Lab 1: Exploratory Analysis of CEO Salary Data

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Introduction

Salary is our outcome variable, and profits and mktval are the key measures of market performance.

```
setwd("~/Desktop/MIDS/Statistics/stats_lab1")
ceosal <- load("ceo_w203.RData", ceo.env <- new.env())
ceo.df <- ceo.env[["CEO"]]
```

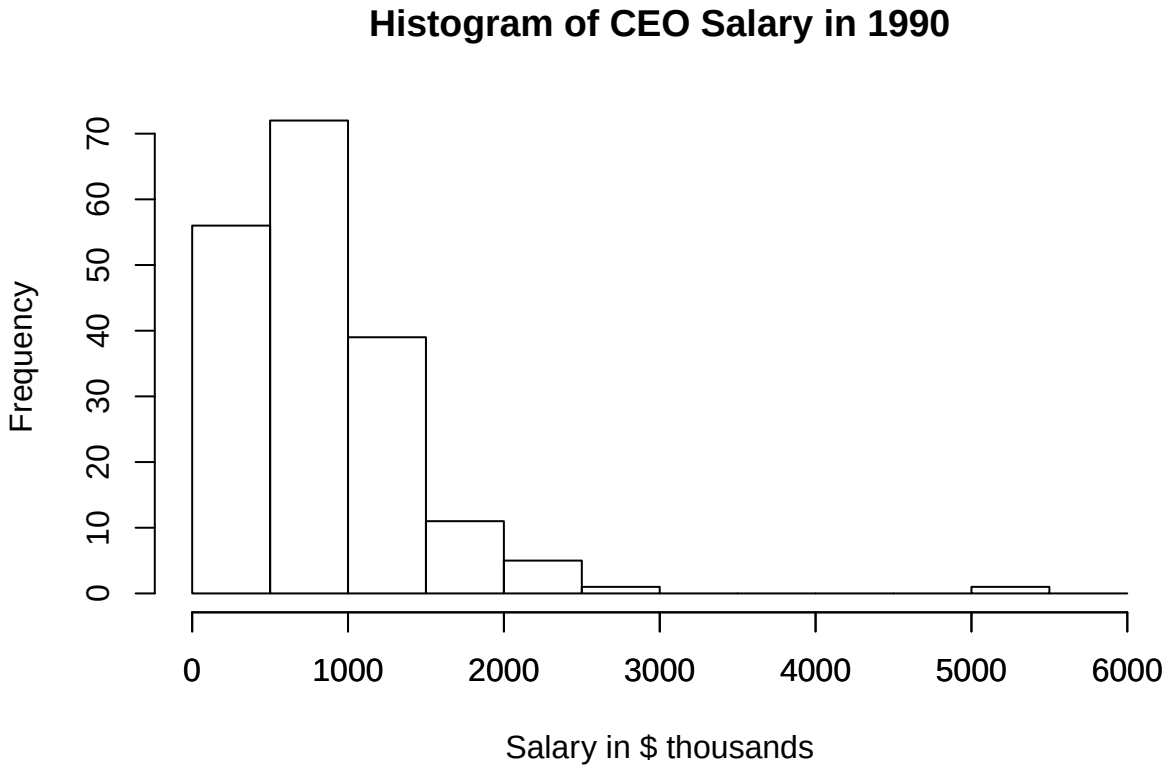
Univariate Analysis of Key Variables

In this section we will analyze each variable individually.

Salary

CEO salary distribution is strongly skewed right.

```
hist(ceo.df$salary, main = "Histogram of CEO Salary in 1990",
     xlab = "Salary in $ thousands", breaks = seq(0, 6000, by = 500))
axis(1, at = seq(0, 6000, by = 1000))
```



Median salary is $697 thousand, and there is one extreme outlier at $5.3 million.

```
summary(ceo.df$salary)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   100.0   467.0   697.0   852.9  1101.0  5299.0
```

Age

CEO age peaks between 50 and 65 years old, but ranges all the way from 21 to 86.

```
hist(ceo.df$age, breaks = 14, main = "Histogram of CEO Age", xlab = "Age")
```


```
summary(ceo.df$age)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   21.00   51.00   57.00   55.78   61.00   86.00
```

The variance of Age is large:

```
var(ceo.df$age)
```

```
## [1] 85.37996
```

College Degree

College is a dummy variable that takes a value of 1 if the CEO is a college graduate and 0 otherwise.

```
pct.college <- (sum(ceo.df$college) / length(ceo.df$college))
```

96.2% of the CEOs in this dataset are college graduates.

Graduate Degree

Grad is a dummy variable that takes a value of 1 if the CEO holds an advanced degree and 0 otherwise.

```
pct.grad <- (sum(ceo.df$grad) / length(ceo.df$grad))
```

55.1% of the CEOs in this dataset hold advanced degrees.

Years With Company

Summary Statistics for Years with Company

```
summary(ceo.df$comten)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    2.00    9.00   21.00   21.66   33.00   58.00
```

Variance of Years with Company

```
var(ceo.df$comten)
```

```
## [1] 160.2132
```

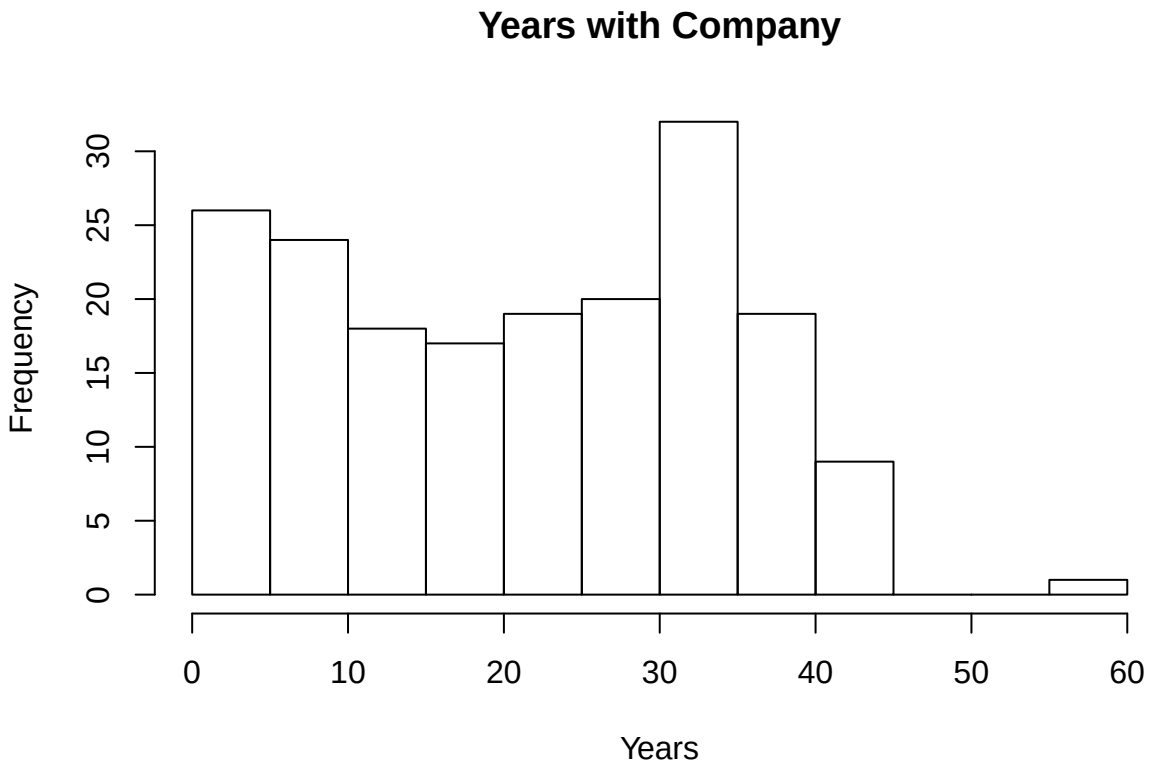
Standard Deviation of Years with Company

```
sd(ceo.df$comten)
```

```
## [1] 12.65753
```

Histogram of Years with Company

```
hist(ceo.df$comten, main="Years with Company", xlab = "Years")
```



Years as CEO

Summary Statistics for Years as CEO

```
summary(ceo.df$ceoten)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   3.000   5.000   7.681  11.000  37.000
```

Variance of Years as CEO

```
var(ceo.df$ceoten)
```

```
## [1] 50.65317
```

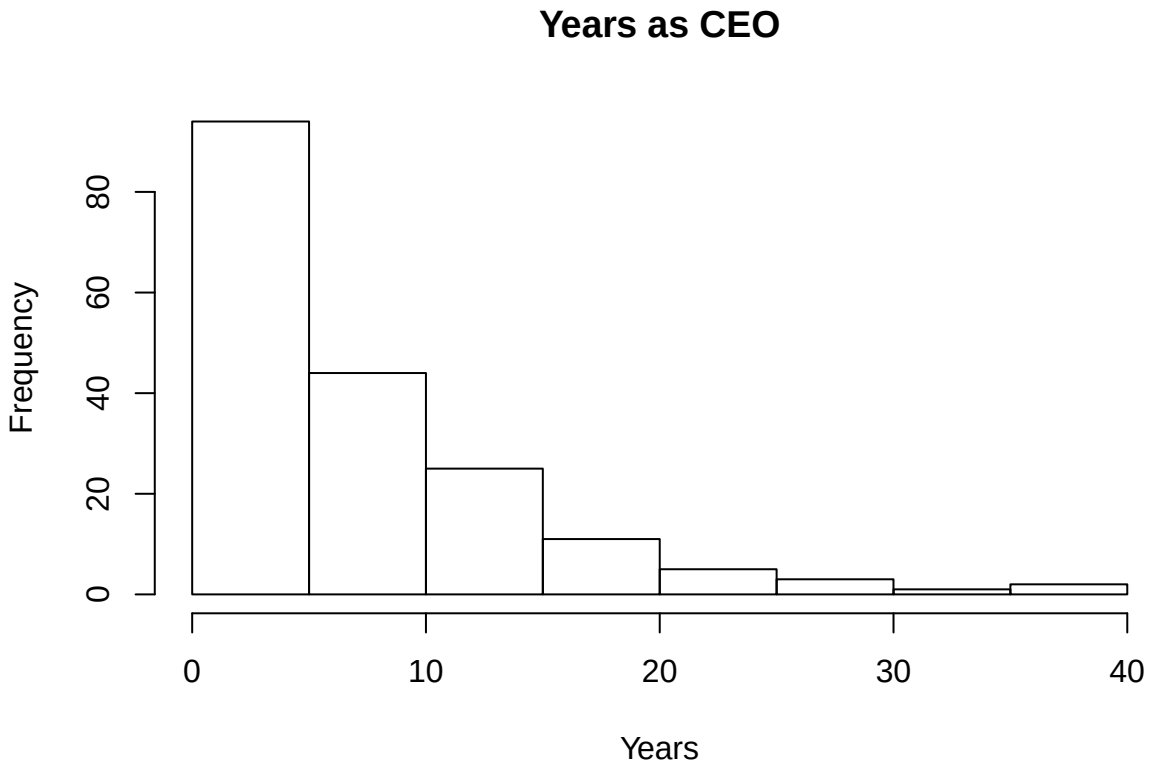
Standard Deviation of Years as CEO

```
sd(ceo.df$ceoten)
```

```
## [1] 7.117104
```

Histogram of Years as CEO

```
hist(ceo.df$ceoten, main="Years as CEO", xlab = "Years")
```



Profits

Summary Statistics for Profits

```
summary(ceo.df$profits)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  -463.0    33.0    57.0   199.2   195.0  2700.0
```

Variance of Profits

```
var(ceo.df$profits)
```

```
## [1] 158154.2
```

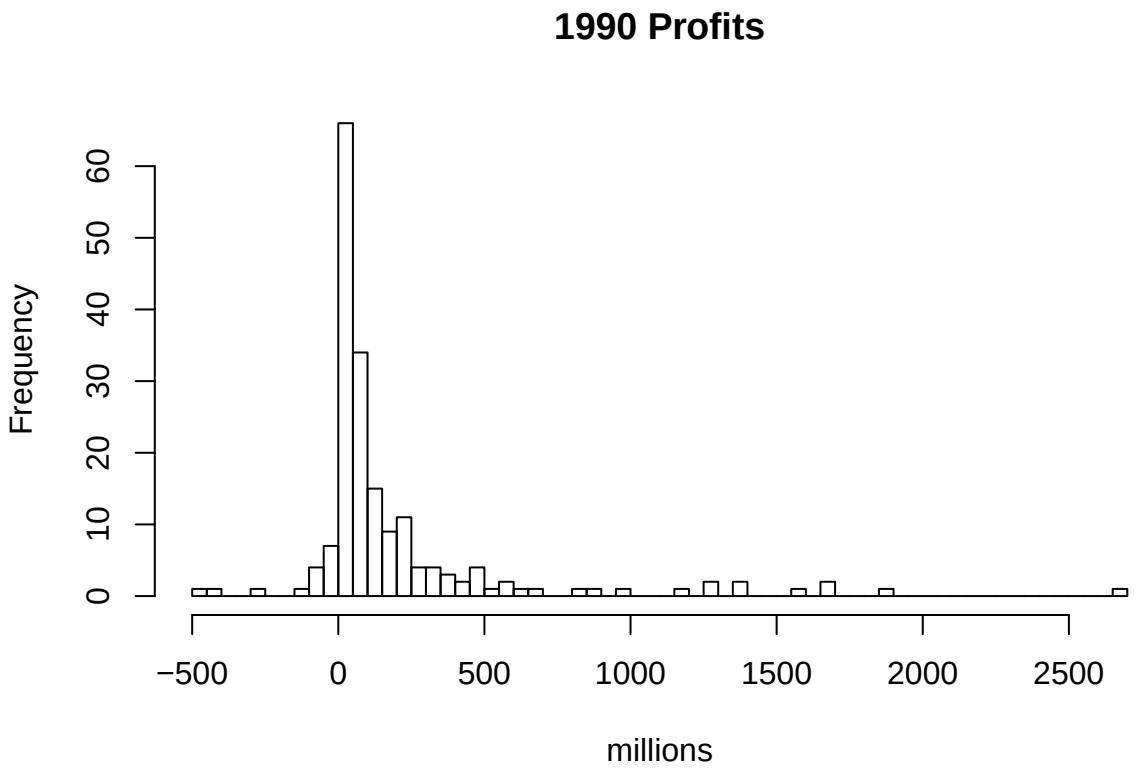
Standard Deviation of Profits

```
sd(ceo.df$profits)
```

```
## [1] 397.686
```

Histogram of Profits

```
hist(ceo.df$profits, main="1990 Profits",
     xlab = "millions", breaks = 100)
```



Market Value

Summary Statistics for Market Value

```
summary(ceo.df$mktval)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##      -1     567    1200    3450    3200   45400
```

Variance of Market Value

```
var(ceo.df$mktval)
```

```
## [1] 40202491
```

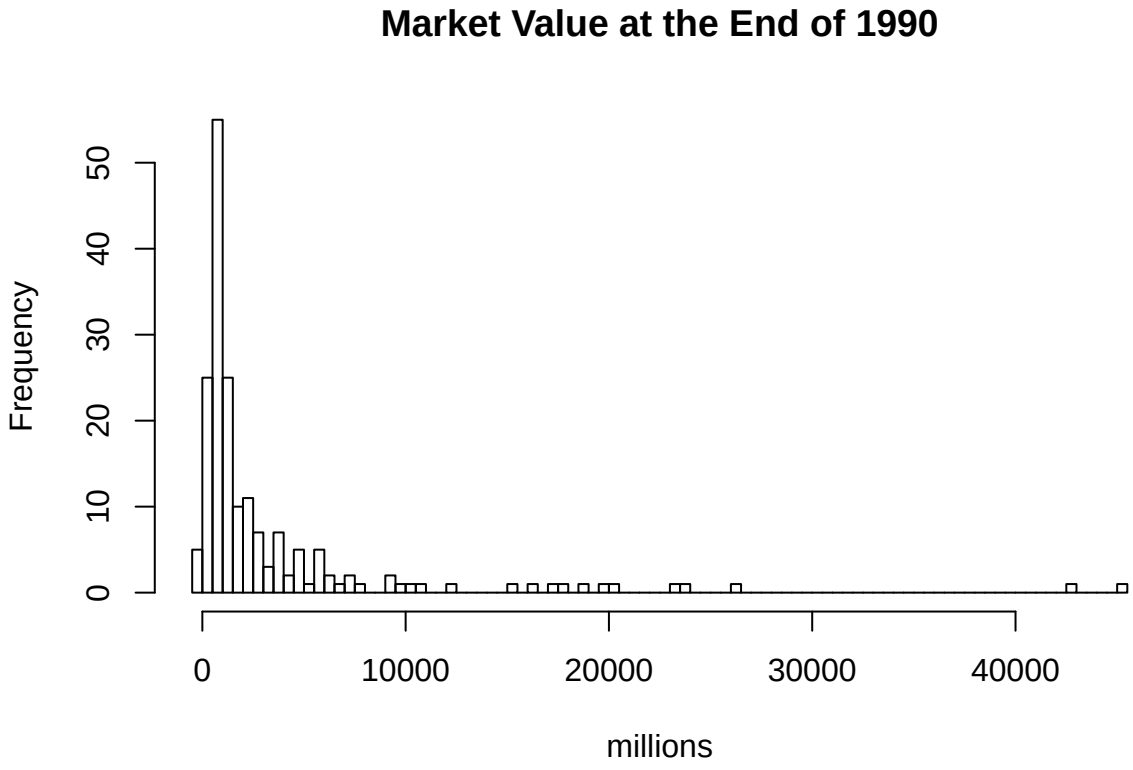
Standard Deviation of Market Value

```
sd(ceo.df$mktval)
```

```
## [1] 6340.543
```

Histogram of Market Value

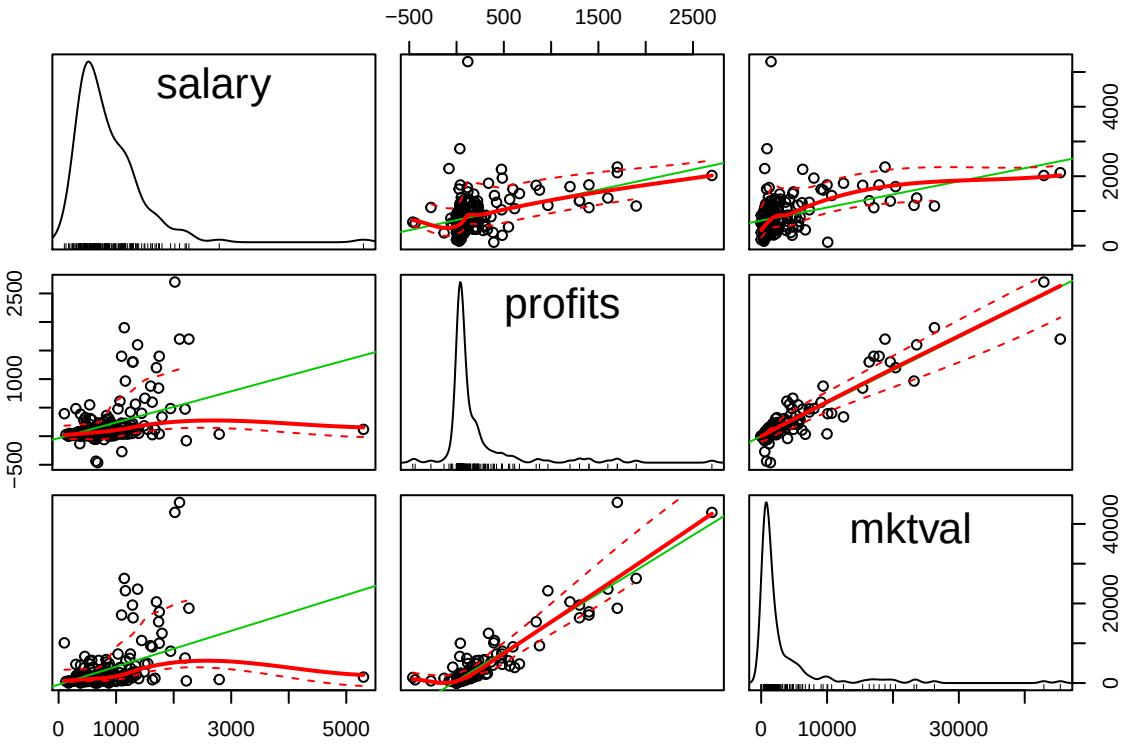
```
hist(ceo.df$mktval, main="Market Value at the End of 1990",
     xlab = "millions", breaks = 100)
```



Key Bivariate Relationships

In this section we analyze some key bivariate relationships. Below is a scatterplot matrix of these key variables.

```
library(car)
scatterplotMatrix(~ salary + profits + mktval, data = ceo.df)
```



Profits & Market Value

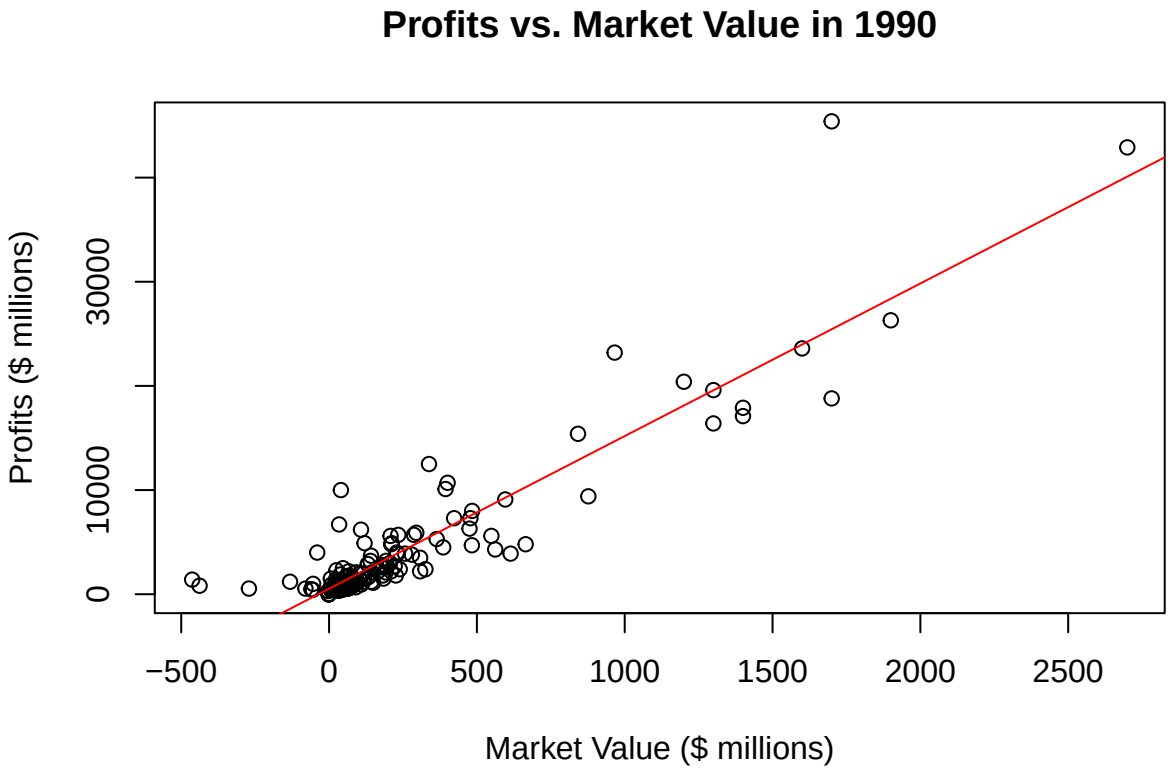
These are our two measures of company performance, so we confirm they are positively correlated.

```
cor(ceo.df$profits, ceo.df$mktval)
```

```
## [1] 0.9190233
```

For the most part, as profits increase, so does market value.

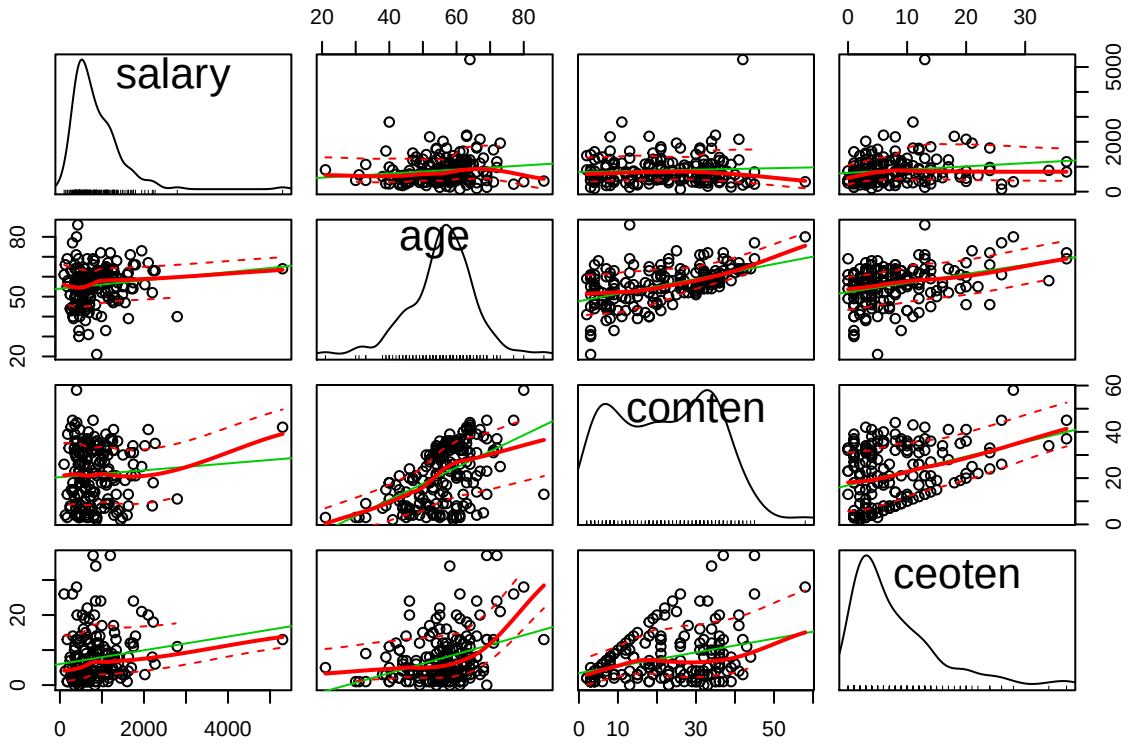
```
plot(ceo.df$profits, ceo.df$mktval,
     main = "Profits vs. Market Value in 1990",
     xlab = "Market Value ($ millions)",
     ylab = "Profits ($ millions)")
abline(lm(ceo.df$mktval ~ ceo.df$profits), col = "red")
```



Possible Secondary Variables

Some secondary variables that may affect salary are the CEO's age, tenure, and education level. Below is a scatterplot of salary on age and tenure variables. Since education level is split into two dummy variables, we do not find a scatterplot of it to be useful.

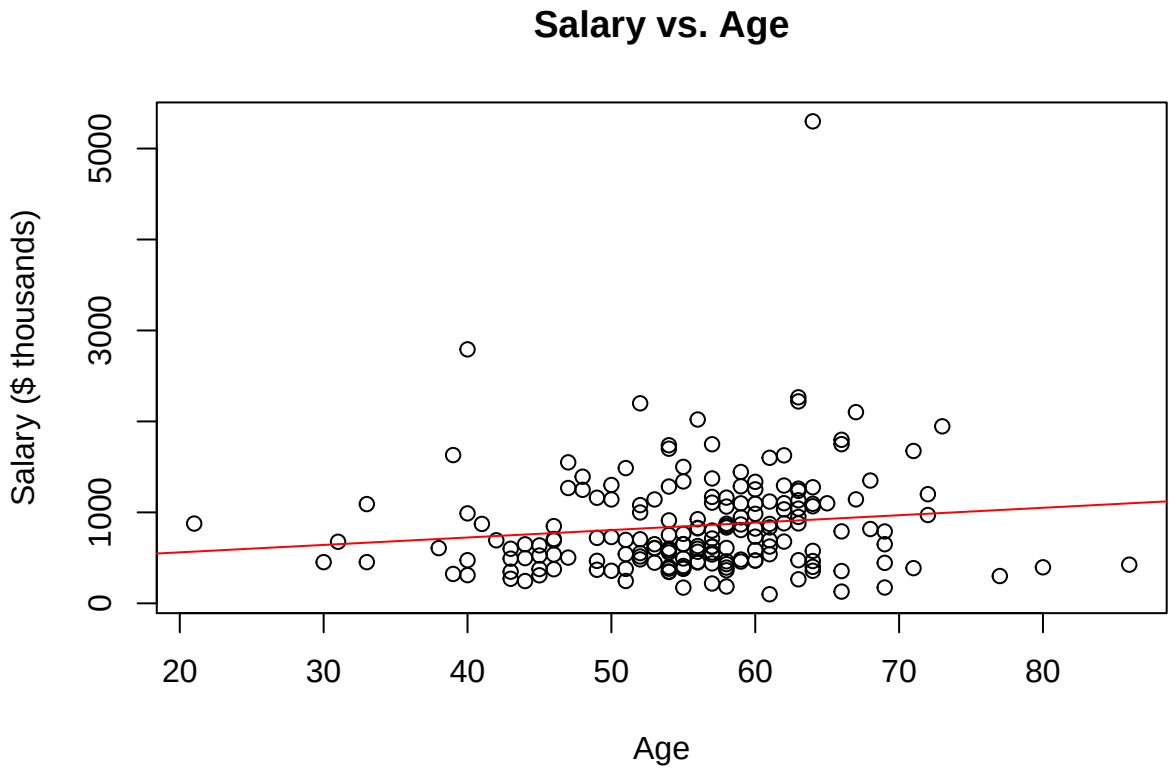
```
scatterplotMatrix(~ salary + age + comten + ceoten, data = ceo.df)
```



Salary vs. Age

Age has a slight positive relationship with CEO salary, likely because older CEOs have more work experience. However, with a correlation of only 0.130081, age is not a key variable in this analysis.

```
plot(ceo.df$age, ceo.df$salary,
     main = "Salary vs. Age",
     xlab = "Age",
     ylab = "Salary ($ thousands)")
abline(lm(ceo.df$salary ~ ceo.df$age), col = "red")
```



Salary vs. Education

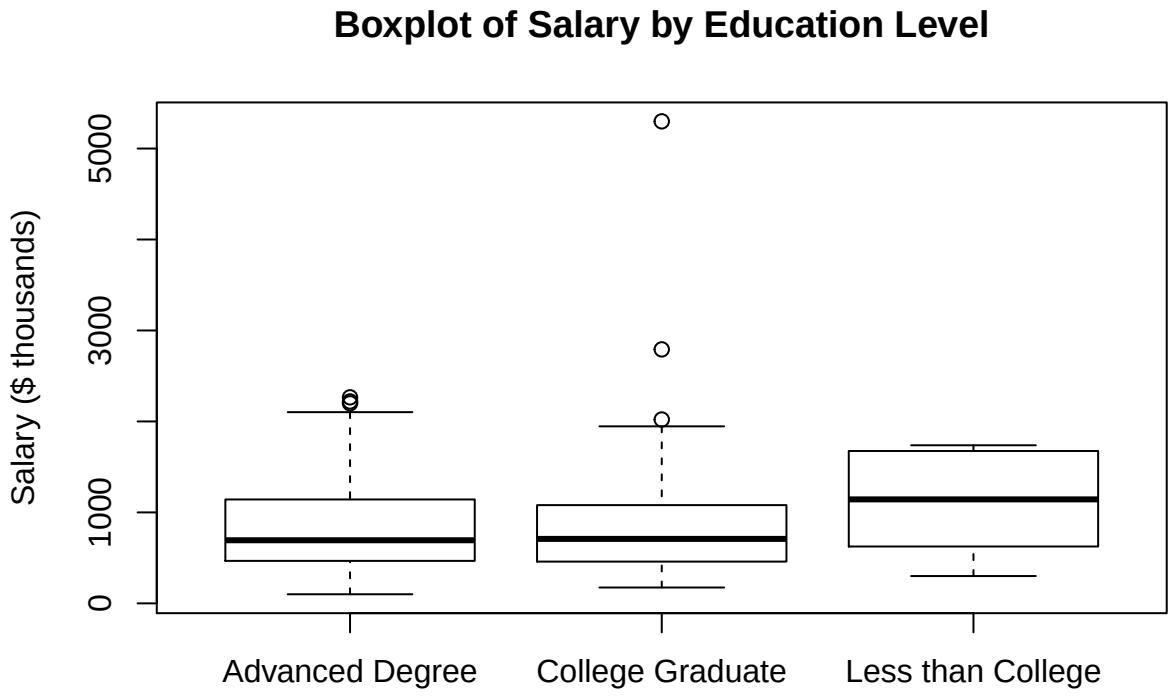
We assign each CEO to one of three education levels: Advanced Degree, College Graduate, or Less than College. There are 2 cases of CEOs with an advanced degree but no college degree, and these are assigned to the "Advanced Degree" level.

```
educLevelFunc <- function(college, grad) {

    if (grad == 1) {retStr = "Advanced Degree"}
    else if (college == 1) {retStr = "College Graduate"}
    else {retStr = "Less than College"}

    return(retStr)
}

ceo.df$educLevel <- mapply(educLevelFunc, ceo.df$college, ceo.df$grad)
table(ceo.df$educLevel)
```

```
##
##   Advanced Degree  College Graduate Less than College
##               102                78                 5
```

Following is a boxplot of CEO salary by education level. The distribution category for the "less than college" category is not reliable since it only has 5 data points. However, we can see that CEOs with an advanced degree have approximately the same salary distribution as CEOs with only a college degree.

```
boxplot(salary ~ educLevel, data=ceo.df,
     main = "Boxplot of Salary by Education Level",
     ylab = "Salary ($ thousands)")
```



Salary vs. Tenure

We have two tenure variables: CEO tenure and company tenure. These variables are closely related, since company tenure must rise whenever CEO tenure rises. Note that for CEOs who are hired from outside the company, CEO tenure and company tenure are the same.

```
outside.ceo <- subset(ceo.df, ceo.df$ceoten == ceo.df$comten)
pct.outside.ceo <- (length(outside.ceo$ceoten) / length(ceo.df$ceoten))
```

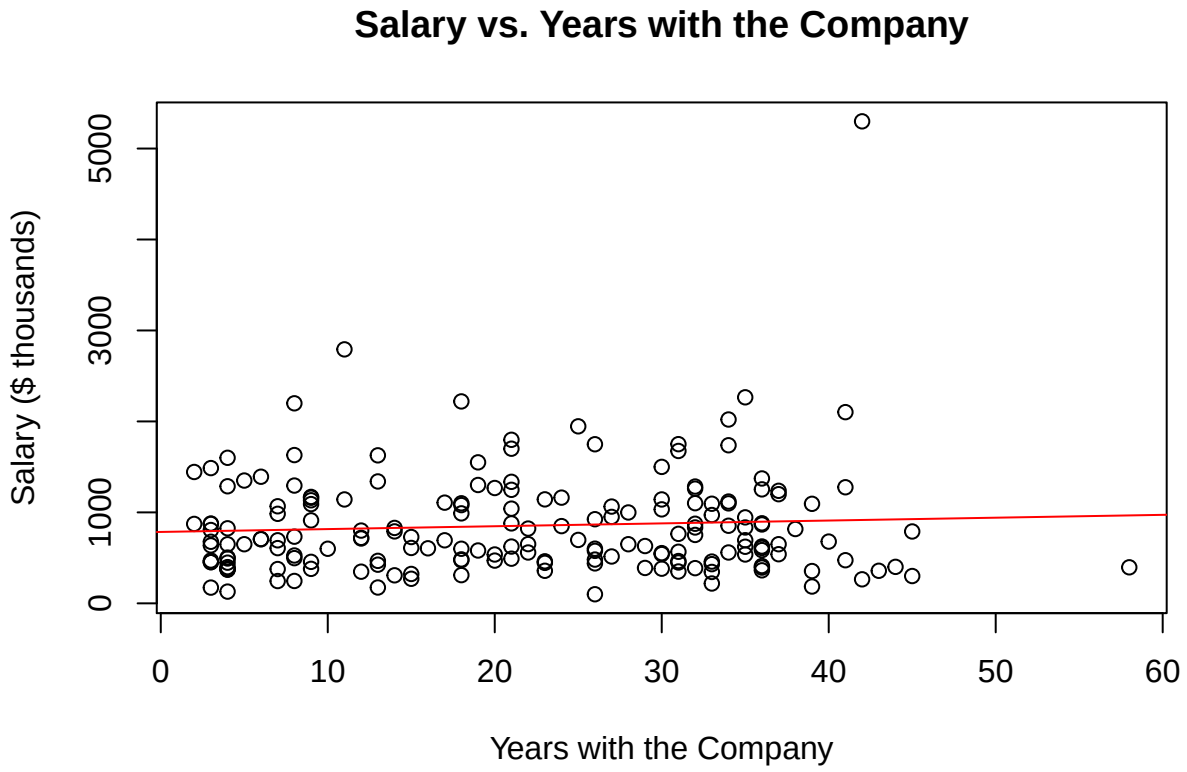
(*Note:* In this dataset, 20.5% of CEOs are brought in from outside the company.)

As shown in the scatterplots below, CEO salary has essentially no relationship with the number of years the CEO has been with the company, and only a slight positive relationship with the number of years as CEO.

```
cor(ceo.df$salary, ceo.df$comten)
```

```
## [1] 0.06836262
```

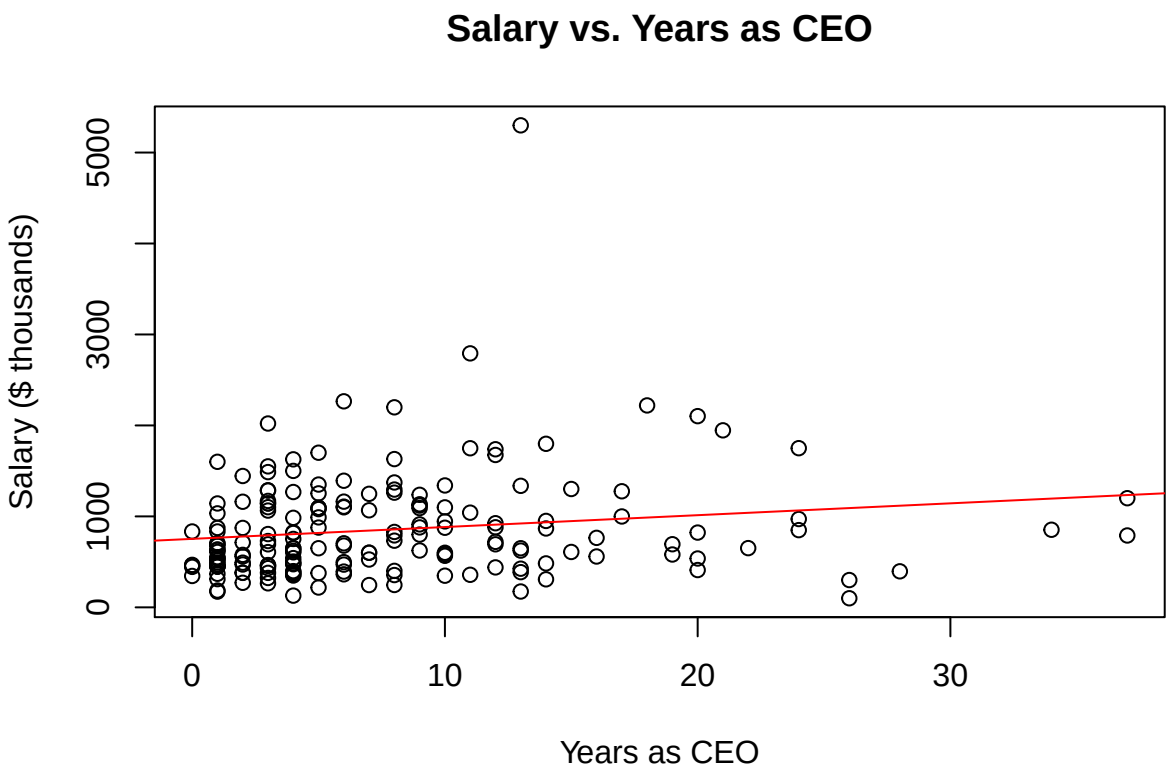
```
plot(ceo.df$comten, ceo.df$salary,
     main = "Salary vs. Years with the Company",
     xlab = "Years with the Company",
     ylab = "Salary ($ thousands)")
abline(lm(ceo.df$salary ~ ceo.df$comten), col = "red")
```




```
cor(ceo.df$salary, ceo.df$ceoten)
```

```
## [1] 0.1597714
```

```
plot(ceo.df$ceoten, ceo.df$salary,
     main = "Salary vs. Years as CEO",
     xlab = "Years as CEO",
     ylab = "Salary ($ thousands)")
abline(lm(ceo.df$salary ~ ceo.df$ceoten), col = "red")
```



Potential Confounding Effects

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Variable Coding Issues and Missing Values

Mention 2 CEOs with advanced degree but not college degree
Mention 1 CEO with CEO tenure > company tenure

Conclusion

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