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% MatLab-codes of phase diagram

clear all
close all
clc
syms x y m k1 k2 r1 r2 d1 d2
eqns=[r1*x*(1-x/k1)-d1*x-m*x==0,r2*y*(1-y/k2)-d2*y+m*x==0];
vars=[x,y];
[solx,soly]=solve(eqns,vars);

k1=1198164.6;
k2=2003671.8;
m=0.1;
r1=0.8;
r2=0.3;

%%% r1-d1-m≤0 r2-d2≤0 (0,0)
% d1=0.7;
% d2=0.3;
%
% %%% r1-d1-m≤0 r2-d2>0 (0,0),(0,y)
d1=0.7;
d2=0.05;
%
% %%% r1-d1-m>0 r2-d2≤0 (0,0),(x,y)
% d1=0.5;
% d2=0.3;

% %%% r1-d1-m>0 r2-d2>0 (0,0),(0,y),(x,y)
% d1=0.5;
% d2=0.1;

X1=double(subs(solx));
Y1=double(subs(soly));
XX2=linspace(0,5e5,20);
YY2=linspace(0,2e6,20);
[X2,Y2]=meshgrid(XX2,YY2);

s=r1*X2.*(1-X2/k1)-d1*X2-m*X2;
t=r2*Y2.*(1-Y2/k2)-d2*Y2+m*X2;
r=sqrt(s.^2+t.^2);
figure(1)
quiver(X2,Y2,s,t)
hold on
scatter(X1([1:4]),Y1([1:4]),10,'MarkerEdgeColor','b',...
        'MarkerFaceColor','b',...
        'LineWidth',1.5)
[s1,s2]=meshgrid(XX2(1:3:end),YY2(1:3:end));
xlabel('x')
ylabel('y')
set(gcf,'color','white')
box on
set(gca,'XLim',[0 5e5]);
set(gca,'XTick',[0:1e5:5e5]);

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set(gca,'YLim',[0 2e6]);  
set(gca,'YTick',[0:2e5:2e6]);  
  
figure(2)  
h=streamslice(X2,Y2,s,t);  
set(h,'Color','r');  
xlabel('x(t)')  
ylabel('y(t)')  
set(gcf,'color','white')  
box on
```