log_gaussian_cox_model

December 8, 2017

0.1 Log Gaussian Cox process

This notebook implements the log gaussian cox process up dimension 64^2

```
In [1]: import numpy as np
        import numexpr as ne
        from numba import jit
        from matplotlib import pyplot as plt
        import sys
        sys.path.append("/home/alex/Dropbox/smc_hmc/python_smchmc/")
        #sys.path.append("/home/alex/Dropbox/smc_hmc/python_smchmc/smc_sampler_functions")
```

Load the data

```
In [2]: dim = 400
        from smc_sampler_functions.target_distributions_logcox import f_dict_log_cox
        parameters_log_cox = f_dict_log_cox(int(dim**0.5))
```

Defining the sampler parameters

```
In [3]: N_particles = 2**10
        T_time = 40
        move_steps_hmc = 1
        move_steps_rw_mala = 1
        ESStarget = 0.8
        M_num_repetions = 1
        epsilon = 1.
        epsilon_hmc = .1
        verbose = False
        parameters = {'dim' : dim,
                      'N_particles' : N_particles,
                      'T_time' : T_time,
                      'autotempering' : True,
                      'ESStarget': ESStarget,
                      'adaptive_covariance' : True
                     }
        from smc_sampler_functions.functions_smc_help import sequence_distributions
        from smc_sampler_functions.proposal_kernels import proposalmala, proposalrw, proposalhmc
```

```
        from smc_sampler_functions.functions_smc_main import smc_sampler
        maladict = {'proposalkernel_tune': proposalmala,
                                'proposalkernel_sample': proposalmala,
                                'proposalname' : 'MALA',
                                'target_probability' : 0.65,
                                'covariance_matrix' : np.eye(dim),
                                'L_steps' : 1,
                                'epsilon' : np.array([epsilon]),
                                'epsilon_max' : np.array([epsilon]),
                                'tune_kernel': True,
                                'sample_eps_L' : True,
                                'verbose' : verbose,
                                'move_steps': move_steps_rw_mala
                                }
        hmcdict = {'proposalkernel_tune': proposalhmc,
                                'proposalkernel_sample': proposalhmc_parallel,
                                'proposalname' : 'HMC',
                                'target_probability' : 0.9,
                                'covariance_matrix' : np.eye(dim),
                                'L_steps' : 20,
                                'epsilon' : np.array([epsilon_hmc]),
                                'epsilon_max' : np.array([epsilon_hmc]),
                                'accept_reject' : True,
                                'tune_kernel': True,
                                'sample_eps_L' : True,
                                'parallelize' : False,
                                'verbose' : verbose,
                                'move_steps': move_steps_hmc,
                                'mean_L' : False
                                }

        from smc_sampler_functions.functions_smc_main import repeat_sampling
        from smc_sampler_functions.target_distributions_logcox import priorlogdens_log_cox, prio
        from smc_sampler_functions.target_distributions_logcox import targetlogdens_log_cox, tar


        parameters.update(parameters_log_cox)

        priordistribution = {'logdensity' : priorlogdens_log_cox, 'gradlogdensity' : priorgradlo
        targetdistribution = {'logdensity' : targetlogdens_log_cox, 'gradlogdensity' : targetgra
        samplers_list_dict = [maladict, hmcdict]


        temperedist = sequence_distributions(parameters, priordistribution, targetdistribution)
        res_repeated_sampling, res_first_iteration = repeat_sampling(samplers_list_dict, tempere
```

```
/usr/local/lib/python2.7/dist-packages/pandas/core/computation/__init__.py:18: UserWarning: The
The minimum supported version is 2.4.6
```

```
  ver=ver, min_ver=_MIN_NUMEXPR_VERSION), UserWarning)


repetition 0 of 1
Now runing smc sampler with MALA kernel
now tuning
now sampling
now tuninge 0.0080109834671
now sampling
now tuninge 0.0158061299308
now sampling
now tuninge 0.0235310460066
now sampling
now tuninge 0.0313952826493
now sampling
now tuninge 0.0399397015182
now sampling
now tuninge 0.0499947687765
now sampling
now tuninge 0.06279150348
now sampling
now tuninge 0.0787975247466
now sampling
now tuninge 0.0965034705594
now sampling
now tuninge 0.114193615453
now sampling
now tuninge 0.131945101026
now sampling
now tuninge 0.150522902731
now sampling
now tuninge 0.170209737964
now sampling
now tuninge 0.191192769898
now sampling
now tuninge 0.212615641207
now sampling
now tuninge 0.233477186207
now sampling
now tuninge 0.254056393444
now sampling
now tuninge 0.273830914008
now sampling
now tuninge 0.293695496865
now sampling
now tuninge 0.314335219423
now sampling
```

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now tuninge 0.335001675342
now sampling
now tuninge 0.355594676564
now sampling
now tuninge 0.375282490267
now sampling
now tuninge 0.394136227187
now sampling
now tuninge 0.411868014034
now sampling
now tuninge 0.429109100151
now sampling
now tuninge 0.445029867378
now sampling
now tuninge 0.460472108627
now sampling
now tuninge 0.475321621095
now sampling
now tuninge 0.490232340187
now sampling
now tuninge 0.505489987815
now sampling
now tuninge 0.520760798016
now sampling
now tuninge 0.536103053481
now sampling
now tuninge 0.551429456043
now sampling
now tuninge 0.567031178782
now sampling
now tuninge 0.582994946866
now sampling
now tuninge 0.599195721394
now sampling
now tuninge 0.615609922877
now sampling
now tuninge 0.632075545683
now sampling
now tuninge 0.648602086228
now sampling
now tuninge 0.666011526861
now sampling
now tuninge 0.682755208348
now sampling
now tuninge 0.699368281823
now sampling
now tuninge 0.715631465319
now sampling
```

```
now tuninge 0.732178833079
now sampling
now tuninge 0.749617235418
now sampling
now tuninge 0.767356589335
now sampling
now tuninge 0.784053950596
now sampling
now tuninge 0.800264793923
now sampling
now tuninge 0.815809724029
now sampling
now tuninge 0.831181602792
now sampling
now tuninge 0.846606557596
now sampling
now tuninge 0.862100000969
now sampling
now tuninge 0.877172949987
now sampling
now tuninge 0.891933969415
now sampling
now tuninge 0.906947205466
now sampling
now tuninge 0.922688094623
now sampling
now tuninge 0.939202740914
now sampling
now tuninge 0.955723321803
now sampling
now tuninge 0.971462466158
now sampling
now tuninge 0.98604584441
now sampling
now tuninge 0.999981156269
now sampling
now tuninge 1.0
now sampling
Sampler ended at time 64 after 418.643194914 seconds

Now runing smc sampler with HMC kernel
now tuning
now sampling
now tuninge 0.00849941372871
now sampling
now tuninge 0.016993102268
now sampling
now tuninge 0.0252928618402
```

```
now sampling
now tuninge 0.0331734973678
now sampling
now tuninge 0.0412156246044
now sampling
now tuninge 0.0496442691398
now sampling
now tuninge 0.0581629200641
now sampling
now tuninge 0.0669250863823
now sampling
now tuninge 0.0755141369947
now sampling
now tuninge 0.0842260793948
now sampling
now tuninge 0.092932369759
now sampling
now tuninge 0.10170210915
now sampling
now tuninge 0.109967874668
now sampling
now tuninge 0.11845628033
now sampling
now tuninge 0.126554639784
now sampling
now tuninge 0.134972786018
now sampling
now tuninge 0.143510237416
now sampling
now tuninge 0.152433758519
now sampling
now tuninge 0.16148113507
now sampling
now tuninge 0.170437632748
now sampling
now tuninge 0.179281354872
now sampling
now tuninge 0.188206267831
now sampling
now tuninge 0.196615920687
now sampling
now tuninge 0.204667950279
now sampling
now tuninge 0.213037009288
now sampling
now tuninge 0.221718679607
now sampling
now tuninge 0.230725046443
```

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now sampling
now tuninge 0.23937912923
now sampling
now tuninge 0.248135699968
now sampling
now tuninge 0.256725584105
now sampling
now tuninge 0.265497323185
now sampling
now tuninge 0.274345346272
now sampling
now tuninge 0.282829172394
now sampling
now tuninge 0.290972634844
now sampling
now tuninge 0.299277027318
now sampling
now tuninge 0.307736090242
now sampling
now tuninge 0.316137805567
now sampling
now tuninge 0.324696632038
now sampling
now tuninge 0.333653654935
now sampling
now tuninge 0.342750235825
now sampling
now tuninge 0.351810661909
now sampling
now tuninge 0.36068046844
now sampling
now tuninge 0.369518641366
now sampling
now tuninge 0.378461312605
now sampling
now tuninge 0.387701992403
now sampling
now tuninge 0.397397176056
now sampling
now tuninge 0.406786481422
now sampling
now tuninge 0.415432818678
now sampling
now tuninge 0.424514416508
now sampling
now tuninge 0.433237591304
now sampling
now tuninge 0.442180174182
```

```
now sampling
now tuninge 0.450939332209
now sampling
now tuninge 0.459647413267
now sampling
now tuninge 0.46803064527
now sampling
now tuninge 0.476159839007
now sampling
now tuninge 0.484073323647
now sampling
now tuninge 0.491558884515
now sampling
now tuninge 0.499189009406
now sampling
now tuninge 0.507298777338
now sampling
now tuninge 0.515653299007
now sampling
now tuninge 0.524128116811
now sampling
now tuninge 0.532653990584
now sampling
now tuninge 0.540914406712
now sampling
now tuninge 0.549354664803
now sampling
now tuninge 0.557815981412
now sampling
now tuninge 0.56634082214
now sampling
now tuninge 0.574898559805
now sampling
now tuninge 0.583592085259
now sampling
now tuninge 0.59228910816
now sampling
now tuninge 0.601064560818
now sampling
now tuninge 0.609672391035
now sampling
now tuninge 0.61845915101
now sampling
now tuninge 0.627094139102
now sampling
now tuninge 0.635564107576
now sampling
now tuninge 0.644256542204
```

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now sampling
now tuninge 0.65282820161
now sampling
now tuninge 0.66127597443
now sampling
now tuninge 0.670002614053
now sampling
now tuninge 0.679031880888
now sampling
now tuninge 0.687708679391
now sampling
now tuninge 0.696011869501
now sampling
now tuninge 0.704683672932
now sampling
now tuninge 0.713713755057
now sampling
now tuninge 0.722903089044
now sampling
now tuninge 0.73180231578
now sampling
now tuninge 0.74089825174
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now tuninge 0.749529964697
now sampling
now tuninge 0.758029563454
now sampling
now tuninge 0.766462377716
now sampling
now tuninge 0.775139559102
now sampling
now tuninge 0.783622627331
now sampling
now tuninge 0.792140127758
now sampling
now tuninge 0.800618649674
now sampling
now tuninge 0.809357517891
now sampling
now tuninge 0.818311428985
now sampling
now tuninge 0.827342004684
now sampling
now tuninge 0.836838288283
now sampling
now tuninge 0.846156659757
now sampling
now tuninge 0.855249484629
```

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now sampling
now tuninge 0.863655656674
now sampling
now tuninge 0.87216277752
now sampling
now tuninge 0.880572113701
now sampling
now tuninge 0.889322974939
now sampling
now tuninge 0.897772397653
now sampling
now tuninge 0.906043361526
now sampling
now tuninge 0.914610627128
now sampling
now tuninge 0.923111811775
now sampling
now tuninge 0.931773699801
now sampling
now tuninge 0.940211025519
now sampling
now tuninge 0.948607873857
now sampling
now tuninge 0.957469567178
now sampling
now tuninge 0.966138575879
now sampling
now tuninge 0.974594437835
now sampling
now tuninge 0.98350931457
now sampling
now tuninge 0.992367905908
now sampling
now tuninge 1.0
now sampling
Sampler ended at time 117 after 1559.6117959 seconds
```
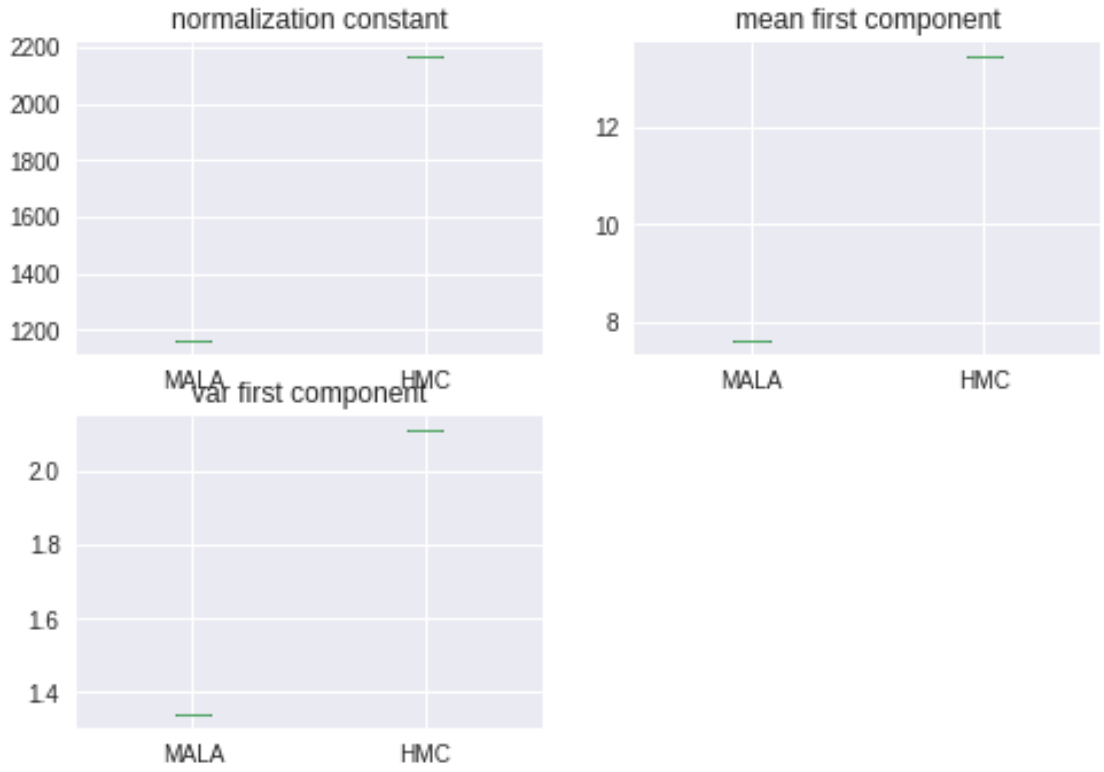
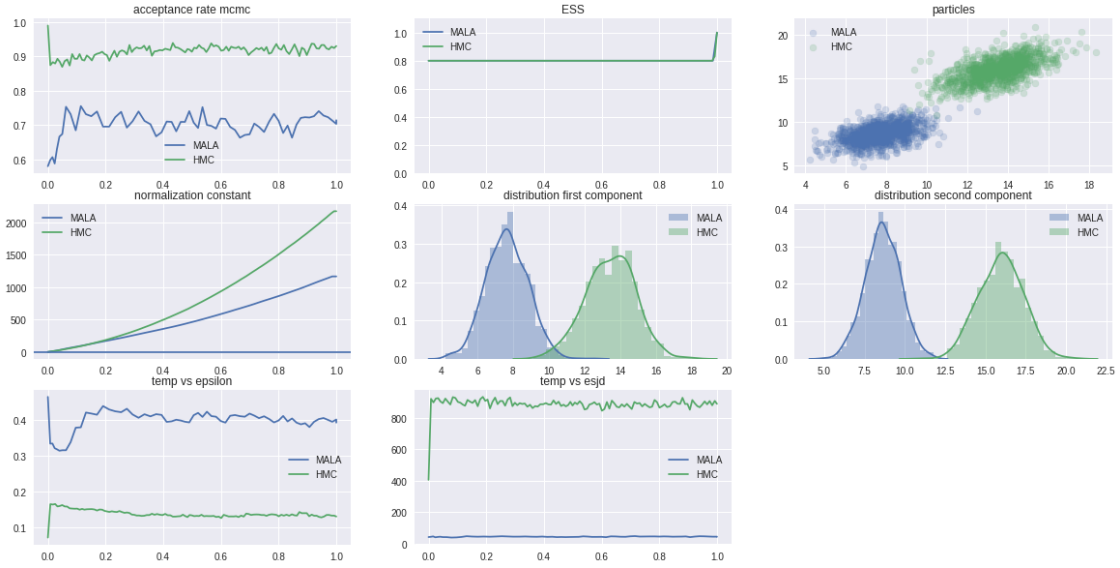
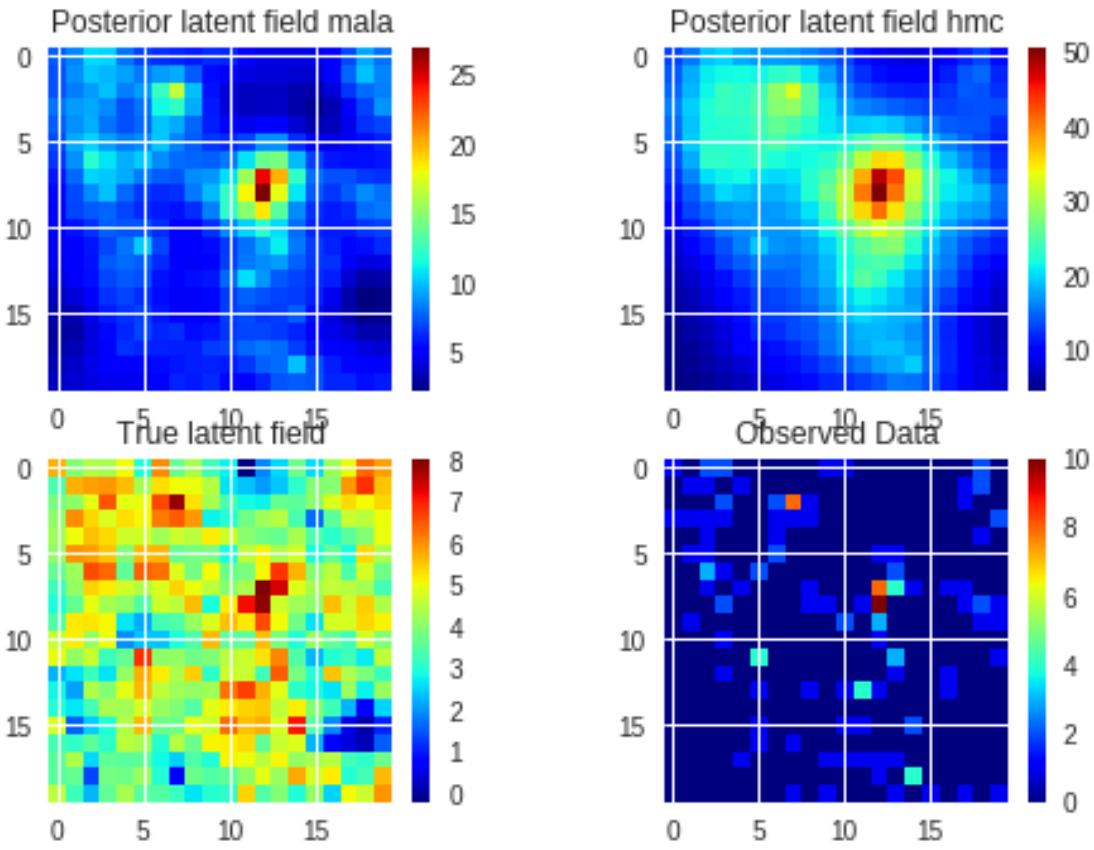

```
In [5]: from smc_sampler_functions.functions_smc_plotting import plot_repeated_simulations, plot
        plot_repeated_simulations(res_repeated_sampling)
        plot_results_single_simulation(res_first_iteration)
```



<matplotlib.figure.Figure at 0x7f82f40d3bd0>



In [25]:
```
x_res_matrix1 = res_first_iteration[0]['particles_resampled'].mean(axis=0).reshape(para
x_res_matrix2 = res_first_iteration[1]['particles_resampled'].mean(axis=0).reshape(para

Y_matrix = parameters_log_cox['Y'].reshape(parameters_log_cox['N'],parameters_log_cox['
X_matrix = parameters_log_cox['X_true'].reshape(parameters_log_cox['N'],parameters_log_

#plt.figure(figsize=(16,16))

plt.subplot(221)
plt.title('Posterior latent field mala')
im = plt.imshow(x_res_matrix1,cmap='jet')
plt.colorbar(im,fraction=0.046, pad=0.04)

plt.subplot(222)
plt.title('Posterior latent field hmc')
im = plt.imshow(x_res_matrix2, cmap='jet')
plt.colorbar(im,fraction=0.046, pad=0.04)

plt.subplot(223)
plt.title('True latent field')
im = plt.imshow(X_matrix,cmap='jet')
plt.colorbar(im,fraction=0.046, pad=0.04)


plt.subplot(224)
plt.title('Observed Data')
im = plt.imshow(Y_matrix,cmap='jet')
plt.colorbar(im,fraction=0.046, pad=0.04)

plt.savefig('log_cox_model_dim_%s.png'%(dim))
plt.show()
```


Posterior latent field mala
Posterior latent field hmc
True latent field
Observed Data

In [ ]: