```
clear all
datetime
N = [1000,2000];
N_sims = 20;

alpha = 0;
phi = [-0.9,-0.1,0.1:0.4:0.9];
sigma1 = [1,10];
mu = 15;
sigma2 = [1,10];
P11 = 0.1:0.4:0.9;
P22 = 0.1:0.4:0.9;
save_params = [];
save_P = [];
save_mle_alpha = [];
save_mle_phi = [];
save_mle_sigma1 = [];
save_mle_mu = [];
save_mle_sigma2 = [];
save_mle_P11 = [];
save_mle_P22 = [];
save_time = [];
save_time_MCMC = [];
c1 = 1;
options = optimoptions('fmincon','Display','off');
how_many = 0;
for i1 = 1:length(alpha)
    for i2 = 1:length(phi)
        for i3 = 1:length(sigma1)
            for i4 = 1:length(mu)
                for i5 = 1:length(sigma2)
                    for i6 = 1:length(P11)
                        for i7 = 1:length(P22)
                            how_many = how_many+1;
                            Param =
[phi(i2),alpha(i1),sigma1(i3)^2,0,nan;nan,mu(i4),sigma2(i5)^2,0,nan]
;
                            P = [P11(i6),1-P11(i6);1-
P22(i7),P22(i7)];
                            save_params(:,:,c1) = Param;
                            save_P(:,:,c1) = P;
                            c2 = 1;
                            for sample_size = N
                                parfor i = 1:N_sims
                                    [Y,S] = mrs2ir_sim(P,Param,'G',
0,[1,0],sample_size,1);

                                    fun = @(theta) -
loglikefstfwd(Y,theta(1:5),[theta(6),1-theta(6);theta(7),1-
theta(7)]);
                                    x0 =
[alpha(i1),phi(i2),sigma1(i3),mu(i4),sigma2(i5),P11(i6),P22(i7)];
                                    tic
                                    x = fmincon(fun,x0,[],[],[],[],
```

```
[-Inf,-1,0,-Inf,0,0,0],[Inf,1,Inf,Inf,Inf,1,1],[],options);
                                    T = toc;
                                    save_mle_alpha(i,c1,c2) = x(1);
                                    save_mle_phi(i,c1,c2) = x(2);
                                    save_mle_sigma1(i,c1,c2) = x(3);
                                    save_mle_mu(i,c1,c2) = x(4);
                                    save_mle_sigma2(i,c1,c2) = x(5);
                                    save_mle_P11(i,c1,c2) = x(6);
                                    save_mle_P22(i,c1,c2) = x(7);
                                    save_time(i,c1,c2) = T;

                                    tic
                                    mcmc = MRS_MCMC_wStart(Y,
300000,50000,{{'AR(1)'} {'G'}},S,[0.1],false,x0);
                                    T =toc;
                                    Mode = nan(1,7);
                                    Mean = nan(1,7);
                                    c3 = 1;
                                    for i8 = [1:6,8]
                                        [a,b] =
ksdensity(mcmc(50000:end,i8));
                                        [~,ind] = max(a);
                                        Mode(c3) = b(ind);
                                        Mean(c3) =
mean(mcmc(50000:end,i8));
                                        c3 = c3 + 1;
                                    end
                                    save_MCMC_mean_time(i,c1,c2) =
T;
                                    save_MCMC_mean_alpha(i,c1,c2) =
Mean(1);
                                    save_MCMC_mean_phi(i,c1,c2) =
Mean(2);
                                    save_MCMC_mean_sigma1(i,c1,c2) =
Mean(3);
                                    save_MCMC_mean_mu(i,c1,c2) =
Mean(4);
                                    save_MCMC_mean_sigma2(i,c1,c2) =
Mean(5);
                                    save_MCMC_mean_P11(i,c1,c2) =
Mean(6);
                                    save_MCMC_mean_P22(i,c1,c2) =
Mean(7);


                                    save_MCMC_mode_alpha(i,c1,c2) =
Mode(1);
                                    save_MCMC_mode_phi(i,c1,c2) =
Mode(2);
                                    save_MCMC_mode_sigma1(i,c1,c2) =
Mode(3);
                                    save_MCMC_mode_mu(i,c1,c2) =
Mode(4);
                                    save_MCMC_mode_sigma2(i,c1,c2) =
Mode(5);
```

```
                                        save_MCMC_mode_P11(i,c1,c2) =
Mode(6);
                                        save_MCMC_mode_P22(i,c1,c2) =
Mode(7);
                                    end
                                    c2 = c2 + 1;
                                end
                                c1 = c1 + 1;
                            end
                        end
                    end
                end
            end
    end
end

save '/Users/anguslewis/Documents/MATLAB/Output/
simstudy_180_100_1000_10000' '-v7.3'
datetime
```