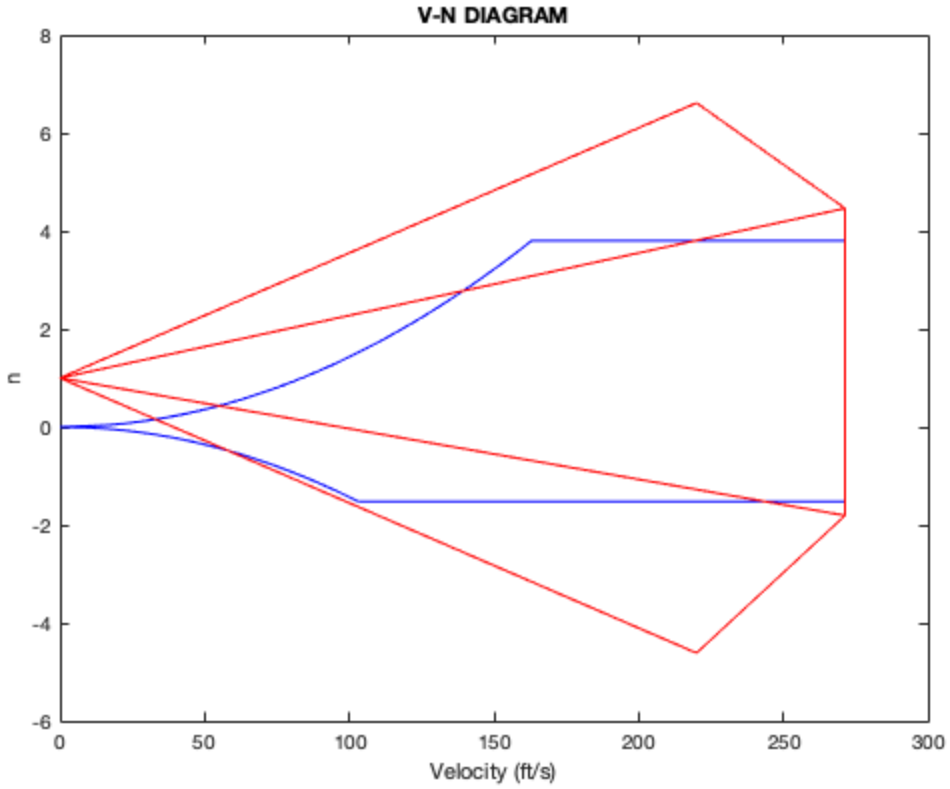
```
Data = xlsread('SE160A_Project1_InputFile.xlsx','Input');
%defining variables

%AIRCRAFTGEOMETRY
wingstation=(Data(1,1))*12;
tailstation=(Data(2,1))*12;
weightwing=Data(3,1);
wingarea=(Data(4,1));
wingspan=(Data(5,1));
wingchord=(Data(6,1));
st=(Data(7,1));
bt=(Data(8,1));
ct=(Data(9,1));

%AIRCRAFTAER0DYNAMICDEFINITION
liftslope=Data(14,1)*(180/pi);
zeroliftangle=(Data(15,1))*(pi/180);
CLPOSITIVE=Data(16,1);
stallanglepositive=Data(17,1);
CLNEGATIVE=Data(18,1);
stallanglenegative=Data(19,1);
CMO=Data(20,1);
CDO=Data(21,1);
K=Data(22,1);
spanwisedrag=Data(23,1);
spanwisedragten=Data(24,1);

%AIRCRAFT PERFORMANCE
vstall=(Data(29,1))*1.46667;
vcruise=(Data(30,1))*1.46667;
vdive=(Data(31,1))*1.46667;
npositive=Data(32,1);
nnegative=Data(33,1);

%AIRCRAFTWEIGHTANDBALANCE
empty=Data(38,1);
fuel=Data(39,1);
pilot=Data(40,1);
copilot=Data(41,1);
rearpass=Data(42,1);
luggage=Data(43,1);
totalw=empty+fuel+pilot+copilot+rearpass+luggage;

emptystation=(Data(38,2))/12;
fuelstation=(Data(39,2))/12;
pilotstation=(Data(40,2))/12;
copilotstation=(Data(41,2))/12;
rearpassstation=(Data(42,2))/12;
luggagestation=(Data(43,2))/12;


%rearpassenger=0
```

```
%luggage=0

%ANALYSIS
p=Data(48,1);
analysiscase=Data(49,1);
maxvehicleweight=Data(50,1);
mincg=Data(51,1)/12;
maxcg=Data(52,2)/12;

% #1 PLOT V-N & GUST ENVELOPE

%PHAA
n0=linspace(0,npositive);
v0=(n0.^.5)*vstall;
plot(v0,n0,'b')
hold on

%NHAA
n1=linspace(0,nnegative);
v1=((-n1).^.5)*vstall;
plot(v1,n1,'b')
hold on

%PLAA
n2=[npositive,npositive];
v2=[(npositive^.5)*vstall,vdive];
plot(v2,n2,'b')
hold on

%PLAA TO NLAA
v3=[vdive,vdive];
n3=[npositive,nnegative];
plot(v3,n3,'b')
hold on

%NLAA TO NHAA
v4=[((-nnegative)^.5)*vstall,vdive];
n4=[nnegative,nnegative];
plot(v4,n4,'b')
hold on

%gust envelope

v5=[0,vcruise];
%here u=50, VCRUISE TOP
%this line goes from origin to the top right (vcruise) and has an n
%value that comes from u=50 and vcruise
n5=[1,1+(.5*p*(wingarea/totalw)*liftslope)*50*vcruise];
plot(v5,n5,'r')
hold on

v6=[0,vcruise];
%here u=-50, VCRUISE BOTTOM
%this line goes from origin to the bottom right (vcruise) and has an n
```

```
%value that comes from u=-50 and vcruise
n6=[1,1+(.5*p*(wingarea/totalw)*liftslope)*-50*vcruise];
plot(v6,n6,'r')

v7=[vcruise,vdive];
%u=25, VDIVE TOP
%the n value here goes from n5 to a new n calculated by using the same
 eq
%and a value of +25 for u and vdive for v
n7=[1+(.5*p*(wingarea/totalw)*liftslope)*50*vcruise,1+...
    (.5*p*(wingarea/totalw)*liftslope)*25*vdive];
plot(v7,n7,'r')

v8=[vcruise,vdive];
%u=-25, VDIVE BOTTOM
%the n value here goes from n6 to a new n calculated by using the same
 eq
%and a value of -25 for u and vdive for v
n8=[1+(.5*p*(wingarea/totalw)*liftslope)*-50*vcruise,1+...
    (.5*p*(wingarea/totalw)*liftslope)*-25*vcruise];
plot(v8,n8,'r')

v9=[vdive,vdive];
n9=[1+(.5*p*(wingarea/totalw)*liftslope)*25*vdive,1+(.5*p*(wingarea/
totalw)*liftslope)*-25*vcruise];
plot(v9,n9,'r')
xlabel('Velocity (ft/s)'); title('V-N DIAGRAM')
ylabel('n')

%final +u25
v10=[0,vdive];
n10=[1,1+(.5*p*(wingarea/totalw)*liftslope)*25*vdive];
plot(v10,n10,'r')

%final -u25
v11=[0,vdive];
n11=[1,1+(.5*p*(wingarea/totalw)*liftslope)*-25*vcruise];
plot(v11,n11,'r')

% #2 WEIGHT & CG LOCATION

totalplaneweight=(empty+fuel+pilot+copilot+rearpass+luggage);
cg=(((empty)*(emptystation))+((fuel)*(fuelstation))+((pilot)*(pilotstation))+((cop
(empty+fuel+pilot+copilot+rearpass+luggage);
fprintf('\nTotal Plane Weight: %f lb\n CG: %f ft.
\n',totalplaneweight,cg);
fprintf('Both weight & CG are within allowable limits\n');

% #3 Calculations
%EVERYTHING IS IN FEET
%for phaa n=npositive, v=(n0.^.5)*vstall
%CG is .0736 ft foward of wing(c/4) station
%moment arm =tailstation-wingstation=14.0833
```

```
a=('analysiscase:');

%PHAA
if analysiscase==1
    valueofn=npositive;
    valueofv=(((npositive^.5)*vstall));

%PLAA
elseif analysiscase==2
        valueofn=npositive;
     valueofv=vdive;

%NHAA
elseif analysiscase==3
    valueofn=nnegative;
    valueofv=(((-(nnegative).^.5)*vstall));

%NLAA
elseif analysiscase==4
    valueofn=nnegative;
    valueofv=vdive;

%+Gustcruise50
elseif analysiscase==5
    valueofn=(1+(.5*p*(wingarea/totalw)*liftslope)*50*vcruise);
    valueofv=vcruise;

%+Gustdive25
elseif analysiscase==6
    valueofn=(1+(.5*p*(wingarea/totalw)*liftslope)*25*vdive);
    valueofv=vdive;

%-Gustcruise50
elseif analysiscase==7
    valueofn=(1+(.5*p*(wingarea/totalw)*liftslope)*-50*vcruise);
    valueofv=vcruise;

%-Gustdive25
elseif analysiscase==8
    valueofn=(1+(.52*p*(wingarea/totalw)*liftslope)*-25*vcruise);
    valueofv=vdive;
end


Total Plane Weight: 2064.000000 lb
 CG: 3.343142 ft.
Both weight & CG are within allowable limits
```




```
moment=.5*p*((valueofv)^2)*wingarea*wingchord*CMO
lifttail=(moment-(valueofn*totalplaneweight*.0736))/(14.0833)
winglift=(valueofn*totalplaneweight)-lifttail
alpha=(winglift/
(.5*p*((valueofv)^2)*wingarea*liftslope))+zeroliftangle
derivedcl=liftslope*(alpha-zeroliftangle)
cdrag=CDO+(K*(derivedcl^2))
drag=.5*p*(valueofv^2)*wingarea*cdrag
thrust=.5*p*(valueofv^2)*wingarea*cdrag
alphadg=(alpha*(180/pi))

format short g
disp([totalplaneweight cg valueofv valueofn moment winglift lifttail
 drag thrust alphadg])
disp('everything converted to feet and radians(alphadg show as
 degrees)')
```

```
moment =

       2941.5


lifttail =

       160.73
```

```
winglift =

       9048.5


alpha =

     0.081773


derivedcl =

      0.59432


cdrag =

     0.038014


drag =

       578.76


thrust =

       578.76


alphadg =

       4.6853

  Columns 1 through 6

         2064       3.3431       271.33       4.4618       2941.5
  9048.5

  Columns 7 through 10

       160.73       578.76       578.76       4.6853

everything converted to feet and radians(alphadg show as degrees)

syms x
%f=(2*(winglift/(2*wingspan))*(1+((4/pi)*(sqrt(1-(((4*(x.^2))/
(wingspan^2))))))));
%t10=taylor(f,x,'Order',10);
t10=(winglift/wingspan)*((2/pi)+(1/2)-((1/pi)*(4*(x.^2)/
(wingspan^2)))-((1/(4*pi))*(16*(x.^4)/(wingspan^4)))-((1/
```

```
(8*pi))*(64*(x.^6)/(wingspan^6)))-((5/(64*pi))*(256*(x.^8)/
(wingspan^8)))-((7/(128*pi))*(1024*(x.^10)/(wingspan^10))));
xaxis=((-wingspan/2):(wingspan/2));
a=matlabFunction(t10);
figure(2)
area(xaxis,a(xaxis))
ylim([0 300])
xlabel('Distance along span(ft)'); title('Lift Dist.')
ylabel('Lift lb/ft')

DG=(.5*p*((valueofv)^2)*wingchord)*(cdrag
+(K*((derivedcl)^2)*((spanwisedrag+(spanwisedragten*((2^10)*(x.^10))/
(wingspan^10))))));
z=matlabFunction(DG);
figure(3)
area(xaxis,z(xaxis))
xlabel('Distance along span(ft)'); title('Drag Dist.')
ylabel('Drag lb/ft')

wwperx=((valueofn)*weightwing)/wingspan;
normalforce=((cos(alpha)*(t10-wwperx))+(sin(alpha)*DG));
y=matlabFunction(normalforce);
figure(4)
area(xaxis,y(xaxis))
ylim([0 300])
xlabel('Distance along span(ft)'); title('Normal Force Dist.')
ylabel('Nforce lb/ft')

chordwiseforce=(t10*(-sin(alpha)))+(wwperx*(-
sin(alpha)))+((cos(alpha))*DG);
u=matlabFunction(chordwiseforce);
figure(5)
area(xaxis,u(xaxis))
xlabel('Distance along span(ft)'); title('Chordwiseforce Dist.')
ylabel('Parallel force lb/ft')

figure(6)
i=[(-wingspan/2),(wingspan/2)];
j=[wwperx,wwperx];
plot(i,j)
xlabel('Distance along span(ft)'); title('Weight Dist.')
ylabel('Weight lb/ft')

figure(7)
momentx=((moment)/(wingspan));
m=[momentx,momentx];
plot(i,m)
xlabel('Distance along span(ft)'); title('Moment Dist.')
ylabel('Moment lb-ft/ft')

grid on
```

Published with MATLAB® R2017b