1 :Plot the frst couple hundred trajectories of the MC history of m. How do the trajectories differ for the two MCs?

The plots in my plot do not seem really different but we would expect a lower acceptance rate for lower N_{md} and that means more flat line between the fluctuating point. The error probably comes from errors in previous in previous sheets, but I wasn't able to find it and correct it.

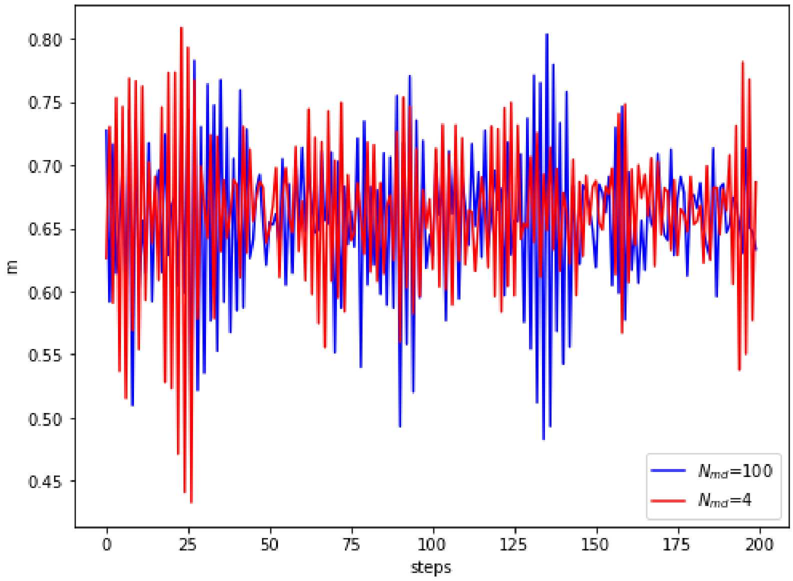

Figure 1: First 200 trajectories for $N_{md} = 4$ and $N_{md} = 100$

2 : Implement the straightforward estimator $C(\tau) = \bar{\Gamma}^{(m)}(\tau)/\bar{\Gamma}^{(m)}(0)$for the normalized autocorrelation function using:

$$\bar{\Gamma}^{(m)}(\tau) = \frac{1}{\#(k,l)} \sum_{(k,l:\tau=|k-l|)} (m_k - \bar{m}_N) \cdot (m_l - \bar{m}_N)$$

and plot the function of $C(\tau)$ for your generated data sets.

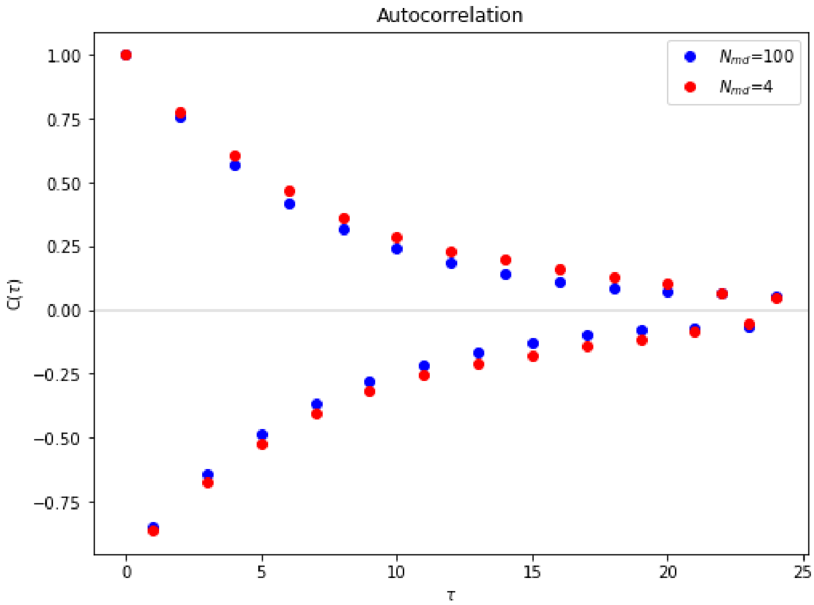

Figure 2: Autocorrelation for $N_{md} = 4$ and $N_{md} = 100$

3 :Generate blocked data for b =2,4,8,16, 32, and 64, and calculate the autocorrelation for each blocked list. Does it behave the way you expect? With the blocked lists, estimate the naive standard error with $\sigma/\sqrt{Nb}$ and observe the behavior, where σ is the standard deviation of the blocked list.

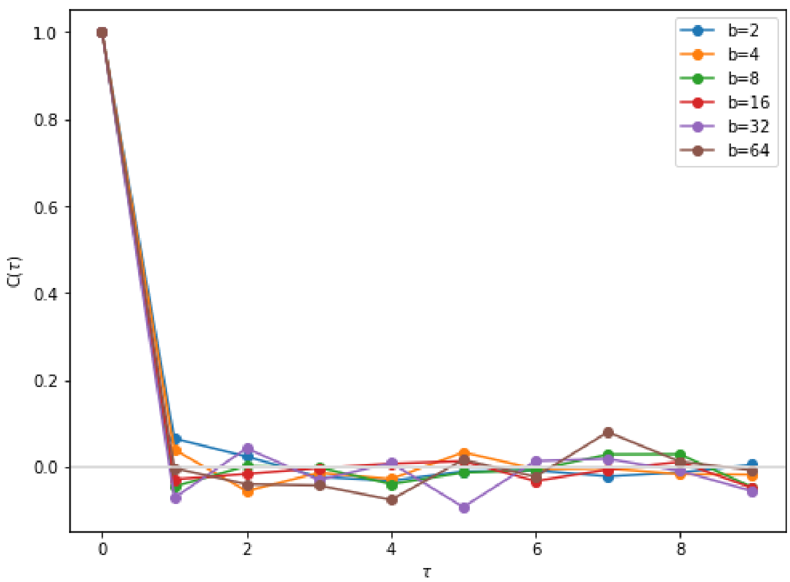

Figure 3: Autocorrelation for $N_{md} = 100$ for different size of bins

The behavior is not what we are expecting and this can again come from the wrong generation of the data. The expected behavior would be that as we increase the size of the bin the autocorrelation would decrease faster.
The behavior of the naive error in this case is the following:

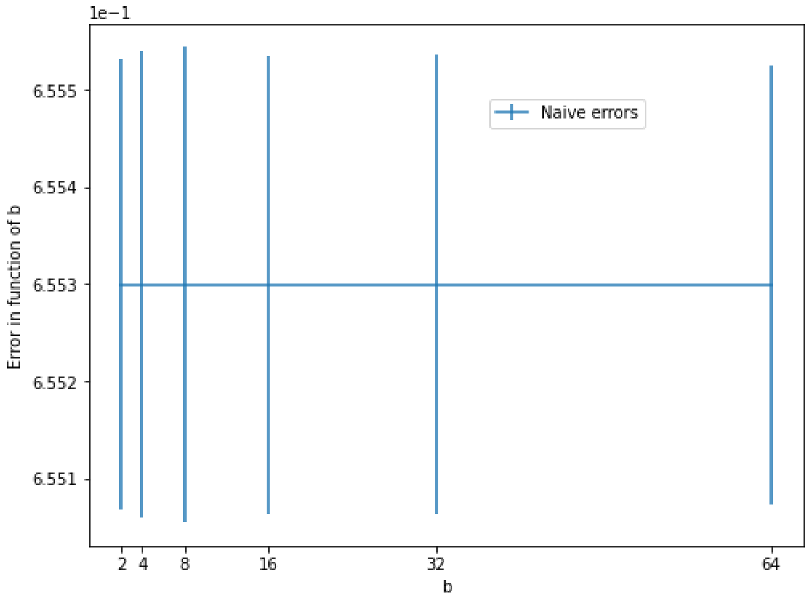

Figure 4: Naive error estimation for increasing bin size

and again the behavior of the error is not as expected as we are expecting that the error would be small at the beginning and then stabilize at some point for larger bin size.

4 :Code up the bootstrap procedure and calculate the bootstrap error for your blocked list of m. Investigate the stability of the error as a function of N_{bs}. How does the bootstrap error compare with your naive estimate from above?

The investigation of N_{bs} is presented in the following plot but unfortunately the is no clear stabilization of the variable, but just a small decrease of the fluctuations.

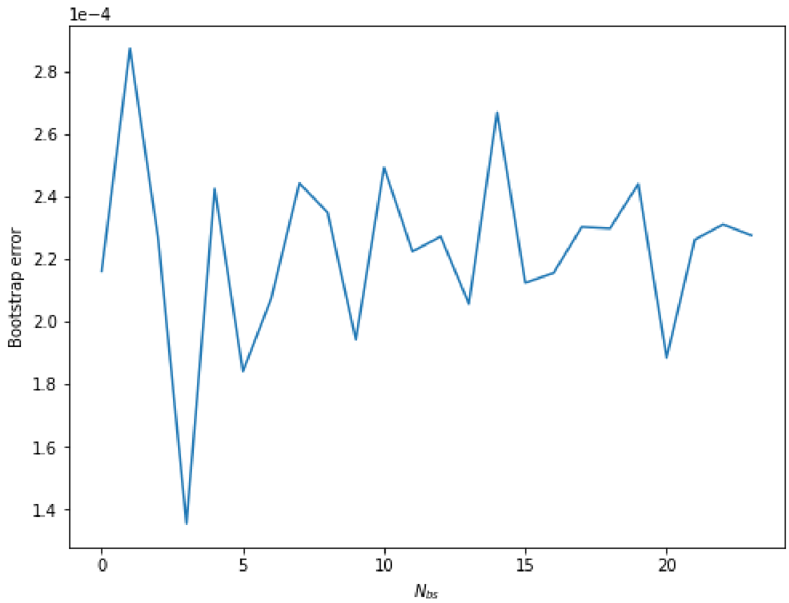

Figure 5: Size of the error as a function of N_{bs}

After, implementing the bootstrap method to the binned list we have the comparison of the two errors:

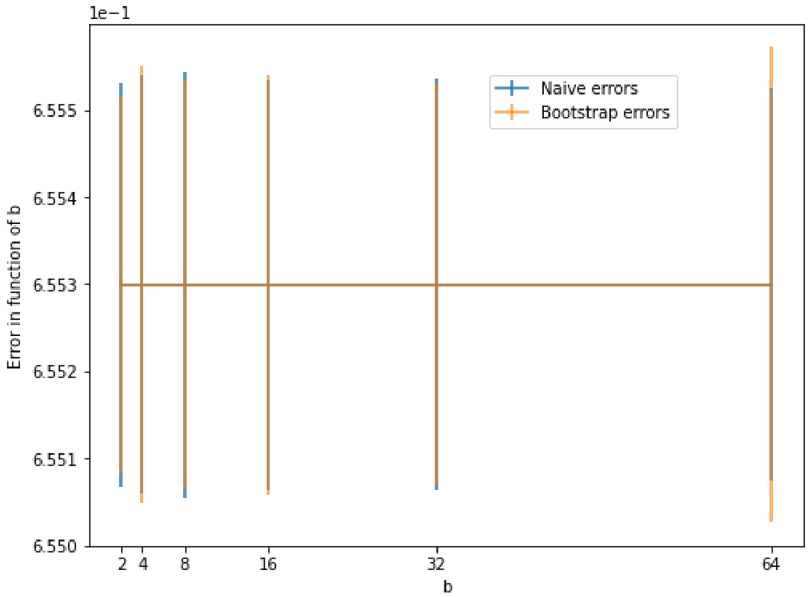

Figure 6: Comparison of naive error to bootstrap error

But again we see that there are no significant changes. and that's again due to the fact of originally wrong data.