Chemostat Script 2nutrient Dynamics (script):

```
clear all

t0 = 0; %initial time

t1 = 100; % final time

x0 = 1; % initial cell population

y0 = 20; % initial yeast concentration

z0 = 3.5;

%

% initial state for use in DE solver.

%

S0 = [x0;y0;z0];

%

% rate constants and problem parameters

%

r = 0.46;

K = 0.778;

ep = 25;

u = 25;

q = 0.03;

ef = 0.526;

v = 5;

l = 15.91;

%

% rate constants into parameter vector

%

params(1) = r;

params(2) = K;

params(3) = ep;

params(4) = u;
```

```
params(5) = q;

params(6) = ef;

params(7) = v;

params(8) = l;

%

% define function for fixed parameter values

%

chemostat_dynamics_params = @(t,S)chemostat_2nutrient_dynamics(t,S,params);

%

% call the matlab function to solve the DE for us.

%

[t,St] = ode45(chemostat_dynamics_params,[t0 t1],S0);

%

% Plot the results.

%

plot(t,St,'LineWidth',3)

legend('cells','food')

xlabel('time')

ylabel('states')
```

Chemostat Script 2nutrient Dynamics:

```
function [ dSdt ] = chemostat_2nutrient_dynamics(t,S,params)

% this function defines the chemostat differential equation

%

% get the individual parameters from the vector

%

r = params(1);

K = params(2);
```

```
ep = params(3);
u = params(4);
q = params(5);
ef = params(6);
v = params(7);
l = params(8);
%
% initialize the state's derivative
%
dSdt = zeros(size(S));
%
% put things in terms of individual variables
%
x = S(1); % cells
y = S(2); % food
z = S(3);
%
% form the differential equation formulae
%
ryz = r*y/(K+y)*(z/z+l);
dxdt = (ryz)*x - q*x;
dydt = q*(u - y) - ep*ryz*x;
dzdt = q*(v - z) - ef*ryz*x;
%
% put things back in terms of state vector variable
%
dSdt(1) = dxdt;
dSdt(2) = dydt;
dSdt(3) = dzdt;
```

```
end
```