MCMC

```
function
[H,Hc,M,C,R]=realpop_xi(beta,theta,eta,mu_M,c_min,c_max,mu_c,q_max,q_
min,mu_q,alpha,gamma_H2,delta_H,Y1);
global sigma  delta_I  gamma_H1 lambda A
S=zeros(80,1);   S(1)=Y1(1);
Sq=zeros(80,1);  Sq(1)=Y1(2);
E=zeros(80,1);   E(1)=Y1(3);
Eq=zeros(80,1);  Eq(1)=Y1(4);
I=zeros(80,1);   I(1)=Y1(5);
H=zeros(80,1);   H(1)=Y1(6);
Hc=zeros(80,1);  Hc(1)=Y1(7);
R=zeros(80,1);   R(1)=Y1(8);
M=zeros(80,1);   M(1)=Y1(9);
cM=zeros(80,1);  cM(1)=c_min+(c_max-c_min)/(1+mu_c*M(1));
qM=zeros(80,1);  qM(1)=q_max+(q_min-q_max)/(1+mu_q*M(1));
C=zeros(80,1);   C(1)=Y1(10);
N=zeros(53,1);   N(1)=S(1)+Sq(1)+E(1)+Eq(1)+I(1)+H(1)+Hc(1)+R(1);
for t=2:1:80
    if t<12
        gamma_H=gamma_H1;
    else
        gamma_H=gamma_H2;
    end
S(t)=S(t-1)-(beta*cM(t-1)+(1-beta)*cM(t-1)*qM(t-1))*S(t-1)*(I(t-1)+th
eta*E(t-1))/N(t-1)+(1-exp(-lambda))*Sq(t-1);
Sq(t)=exp(-lambda)*Sq(t-1)+(1-beta)*cM(t-1)*qM(t-1)*S(t-1)*(I(t-1)+th
eta*E(t-1))/N(t-1);
E(t)=exp(-sigma)*E(t-1)+beta*cM(t-1)*(1-qM(t-1))*S(t-1)*(I(t-1)+theta
*E(t-1))/N(t-1);
Eq(t)=exp(-sigma)*Eq(t-1)+beta*cM(t-1)*qM(t-1)*S(t-1)*(I(t-1)+theta*E
(t-1))/N(t-1);
I(t)=exp(-(alpha+delta_I))*I(t-1)+(1-exp(-sigma))*E(t-1);
H(t)=exp(-delta_H)*H(t-1)+exp(-alpha)*(1-exp(-delta_I))*I(t-1)+(1-exp
(-sigma))*Eq(t-1);
Hc(t)=exp(-(alpha+gamma_H))*Hc(t-1)+(1-exp(-delta_H))*H(t-1);
R(t)=R(t-1)+exp(-alpha)*(1-exp(-gamma_H))*Hc(t-1);
M(t)=exp(-mu_M)*M(t-1)+eta*(H(t-1)+Hc(t-1));
    if t==2
        H(t)=H(t)+1*A; I(t)=I(t)+2*A; E(t)=E(t)+4*A;
    elseif t==3
        E(t)=E(t)+2*A;
    elseif t==4
```

```
        I(t)=I(t)+1*A;
    elseif t==5
        E(t)=E(t)+6*A;
    elseif t==6
        E(t)=E(t)+1*A;
    elseif t==8
        E(t)=E(t)+1*A;
    elseif t==12
        I(t)=I(t)+1*A;
    end
    C(t)=C(t-1)+(1-exp(-delta_H))*H(t-1);
    N(t)=S(t)+Sq(t)+E(t)+Eq(t)+I(t)+H(t)+Hc(t)+R(t);
    cM(t)=c_min+(c_max-c_min)/(1+mu_c*M(t));
    qM(t)=q_max+(q_min-q_max)/(1+mu_q*M(t));
end

 function [Nlik]=Loglik(beta,theta,eta,mu_M,c_min,c_max,mu_c,q_max,
q_min,mu_q,alpha,gamma_H2,delta_H,Y1,Data_Cases,Data_Re,Data_Media)
  global sigma  delta_I gamma_H1 lambda   A
[H,C,R]=realpop_xi(beta,theta,eta,mu_M,c_min,c_max,mu_c,q_max,q_min,m
u_q,alpha,gamma_H2,delta_H,Y1);
Nlika=sum(log(C).*(Data_Cases)-C-gammaln(Data_Cases+1)+....
log(eta*(1-exp(-delta_H)).*H).*(Data_Media)-(eta*(1-exp(-delta_H)).*H
)-gammaln(Data_Media+1));
Nlikb=sum(log(R).*(Data_Re)-R-gammaln(Data_Re+1));
 Nlik= Nlika+Nlikb;

function MCMC_Shaanxi_media
tic;
clear all
close all
clc
[Data_Shaanxi]=xlsread('Shaanxi_virus');
size(Data_Shaanxi);
Data_Cases=Data_Shaanxi(1:end,1);
Data_Re=Data_Shaanxi(1:end,2);
Data_Media=Data_Shaanxi(1:end,3);
global sigma  delta_I  gamma_H1 lambda A
A=1;
S1=38640000;
H1=29*A+7;
I1=15*A+11;
Hc1=3*A;
M1=Data_Media(1);
```

```
C1=Data_Cases(1);
R1=Data_Re(1);
sigma=1/5.3889; delta_I=1/2.4299;  gamma_H1=0;  lambda=1/14;
beta=0.1068;theta=0;eta=0.6487;mu_M=0.9821;c_max=10.1163;mu_c=0.8961;
q_min=0.0280; c_min=3.1459;q_max=0.9259;mu_q=0.8189;
E1 =52.0564;  Eq1 =0.9325;  alpha =1.1715e-03;
gamma_H2=0.0874;delta_H=0.46461;
Sq1=53-Eq1;
Y1=[S1,Sq1,E1,Eq1,I1,H1,Hc1,R1,M1,C1] ;
Olik=Loglik(beta,theta,eta,mu_M,c_min,c_max,mu_c,q_max,q_min,mu_q,alp
ha,gamma_H2,delta_H,Y1,Data_Cases,Data_Re,Data_Media);
w=[0.00001  0   0.001    0.0001  0.001     0.001     0.0001   0.00001
0.00001    0.0001     0.001     0.01    0.00001      0.0001    0.0001];
N=1000000;  m=5000;
MCMC_Par(1,:)=[beta theta eta mu_M c_min c_max mu_c q_max q_min mu_q E1
Eq1 alpha gamma_H2 delta_H];
MM=size(MCMC_Par);m=MM(1);
beta=mean(MCMC_Par(m:end,1));
theta=mean(MCMC_Par(m:end,2));
eta=mean(MCMC_Par(m:end,3));
mu_M=mean(MCMC_Par(m:end,4));
c_min=mean(MCMC_Par(m:end,5));
c_max=mean(MCMC_Par(m:end,6));
mu_c=mean(MCMC_Par(m:end,7));
q_max=mean(MCMC_Par(m:end,8));
q_min=mean(MCMC_Par(m:end,9));
mu_q=mean(MCMC_Par(m:end,10));
E1=mean(MCMC_Par(m:end,11));
Eq1=mean(MCMC_Par(m:end,12));
alpha=mean(MCMC_Par(m:end,13));
gamma_H2=mean(MCMC_Par(m:end,14));
delta_H=mean(MCMC_Par(m:end,15));
[H,Hc,M,C,R]=realpop_xi(beta,theta,eta,mu_M,c_min,c_max,mu_c,q_max,q_
min,mu_q,alpha,gamma_H2,delta_H,Y1);
R0=((1-q_min)*c_max*beta)/(1-exp(-(alpha+delta_I)))
figure(1)
subplot(131)
plot(C,'r*')
hold on
plot(Data_Cases,'k*');
ylabel('Cumulativ number of confirmed individuls');
ylabel('Days after Jan 2')
ylim([0,300])
subplot(132)
```

```
plot(R,'r*');
hold on
plot(Data_Re,'k*');
ylabel('Cumulativ number of recovered individuls');
ylabel('Days after Jan 2')
subplot(133)
plot(Data_Media,'k*');
hold on
plot(M,'r*')
ylabel('Average number of daily media items');
ylabel('Days after Jan 2')
ylim([0,180])
end
toc;
```

Confidence interval

```
function Shaanxi_media
tic;
clear all
close all
clc
TG=[C Data_Cases R Data_Re M Data_Media];
[Data_C]=xlsread('500Solutions_cases');
size(Data_C);
ave_C=mean(Data_C,2);
std_C=std(Data_C,0,2);
x=1:length(ave_C);
CI_C= [(ave_C-1.96 *std_C)/1, (ave_C + 1.96 *std_C)/1];
size(CI_C);
CI_C(1,1)=0;
figure(1)
subplot(131)  fill([x,fliplr(x)],[CI_C(:,1)' ,fliplr(CI_C(:,2)')],[0.9
0.9 0.9])
hold on
plot(x',CI_C(:,2))
hold on
plot(x',CI_C(:,1))
plot(C,'k*')
plot(Data_Cases,'r*');
hold on
ylabel('Cumulativ number of confirmed individuls');
xlabel('Days after Jan 23 2020')
ylim([0,300])
[Data_R]=xlsread('500Solutions_recovered');
```

```
size(Data_R)
ave_R=mean(Data_R,2);
std_R= std(Data_R,0,2);
x=1:length(ave_R);
CI_R= [(ave_R-1.96*std_R)/1 , (ave_R + 1.96 * std_R)/1];
size(CI_R);
for j=1:20
if CI_R(j,1)<0;
   CI_R(j,1)=0;
end
end
subplot(132) fill([x,fliplr(x)],[CI_R(:,1)' ,fliplr(CI_R(:,2)')],[0.9
0.9 0.9])
hold on
plot(x',CI_R(:,2))
hold on
plot(x',CI_R(:,1))
set(gca,'XLim',[1,length(ave_R)-1])
plot(R,'k*')
plot(Data_Re,'r*');
hold on
ylabel('Cumulativ number of recovered individuls');
xlabel('Days after Jan 23 2020')
ylim([0,280])
[Data_M]=xlsread('500Solutions_media');
size(Data_M);
ave_M=mean(Data_M,2);
std_M= std(Data_M,0,2);
x=1:length(ave_M);
CI_M= [(ave_M -1.96 * std_M)/1 , (ave_M+ 1.96 * std_M)/1];
size(CI_M);
subplot(133) fill([x,fliplr(x)],[CI_M(:,1)' ,fliplr(CI_M(:,2)')],[0.9
0.9 0.9]);
hold on
plot(x',CI_M(:,2))
plot(x',CI_M(:,1))
set(gca,'XLim',[1,length(ave_M)-1])
hold on
plot(M,'k*')
plot(Data_Media,'r*');
ylabel('Average number of daily media items');
xlabel('Days after Jan 23 2020')
ylim([0,180])
```

Contour

```
function contour_imput_c(M)
clear all
close all
clc
tic
can=[0 1 1/5.3889 1/2.4299 0 1/14 10.8377 0.9255 0.0280 0.5981 4.1715e-04
0.0851 0.6487 0.0241 3.1459 0.2461 0.0926 0.8961]
theta=can(1);    A0=can(2);    sigma=can(3);    delta_I=can(4);
gamma_H1=can(5);    lambda=can(6);   c_0=can(7);      q_1=can(8);
q_0=can(9);        mu_q=can(10);
alpha=can(11);   gamma_H2=can(12);   eta=can(13);       mu_M=can(14);
c_10=can(15);    delta_H=can(16);    beta=can(17);      mu_c=can(18);
S1=38640000;    E1=50*A0+2;   I1=15*A0+11;    H1=29*A0+7;   Hc1=3*A0;
Eq1=0.3189;   Sq1=53-Eq1;   R1=0.001;  M1=29.5;
NC1=Hc1;
Y1=[S1,Sq1,E1,Eq1,I1,H1,Hc1,R1,M1,NC1];
A=0:0.00398:2;
c_1=2.46:0.015:10;
[A,c_1] = meshgrid(A,c_1);
runs=503;
for i=1:runs
    for j=1:runs
    A1=A(i,j);
    c_11=c_1(i,j);
    [NC]=realpop_shaanxi(Y1);
    [NC_max1,TNC_max1]=max(NC);
    NC_max(i,j)=NC_max1;
    TNC_max(i,j)=TNC_max1;
    end
end
figure(2)
hold on
subplot(122)
[c1,h1]=contourf(A,c_1,NC_max);
h_clabel=clabel(c1,h1);
hold on
plot(A0,c_10,'ro')
title('Contour plot for the peak size of Hc')
xlabel('Imput cases')
ylabel('c_1')
subplot(121)
[c2,h2]=contourf(A,c_1,TNC_max);
```

```
h_clabel=clabel(c2,h2);
hold on
plot(A0,c_10,'wo')
title('Contour plot for the peak time of Hc')
xlabel('Imput cases')
ylabel('c_1')
toc
function [NC]=realpop_shaanxi(Y1);
S=zeros(53,1);   S(1)=Y1(1);
Sq=zeros(53,1);  Sq(1)=Y1(2);
E=zeros(53,1);   E(1)=Y1(3);
Eq=zeros(53,1);  Eq(1)=Y1(4);
I=zeros(53,1);   I(1)=Y1(5);
H=zeros(53,1);   H(1)=Y1(6);
Hc=zeros(53,1);  Hc(1)=Y1(7);
R=zeros(53,1);   R(1)=Y1(8);
M=zeros(53,1);   M(1)=Y1(9);
cM=zeros(53,1);  cM(1)=c_11+(c_0-c_11)/(1+mu_c*M(1));
qM=zeros(53,1);  qM(1)=q_1+(q_0-q_1)/(1+mu_q*M(1));
N=zeros(53,1);    N(1)=S(1)+Sq(1)+E(1)+Eq(1)+I(1)+H(1)+Hc(1)+R(1);
NC=zeros(53,1);   NC(1)=Y1(10);
for t=2:1:53
    if t<12
        gamma_H=gamma_H1;
    else
        gamma_H=gamma_H2;
    end
S(t)=S(t-1)-(beta*cM(t-1)+(1-beta)*cM(t-1)*qM(t-1))*S(t-1)*(I(t-1)+th
eta*E(t-1))/N(t-1)+(1-exp(-lambda))*Sq(t-1);
Sq(t)=exp(-lambda)*Sq(t-1)+(1-beta)*cM(t-1)*qM(t-1)*S(t-1)*(I(t-1)+th
eta*E(t-1))/N(t-1);
E(t)=exp(-sigma)*E(t-1)+beta*cM(t-1)*(1-qM(t-1))*S(t-1)*(I(t-1)+theta
*E(t-1))/N(t-1);
Eq(t)=exp(-sigma)*Eq(t-1)+beta*cM(t-1)*qM(t-1)*S(t-1)*(I(t-1)+theta*E
(t-1))/N(t-1);
I(t)=exp(-(alpha+delta_I))*I(t-1)+(1-exp(-sigma))*E(t-1);
H(t)=exp(-delta_H)*H(t-1)+exp(-alpha)*(1-exp(-delta_I))*I(t-1)+(1-exp
(-sigma))*Eq(t-1);
Hc(t)=exp(-(alpha+gamma_H))*Hc(t-1)+(1-exp(-delta_H))*H(t-1);
R(t)=R(t-1)+exp(-alpha)*(1-exp(-gamma_H))*Hc(t-1);
M(t)=exp(-mu_M)*M(t-1)+eta*(H(t-1)+Hc(t-1));
    if t==2
        H(t)=H(t)+1*A1; I(t)=I(t)+2*A1; E(t)=E(t)+4*A1;
    elseif t==3
```

```
        E(t)=E(t)+2*A1;
    elseif t==4
        I(t)=I(t)+1*A1;
    elseif t==5
        E(t)=E(t)+6*A1;
    elseif t==6
        E(t)=E(t)+1*A1;
    elseif t==8
        E(t)=E(t)+1*A1;
    elseif t==12
        I(t)=I(t)+1*A1;
    end
    NC(t)=(1-exp(-delta_H))*H(t-1);
    N(t)=S(t)+Sq(t)+E(t)+Eq(t)+I(t)+H(t)+Hc(t)+R(t);
    cM(t)=c_11+(c_0-c_11)/(1+mu_c*M(t));
    qM(t)=q_1+(q_0-q_1)/(1+mu_q*M(t));
end
end
end
```

PRCC

```
function PRCC_peak_shaanxi_Media_GuoJ
clc
clear all
close all
runs=5000;
step=1;
T=500;
sigma=1/5.3889; delta_I=1/2.4299;gamma_H1=0;  lambda=1/14;
beta=0.1068;theta=0;eta=0.6487;mu_M=0.9821;c_0=10.1163;mu_c=0.8961;
q_0=0.0280; c_1=3.1459;q_1=0.9259;mu_q=0.8189;alpha
=1.1715e-03  ;gamma_H2 =0.0874;delta_H=0.46461; A=1;
S0=38640000;E0=52;I0=15*A+11;Sq0=53;Eq0=0;H0=29*A+7;Hc0=3*A;R0=0.0001
;M0=29.5;C0=3;MZC0=3*A;
yy0=[S0,E0,I0,Sq0,Eq0,H0,Hc0,R0,M0,C0,MZC0];
sigma_LHS=LHS_Call(1/14,sigma,1/2,0,runs,'unif');
delta_I_LHS=LHS_Call(0.05,delta_I,0.8,0,runs,'unif');
delta_H_LHS=LHS_Call(0.1,delta_H,1,0,runs,'unif');
gamma_H1_LHS=LHS_Call(0.1,gamma_H1,1,0,runs,'unif');
lambda_LHS=LHS_Call(1/20,lambda,1/5,0,runs,'unif');
beta_LHS=LHS_Call(0.01,beta,1,0,runs,'unif');
theta_LHS=LHS_Call(0,theta,0,0,runs,'unif');
eta_LHS=LHS_Call(0.1,eta,20,0,runs,'unif');
mu_M_LHS=LHS_Call(0.001,mu_M,0.05,0,runs,'unif');
```

```
c_1_LHS=LHS_Call(1,c_1,6,0,runs,'unif');
c_0_LHS=LHS_Call(6,c_0,20,0,runs,'unif');
mu_c_LHS=LHS_Call(0,mu_c,1,0,runs,'unif');
q_1_LHS=LHS_Call(0.2,q_1,1,0,runs,'unif');
q_0_LHS=LHS_Call(0.0001,q_0,0.1,0,runs,'unif');
mu_q_LHS=LHS_Call(0,mu_q,1,0,runs,'unif');
A_LHS=LHS_Call(0.5,A,1.5,0,runs,'unif');
alpha_LHS=LHS_Call(4e-5,alpha,1,5e-2,runs,'unif');
gamma_H2_LHS=LHS_Call(0.005,gamma_H2,0.8,0,runs,'unif');
alpha_LHS=LHS_Call(4e-5,alpha,1,5e-2,runs,'unif');
LHSmatrix=[sigma_LHS delta_I_LHS delta_H_LHS gamma_H1_LHS lambda_LHS
beta_LHS theta_LHS eta_LHS mu_M_LHS...
    c_1_LHS c_0_LHS mu_c_LHS q_1_LHS q_0_LHS mu_q_LHS A_LHS gamma_H2_LHS
alpha_LHS];
for i=1:runs
[I,C,XZH]=realpop_shaanxi([sigma_LHS(i),delta_I_LHS(i),delta_H_LHS(i)
,gamma_H1_LHS(i),lambda_LHS(i),beta_LHS(i),theta_LHS(i),...
eta_LHS(i),mu_M_LHS(i),c_1_LHS(i),c_0_LHS(i),mu_c_LHS(i),q_1_LHS(i),q
_0_LHS(i),mu_q_LHS(i),A_LHS(i),gamma_H2_LHS(i),alpha_LHS(i)],yy0);
[Imax(i),tm1(i)]=max(I);
tmax1(i)=(tm1(i)-1)*step;
    [Cmax(i),tm2(i)]=max(C);
    tmax2(i)=(tm2(i)-1)*step;
    [XZHmax(i),tm3(i)]=max(XZH);
    tmax3(i)=(tm3(i)-1)*step;
    end
Inputmatrix=[LHSmatrix tmax1' Imax' tmax2' Cmax' tmax3' XZHmax'];
[mInput,nInput]=size(Inputmatrix);
[peaktr13,peaktp13]=partialcorr(Inputmatrix(:,[1
nInput-1]),Inputmatrix(:,[2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr23,peaktp23]=partialcorr(Inputmatrix(:,[2
nInput-1]),Inputmatrix(:,[1 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr33,peaktp33]=partialcorr(Inputmatrix(:,[3
nInput-1]),Inputmatrix(:,[1 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr53,peaktp53]=partialcorr(Inputmatrix(:,[5
nInput-1]),Inputmatrix(:,[1 2 3 4 6 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr63,peaktp63]=partialcorr(Inputmatrix(:,[6
nInput-1]),Inputmatrix(:,[1 2 3 4 5 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr73,peaktp73]=partialcorr(Inputmatrix(:,[7
```

```
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr83,peaktp83]=partialcorr(Inputmatrix(:,[8
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr93,peaktp93]=partialcorr(Inputmatrix(:,[9
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 8 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr103,peaktp103]=partialcorr(Inputmatrix(:,[10
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr113,peaktp113]=partialcorr(Inputmatrix(:,[11
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 12 13 14 15 16 17
18]),'type','Spearman');
[peaktr123,peaktp123]=partialcorr(Inputmatrix(:,[12
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 13 14 15 16 17
18]),'type','Spearman');
[peaktr133,peaktp133]=partialcorr(Inputmatrix(:,[13
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 14 15 16 17
18]),'type','Spearman');
[peaktr143,peaktp143]=partialcorr(Inputmatrix(:,[14
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 13 15 16 17
18]),'type','Spearman');
[peaktr153,peaktp153]=partialcorr(Inputmatrix(:,[15
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 13 14 16 17
18]),'type','Spearman');
[peaktr173,peaktp173]=partialcorr(Inputmatrix(:,[17
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
18]),'type','Spearman');
[peaktr183,peaktp183]=partialcorr(Inputmatrix(:,[18
nInput-1]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
17]),'type','Spearman');
[peakvr13,peakvp13]=partialcorr(Inputmatrix(:,[1
nInput]),Inputmatrix(:,[2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peakvr23,peakvp23]=partialcorr(Inputmatrix(:,[2
nInput]),Inputmatrix(:,[1 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peakvr33,peakvp33]=partialcorr(Inputmatrix(:,[3
nInput]),Inputmatrix(:,[1 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peakvr53,peakvp53]=partialcorr(Inputmatrix(:,[5
nInput]),Inputmatrix(:,[1 2 3 4 6 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
```

```
[peakvr63,peakvp63]=partialcorr(Inputmatrix(:,[6
nInput]),Inputmatrix(:,[1 2 3 4 5 7 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peakvr73,peakvp73]=partialcorr(Inputmatrix(:,[7
nInput]),Inputmatrix(:,[1 2 3 4 5 6 8 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peakvr83,peakvp83]=partialcorr(Inputmatrix(:,[8
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 9 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peakvr93,peakvp93]=partialcorr(Inputmatrix(:,[9
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 8 10 11 12 13 14 15 16 17
18]),'type','Spearman');
[peakvr103,peakvp103]=partialcorr(Inputmatrix(:,[10
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17
18]),'type','Spearman');
[peakvr113,peakvp113]=partialcorr(Inputmatrix(:,[11
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 12 13 14 15 16 17
18]),'type','Spearman');
[peakvr123,peakvp123]=partialcorr(Inputmatrix(:,[12
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 13 14 15 16 17
18]),'type','Spearman');
[peakvr133,peakvp133]=partialcorr(Inputmatrix(:,[13
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 14 15 16 17
18]),'type','Spearman');
[peakvr143,peakvp143]=partialcorr(Inputmatrix(:,[14
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 13 15 16 17
18]),'type','Spearman');
[peakvr153,peakvp153]=partialcorr(Inputmatrix(:,[15
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 13 14 16 17
18]),'type','Spearman');
[peakvr173,peakvp173]=partialcorr(Inputmatrix(:,[17
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
18]),'type','Spearman');
[peakvr183,peakvp183]=partialcorr(Inputmatrix(:,[18
nInput]),Inputmatrix(:,[1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
17]),'type','Spearman');
peakt_PRCC3=[peaktr13(1,2),peaktr23(1,2),peaktr33(1,2),peaktr53(1,2),
peaktr63(1,2),peaktr83(1,2),peaktr93(1,2),peaktr103(1,2),peaktr113(1,
2),peaktr123(1,2),peaktr133(1,2),peaktr143(1,2),peaktr153(1,2),peaktr
173(1,2),peaktr183(1,2)]peakt_p3=[peaktp13(1,2),peaktp23(1,2),peaktp3
3(1,2),peaktp53(1,2),peaktp63(1,2),peaktp83(1,2),peaktp93(1,2),peaktp
103(1,2),peaktp113(1,2),peaktp123(1,2),peaktp133(1,2),peaktp143(1,2),
peaktp153(1,2),peaktp173(1,2),peaktp183(1,2)]
peakv_PRCC3=[peakvr13(1,2),peakvr23(1,2),peakvr33(1,2),peakvr53(1,2),
```

```
peakvr63(1,2),peakvr83(1,2),peakvr93(1,2),peakvr103(1,2),peakvr113(1,
2),peakvr123(1,2),peakvr133(1,2),peakvr143(1,2),peakvr153(1,2),peakvr
173(1,2),peakvr183(1,2)]peakv_p3=[peakvp13(1,2),peakvp23(1,2),peakvp3
3(1,2),peakvp53(1,2),peakvp63(1,2),peakvp83(1,2),peakvp93(1,2),peakvp
103(1,2),peakvp113(1,2),peakvp123(1,2),peakvp133(1,2),peakvp143(1,2),
peakvp153(1,2),peakvp173(1,2),peakvp183(1,2)]
figure(5)
hold on
bar(peakt_PRCC3)
axis([0 17 -1 1])
set(gca,'xticklabel',{''});
text(1,-1.1,'\sigma');
text(2,-1.1,'\delta_I');
text(3,-1.1,'\delta_H');
text(4,-1.1,'\lambda');
text(5,-1.1,'\beta');
text(6,-1.1,'\eta');
text(7,-1.1,'\mu_M');
text(8,-1.1,'c_1');
text(9,-1.1,'c_0');
text(10,-1.1,'\mu_c');
text(11,-1.1,'q_1');
text(12,-1.1,'q_0');
text(13,-1.1,'\mu_q');
text(14,-1.1,'\gamma_{H2}');
text(15,-1.1,'\xi');
ylabel('PRCCs for peak time')
figure(6)
hold on
bar(peakv_PRCC3)
axis([0 17 -1 1])
set(gca,'xticklabel',{''});
text(1,-1.1,'\sigma');
text(2,-1.1,'\delta_I');
text(3,-1.1,'\delta_H');
text(4,-1.1,'\lambda');
text(5,-1.1,'\beta');
text(6,-1.1,'\eta');
text(7,-1.1,'\mu_M');
text(8,-1.1,'c_1');
text(9,-1.1,'c_0');
text(10,-1.1,'\mu_1');
text(11,-1.1,'q_1');
text(12,-1.1,'q_0');
```

```
text(13,-1.1,'\mu_2');
text(14,-1.1,'\gamma_{H2}');
text(15,-1.1,'\xi');
ylabel('PRCCs for peak size')

function [H,C,MZC]=realpop_shaanxi(parameter,Y1);
sigma=parameter(1);
delta_I=parameter(2);
delta_H=parameter(3);
gamma_H1=parameter(4);
lambda=parameter(5);
beta=parameter(6);
theta=parameter(7);
eta=parameter(8);
mu_M=parameter(9);
c_1=parameter(10);
c_0=parameter(11);
mu_c=parameter(12);
q_1=parameter(13);
q_0=parameter(14);
mu_q=parameter(15);
alpha=parameter(16);
gamma_H2=parameter(17);
A=parameter(18);
S=zeros(500,1);   S(1)=Y1(1);
Sq=zeros(500,1);  Sq(1)=Y1(2);
E=zeros(500,1);   E(1)=Y1(3);
Eq=zeros(500,1);  Eq(1)=Y1(4);
I=zeros(500,1);   I(1)=Y1(5);
H=zeros(500,1);   H(1)=Y1(6);
Hc=zeros(500,1);  Hc(1)=Y1(7);
R=zeros(500,1);   R(1)=Y1(8);
M=zeros(500,1);   M(1)=Y1(9);
cM=zeros(500,1);  cM(1)=c_1+(c_0-c_1)/(1+mu_c*M(1));
qM=zeros(500,1);  qM(1)=q_1+(q_0-q_1)/(1+mu_q*M(1));
C=zeros(500,1);   C(1)=Y1(10);
N=zeros(500,1);   N(1)=S(1)+Sq(1)+E(1)+Eq(1)+I(1)+H(1)+Hc(1)+R(1);
MZC=zeros(500,1);  MZC(1)=Y1(11);
for t=2:1:500
    if t<12
        gamma_H=gamma_H1;
    else
        gamma_H=gamma_H2;
    end
```

```
S(t)=S(t-1)-(beta*cM(t-1)+(1-beta)*cM(t-1)*qM(t-1))*S(t-1)*(I(t-1)+th
eta*E(t-1))/N(t-1)+(1-exp(-lambda))*Sq(t-1);
Sq(t)=exp(-lambda)*Sq(t-1)+(1-beta)*cM(t-1)*qM(t-1)*S(t-1)*(I(t-1)+th
eta*E(t-1))/N(t-1);
E(t)=exp(-sigma)*E(t-1)+beta*cM(t-1)*(1-qM(t-1))*S(t-1)*(I(t-1)+theta
*E(t-1))/N(t-1);
Eq(t)=exp(-sigma)*Eq(t-1)+beta*cM(t-1)*qM(t-1)*S(t-1)*(I(t-1)+theta*E
(t-1))/N(t-1);
I(t)=exp(-(alpha+delta_I))*I(t-1)+(1-exp(-sigma))*E(t-1);
H(t)=exp(-delta_H)*H(t-1)+exp(-alpha)*(1-exp(-delta_I))*I(t-1)+(1-exp
(-sigma))*Eq(t-1);
Hc(t)=exp(-(alpha+gamma_H))*Hc(t-1)+(1-exp(-delta_H))*H(t-1);
R(t)=R(t-1)+exp(-alpha)*(1-exp(-gamma_H))*Hc(t-1);
M(t)=exp(-mu_M)*M(t-1)+eta*(H(t-1)+Hc(t-1));
    if t==2
        H(t)=H(t)+1*A; I(t)=I(t)+2*A; E(t)=E(t)+4*A;
    elseif t==3
        E(t)=E(t)+2*A;
    elseif t==4
        I(t)=I(t)+1*A;
    elseif t==5
        E(t)=E(t)+6*A;
    elseif t==6
        E(t)=E(t)+1*A;
    elseif t==8
        E(t)=E(t)+1*A;
    elseif t==12
        I(t)=I(t)+1*A;
    end
C(t)=(1-exp(-sigma))*E(t-1)+exp(-alpha)*(1-exp(-delta_I))*I(t-1)+(1-e
xp(-delta_H))*H(t-1);
MZC(t)=(1-exp(-delta_H))*H(t-1);
N(t)=S(t)+Sq(t)+E(t)+Eq(t)+I(t)+H(t)+Hc(t)+R(t);
cM(t)=c_1+(c_0-c_1)/(1+mu_c*M(t));
qM(t)=q_1+(q_0-q_1)/(1+mu_q*M(t));
End

function s=LHS_Call(xmin,xmean,xmax,xsd,nsample,distrib,threshold)
if nsample==1
    s=xmean;
    return
end
if nargin<7
    threshold=1e20;
```

```
end
[sample,nvar]=size(xmean);
if distrib == 'norm'
    ran=rand(nsample,nvar);
    s=zeros(nsample,nvar);
    for j=1: nvar
        idx=randperm(nsample);
        P=(idx'-ran(:,j))/nsample;
        s(:,j) = xmean(j) + ltqnorm(P).* xsd(j);
    end
end
if distrib == 'unif'
    if xmin==0
        xmin=1e-300;
    end
    nvar=length(xmin);
    ran=rand(nsample,nvar);
    s=zeros(nsample,nvar);
    for j=1: nvar
        idx=randperm(nsample);
        P =(idx'-ran(:,j))/nsample;
        xmax(j);
        xmin(j);
        xmax(j)/xmin(j);
        if (xmax(j)<1 & xmin(j)<1) || (xmax(j)>1 & xmin(j)>1)
            'SAME RANGE';
            if (xmax(j)/xmin(j))<threshold
                '<1e3: LINEAR SCALE';
                s(:,j) = xmin(j) + P.* (xmax(j)-xmin(j));
            else
                '>=1e3: LOG SCALE';
                s(:,j) = log(xmin(j)) +
P.*abs(abs(log(xmax(j)))-abs(log(xmin(j))));
                s(:,j) = exp(s(:,j));
            end
        else
            'e- to e+';
            if (xmax(j)/xmin(j))<threshold
                '<1e3: LINEAR SCALE';
                s(:,j) = xmin(j) + P.* (xmax(j)-xmin(j));
            else
                '>=1e3: LOG SCALE';
                s(:,j) = log(xmin(j)) + P.*abs(log(xmax(j))-log(xmin(j)));
                s(:,j) = exp(s(:,j));
```

```
          end
       end
    end
end

function z = ltqnorm(p)
   a = [ -3.969683028665376e+01  2.209460984245205e+02 ...
        -2.759285104469687e+02  1.383577518672690e+02 ...
        -3.066479806614716e+01  2.506628277459239e+00 ];
   b = [ -5.447609879822406e+01  1.615858368580409e+02 ...
        -1.556989798598866e+02  6.680131188771972e+01 ...
        -1.328068155288572e+01 ];
   c = [ -7.784894002430293e-03 -3.223964580411365e-01 ...
        -2.400758277161838e+00 -2.549732539343734e+00 ...
         4.374664141464968e+00  2.938163982698783e+00 ];
   d = [  7.784695709041462e-03  3.224671290700398e-01 ...
         2.445134137142996e+00  3.754408661907416e+00 ];
   plow  = 0.02425;
   phigh = 1 - plow;
   z = zeros(size(p));
   k = plow <= p & p <= phigh;
   if any(k(:))
      q = p(k) - 0.5;
      r = q.*q;
      z(k) =
(((((a(1)*r+a(2)).*r+a(3)).*r+a(4)).*r+a(5)).*r+a(6)).*q ./ ...
           (((((b(1)*r+b(2)).*r+b(3)).*r+b(4)).*r+b(5)).*r+1);
   end
   k = 0 < p & p < plow;
   if any(k(:))
      q  = sqrt(-2*log(p(k)));
      z(k) =
(((((c(1)*q+c(2)).*q+c(3)).*q+c(4)).*q+c(5)).*q+c(6)) ./ ...
           ((((d(1)*q+d(2)).*q+d(3)).*q+d(4)).*q+1);
   end
    k = phigh < p & p < 1;
   if any(k(:))
      q  = sqrt(-2*log(1-p(k)));
      z(k) =
-(((((c(1)*q+c(2)).*q+c(3)).*q+c(4)).*q+c(5)).*q+c(6)) ./ ...
           ((((d(1)*q+d(2)).*q+d(3)).*q+d(4)).*q+1);
   end
   z(p == 0) = -Inf;
   z(p == 1) = Inf;
```

```
   k = p < 0 | p > 1 | isnan(p);
   if any(k(:))
      z(k) = NaN;
   end
   k = 0 < p & p < 1;
   if any(k(:))
      e = 0.5*erfc(-z(k)/sqrt(2)) - p(k);
      u = e * sqrt(2*pi) .* exp(z(k).^2/2);
      z(k) = z(k) - u./( 1 + z(k).*u/2 );
   End
```

```
function f=normal_function(mu,sigma,N,x_min,x_max)
x=norminv(1/N:1/N:1-1/N,mu,sigma);
f(1)=x_min+(x(1)-x_min)*rand;
f(N)=x(N-1)+(x_max-x(N-1))*rand;
for i=1:1:(N-2)
    f(i+1)=x(i)+(x(i+1)-x(i))*rand;
end
```