Ph21 Assignment 4(b)

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1 Part I

1.1 Uniform Prior

1.1.1 Changing Chain Length

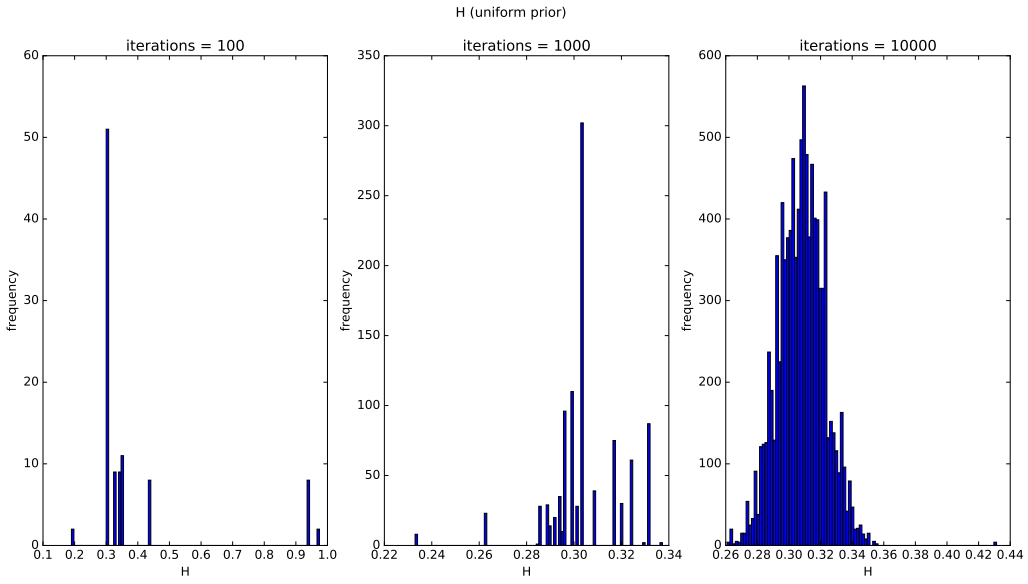

Figure 1: Posterior distributions for chain lengths of 100, 1000 and 10000 with a true H value of 0.30 and $N = 1000$ data points.

With increasing length of the chain, the posterior distribution peaks at the true H value of 0.30.

1.2 Gaussian Prior

1.2.1 Changing Chain Length

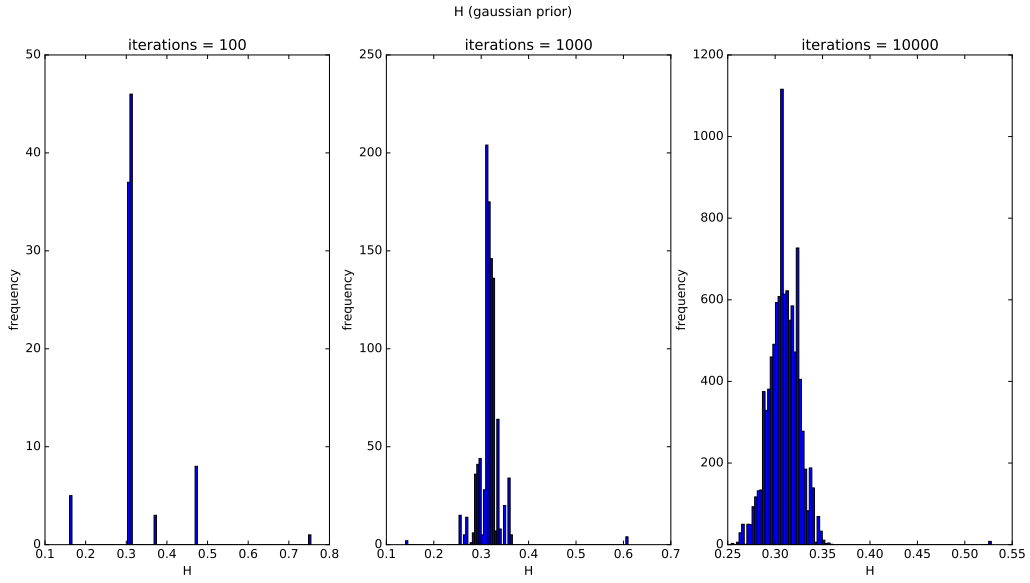

Figure 2: Posterior distributions for chain lengths of 100, 1000 and 10000 with a true H value of 0.30 and $N = 1000$ data points.

With increasing length of the chain, the posterior distributions peak at the true H value of 0.30

1.2.2 Changing μ

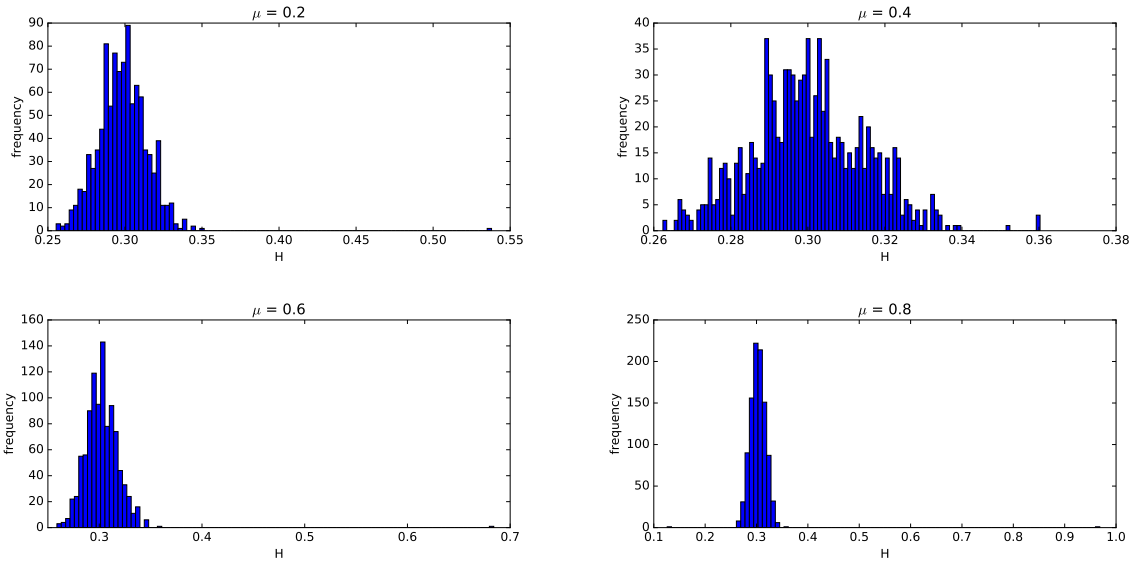

Figure 3: Posterior distributions for $\mu = 0.20,\ 0.40,\ 0.60,\ 0.80$ with a true H value of 0.30. MCMC chain length used was 10 000 with a thin value of 10.

Initial biases with μ closer to the true H give posterior distributions that cluster closer to $H = 0.30$. Inaccurate biases sample H values further away from the true value.

1.2.3 Changing σ

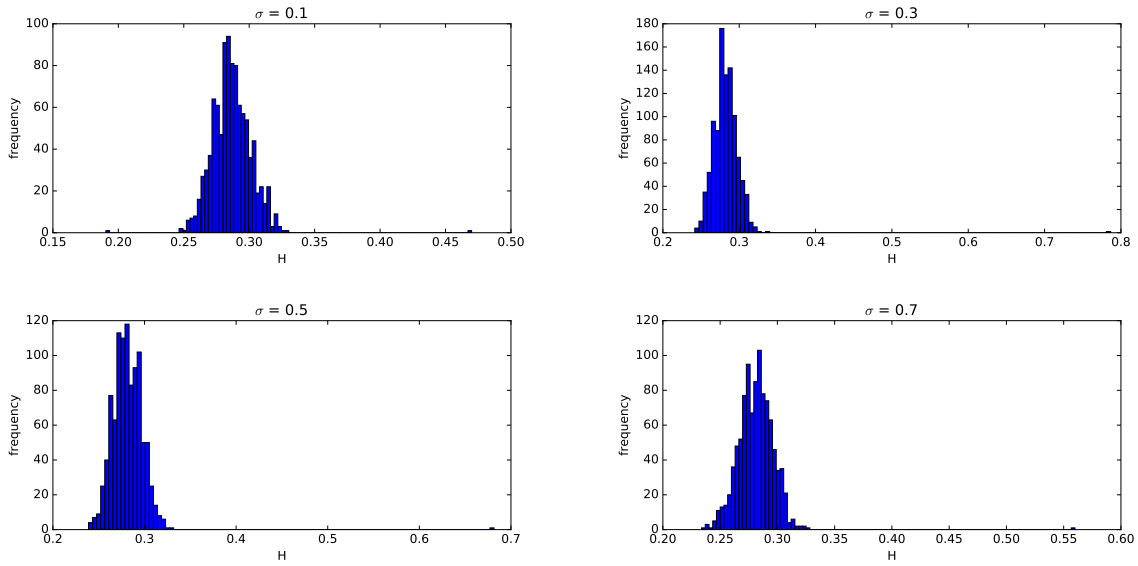

Figure 4: Posterior distributions for $\sigma = 0.10,\ 0.30,\ 0.50,\ 0.70$ with a true H value of 0.30. MCMC chain length used was 10 000 with a thin value of 10.

Initial biases with smaller σ produce samples within a smaller interval containing the true H. Inaccurate biases sample H values further away from the true value.

2 Part II

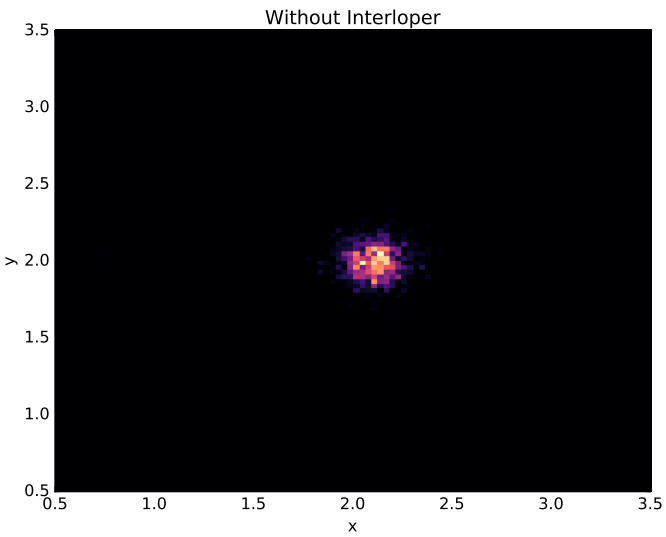

Figure 5: Posterior distribution for the position of the lighthouse with true $x = 2$km and true $y = 2$km. A chain length of 10 000 was used on 1000 data points.

2.1 Interloper

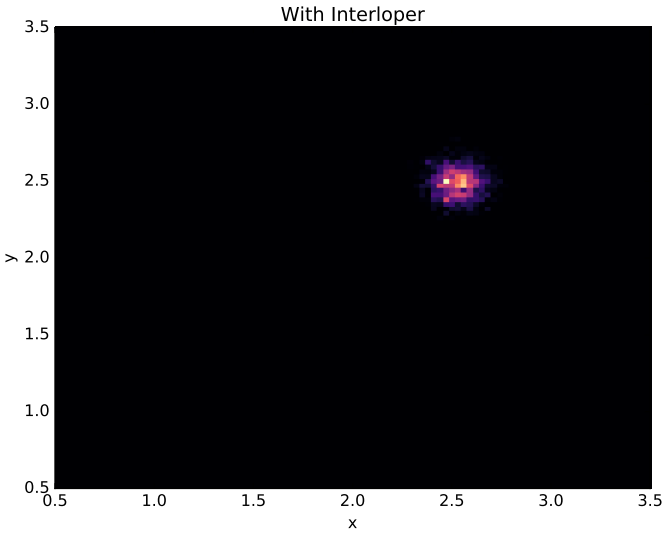

Figure 6: Posterior distributions for the position of the lighthouse with true $x = 2$km and true $y = 2$km. The ship is placed at $x = 3$km and $y = 3$km. A chain length of 10 000 was used on 1000 data points.

The MCMC is able to spot the interloper since the flashes it emits affects the data set. The x, y coordinates the simulations converge on are in between the coordinates of the lighthouse and the coordinates of the ship.