This program uses file lab1.xlsx

```
% a. Import data
% Use the "Import Data" tab
% Select column A to L, row 2 to 210
```

Data on CEO `Salary.`

Variable list

1. salary 1990 salary, thousands $

2. pcsalary % change salary, 89-90

3. sales 1990 firm sales, millions $

4. roe return on equity, 88-90 avg

5. pcroe % change roe, 88-90

6. ros return on firm's stock, 88-90

7. indus =1 if industrial firm

8. finance =1 if financial firm

9. consprod =1 if consumer product firm

10. utility =1 if transport. or utilties

11. lsalary natural log of salary

12. lsales natural log of sales

6. ros return on firm's stock, 88-90

7. indus =1 if industrial firm

8. finance =1 if financial firm

9. consprod =1 if consumer product firm

10. utility =1 if transport. or utilties

11. lsalary natural log of salary

12. lsales natural log of sales

We focus on the determinats of CEO salaries

```
% assign variable names
```

```
salary = lab1{ : ,1};
pcsalary = lab1{ : ,2};
sales = lab1{ : ,3};
roe = lab1{ : ,4};
pcroe = lab1{ : ,5};
ros = lab1{ : ,6};
indus = lab1{ : ,7};
finance = lab1{ : ,8}
```

```
finance = 208×1
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     ⋮
```

```
consprod = lab1{ : ,9}
```

```
consprod = 208×1
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     ⋮
```

```
utility = lab1{ : ,10}
```

```
utility = 208×1
     0
     0
     0
     0
     0
     0
     0
     0
     0
     0
     ⋮
```

```
lsalary = lab1{ : ,11}
```

```
lsalary = 208×1
    6.9088
    7.0229
    6.3596
    7.2211
```

```
    7.0432
    6.9829
    6.9976
    7.1204
    6.7250
    6.3404
      ⋮
```

```
lsales = lab1{ : ,12}
```

```
lsales = 208×1
    9.2061
    8.7203
    9.6956
    9.9889
    8.7031
    7.7261
    7.9952
    8.4273
    7.9480
    6.3916
      ⋮
```

```
% b. Basic statistics of variables
%summary(lab1CEO)
```

```
% imput dataset in matrix lab
lab = lab1{:,:};
```

1. Let's compute the correlation matrix of the first 6 variables

The first row denotes the correlation of salary with the other 5 variables

1. salary 1990 salary, thousands $

2. pcsalary % change salary, 89-90

3. sales 1990 firm sales, millions $

4. roe return on equity, 88-90 avg

5. pcroe % change roe, 88-90

6. ros return on firm's stock, 88-90

```
% correlationn matrix of the first six variables
corrcoef(lab(:,1:6))
```

```
ans = 6×6
    1.0000    0.0088    0.1223    0.1146    0.0294   -0.0327
    0.0088    1.0000    0.0152    0.0877    0.2075    0.1371
    0.1223    0.0152    1.0000   -0.0525   -0.0037   -0.1567
    0.1146    0.0877   -0.0525    1.0000    0.0059    0.2808
    0.0294    0.2075   -0.0037    0.0059    1.0000    0.1213
   -0.0327    0.1371   -0.1567    0.2808    0.1213    1.0000
```

2. Which two variables exhibit the highest correlation with salary?
3. Are these two variables highly correlated?

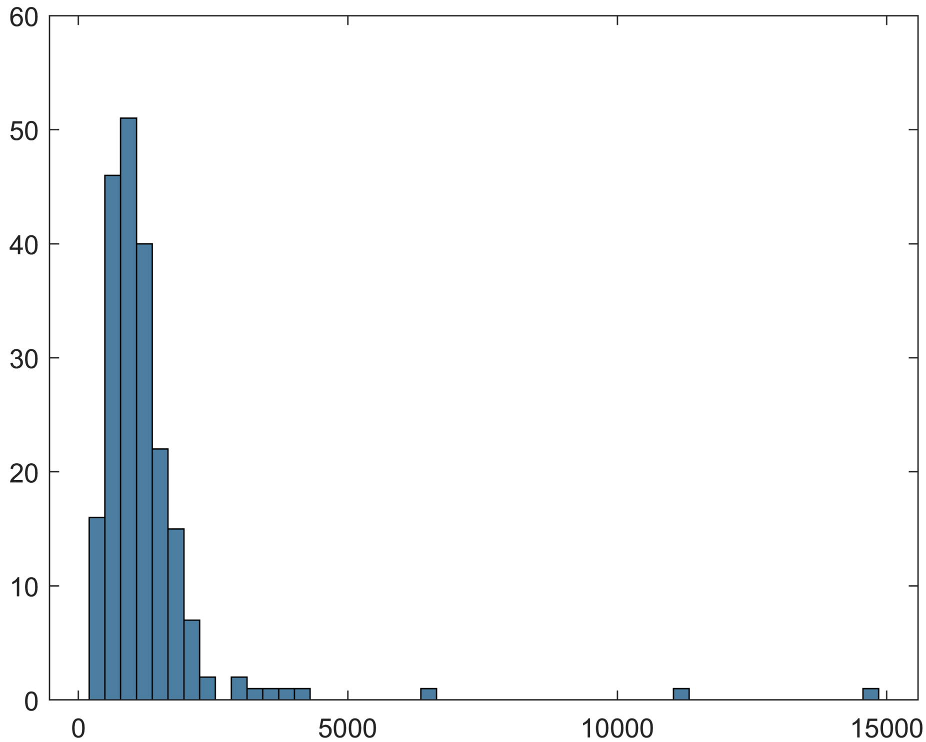
```
corrcoef(sales,roe)
```

```
ans = 2×2
    1.0000   -0.0525
   -0.0525    1.0000
```

Our candidate measures of firm performance to relate to salary are sales and roe.

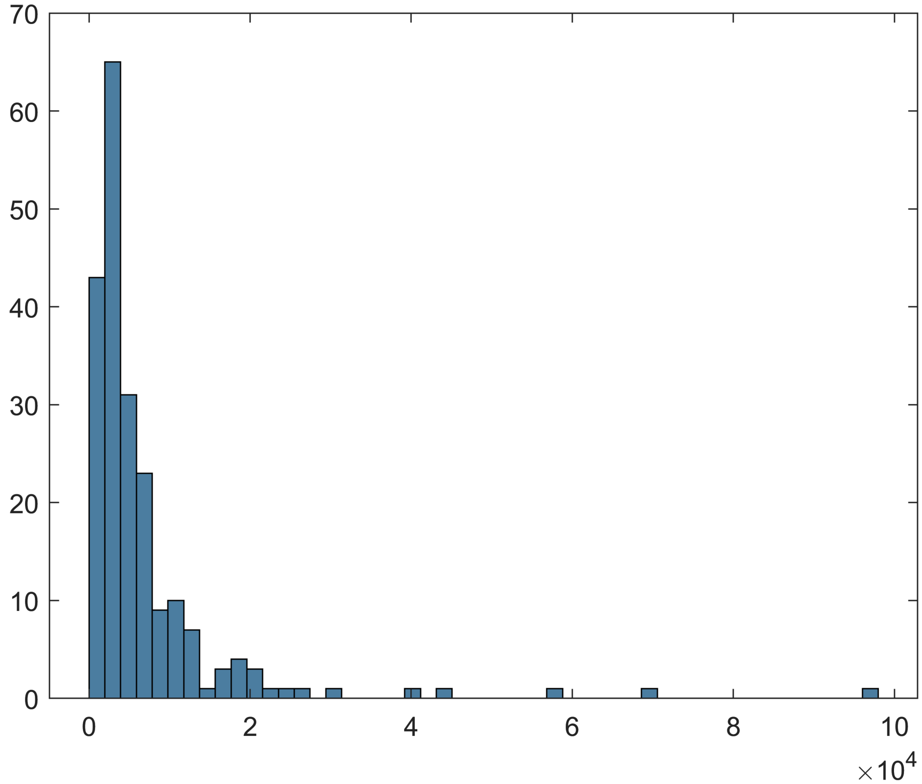
Before proceeding, let's visualize the empirical distribution of salary, sales, and roe with histograms

```
histsalary = histogram(salary, 50)
```



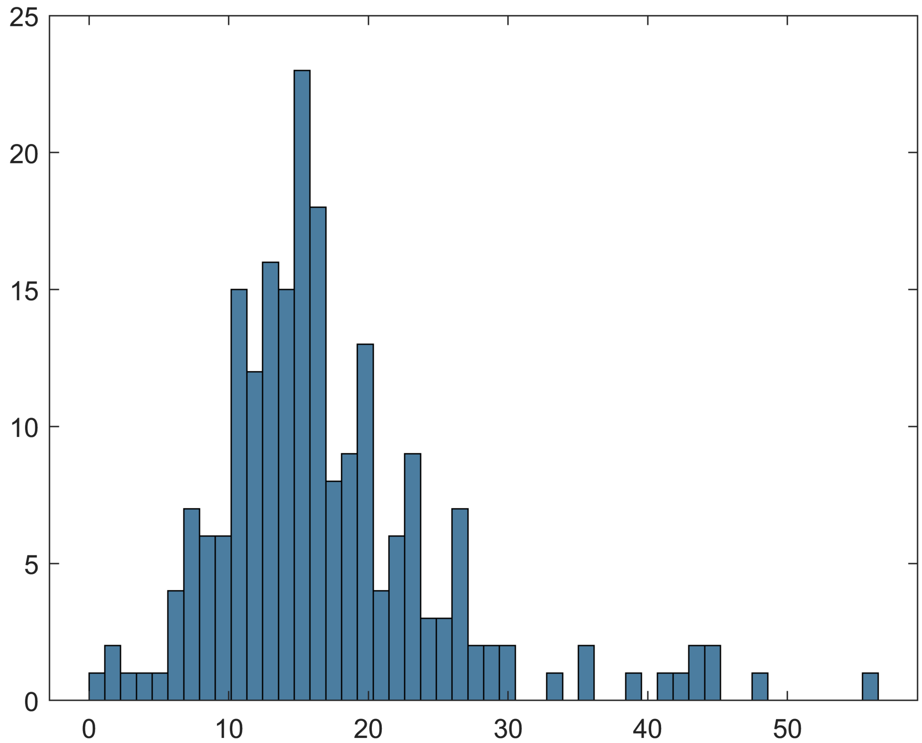

```
histsalary =
  Histogram with properties:

             Data: [208×1 double]
           Values: [16 46 51 40 22 15 7 2 0 2 1 1 1 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0
          NumBins: 50
         BinEdges: [1×51 double]
         BinWidth: 293
        BinLimits: [200 14850]
    Normalization: 'count'
        FaceColor: 'auto'
        EdgeColor: [0 0 0]

  Show all properties
```

```
histsales = histogram(sales, 50)
```




```
histsales =
  Histogram with properties:

             Data: [208×1 double]
           Values: [43 65 31 23 9 10 7 1 3 4 3 1 1 1 0 1 0 0 0 0 1 0 1 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0
          NumBins: 50
         BinEdges: [1×51 double]
         BinWidth: 1960
        BinLimits: [0 98000]
    Normalization: 'count'
        FaceColor: 'auto'
        EdgeColor: [0 0 0]

  Show all properties
```

```
histroe = histogram(roe, 50)
```

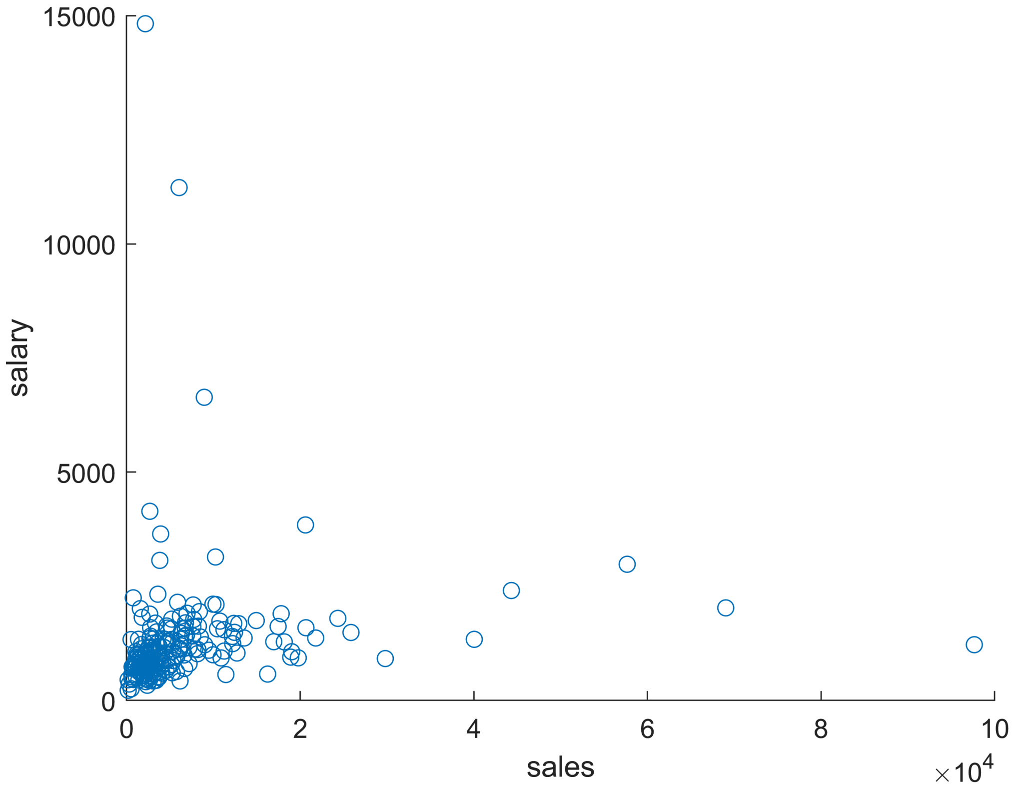



```
histroe =
  Histogram with properties:

             Data: [208×1 double]
           Values: [1 2 1 1 1 4 7 6 6 15 12 16 15 23 18 8 9 13 4 6 9 3 3 7 2 2 2 0 0 1 0 2 0 0 1 0 1 1 2 2 0 0 1 0 0
          NumBins: 50
         BinEdges: [1×51 double]
         BinWidth: 1.1300
        BinLimits: [0 56.5000]
    Normalization: 'count'
        FaceColor: 'auto'
        EdgeColor: [0 0 0]

  Show all properties
```

4. Comment on the results

Let's now look first at a scatter plot of salary (y axis) and sales (x axis)

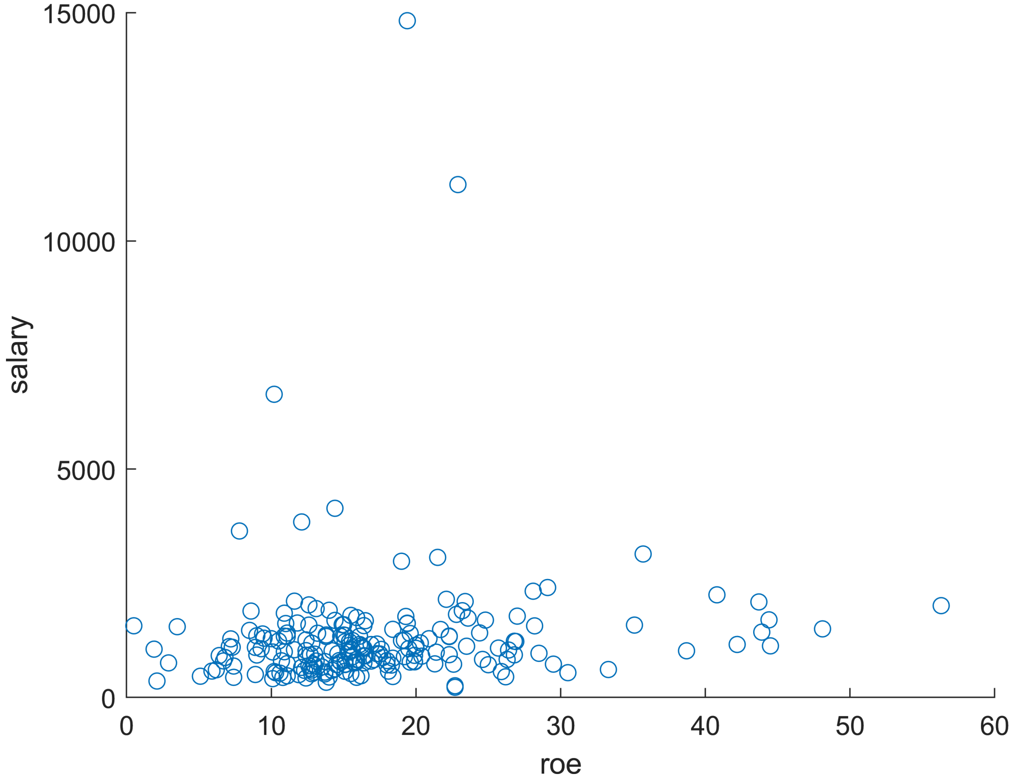
```
scatter (sales,salary)
xlabel('sales')
ylabel('salary')
```



5. Would you expect to find a linear relationship between these two variables?

Let's now look at a scatter plot of salary (y axis) and roe (x axis)

```
scatter (roe,salary)
xlabel('roe')
ylabel('salary')
```



6. Would you expect to find a linear relationship between these two variables?

Let's estimate a simple univariate regression with salary and roe, and plot the results

```
% help fitlm
x = table(salary,roe);
lm =fitlm(x,'salary ~ roe')
```

```
lm = 
Linear regression model:
    salary ~ 1 + roe

Estimated Coefficients:
                   Estimate      SE      tStat      pValue  
                   ________    ______    ______    _________

    (Intercept)     964.27     214.06    4.5047    1.1125e-05
    roe             18.475     11.154    1.6564      0.099163


Number of observations: 208, Error degrees of freedom: 206
Root Mean Squared Error: 1.37e+03
R-squared: 0.0131,  Adjusted R-Squared: 0.00835
F-statistic vs. constant model: 2.74, p-value = 0.0992
```

```
plot(lm)
```

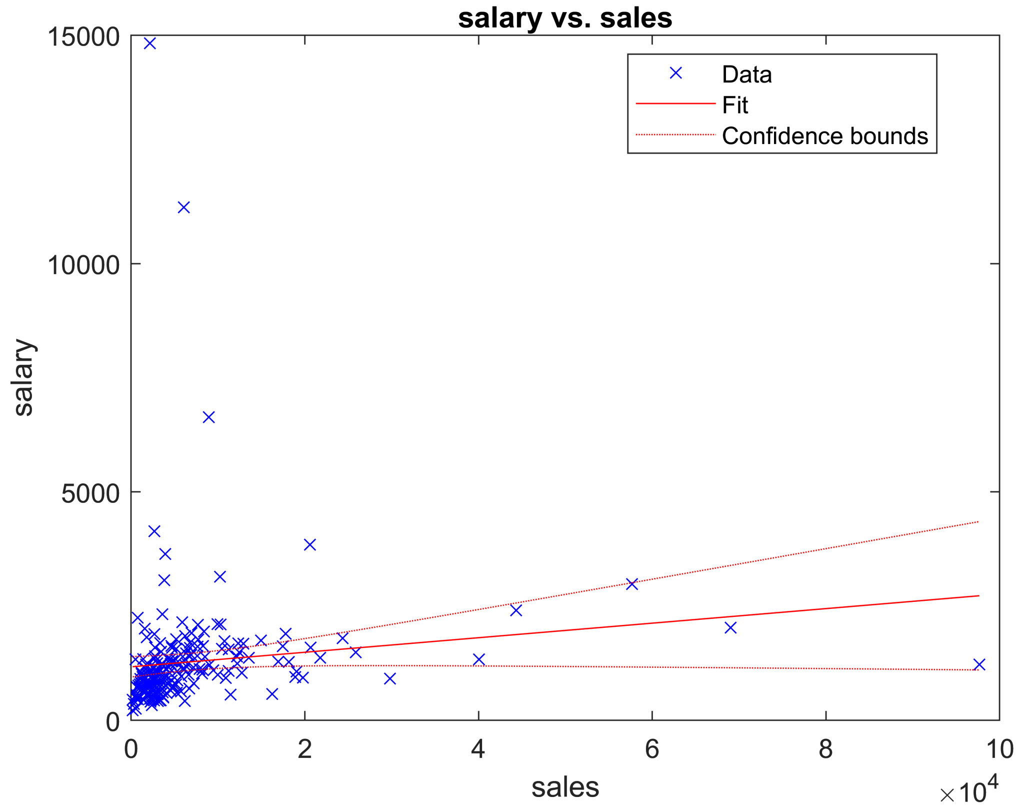
7. Comment the results

Now, let's estimate a regression with salary and sales

```
%help fitml
x = table(salary,sales);
lm =fitlm(x,'salary ~ sales')
```

```
lm =
Linear regression model:
    salary ~ 1 + sales

Estimated Coefficients:
                   Estimate       SE        tStat       pValue  
                   ________    _________    ______    __________

    (Intercept)      1173.3       113.06    10.378    1.4467e-20
    sales          0.015926    0.0090069    1.7682      0.078513


Number of observations: 208, Error degrees of freedom: 206
Root Mean Squared Error: 1.37e+03
R-squared: 0.0149,  Adjusted R-Squared: 0.0102
F-statistic vs. constant model: 3.13, p-value = 0.0785
```

```
plot(lm)
```



7. Comment the results, and compare them with the previous regression

Are there non-linearities in the data?

Let' now consider to incorporate non-linearities

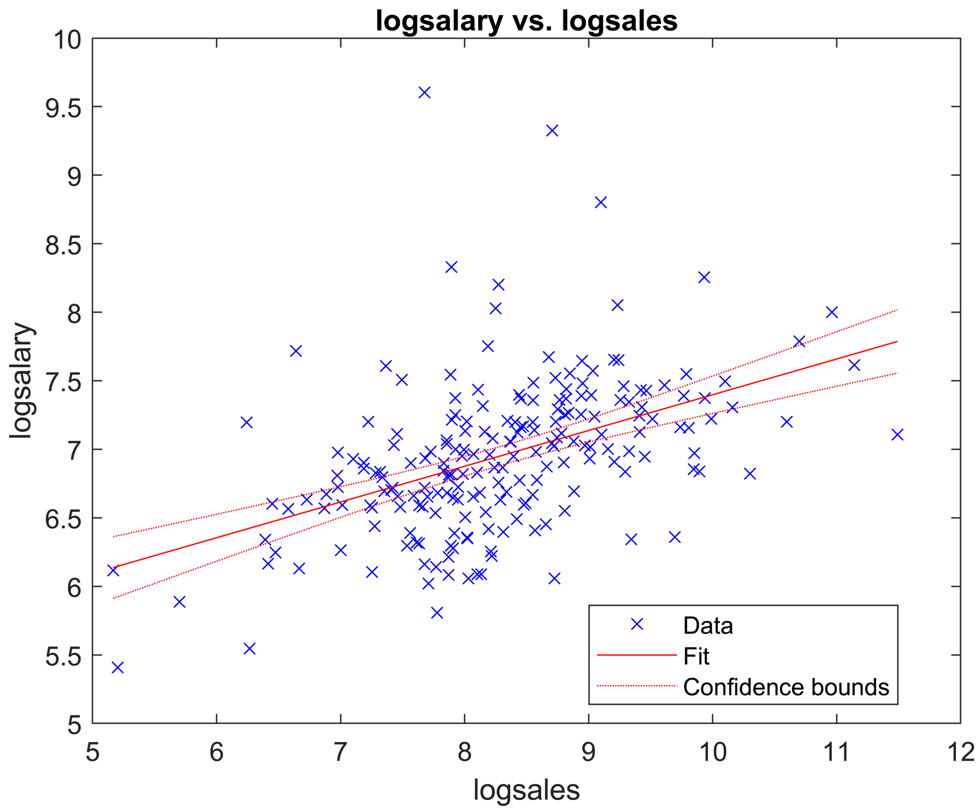
Let's run a regression with logsalary and logsales as a predictor

```
logsalary = log(salary);
logsales = log(sales);
x = table(logsalary,logsales);
lm =fitlm(x,'logsalary ~ logsales')
```

```
lm = 
Linear regression model:
    logsalary ~ 1 + logsales

Estimated Coefficients:
                   Estimate       SE        tStat       pValue  
                   ________    ________    ______    __________

    (Intercept)     4.7898       0.2907    16.477    1.8221e-39
    logsales       0.26082     0.034841    7.4861     2.033e-12


Number of observations: 208, Error degrees of freedom: 206
Root Mean Squared Error: 0.505
```

```
R-squared: 0.214,  Adjusted R-Squared: 0.21
F-statistic vs. constant model: 56, p-value = 2.03e-12
```

```
plot(lm)
```

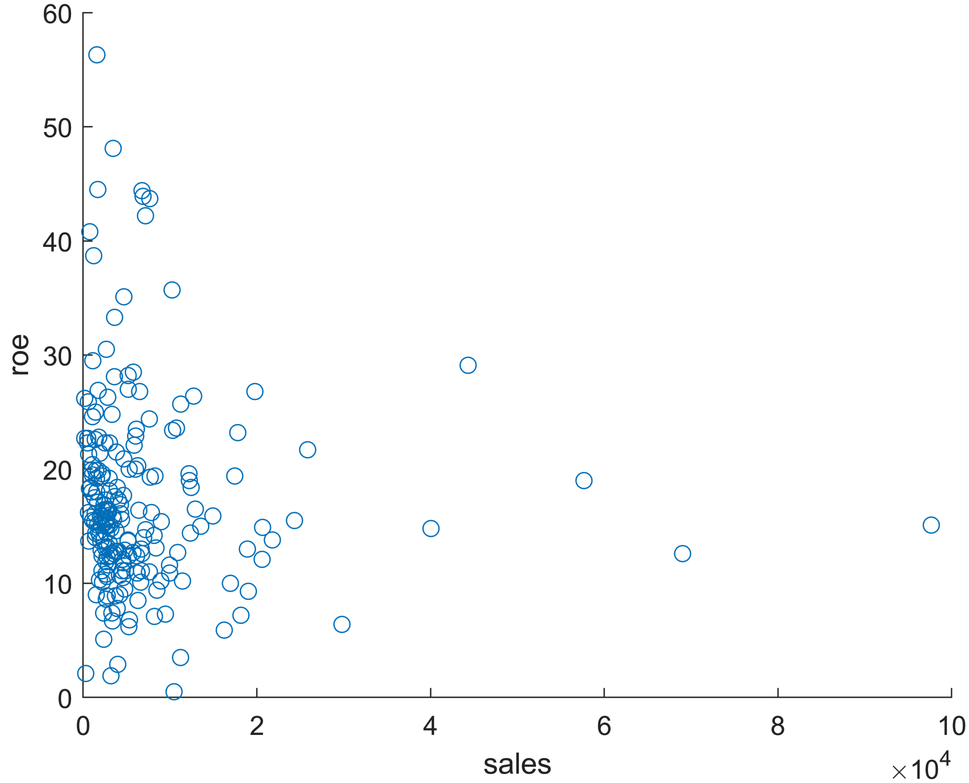


8. Comment the results, and compare with the previous level regression

Finally, as a preview of incoming exercises, we noticed sales and roe have a positive correlation with salary, but their correlation is small.

Let's see a scatter plot of sales and roe

```
scatter(sales,roe)
xlabel('sales')
ylabel('roe')
```



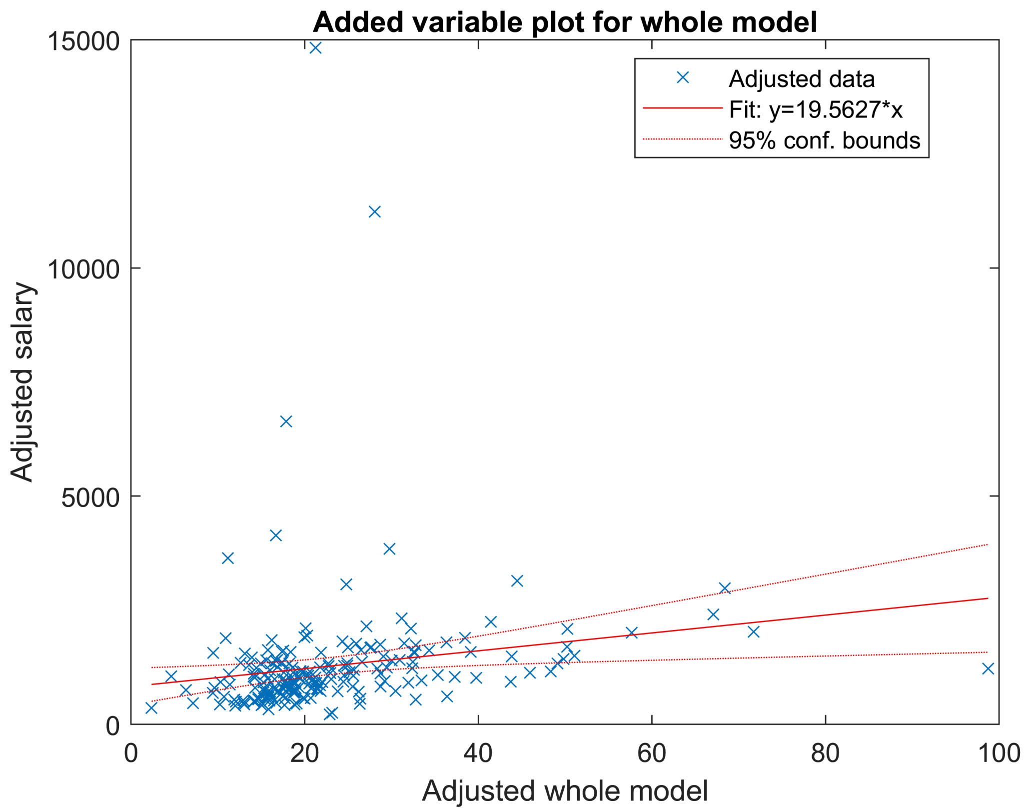
Could a regression with both sales and roe improve the fit of the original one variable regressions?

Let's check this multivariate regression

```
x1 = table(sales,roe,salary);
lm =fitlm(x1,'salary ~ sales + roe')
```

```
lm = 
Linear regression model:
    salary ~ 1 + sales + roe

Estimated Coefficients:
                   Estimate       SE        tStat       pValue  
                   ________    _________    ______    __________

    (Intercept)     831.21        224.39    3.7043    0.00027261
    sales         0.016756     0.0089736    1.8672        0.0633
    roe             19.563        11.102    1.7621      0.079548


Number of observations: 208, Error degrees of freedom: 205
Root Mean Squared Error: 1.36e+03
R-squared: 0.0296,  Adjusted R-Squared: 0.0202
F-statistic vs. constant model: 3.13, p-value = 0.0457
```

```
plot(lm)
```


Added variable plot for whole model
Adjusted data
Fit: y=19.5627*x
95% conf. bounds
Adjusted salary
Adjusted whole model
15000
10000
5000
0
0
20
40
60
80
100