系统工程导论第二次作业

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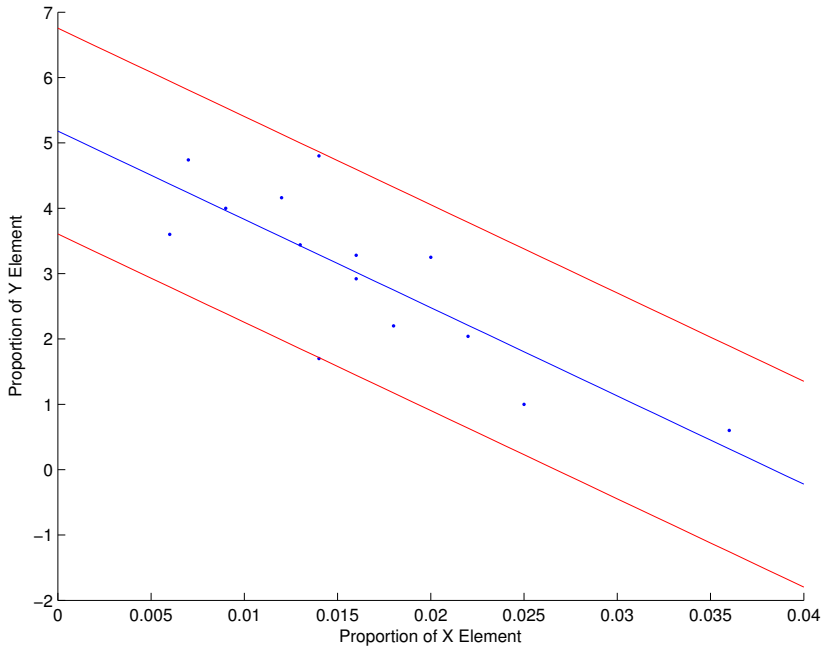
1 计算结果

运行得到的原始数据、回归直线和置信边界如下图：



其中回归方程为：

$$y = 5.180451 - 135.071531x \tag{1}$$

边界方程为：

$$y = 6.755133 - 135.071531x \tag{2}$$

和

$$y = 3.605768 - 135.071531 \tag{3}$$

14个数据点中有13个点在置信区间内，一个点稍超出置信区间边界。
F检验得：

$$F = \frac{(N-2)ESS}{RSS} = 22.5791 \tag{4}$$

$$F_\alpha = 4.7472 \tag{5}$$

$$F > F_\alpha \tag{6}$$

拒绝H_0，即接受H_1：X和Y呈线性关系（显著性水平$\alpha = 0.05$）。

2 具体实现

Matlab代码（.m文件）如下所示：

```
%%
% Input data
%data = [0.009 4.0; 0.013 3.44; 0.006 3.6;
%    0.025 1.0; 0.022 2.04; 0.007 4.74;
%    0.036 0.6; 0.014 1.7; 0.016 2.92;
%    0.014 4.8; 0.016 3.28; 0.012 4.16;
%    0.020 3.25; 0.018 2.2];
%alpha = 0.05;
%%
function linear_regression1(data, alpha)
%Scatter figure
sz = size(data);
N = sz(1);
x = transpose(data(:,1));% data of x-axis
```

```
15 y = transpose(data(:,2));% data of y-axis
16 scatter(x,y,'.');
17 xlabel('Proportion of X Element');
18 ylabel('Proportion of Y Element');
19 hold on;
20 % Calculate the regression equation
21 avgX = mean(x);
22 avgY = mean(y);
23 X = x - avgX;% Move data average to zero
24 Y = y - avgY;% Move data average to zero
25 LXY = dot(X,Y);
26 LXX = dot(X,X);
27 bhat = LXY / LXX;% Estimated value of slope
28 ahat = avgY - bhat * avgX;% Estimated value of
       intersection
29 % Plot the regression equation
30 cx = [0:0.001:0.040];
31 cy = ahat + bhat * cx;
32 plot(cx,cy);
33 hold on;
34 % F-test
35 Yhat = ahat + bhat * x;% Estimated value regard to
       regression equation
36 TSS = dot(Y,Y);% Total square sum
37 ESS = dot(Yhat-avgY,Yhat-avgY);% Explanation square
       sum
38 RSS = TSS - ESS;% Residues
39 F = (N-2)*ESS/RSS;
40 Fa = finv(1-alpha,1,N-2);
41 if F<=Fa
42     fprintf('No linear relation! (p=0.95)\n');
43 else
44     fprintf('Linear relation! (p=0.95)\n');
```

```
45 end
46 % Bounds of confidence interval
47 sdelta = sqrt(RSS/(N-2));
48 Z = norminv(1-alpha/2,0,1) * sdelta;
49 cy1 = ahat + Z + bhat * cx;
50 cy2 = ahat - Z + bhat * cx;
51 plot(cx, cy1, 'r');
52 hold on;
53 plot(cx, cy2, 'r');
54 end
```