12 Maths B Extended Modelling and Problem Solving Assignment Sem Two 2015

SOLUTIONS

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PART_A: Measuring Inequality

In Part A: A Lorenz Curve for Greece will be approximated using the trapezoidal rule. A model for the Lorenz Curve will be found using function fitting

Generating the data for the Lorenz Curve for Greece

```
x_min = 0;
x_max = 1;

X = [x_min: 0.1 :x_max]
Y = [0 0.03 0.07 0.13 0.20 0.28 0.37 0.48 0.60 0.75 1.00]

% X represents the proportion of the population
% Y represents the proportion of income
```

```
X =

  Columns 1 through 7

         0    0.1000    0.2000    0.3000    0.4000    0.5000    0.6000

  Columns 8 through 11

    0.7000    0.8000    0.9000    1.0000


Y =

  Columns 1 through 7

         0    0.0300    0.0700    0.1300    0.2000    0.2800    0.3700

  Columns 8 through 11

    0.4800    0.6000    0.7500    1.0000
```

Using the trapezoidal rule

The proportion of income is plotted against proprotion of population An approximation for the area under the Lorenz Curve is found

```
NUM_PANELS = length(X) - 1;  % number of trapezoidal panels
my_area    = 0;                % the initialised area
```

```
% loop over each panel and accumulate the areas
for kk=1:NUM_PANELS

   h         = X(kk+1) - X(kk);
   y_left    = Y(kk);
   y_right   = Y(kk+1);


   trap_area = h * (y_left + y_right)/2;

   my_area   = my_area + trap_area;
end

title_str = sprintf('The estimated Area = %.3f', my_area);

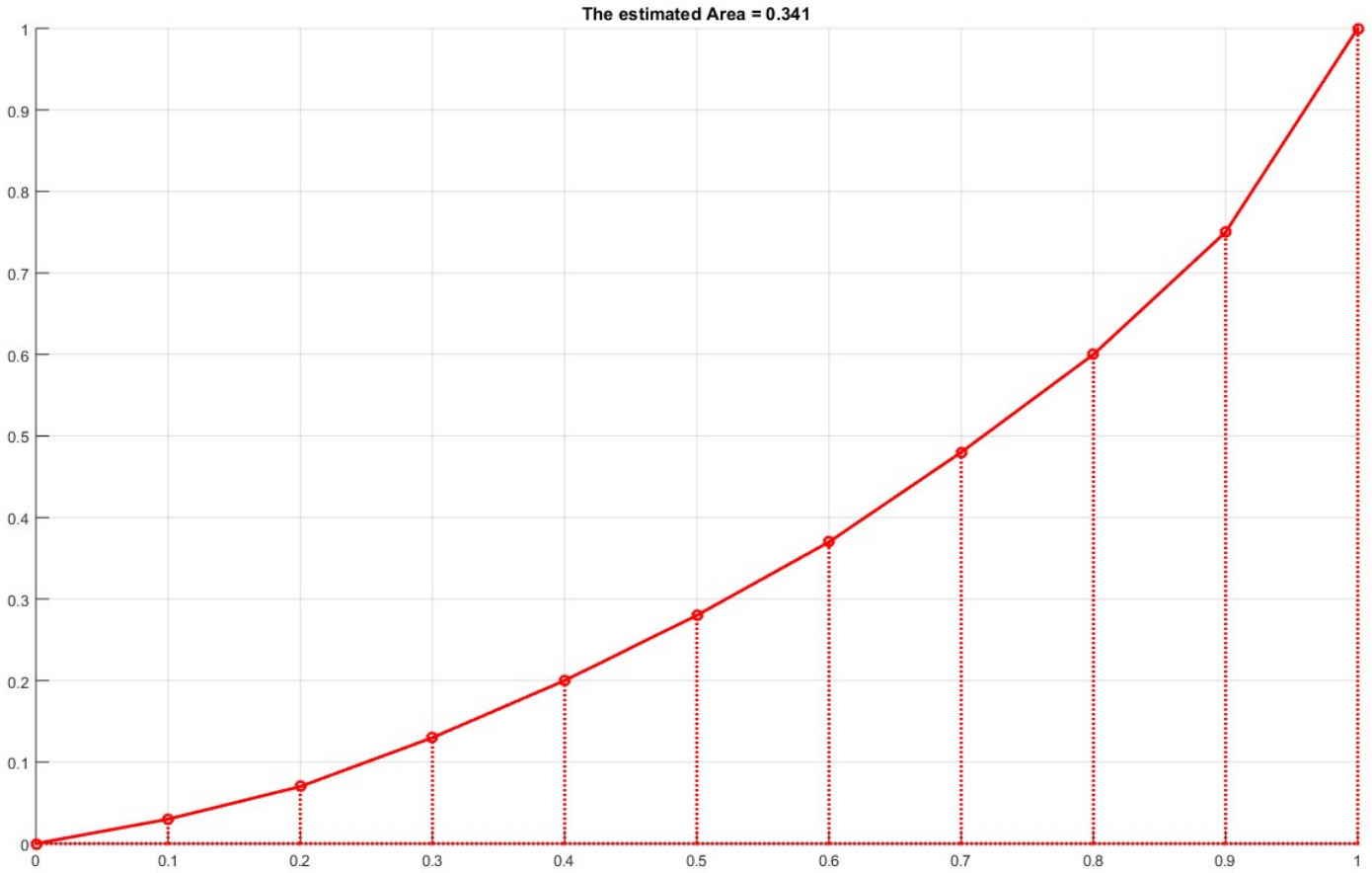
% plot the trapezoids
figure;
hand_ax2 = axes;
title(hand_ax2, title_str);

bh_plot_trapezoids( X, Y, hand_ax2 );

% Calculating the Gini coefficient
% Gini = (area between line of equaiity and Lorenz Curve)/area under line
% of equailty)
Gini = (0.5-my_area)/0.5
% ---------------------------------------------------------------------
```

```
Gini =

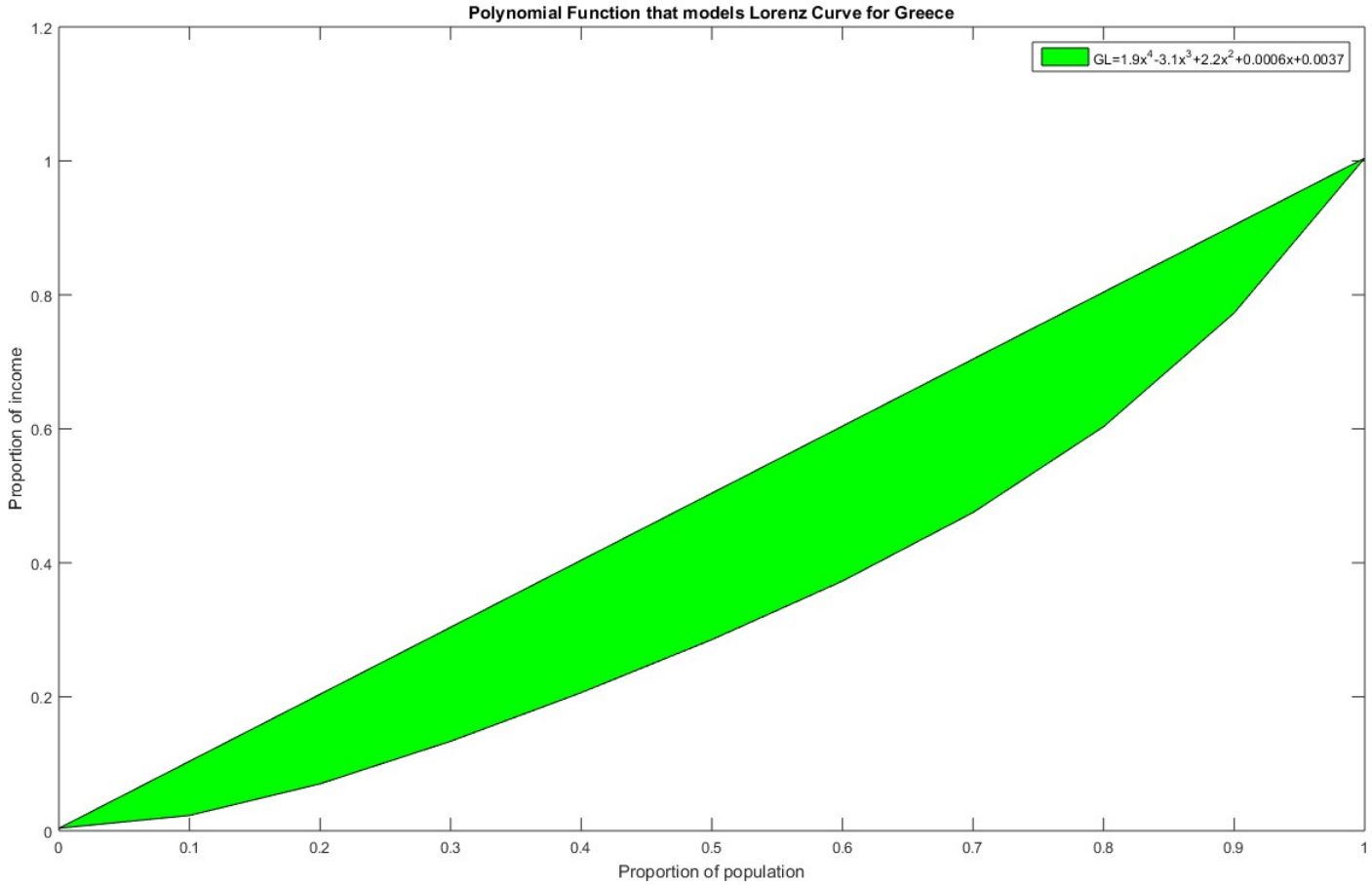
    0.3180
```



Displaying a function that models the Lorenz Curve for Greece

Using basic fitting in MATLAB, trendline in spreadsheet or calculator A suitable function would be 1.9x^4-3.1x^3+2.2x^2+0.0006x+0.0037 The function is then plotted and coloured using the fill function

```
GL = @(X) 1.9*X.^4-3.1*X.^3+2.2*X.^2+0.0006*X+0.0037;
figure;
L=GL(X);
fill(X,L,'g')
title('Polynomial Function that models Lorenz Curve for Greece')
xlabel('Proportion of population')
ylabel('Proportion of income')
legend('GL=1.9x^4-3.1x^3+2.2x^2+0.0006x+0.0037')
```

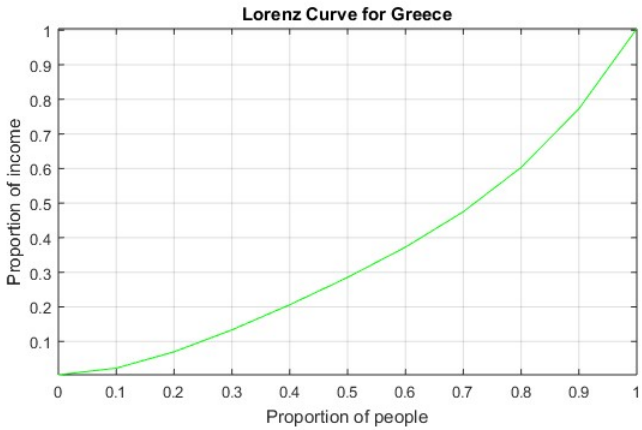

Polynomial Function that models Lorenz Curve for Greece
GL=1.9x^4-3.1x^3+2.2x^2+0.0006x+0.0037
Proportion of income
Proportion of population
0
0.2
0.4
0.6
0.8
1
1.2
0.1
0.3
0.5
0.7
0.9

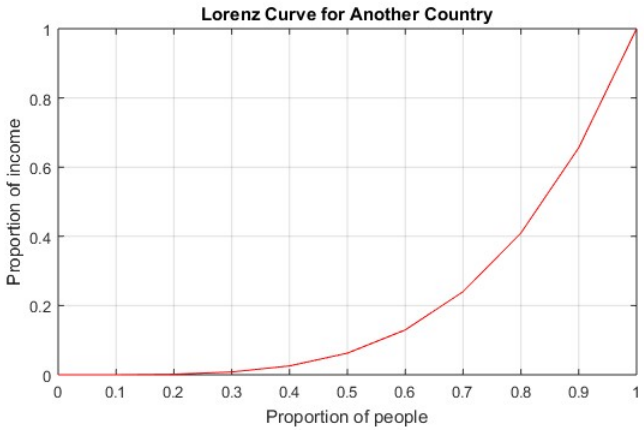
Part B Comparison with another country

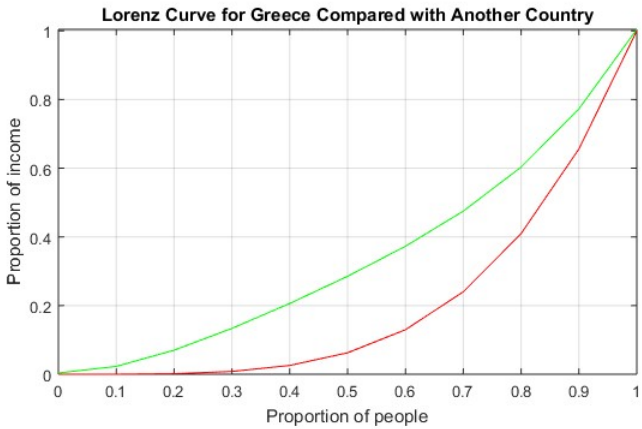
Lorenz Curve for another country is displayed alongside the one for Greece

The function that was found for another country's Lorenz Curve is defined

```
AL = @(X) X.^4;
A = AL(X);
% The Lorenz Curves for both countries are displayed side by side
subplot(2,2,1);
    plot(X, L, 'g');
    xlabel('Proportion of people'); ylabel('Proportion of income');
    axis tight; grid on
    title('Lorenz Curve for Greece');
subplot(2,2,2);
    plot(X, A, 'r');
    xlabel('Proportion of people'); ylabel('Proportion of income');
    axis tight; grid on
    title('Lorenz Curve for Another Country');
% Some sensible students asked if they could display the curves on the same axes
% I should have thought of that...
subplot(2,2,3);
    plot(X, L, 'g');
    xlabel('Proportion of people'); ylabel('Proportion of income');
    axis tight; grid on
    hold on
    plot(X, A, 'r');
    axis tight; grid on
    title('Lorenz Curve for Greece Compared with Another Country');
```







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