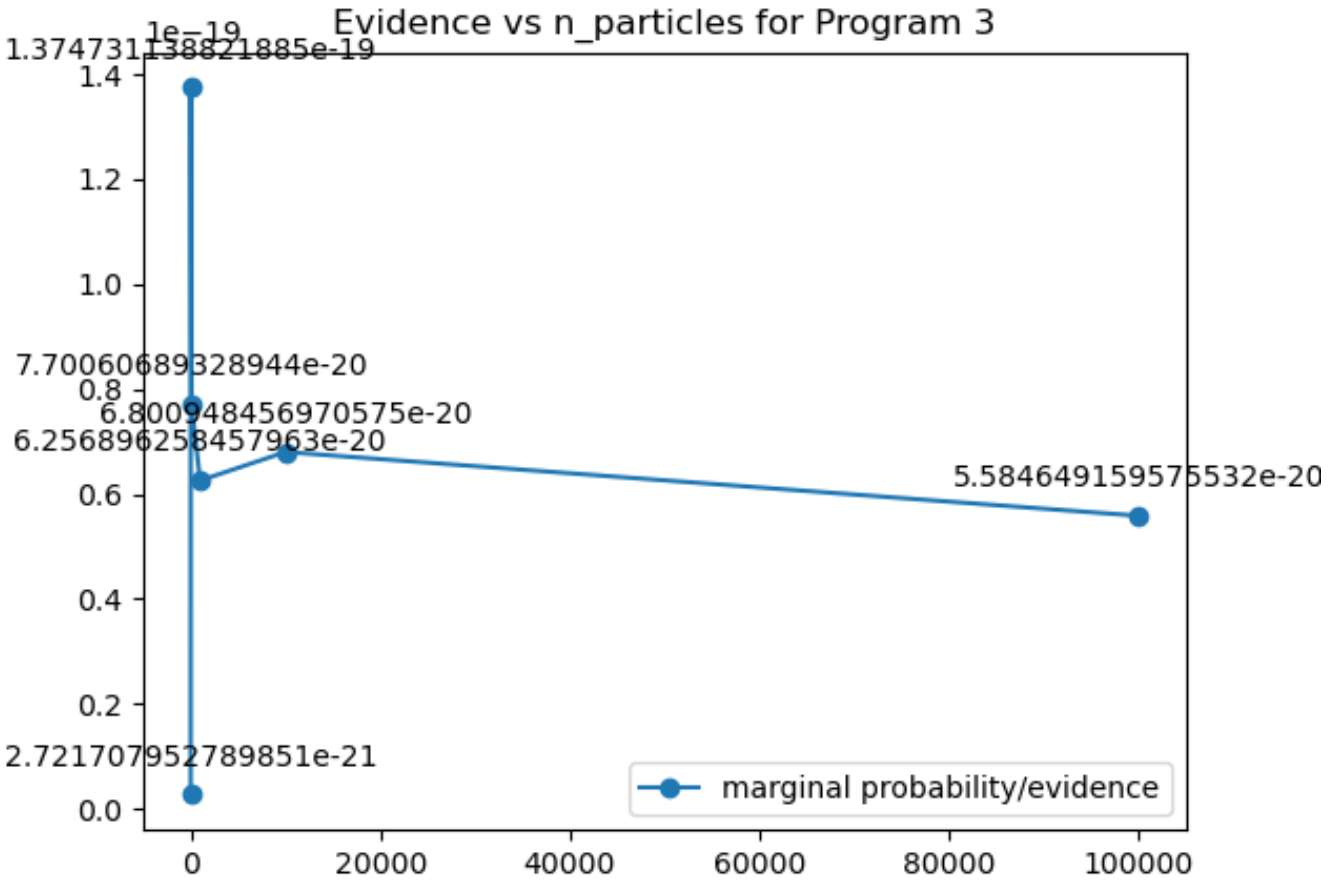

Figure 20: Program 3: Marginal Probability vs number of particles

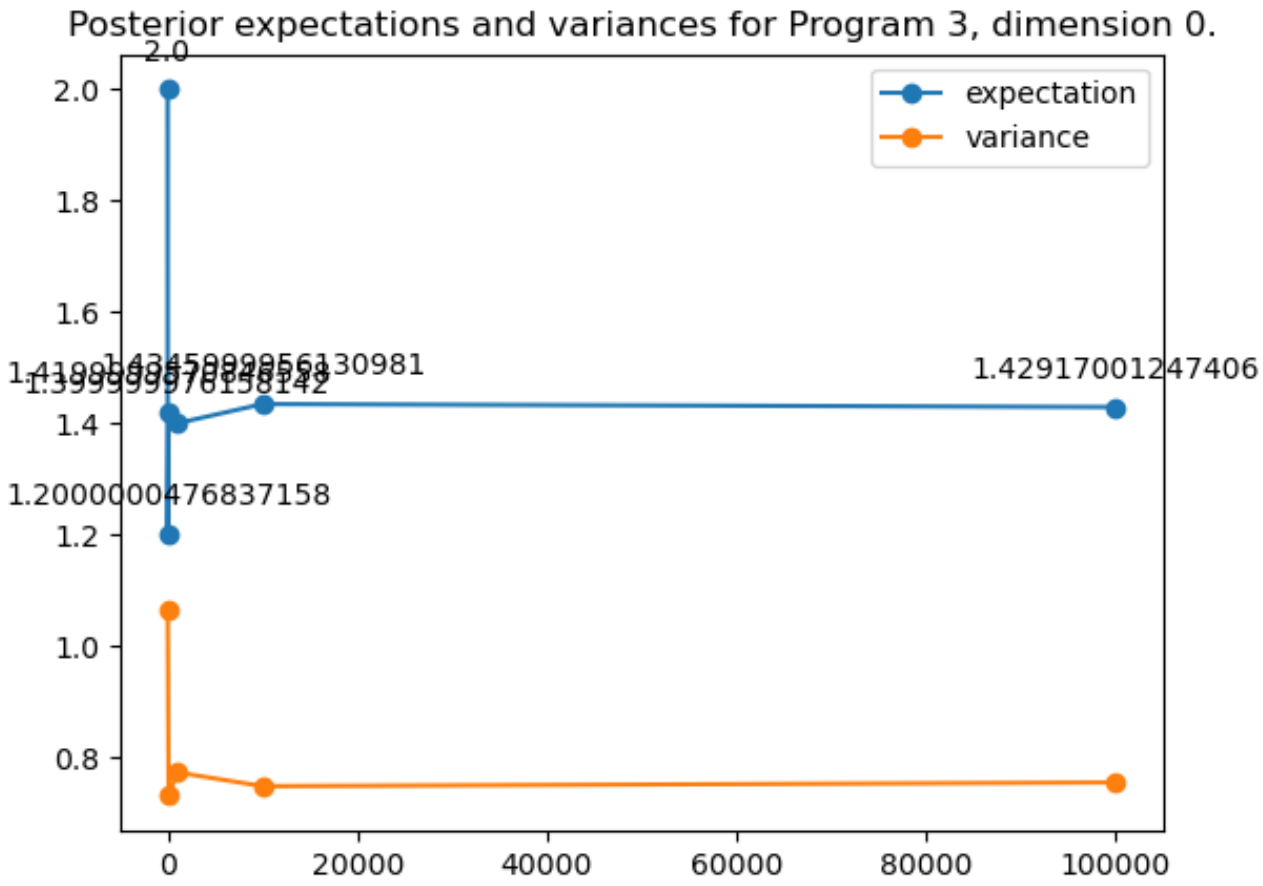

Figure 21: Program 3: Posterior Means and Variances vs number of particles, Dim 0

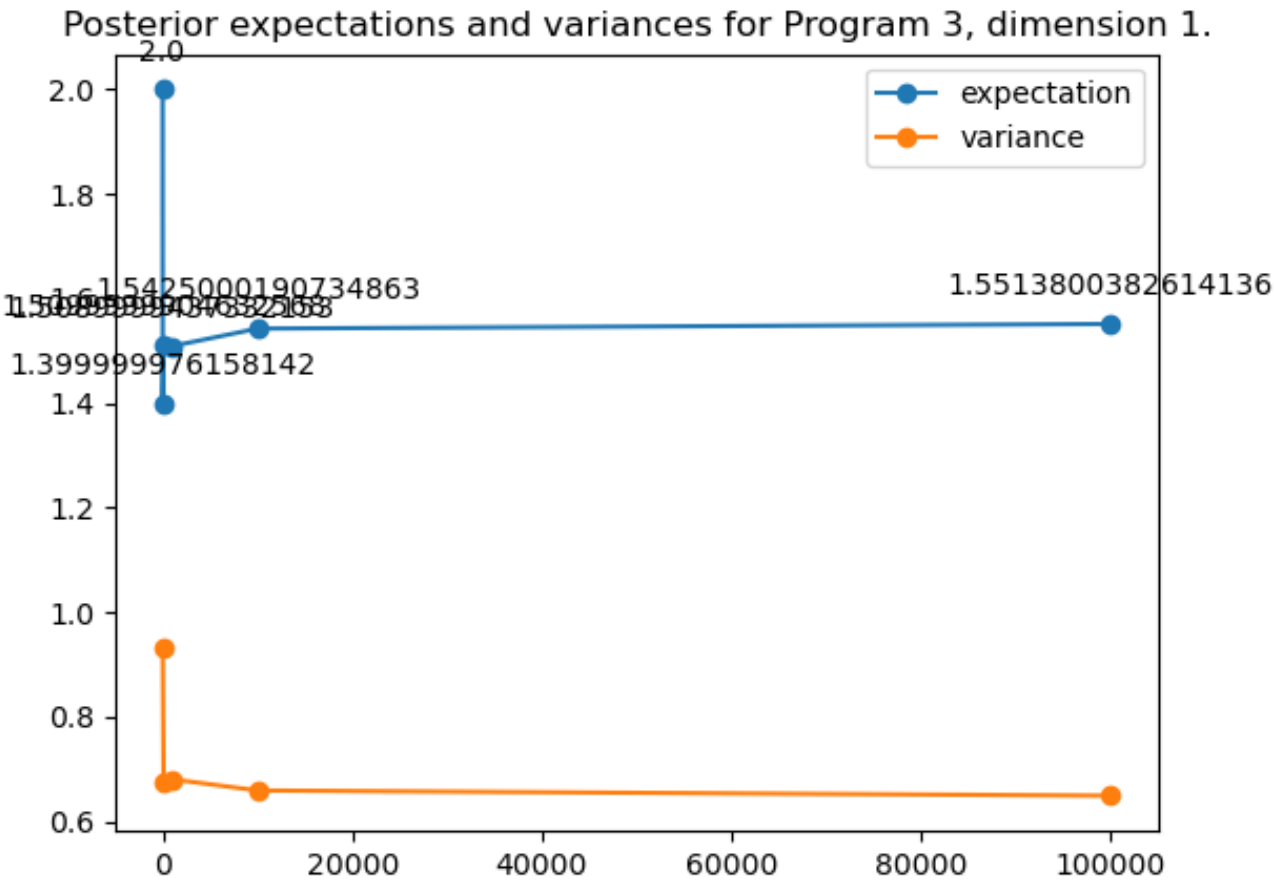

Figure 22: Program 3: Posterior Means and Variances vs number of particles, Dim 1

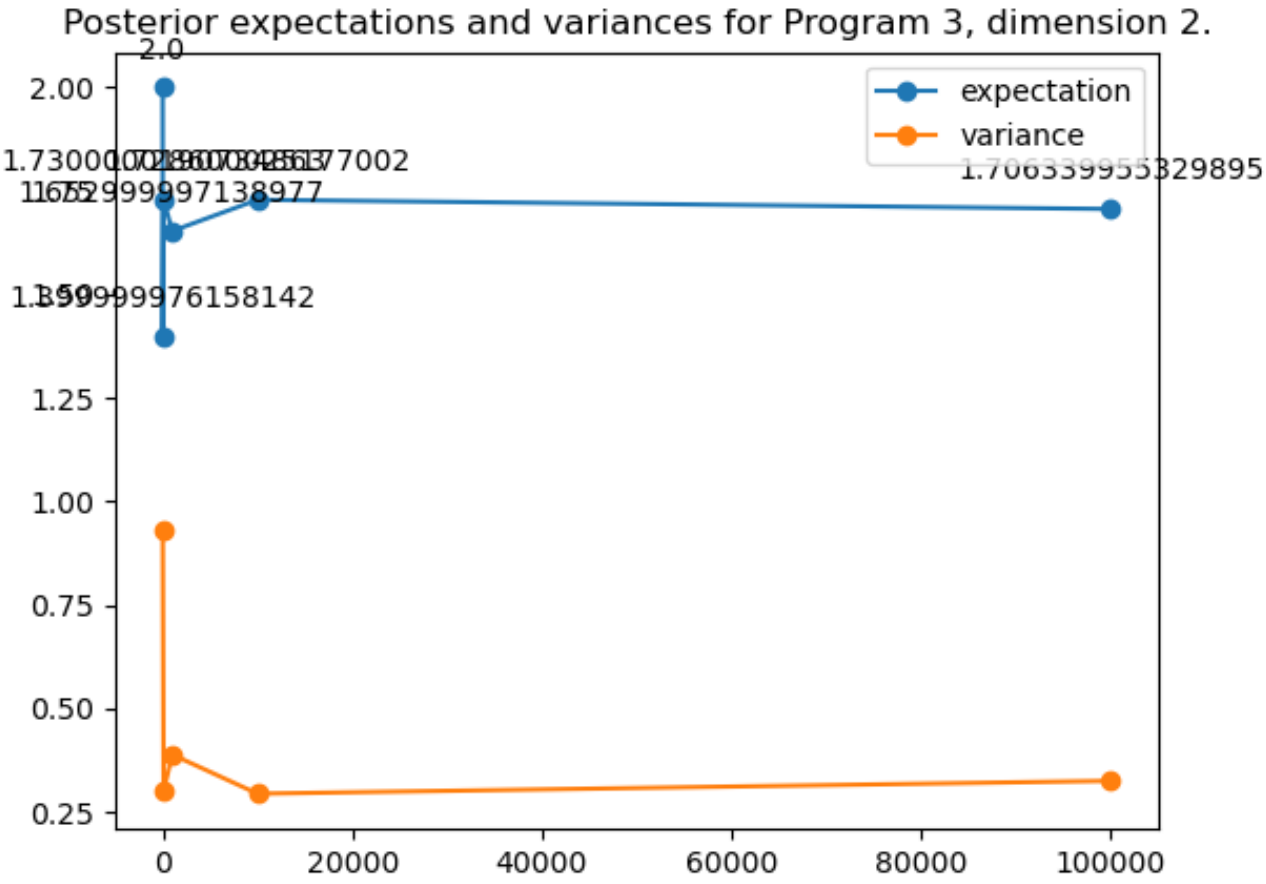

Figure 23: Program 3: Posterior Means and Variances vs number of particles, Dim 2

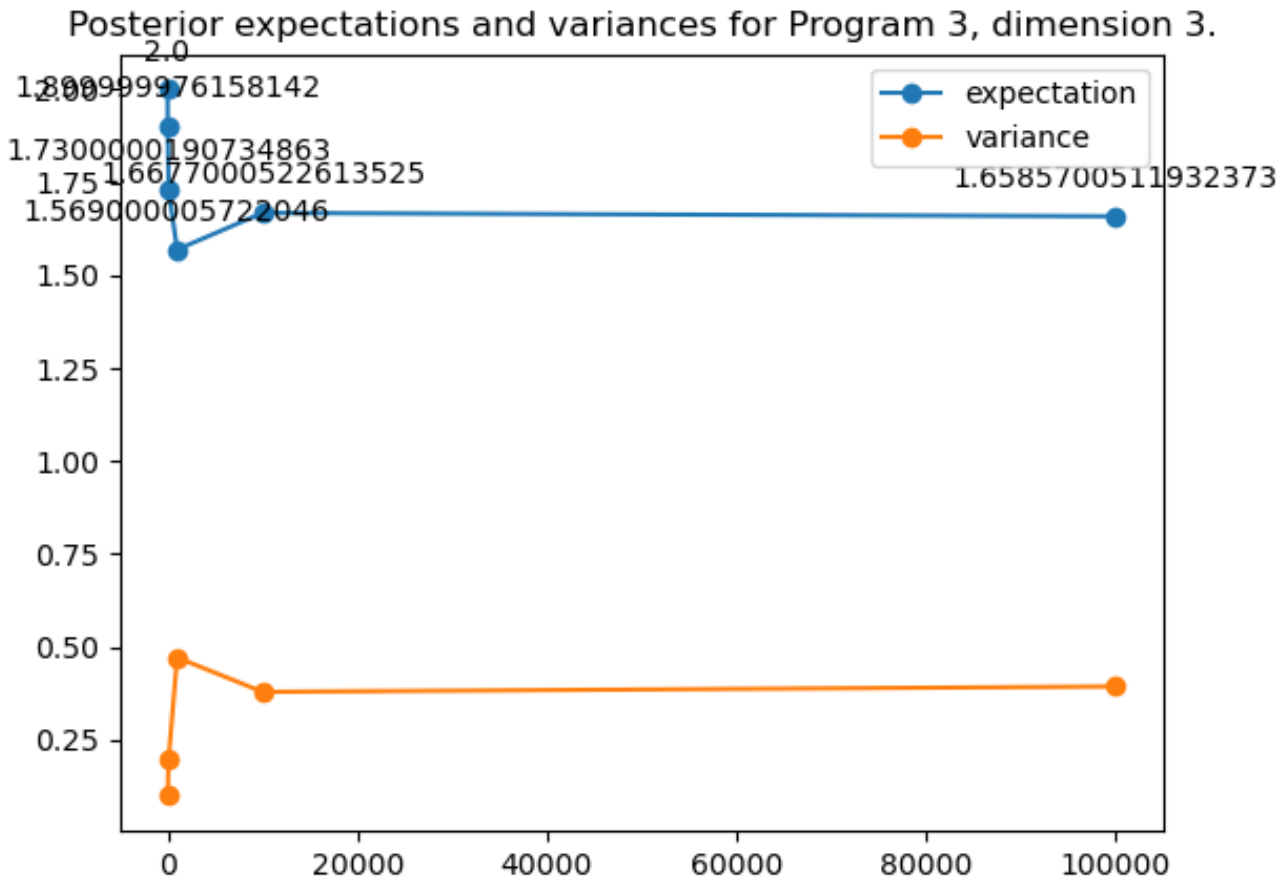

Figure 24: Program 3: Posterior Means and Variances vs number of particles, Dim 3

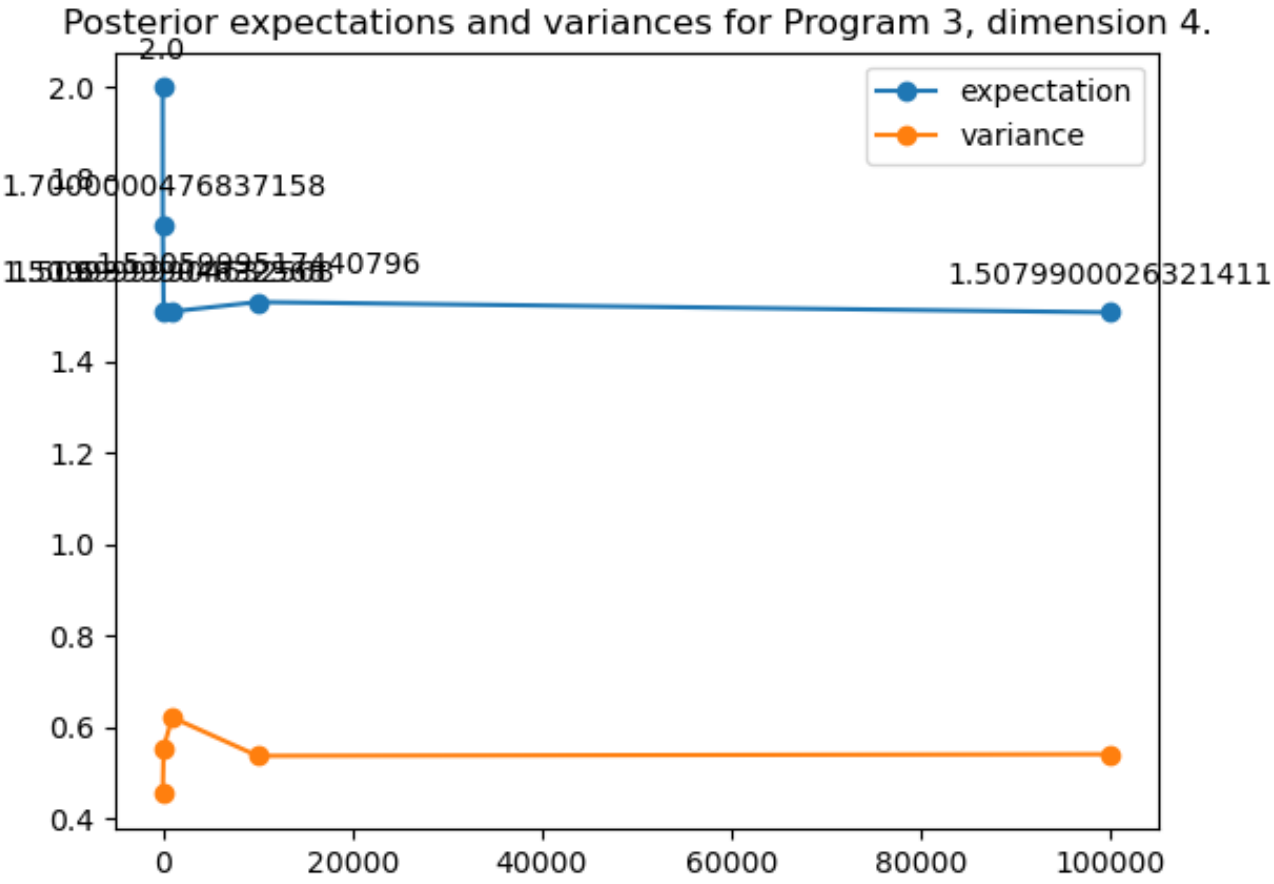

Figure 25: Program 3: Posterior Means and Variances vs number of particles, Dim 4

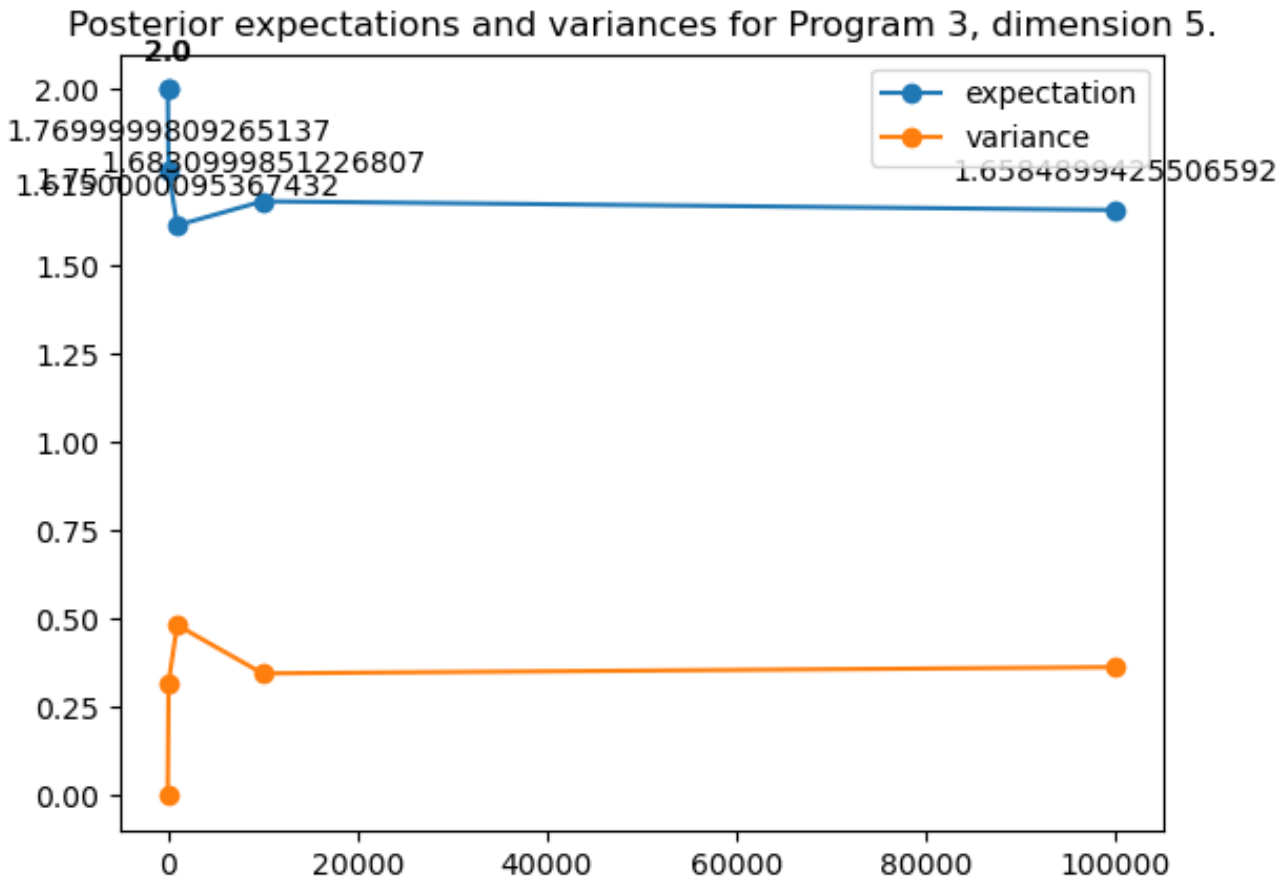

Figure 26: Program 3: Posterior Means and Variances vs number of particles, Dim 5

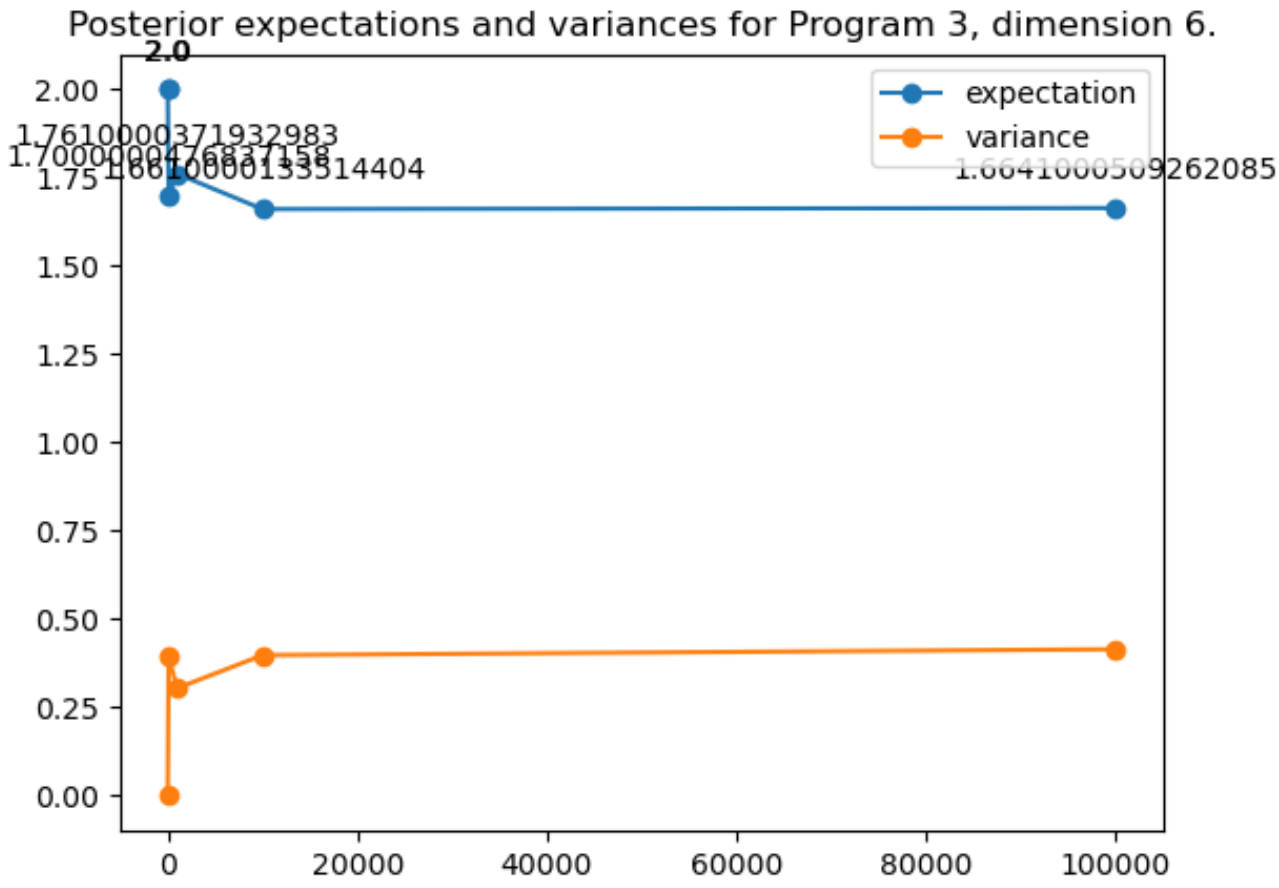

Figure 27: Program 3: Posterior Means and Variances vs number of particles, Dim 6

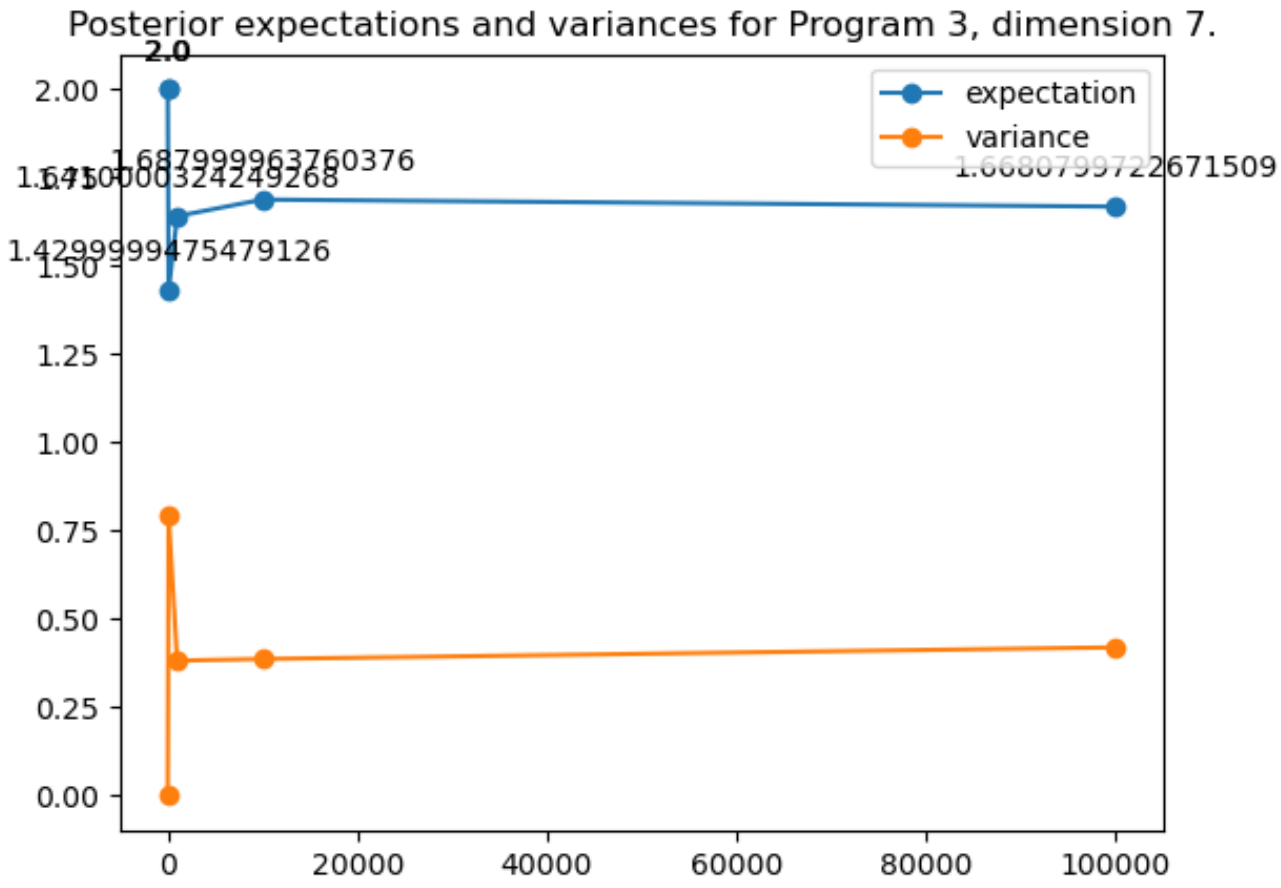

Figure 28: Program 3: Posterior Means and Variances vs number of particles, Dim 7

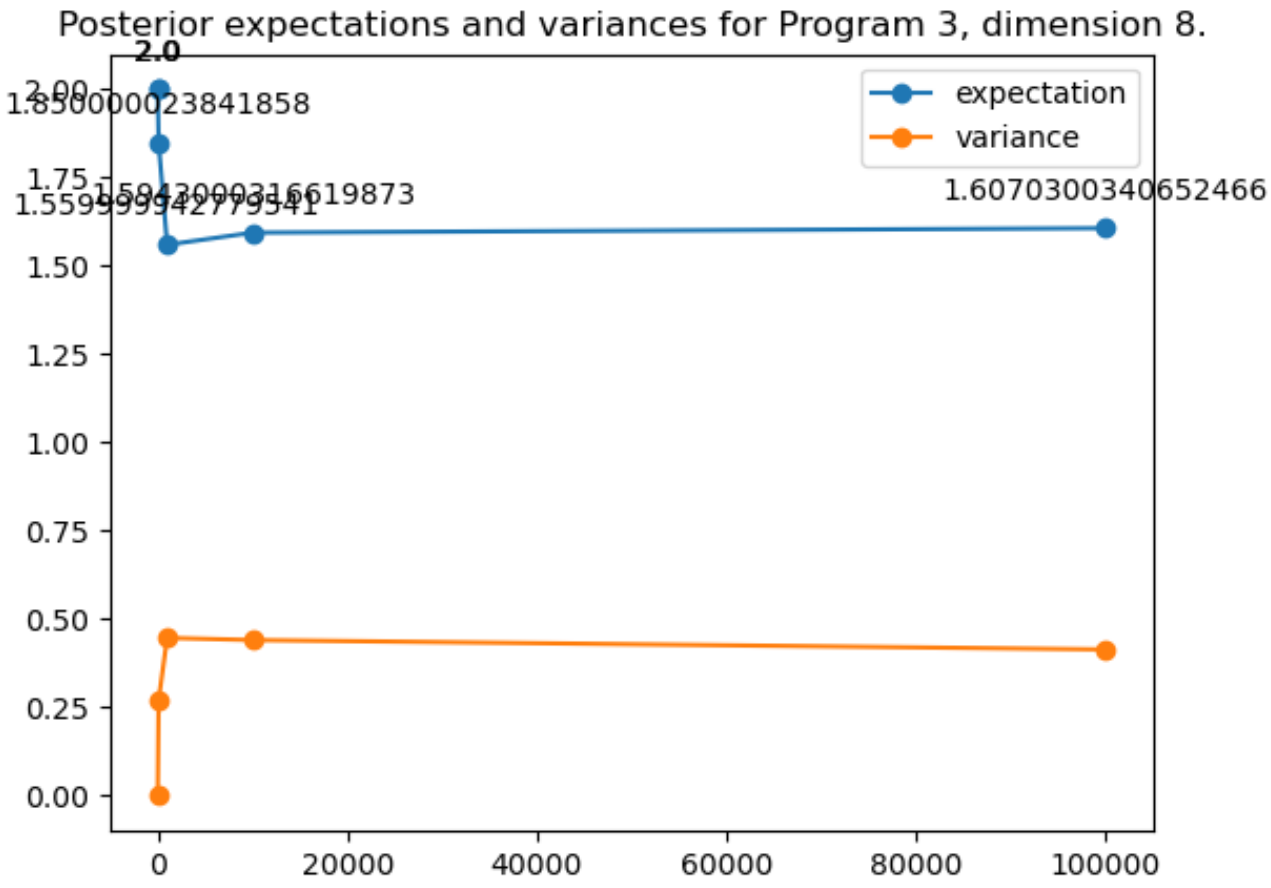

Figure 29: Program 3: Posterior Means and Variances vs number of particles, Dim 8

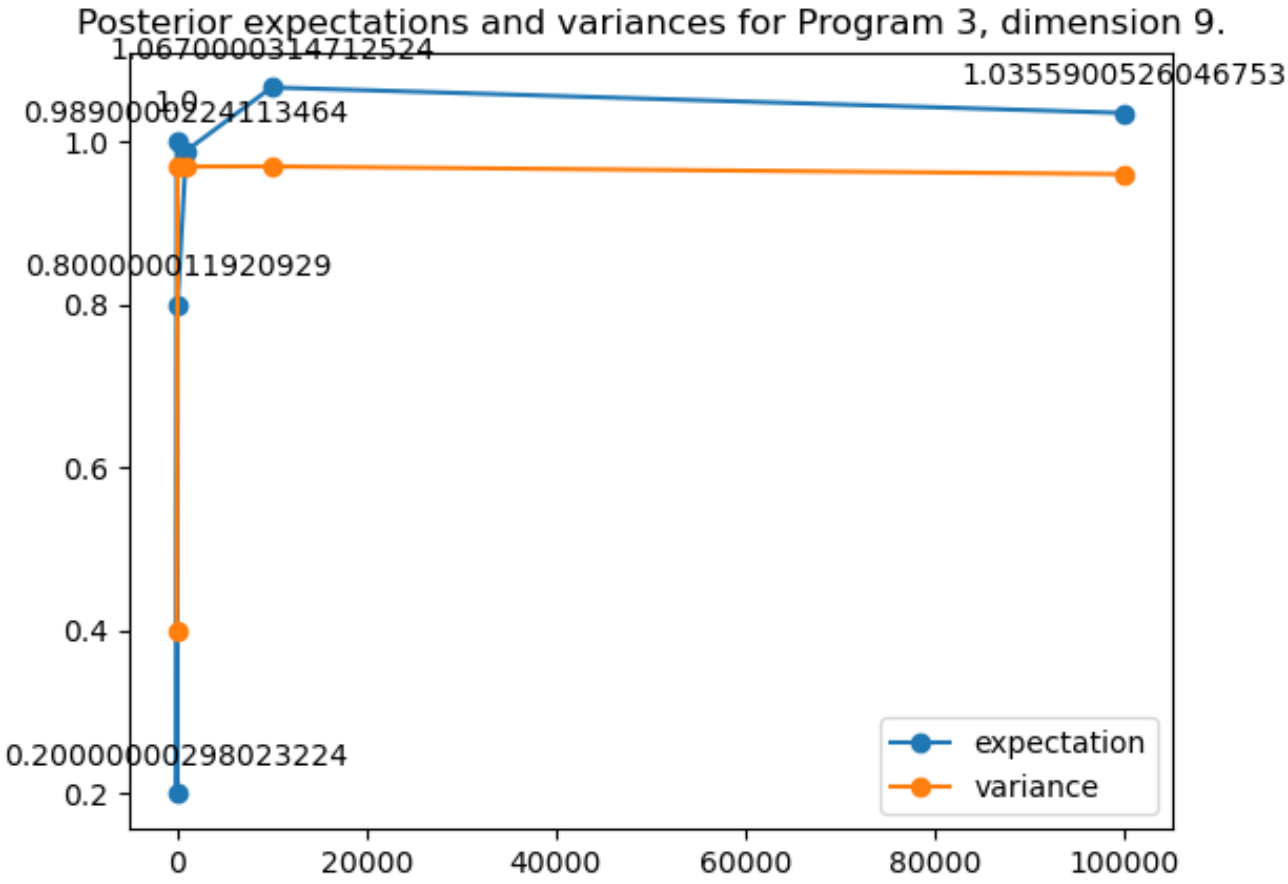

Figure 30: Program 3: Posterior Means and Variances vs number of particles, Dim 9

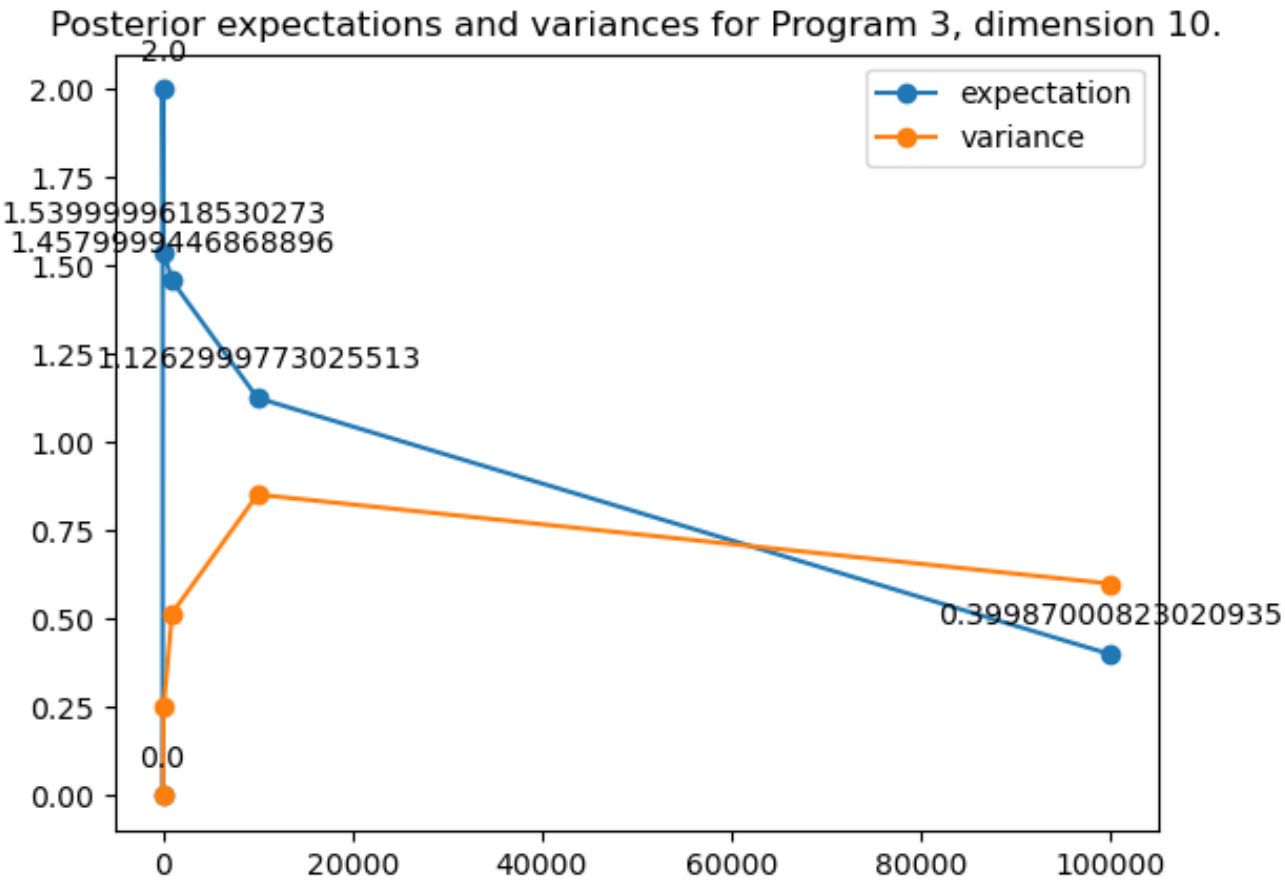

Figure 31: Program 3: Posterior Means and Variances vs number of particles, Dim 10

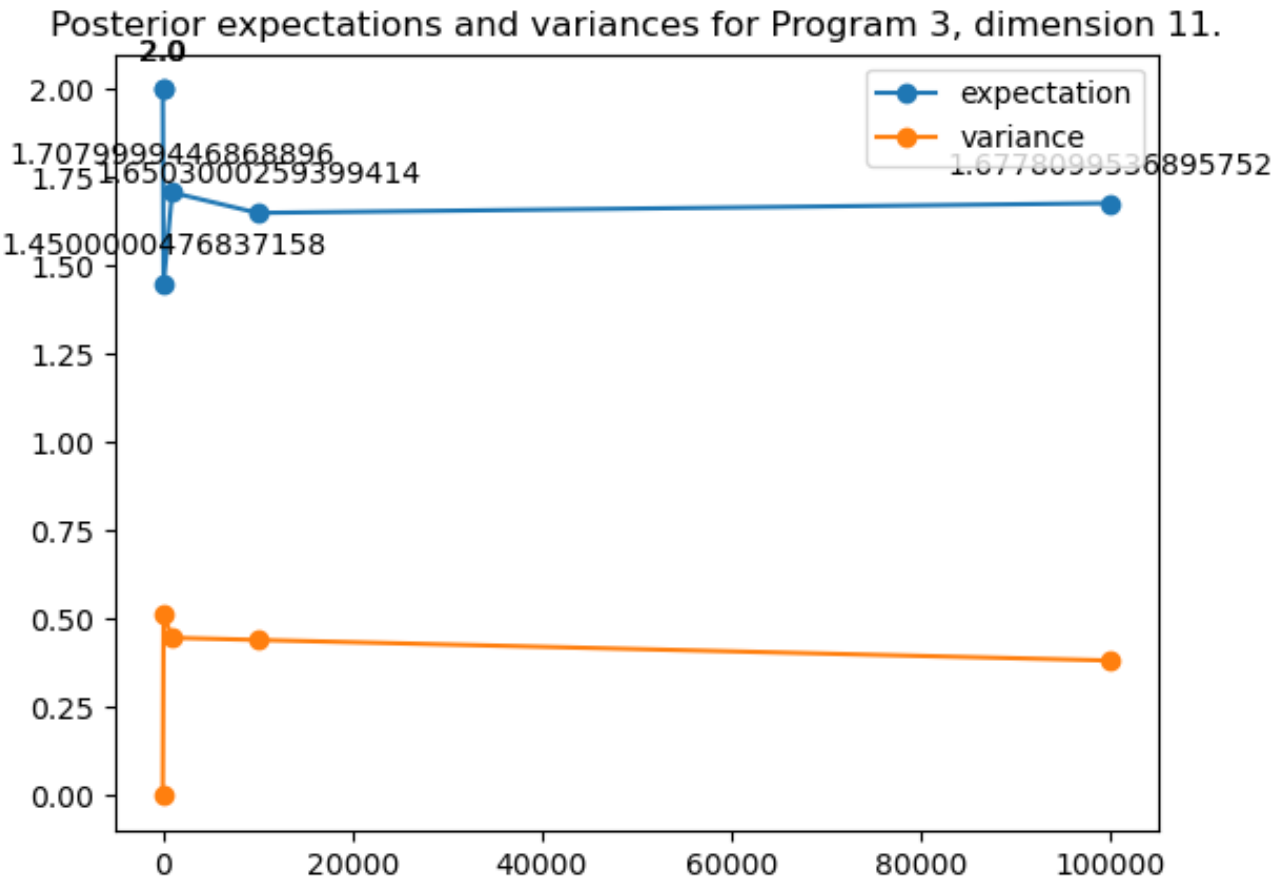

Figure 32: Program 3: Posterior Means and Variances vs number of particles, Dim 11

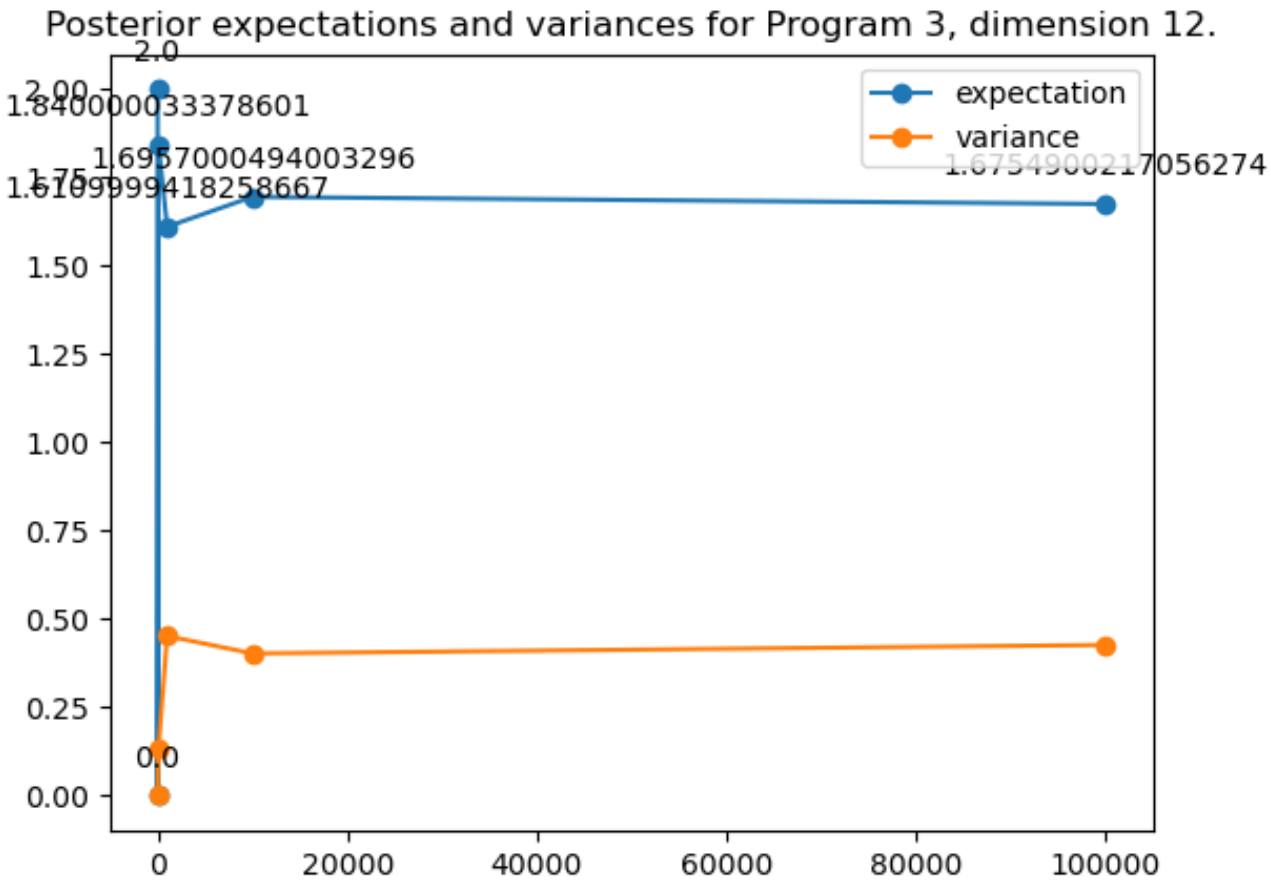

Figure 33: Program 3: Posterior Means and Variances vs number of particles, Dim 12

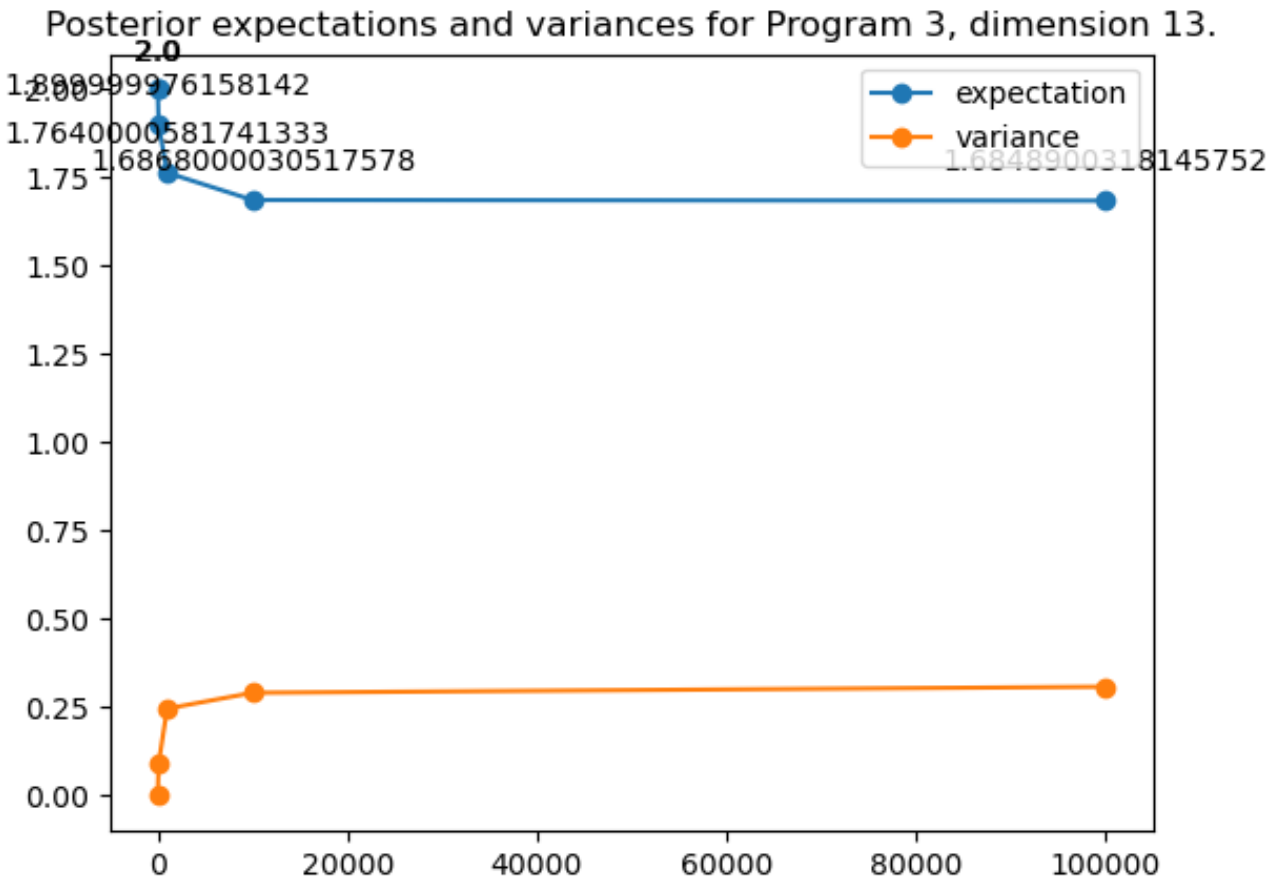

Figure 34: Program 3: Posterior Means and Variances vs number of particles, Dim 13

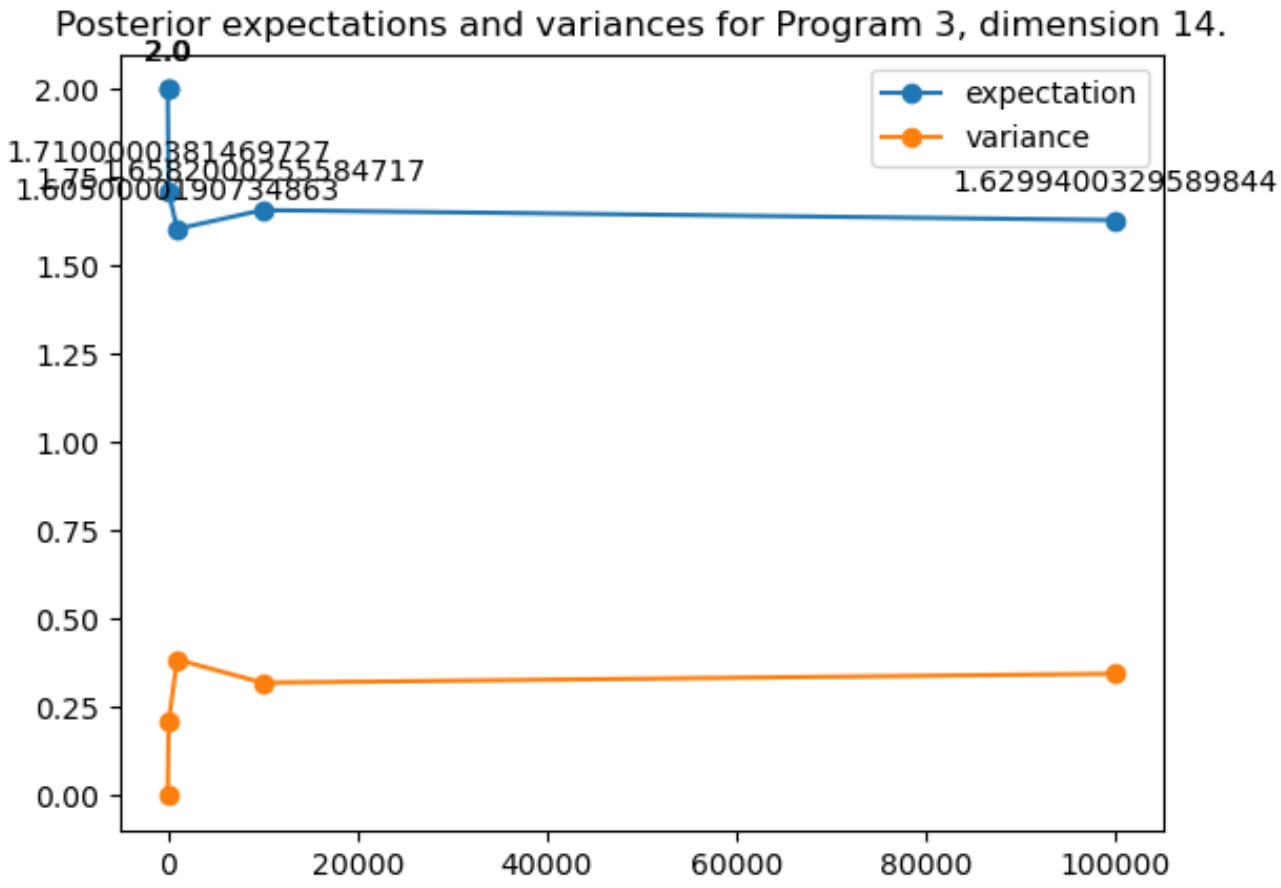

Figure 35: Program 3: Posterior Means and Variances vs number of particles, Dim 14

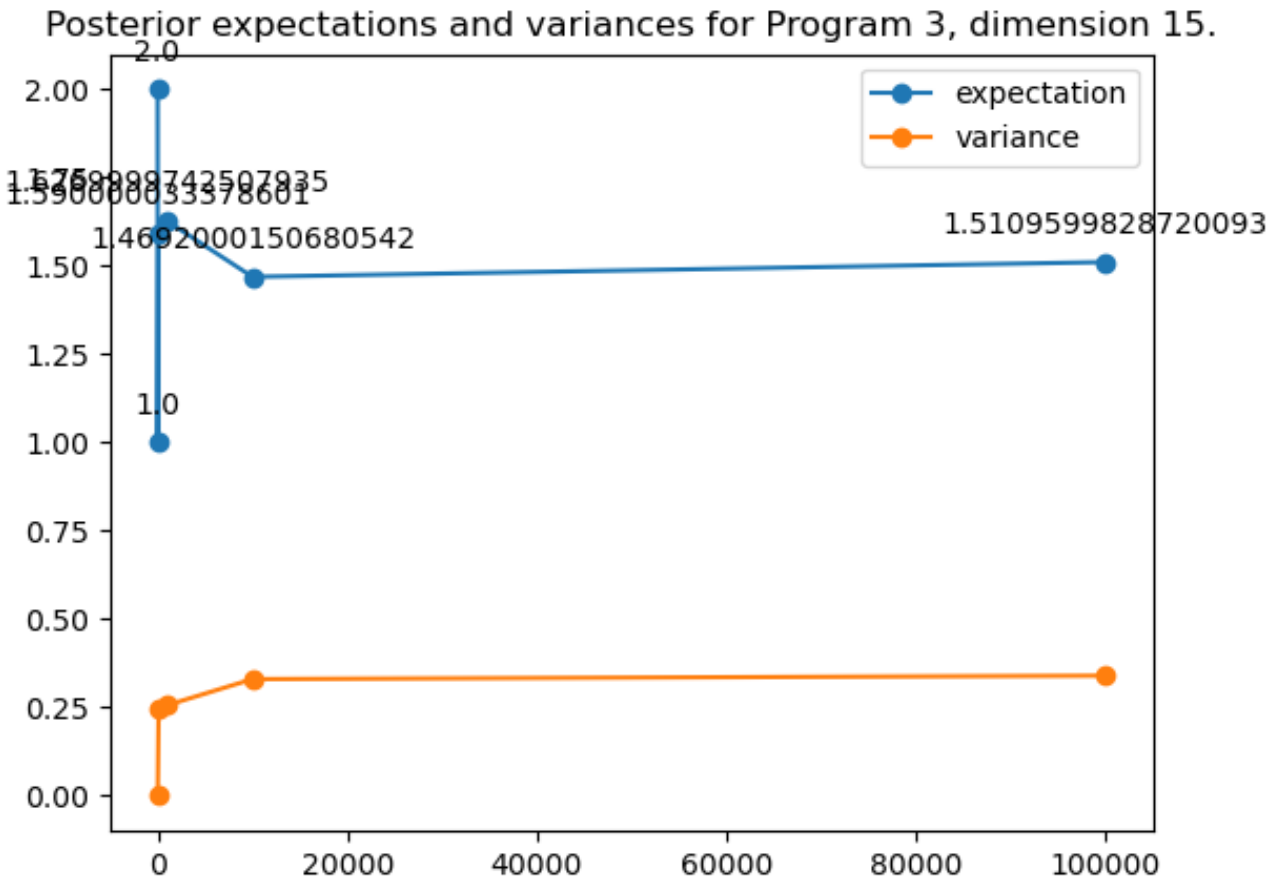

Figure 36: Program 3: Posterior Means and Variances vs number of particles, Dim 15

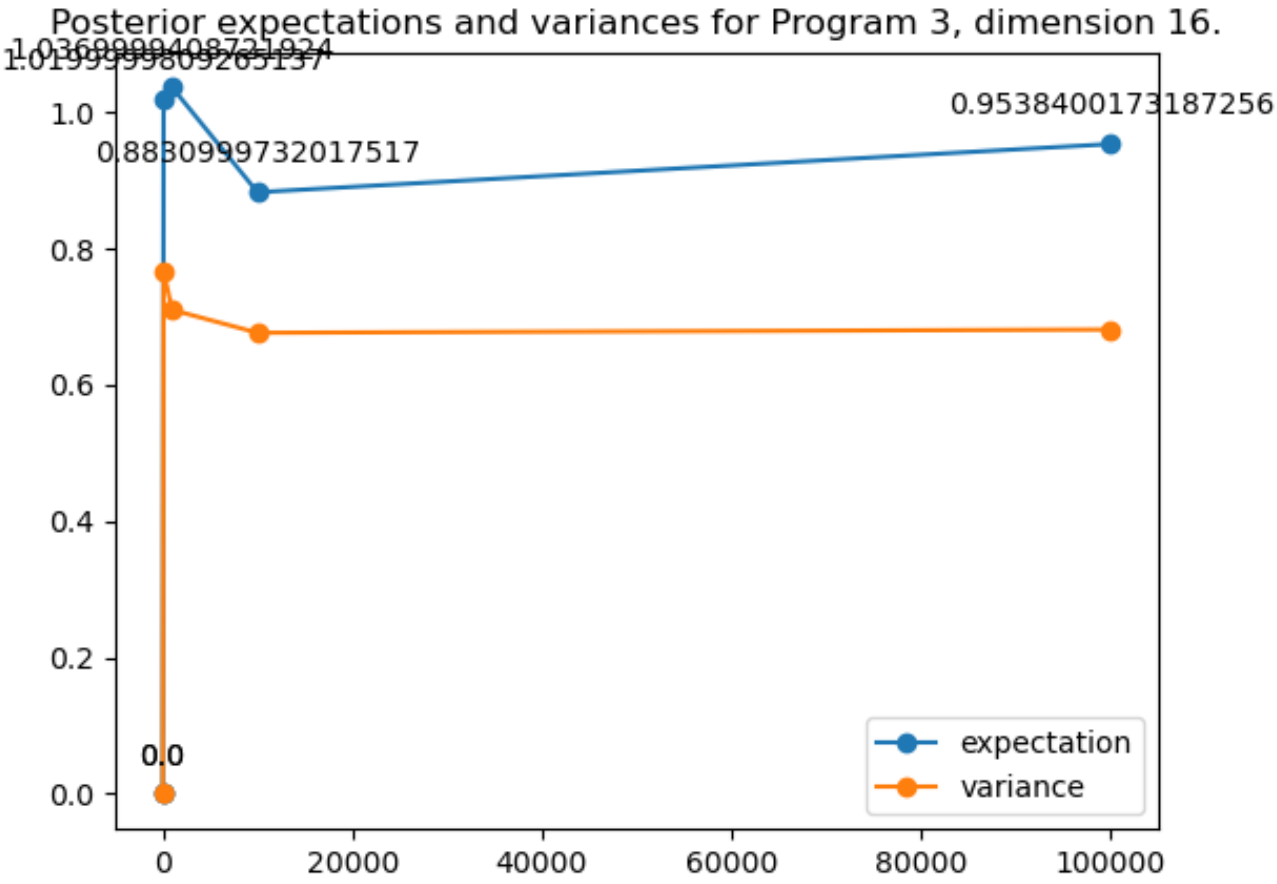

Figure 37: Program 3: Posterior Means and Variances vs number of particles, Dim 16

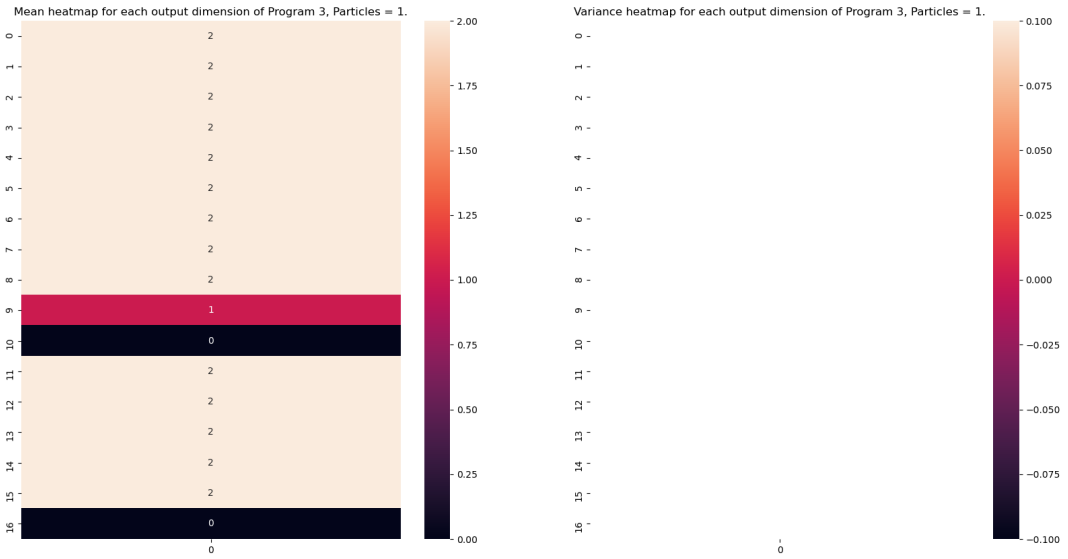

Figure 38: Program 3: Posterior Mean and Variance heatmaps with 1 Particle

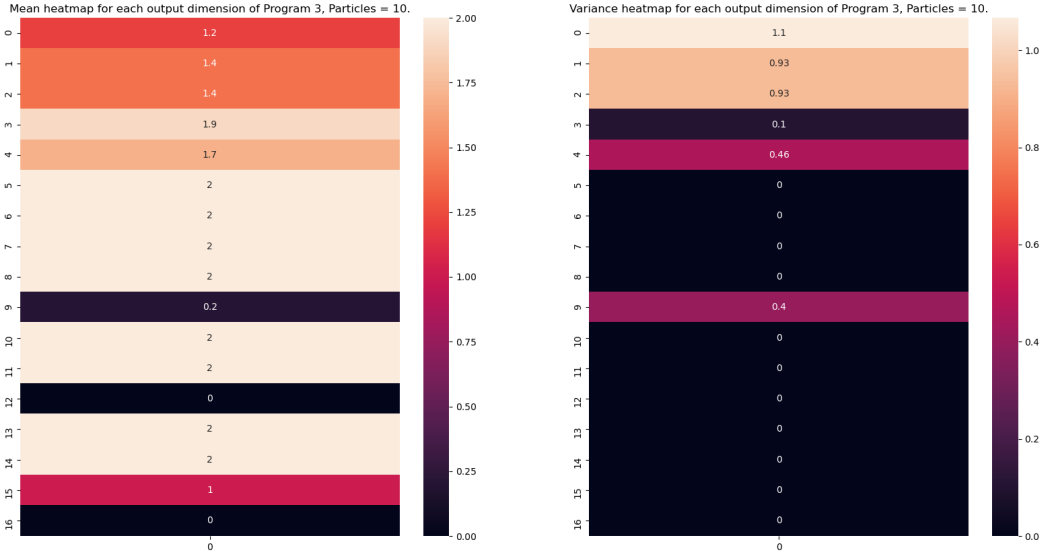

Figure 39: Program 3: Posterior Mean and Variance heatmaps with 10 Particles

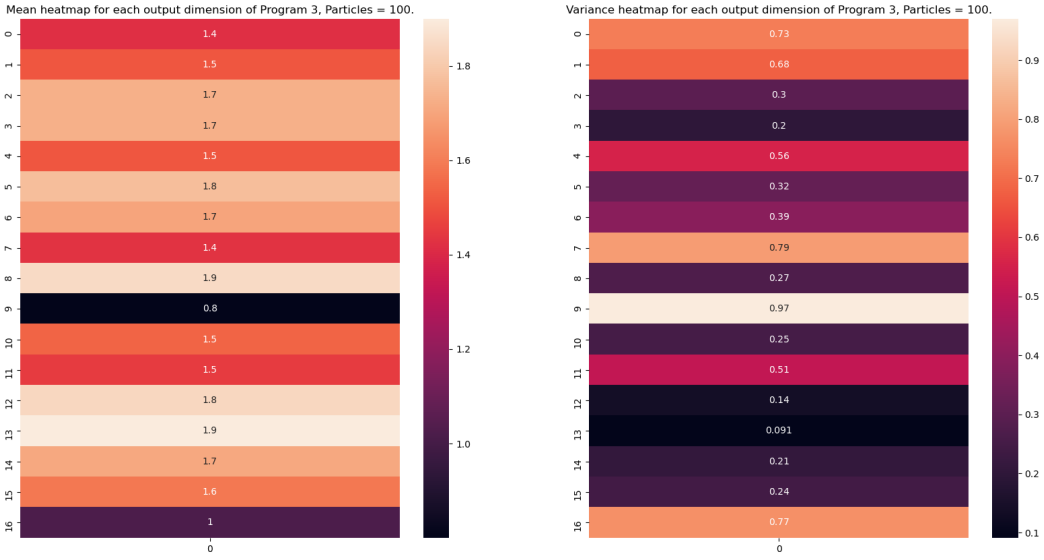

Figure 40: Program 3: Posterior Mean and Variance heatmaps with 100 Particles

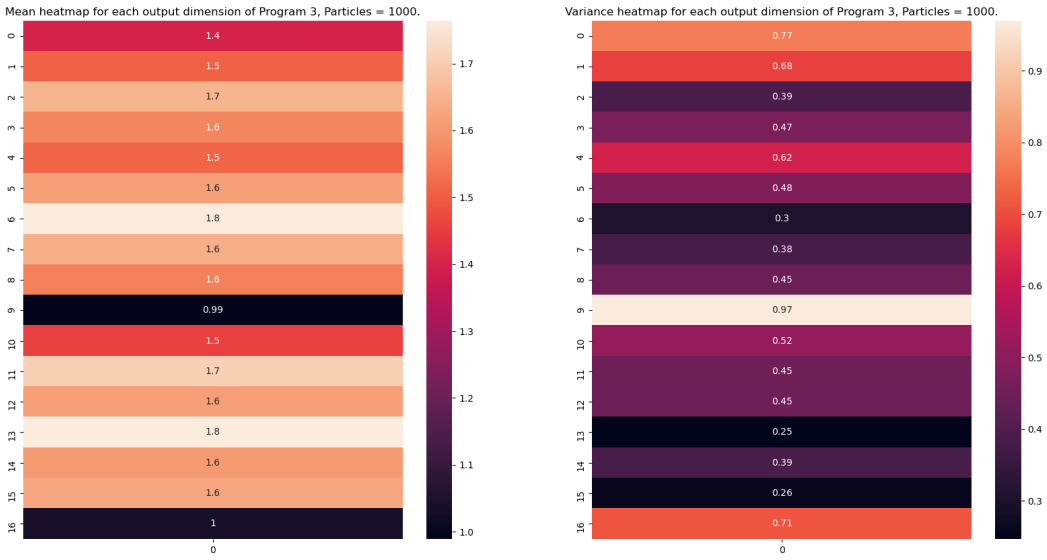

Figure 41: Program 3: Posterior Mean and Variance heatmaps with 1000 Particles

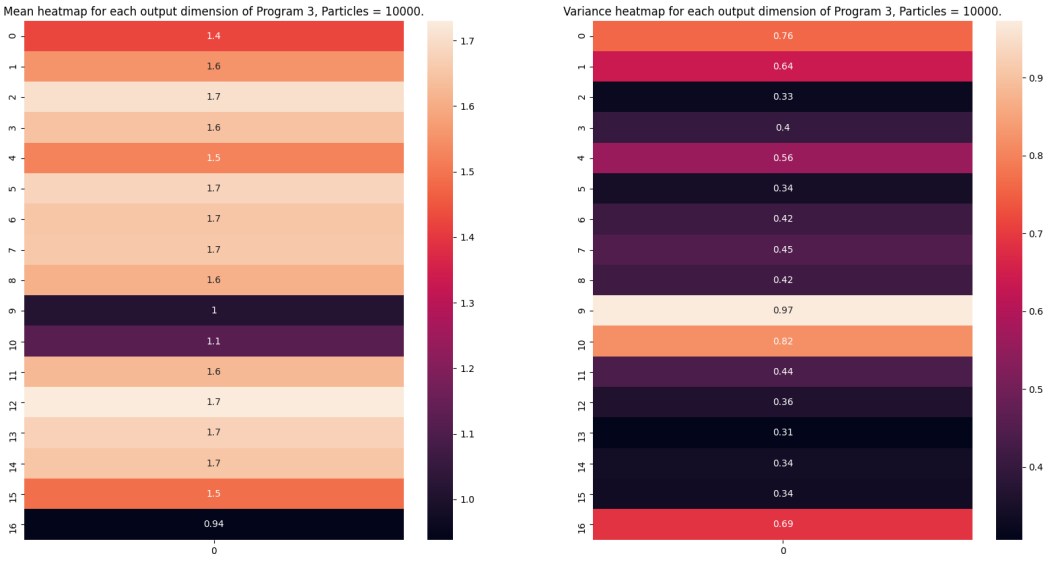

Figure 42: Program 3: Posterior Mean and Variance heatmaps with 10000 Particles

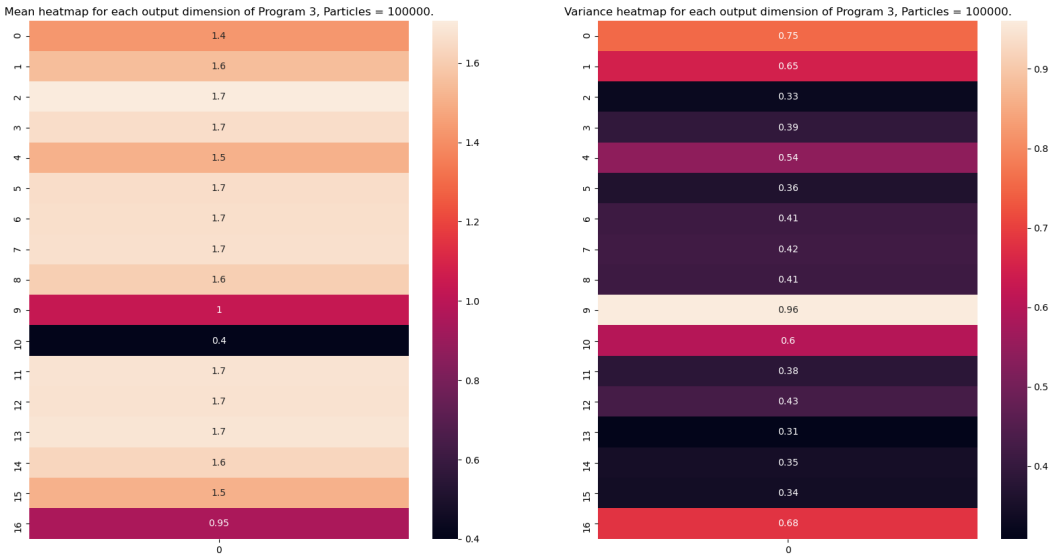

Figure 43: Program 3: Posterior Mean and Variance heatmaps with 100000 Particles

4 Program 4

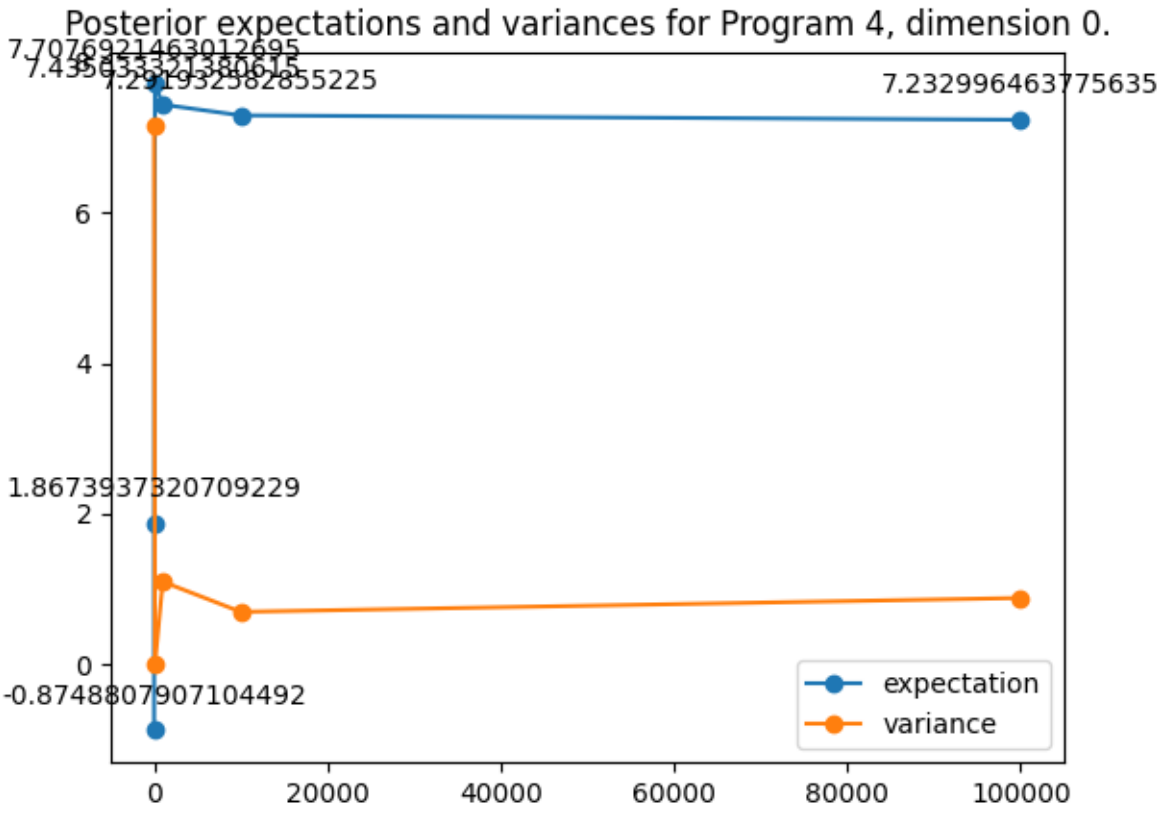

Figure 44: Posterior Means and Variances vs number of particles

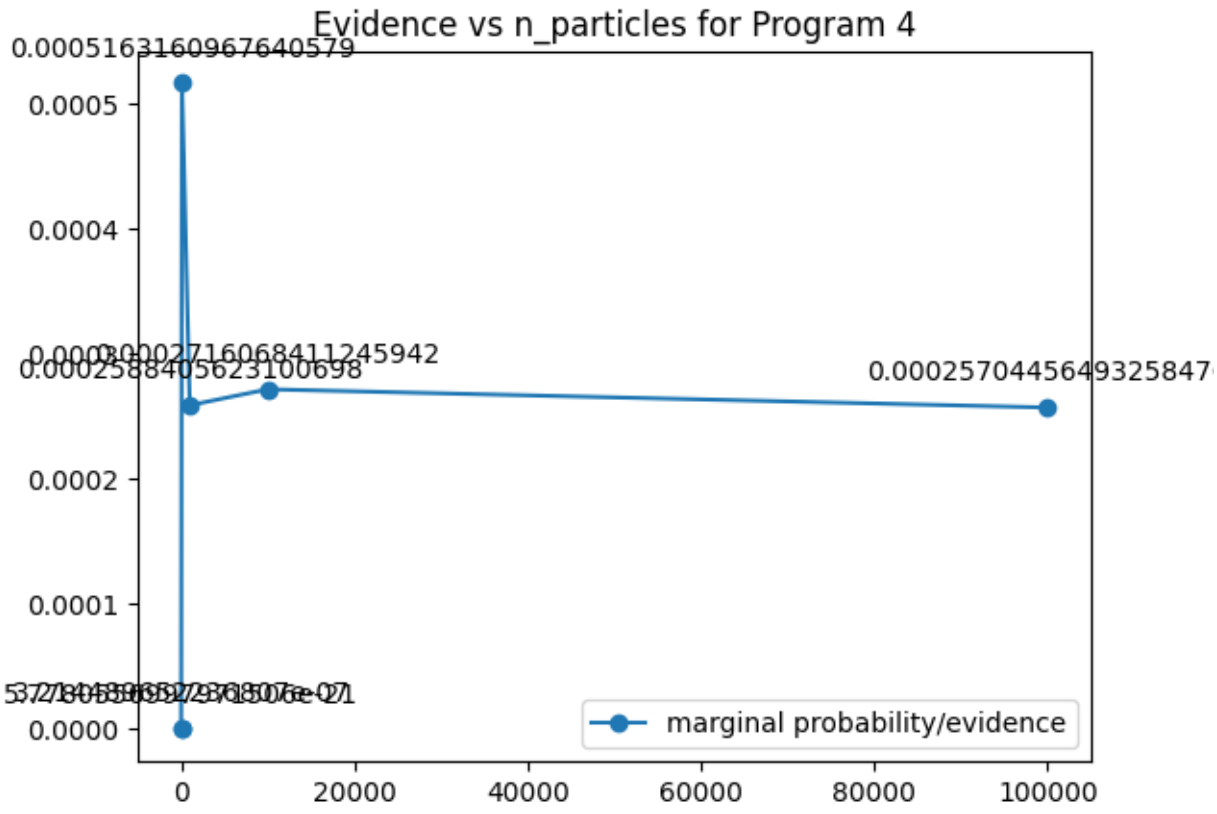

Figure 45: Marginal probability vs number of particles

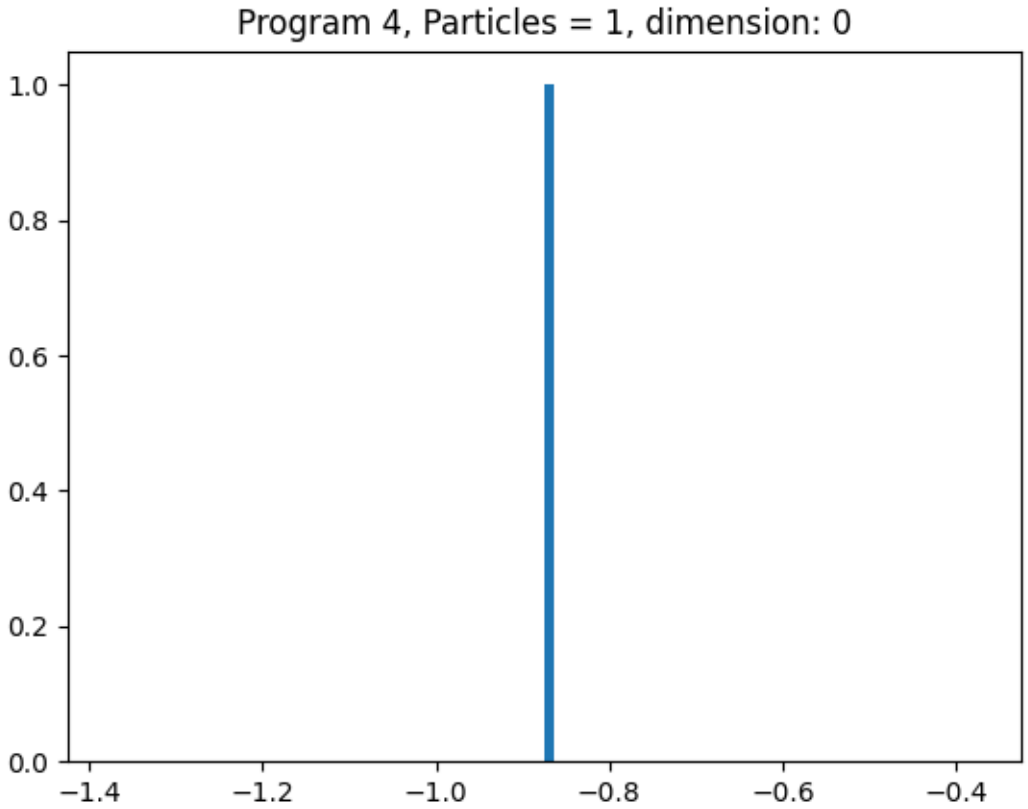

Figure 46: P4 Histogram: 1 particles

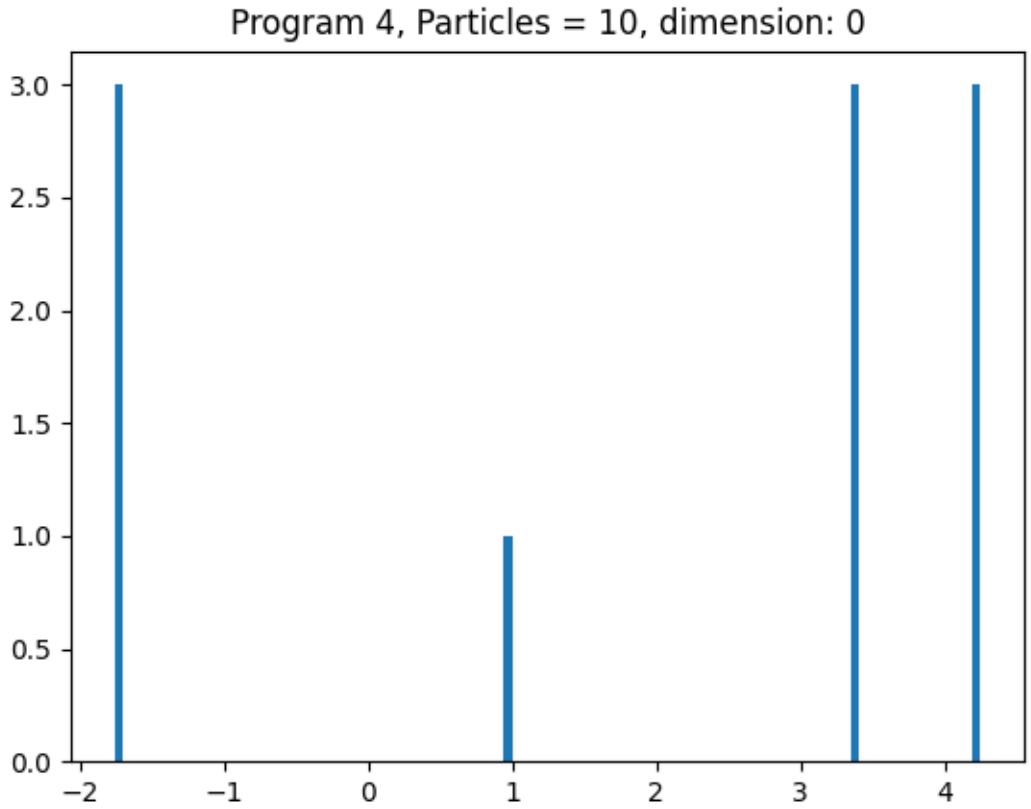

Figure 47: P4 Histogram: 10 particles

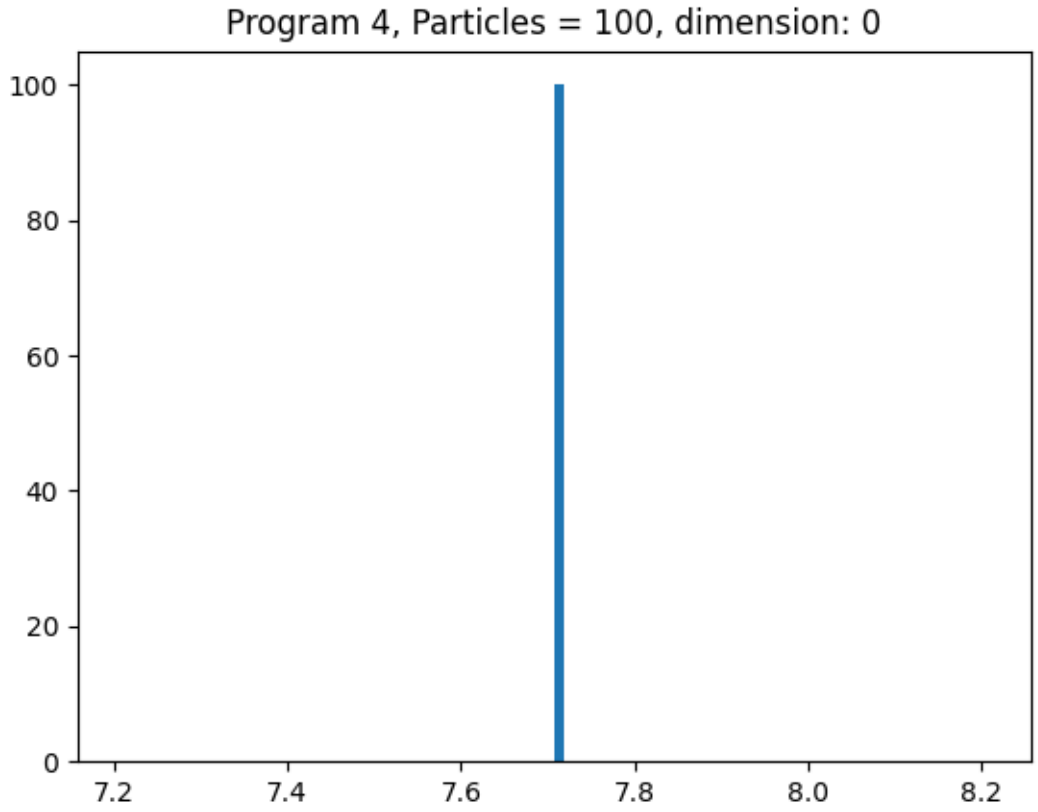

Figure 48: P4 Histogram: 100 particles

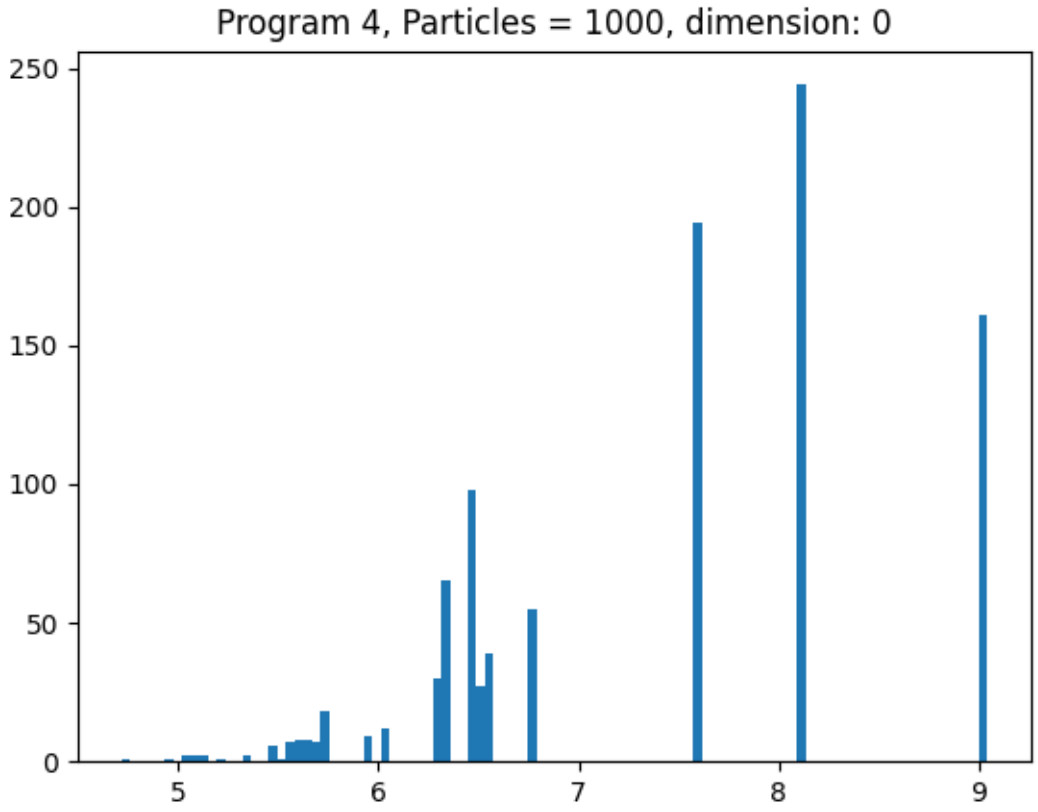

Figure 49: P4 Histogram: 1000 particles

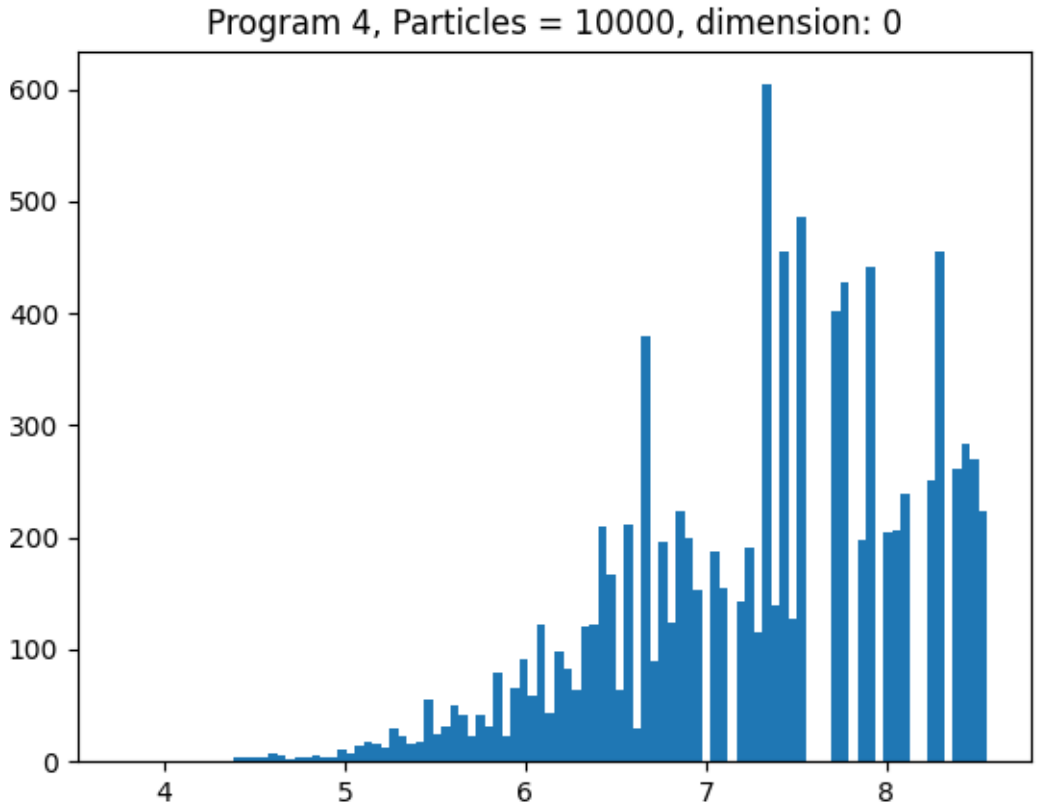

Figure 50: P4 Histogram: 10000 particles

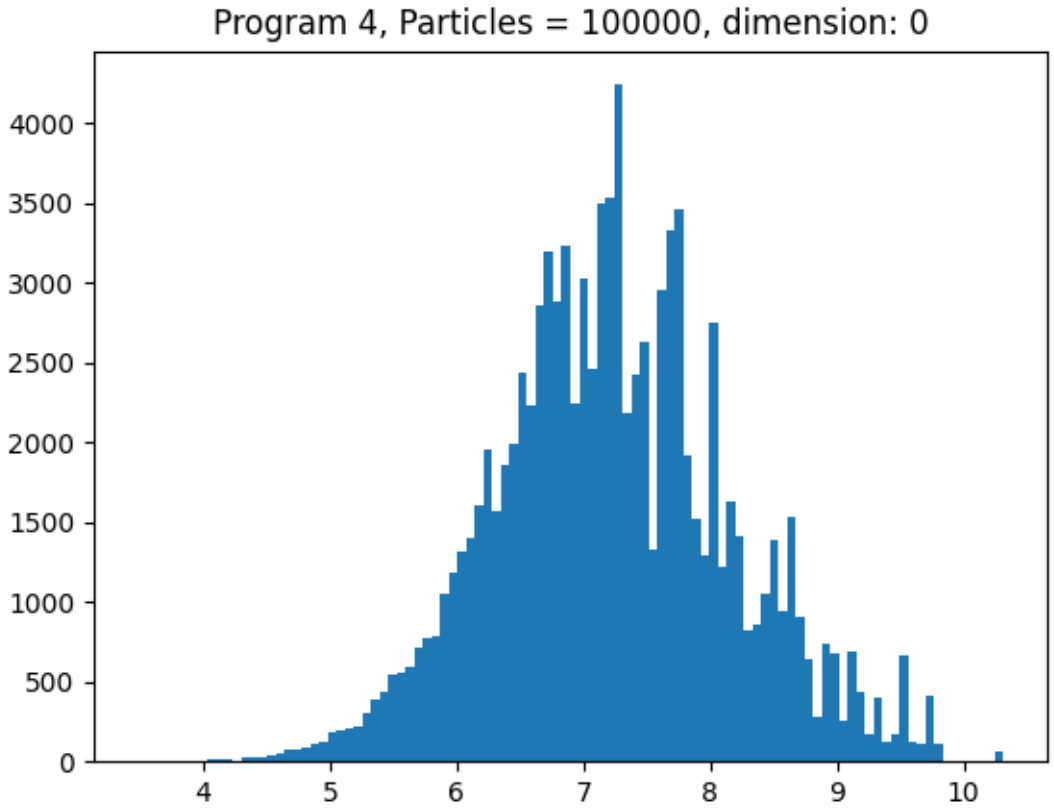

Figure 51: P4 Histogram: 100000 particles