ModSim Exercise 4

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1.

1) alcohol_net_flows.m

```
%params(1) = d
%params(2) = k
%params(3) = Vm
%params(4) = Km
function res = alcohol_net_flows(stock, params)
res = [params(1) - params(2)*stock(1), ...
    params(2)*stock(1) - params(3)*stock(2)/(params(4)+stock(2))];
end
```

2) simulate_alcohol.m

```
function simulate_alcohol()

stocks = [.9,0];
params = [0,0.24/60,1.31/60,3.67];
%params = [0,1/.7*(1/3600),.4/3600,.2];
lim = 5*60*60;

V_s1 = zeros(lim,1);
V_s2 = zeros(lim,1);
for i=1:lim
    stocks = stocks + alcohol_net_flows(stocks,params);
    V_s1(i) = stocks(1);
    V_s2(i) = stocks(2);
end
hold on
plot(V_s1);
plot(V_s2);
end
```

3) simulate_alcohol2.m

```
function simulate_alcohol2()

stocks = [.9,0];
params = [0,0.24/60,1.31/60,3.67];
%params = [0,1/.7*(1/3600),.4/3600,.2];
lim = 5*60*60;
stepsize = 100;

V_s1 = zeros(lim/stepsize,1);
V_s2 = zeros(lim/stepsize,1);

for i=1:stepsize:lim
    stocks = stocks + stepsize*alcohol_net_flows(stocks,params);
    V_s1(1+floor(i/stepsize)) = stocks(1);
    V_s2(1+floor(i/stepsize)) = stocks(2);
end
hold on
```

```
plot(V_s1);
plot(V_s2);
end
```

Graph (Unitless concentration):

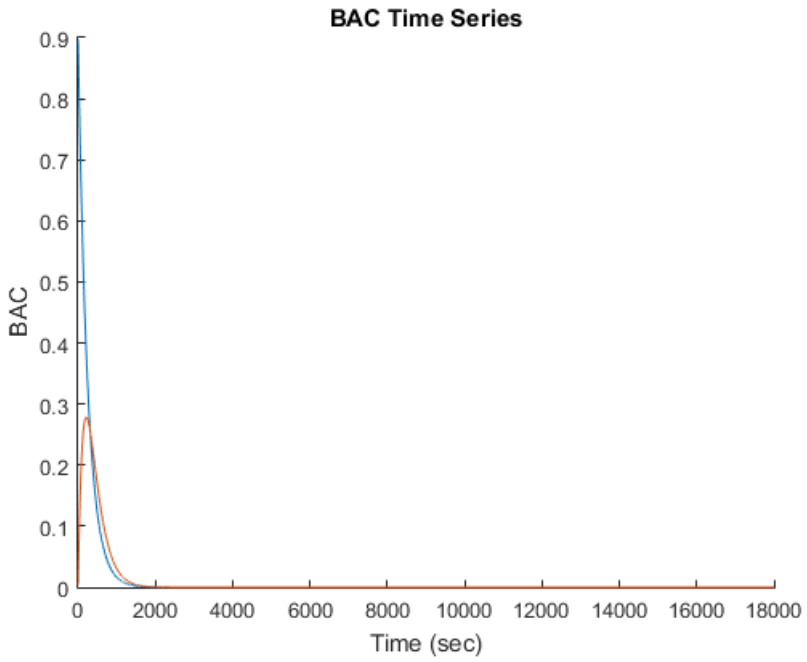

Figure 1 BAC Time Series, simulated per every second

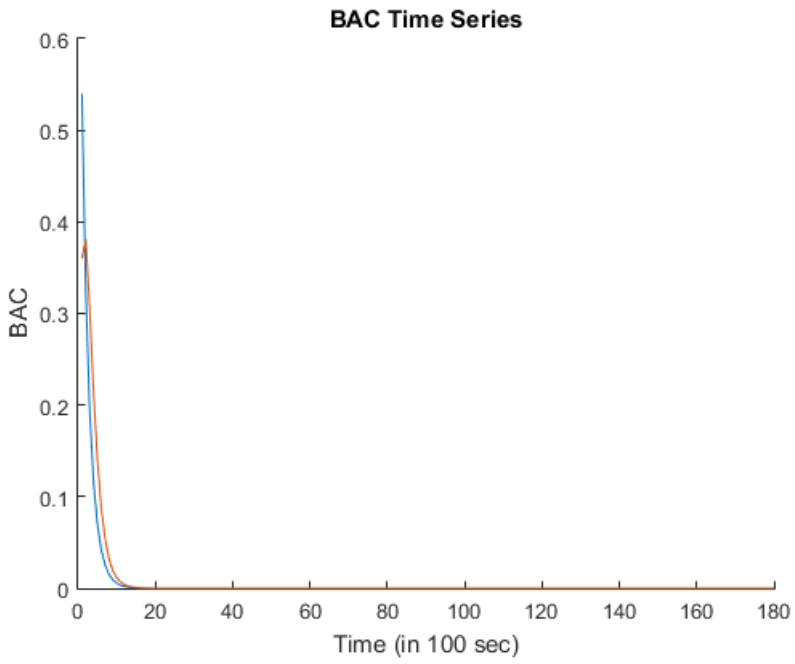

Figure 2. BAC Time Series, simulated per every 100 seconds.

2. duck.m:

```
function duck()
    figure;
    rho = 0.3; %g/cm^3
    rad = 10; %cm
    V_tot = @(r) 4*pi*r^3/3;
    V_sub = @(r,d) pi/3*(3*r*d^2-d^3);
    eqn = @(d) V_sub(rad,d)*1 - V_tot(rad)*rho;
    ezplot(eqn,[-rad*2,rad*2]);
    disp(fzero(eqn,rad));


    figure;
    plotVec = zeros(100,100);
    eqn2 = @(rh,rd) V_tot(rd)*rh - V_sub(rad,10)*1;
    for i = 1:100
        for j = 1:1000
            plotVec(i,j) = eqn2(i/10,j);
        end
    end
    mesh(plotVec);
    xlabel('radius (mm)');
    ylabel('density (g/cm^3)')
    %for i = 1 : 20
     %  for j = 1 : 20
     %      plotVec(i,j) = eqn
     %  end
    %end
    %figure;

end
```

fzero result : 7.2651 cm

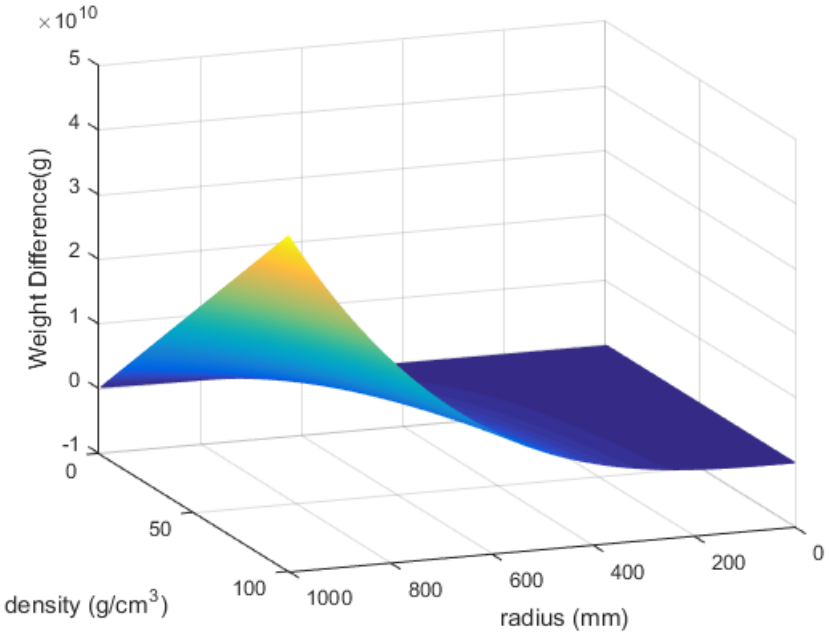

Figure 3 3d plot of weight difference with respect to density and the radius of the duck, given the displacement of 10 cm.