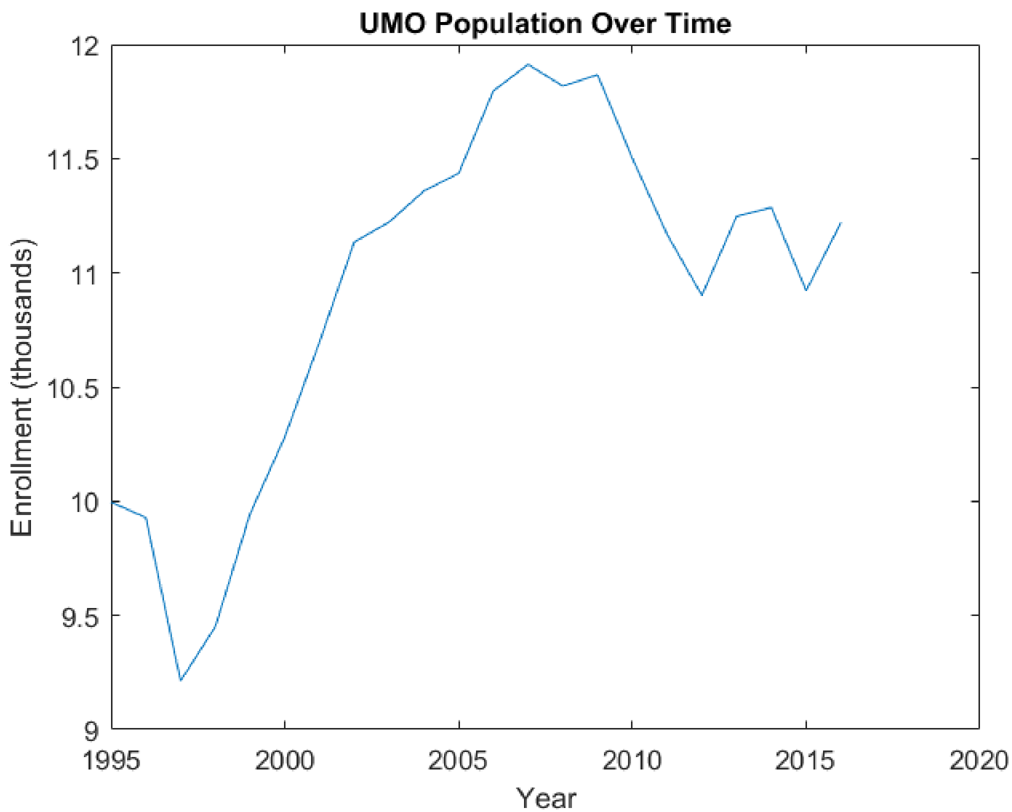
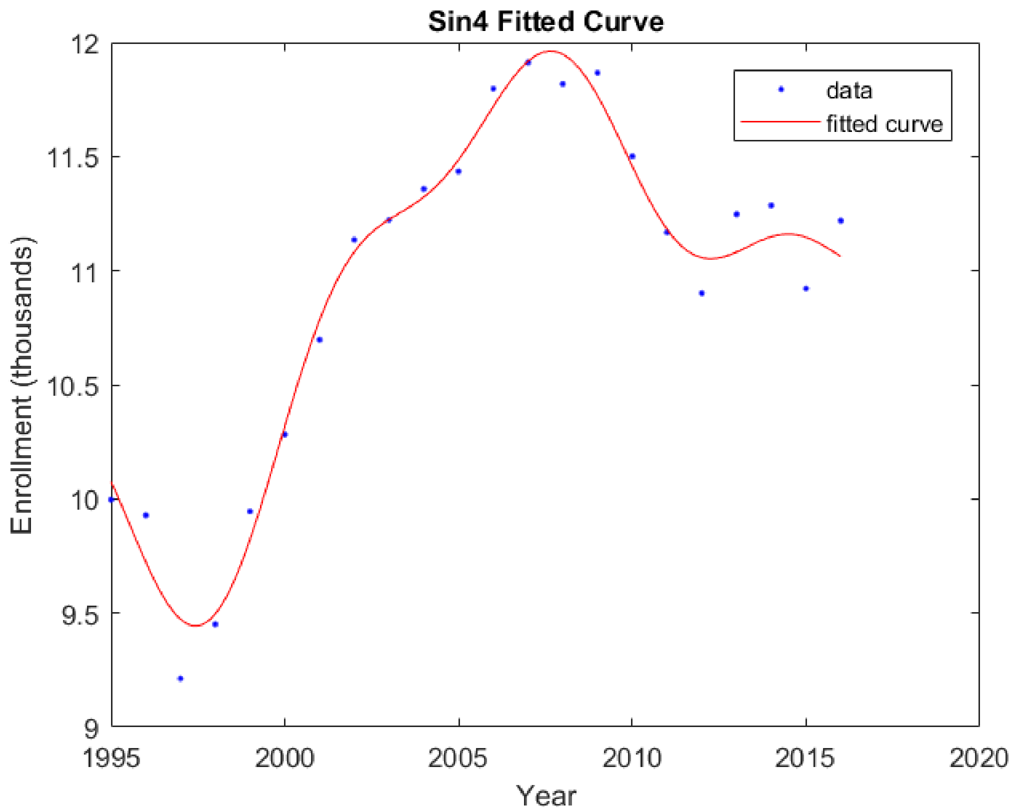
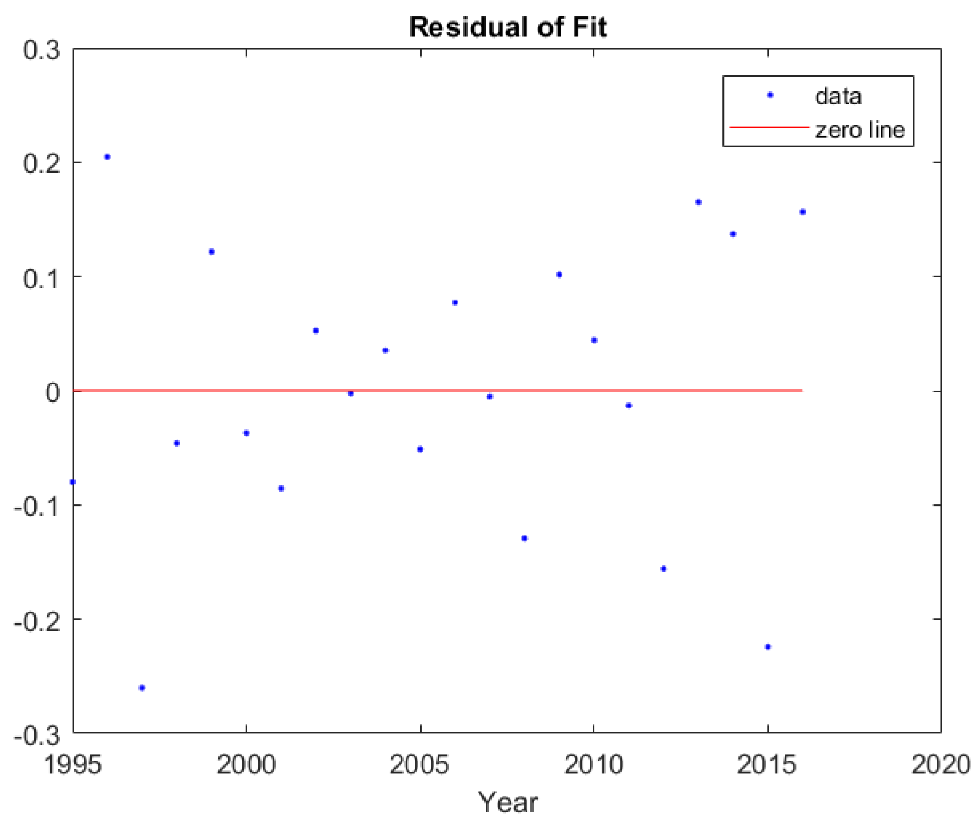
```
%Ryan Plante
%ECE498 Homework 6, Curve Fitting
%3/18/2018
clear
%Given Data
enrollment = [
% Year
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
 2009 2010 2011 2012 2013 2014 2015    2016
% UM
9996 9928 9213 9451 9945 10282 10698 11135 11222 11358 11435 11797
 11912 11818 11867 11501 11168 10901 11247 11286   10922   11219
% UMA
6023 5496 5248 5130 5612 5617 5575 5722 5943 5538 5494 5257 5101 4974
 5054 5074 4974 4990 4770 4664    4683    4416
% UMF
2510 2512 2446 2507 2479 2413 2435 2395 2420 2349 2452 2424 2265 2227
 2238 2322 2269 2179 2061 1960    2016    2000
% UMFK
731 767 690 827 926 886 897 827 924 1076 1193 1339 1269 1102 1126 1073
 1080 1169 1209 1327    1559    1904
% UMM
856 915 884 899 908 927 1017 1068 1313 1191 1149 1259 1093 1023 964
 951 863 925 892 810     786     745
% UMPI
1278 1347 1307 1344 1378 1427 1367 1560 1546 1652 1548 1655 1533 1455
 1436 1434 1453 1463 1263 1138    1289    1326
% USM
9721 9966 10230 10462 10645 10820 10966 11382 11007 11089 10974 10478
 10453 10009 9655 9654 9301 9385 8923 8428    7739    7855
];

year = enrollment(1, :)';
UMO = enrollment(2, :)';


%Conventionally stable natural populations are governed by a negative
%feedback loop that will oscialLate in a sinusoidal fashion around the
%carrying capacity of said population. In the case of UMO the model
 that
%best fits is that of a "new" population. That is to say that a period
 of
%high (often exponential) growth is intially seen as the population
 grows
%towards carry capacity. The population continues to grow until it
%overshoots its carrying capacity at which point the negative feedback
%kicks in and the population begins to decrease and stabilize.

%If we plot the curve of UMO enrollment we can see that this model
%theoretically fits pretty well
figure(1);
plot(year, UMO/1000);
```

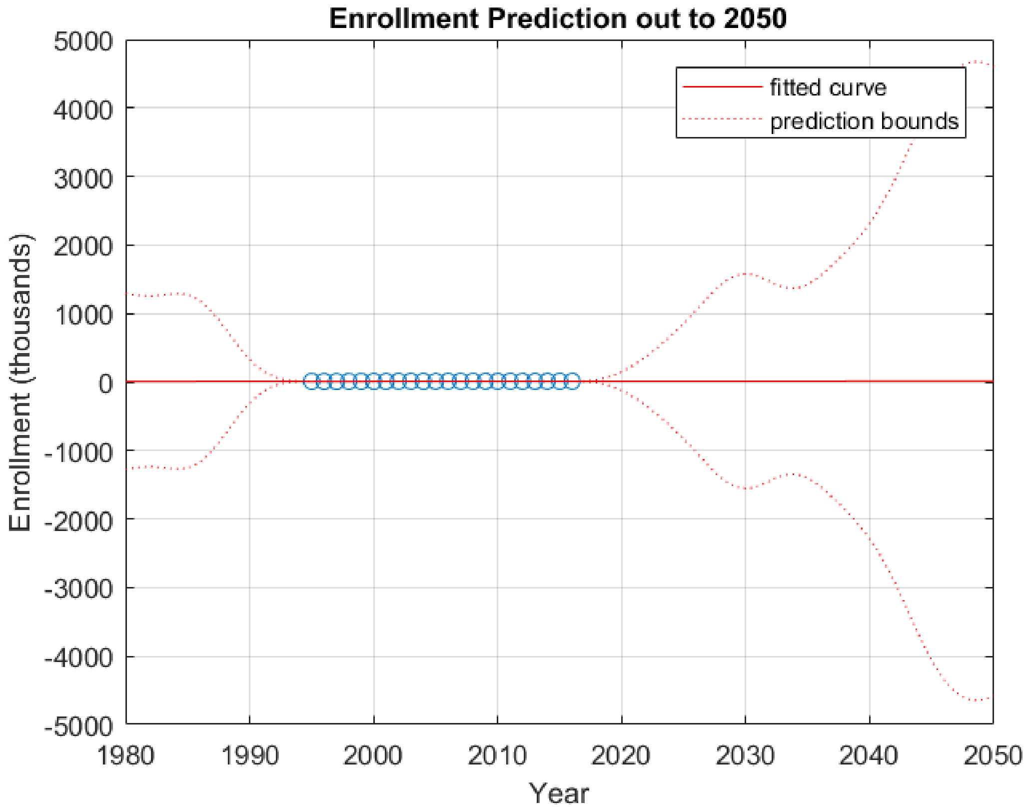
```
title('UMO Population Over Time');
xlabel('Year');
ylabel('Enrollment (thousands)');

%As such a sinusoidal curve fitting algorithm should provide a
 realtively good
%fit with a good prediction value, as a population is naturally
 expected to
%oscillate
figure(2);
[population, gof] = fit(year, UMO/1000, 'sin4');
%looks like a pretty decent fit
plot( population, year, UMO/1000 );
title('Sin4 Fitted Curve');
xlabel('Year');
ylabel('Enrollment (thousands)');


%Residual appears to be very random and follow no specific pattern, so
 we
%can assume that our curve our curve fits decently
figure(3);
plot(population, year, UMO/1000, 'residual' );
title('Residual of Fit');
xlabel('Year');

%Despite a good residual and inital fit, our prediction bounds are
 huge and
%don't seem to offer much prediction value
figure(4);
plot(year, UMO/1000, 'o');
xlim( [1980, 2050] );
hold on;
plot(population, 'predobs');
xlabel('Year');
ylabel('Enrollment (thousands)');
title('Enrollment Prediction out to 2050');
grid on;
hold off;

%The 95% confidence interval confirms that our fit has basically no
%prediction power, with bounds so large the initial data looks like a
%straight line
figure(5);
futureyears= (2000:10:2050).';
popFuture = population(futureyears);
ci = predint(population, futureyears, 0.95, 'observation' );
plot(year, UMO/1000, 'o');
xlim( [1980, 2050] );
hold on;
plot(population);
h = errorbar( futureyears, popFuture, popFuture-ci(:,1), ci(:,2)-
popFuture, '.' );
xlabel('Year');
```

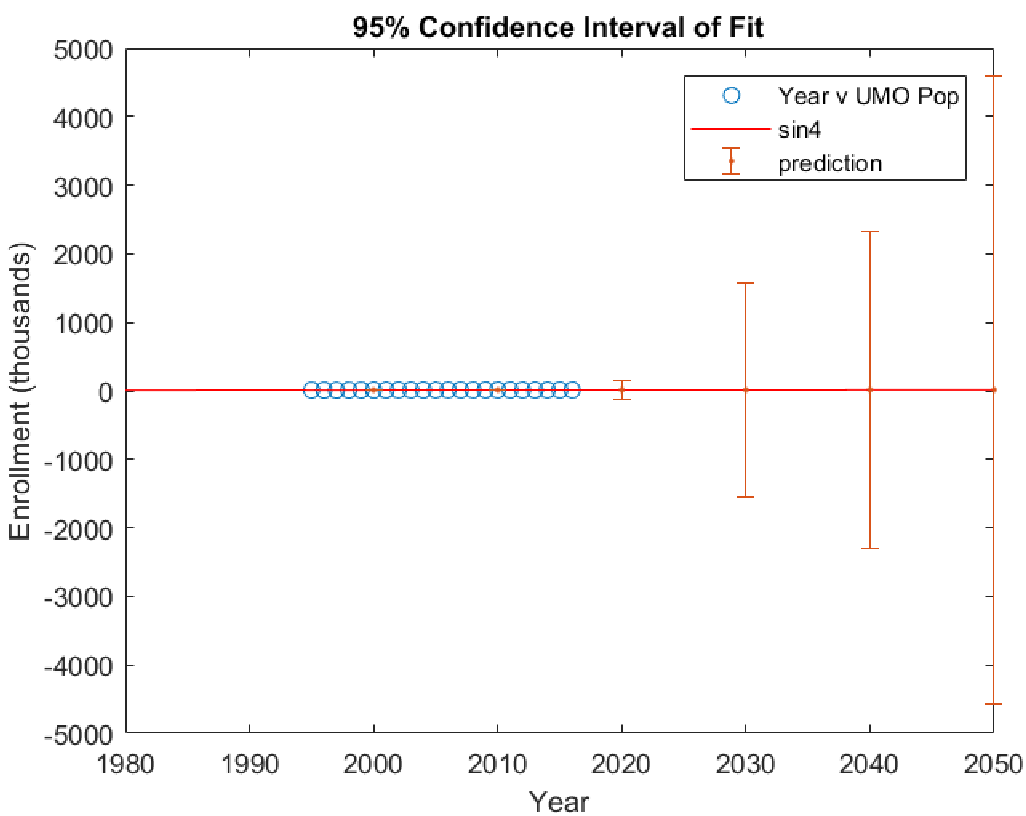
```
ylabel('Enrollment (thousands)');
title('95% Confidence Interval of Fit');
legend( 'Year v UMO Pop', 'sin4', 'prediction');
%Overall it seems as if the sinusoidal function was a very bad choice
 and
%has almost no prediction power. This is surprising due to the face
 that
%populations are naturally expected to oscillate. That being said the
 data
%set we are fitting is relatively small and so a good fit is unlikely.
```




Sin4 Fitted Curve
data
fitted curve
Enrollment (thousands)
Year
12
11.5
11
10.5
10
9.5
9
1995
2000
2005
2010
2015
2020


Residual of Fit
data
zero line
Year
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
1995
2000
2005
2010
2015
2020


Enrollment Prediction out to 2050
fitted curve
prediction bounds
Enrollment (thousands)
Year
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
1980
1990
2000
2010
2020
2030
2040
2050


95% Confidence Interval of Fit
Year v UMO Pop
sin4
prediction
Enrollment (thousands)
Year
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
1980
1990
2000
2010
2020
2030
2040
2050

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