Yara examples

Bernt Arne Ødegaard

21 December 2023

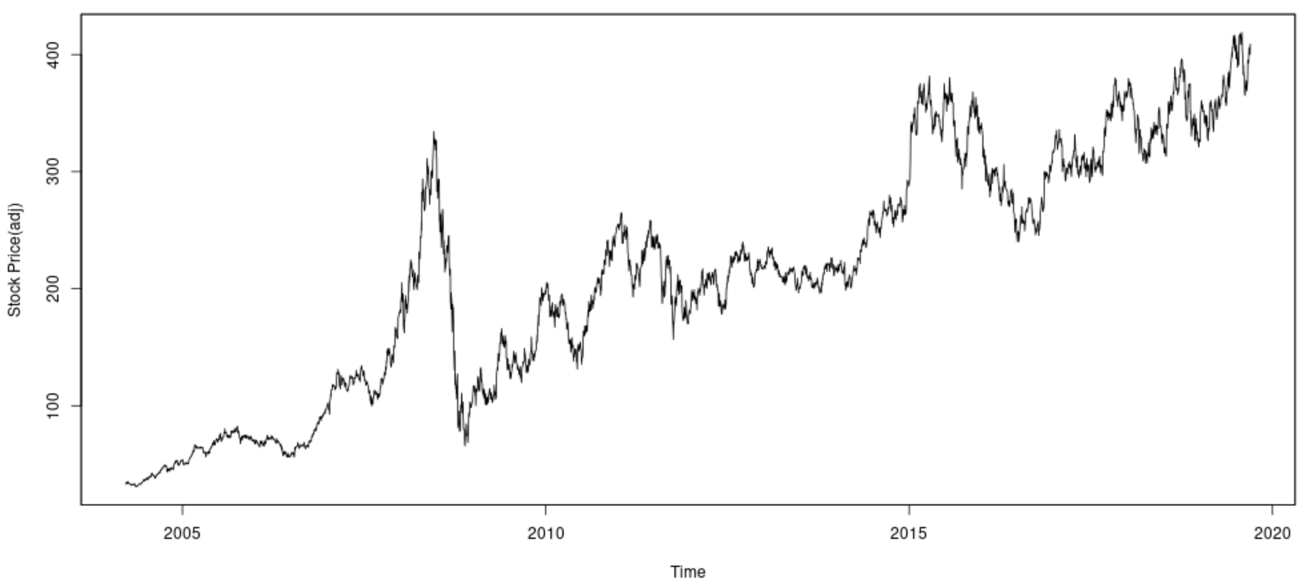
Abstract

Finance examples using equity data for Yara.

1 Yara stock price evolution

Figure 1 shows the stock price development for the most recent past. Note that this is the adjusted stock price.

Figure 1 Stock Price (adjusted) of Yara



2 Predicting earnings

Show using data from Yara in recent years the forecasting of EPS

Exercise 1.

The following table shows annual EPS figures for the Norwegian Company Yara.

2004	11.77
2005	10.19
2006	13.56
2007	20.54
2008	28.27
2009	13.05
2010	30.17

Estimate the growth rate in EPS.

Solution to Exercise 1.

There are any number of ways this can be done.

We will consider the following possibilities

1. Arithmetic average
2. Geometric average
3. Regression
4. Log-linear regression

Let us summarize the various possibilitie

Let X_t be the variable we want to estimate the growth rate of

We calculate the relative change

$$dX_t = \frac{X_t - X_{t-1}}{X_{t-1}}$$

The arithmetic mean of these is one way we can estimate the growth.

The geometric mean is another possibility, but this is only feasible if all the changes dX_t are positive, which is not the case here

Let $t = [1, 2, ...]$ be the period (trend)

We can regress

$$X_t = a + bt$$

Growth is estimated as

$$\text{growth} = \frac{\hat{b}}{\text{mean}(X)}$$

or we can run the logarithmic regression

$$\ln(X_t) = a + bt$$

where $\hat{b}$ is the growth estimate directly.

Calculation of these alternatives using R:

Read data

```
> YaEPS <- read.zoo("../data/yara_eps.csv",
                  header=TRUE,format="%Y%m%d",sep=",")
> YaEPS
2004-12-31 2005-12-31 2006-12-31 2007-12-31 2008-12-31 2009-12-31 2010-12-31
     11.77      10.19      13.56      20.54      28.27      13.05      30.17
> n <- length(YaEPS)
```

Arithmetic mean, first calculate differences, then take mean

```
> dEps <- as.matrix(diff(YaEPS))/as.matrix(YaEPS[1:(n-1)])
> dEps
           diff(YaEPS)
2005-12-31  -0.1342396
2006-12-31   0.3307164
2007-12-31   0.5147493
2008-12-31   0.3763389
2009-12-31  -0.5383799
2010-12-31   1.3118774

> mean(dEps)
[1] 0.3101771
```

Regressing on trend

```
> t <- 1:n
> regr <- lm(YaEPS~t)
Coefficients:
(Intercept)            t
      7.417        2.701
> growth <- regr$coefficients[2]/mean(YaEPS)
0.148236
```

Logarithmic regression

```
> regr <- lm(log(YaEPS)~t)
Coefficients:
(Intercept)            t
     2.2401       0.1448
```

Arithmetic mean	0.310
Trend regression	0.148
Logarithmic regression	0.145

Using matlab for estimation

Whole program

```
eps =[11.7700,10.1900,13.5600,20.5400,28.2700,13.0500,30.1700]'
n=length(eps)
deps = (eps(2:n)-eps(1:n-1))./eps(1:n-1)
mean(deps)
t=1:n
X=[ones(n,1) t']
b=ols(eps,X)
growth = b(2)/mean(eps)
b=ols(log(eps),X)
```

Doing the estimation using matlab

Data

```
eps =
   11.770
   10.190
   13.560
   20.540
   28.270
   13.050
   30.170
```

Take arithmetic mean, by first differencing and then take mean

```
> n=length(eps)

n =  7
> deps = (eps(2:n)-eps(1:n-1))./eps(1:n-1)
deps =

  -0.13424
   0.33072
   0.51475
   0.37634
  -0.53838
   1.31188

> mean(deps)
ans =  0.31018
```

Trend regression

```
> t=1:n
t =
   1   2   3   4   5   6   7
> X=[ones(n,1) t']
X =
   1   1
   1   2
   1   3
   1   4
   1   5
   1   6
   1   7

> b=ols(eps,X)
b =
   7.4171
   2.7011

> growth = b(2)/mean(eps)

growth =  0.14824
```

Doing the analysis as a logarithmic regression

```
> b=ols(log(eps),X)
b =
   2.24008
   0.14476
```

Arithmetic mean	0.310
Trend regression	0.148
Logarithmic regression	0.145

3 Predicting sales

Show using data from Yara in recent years the forecasting of sales

Exercise 2.

The following table gives the annual sales for the Norwegian Company Yara.

2004	43,066,000
2005	46,171,000
2006	46,969,000
2007	56,631,000
2008	87,926,000
2009	60,867,000
2010	64,006,000

Estimate the growth rate in Sales for Yara

Solution to Exercise 2.

Let us summarize the various possibilitie

Let X_t be the variable we want to estimate the growth rate of

We calculate the relative change

$$dX_t = \frac{X_t - X_{t-1}}{X_{t-1}}$$

The arithmetic mean of these is one way we can estimate the growth.

The geometric mean is another possibility, but this is only feasible if all the changes dX_t are positive, which is not the case here

Let $t = [1, 2, ...]$ be the periods in the data (trend)

We can regress on the trend

$$X_t = a + bt$$

Growth is estimated as

$$\frac{\hat{b}}{\text{mean}(X)}$$

or we can run the logarithmic regression

$$\ln(X_t) = a + bt$$

where $\hat{b}$ is the growth estimate directly.

Calculation using R

Reading the data

```
> YaSales <- read.zoo("../data/yara_sales.csv",
                    header=TRUE,format="%Y",sep=",")
> n <- length(YaSales$sales)
> print(YaSales$sales)
2004-08-26 2005-08-26 2006-08-26 2007-08-26 2008-08-26 2009-08-26 2010-08-26
  43066000   46171000   46969000   56631000   87926000   60867000   64006000
```

Arithmetic mean: Difference the sales and take average

```
> dSales <- as.matrix(diff(YaSales$sales))/as.matrix(YaSales$sales[1:(n-1)])
> print(dSales)
           diff(YaSales$sales)
2005-08-26          0.07209864
2006-08-26          0.01728358
2007-08-26          0.20571015
2008-08-26          0.55261253
2009-08-26         -0.30774742
2010-08-26          0.05157146
> mean(dSales)
[1] 0.09858815
```

Regressions: regression on trend

```
> t <- 1:n
> regr <- lm(as.matrix(YaSales$sales)~t)
> regr
Coefficients:
(Intercept)            t
   38923857      4756036
> m <- mean(YaSales$sales)
> print(m)
[1] 57948000
> growth <- regr$coefficents[2]/mean(YaSales$sales)
> growth
  0.0820742044592
```

Full regression output

```
> summary(regr)

Call:
lm(formula = YaEPS ~ t)

Residuals:
2004-12-31 2005-12-31 2006-12-31 2007-12-31 2008-12-31 2009-12-31 2010-12-31
     1.652     -2.629     -1.960      2.319      7.348    -10.574      3.845

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)    7.417      5.338   1.390   0.2234
t              2.701      1.194   2.263   0.0731 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 6.316 on 5 degrees of freedom
Multiple R-squared: 0.506,Adjusted R-squared: 0.4072
F-statistic: 5.122 on 1 and 5 DF,  p-value: 0.07307
```

Logarithmic regression

```
> regr <- lm(log(YaSales$sales)~t)
> print(regr)
Coefficients:
(Intercept)            t
   17.50935      0.08459
```

Full regression output

```
> summary(regr)

Call:
lm(formula = log(YaEPS) ~ t)

Residuals:
2004-12-31 2005-12-31 2006-12-31 2007-12-31 2008-12-31 2009-12-31 2010-12-31
   0.08071   -0.20820   -0.06724    0.20325    0.37791   -0.53986    0.15344

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
```

```
(Intercept)  2.24008    0.28120   7.966 0.000503 ***
t            0.14476    0.06288   2.302 0.069575 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3327 on 5 degrees of freedom
Multiple R-squared: 0.5146,Adjusted R-squared: 0.4175
F-statistic:   5.3 on 1 and 5 DF,  p-value: 0.06957
```

Arithmetic mean	0.099
Trend regression	0.082
Logarithmic regression	0.085

Doing the estimation using Matlab

Whole program

```
sales =[43066000,46171000,46969000,56631000,87926000,60867000,64006000]'
n=length(sales)
dsales = (sales(2:n)-sales(1:n-1))./sales(1:n-1)
mean(dsales)
t=1:n
X=[ones(n,1) t']
b=ols(sales,X)
growth = b(2)/mean(sales)
b=ols(log(sales),X)
```

Results: Data

```
sales =
   43066000
   46171000
   46969000
   56631000
   87926000
   60867000
   64006000
n =  7
```

Difference the sales

```
> dsales = (sales(2:n)-sales(1:n-1))./sales(1:n-1)
dsales =
   0.072099
   0.017284
   0.205710
   0.552613
  -0.307747
   0.051571
```

Take mean of differences

```
> mean(dsales)
ans =  0.098588
```

Regression on trend

```
> t=1:n
t =
   1   2   3   4   5   6   7
> X=[ones(n,1) t']
```

```
X =
   1   1
   1   2
   1   3
   1   4
   1   5
   1   6
   1   7
> b=ols(sales,X)
b =
   3.8924e+07
   4.7560e+06
> growth = b(2)/mean(sales)
growth =  0.082074
```

Alternatively, logarithmic regression on trend, read growth estimate directly

```
b =
   17.509350
    0.084586
```

Growth estimates using the various methods, matlab estimates

Arithmetric mean	0.099
Trend regression	0.082
Logarithmic regression	0.085

Exercise 3.

For purposes of valuation, you want to estimate a historical growth measure for the fertilizer company *Yara*. Your intern has collected selected data from the most recent annual reports of Yara, as shown in the enclosed table.

```
Year;Revenue(USD mill);Operating Income; EBITDA ; Debt/Equity
2019;           12936;    989          ;  2095  ; 0.42
2018;           13054;    402          ;  1523  ; 0.43
2017;           11400;    457          ;  1348  ; 0.25
Year; Revenue(NOK mill);OI             ; EBITDA ; Debt/Equity
2017;          93812;      3777        ; 11120  ; 0.25
2016;          97170;      8771        ; 15563  ; 0.17
2015;         111897;     14104        ; 21361  ;
2014;          95343;     10305        ; 13399  ; 0.17
2013;          85092;      8074        ; 16407  ; 0.06
2012;          84509;     11166        ; 16977  ; 0.02
2011;          80352;     13240        ; 18163  ; 0.12
2010;          65374;      7467        ; 15315  ; 0.27
2009;          61418;      1271        ;  5549  ; 0.56
2008;          88775;     12281        ; 17917  ; 0.84
2007;          56631;                  ;
2006;          46969;                  ;
2005;          46171;                  ;
2004;          43066;                  ;
```

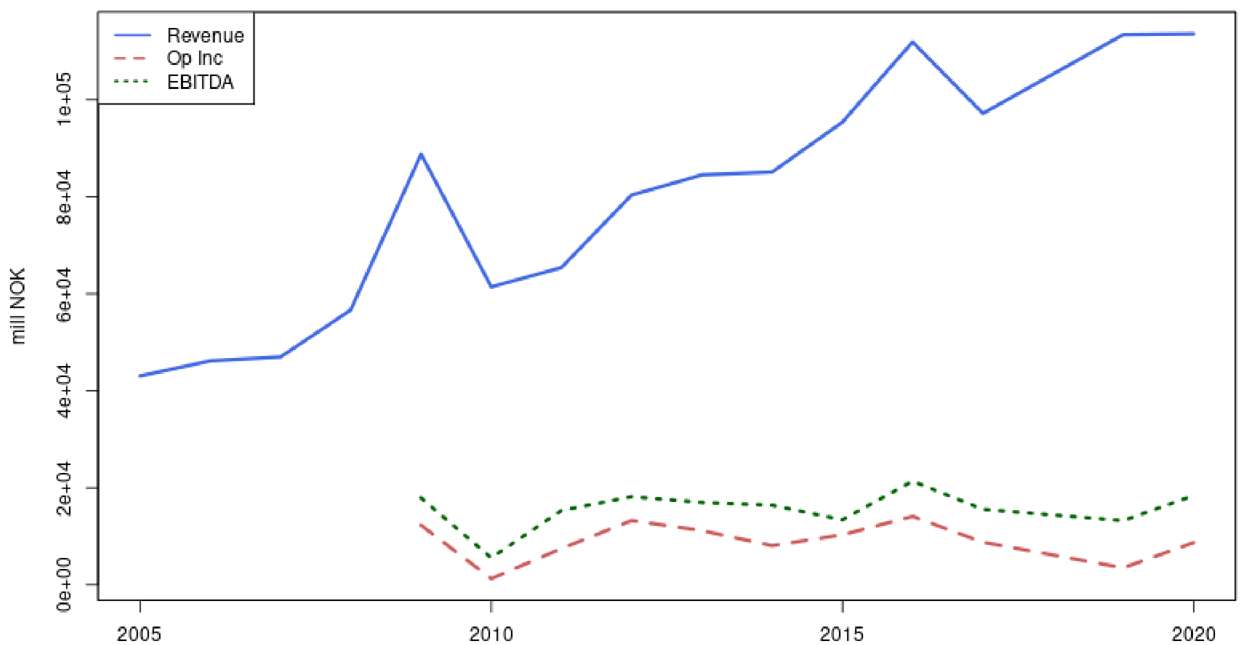
1. Consider first estimation of the revenue growth.
   (a) Plot the time series of annual revenue growth
   (b) Calculate the (arithmetic) average of this series for the period 2004–2019.
   (c) Why is it not possible to calculate the geometric average of annual sales growth?
   (d) Compare the average above with some alternative ways of estimating the growth:
   - regress
     $$Revenue_t = a + b\mathbf{t} + \varepsilon_t$$
     where $\mathbf{t} = (1, 2, \ldots,)$ counts the number of years since the start.
     Dividing the estimated b by the Revenue average is the estimate of growth. This is called a "trend regression"
   - the growth can also be estimated from the logarithmic regression
     $$\log(Revenue_t) = a + b\mathbf{t} + \epsilon t$$
     The coefficient b is the growth estimate
2. Consider next using as alternative bases for estimating growth: Operating Income, and EBIT.
   (a) Estimate the (arithmetic) average growth for these two alternative measures.
   (b) How does growth estimates using these alternatives compare to using revenue?

Solution to Exercise 3.

First things first. Some of the numbers are in dollars, most in NOK. Need to transate everything into a common currency. Get the year-end exchange rate for 2019 and 2018 and translate the dollar values to NOK.

Year	Revenue (NOK mill)	NOK (mill) Operating Income	EBITDA	NOK/USD	Revenue (USD mill)	USD (mill) Operating Income	EBITDA
2019	113582	8684	18395	8.7803	12936	989	2095
2018	113420	3493	13233	8.6885	13054	402	1523
2016	97170	8771	15563				
2015	111897	14104	21361				
2014	95343	10305	13399				
2013	85092	8074	16407				
2012	84509	11166	16977				
2011	80352	13240	18163				
2010	65374	7467	15315				
2009	61418	1271	5549				
2008	88775	12281	17917				
2007	56631						
2006	46969						
2005	46171						
2004	43066						

Now have three time series in NOK: Revenue, Operating Income, and EBITDA.
Plot for a comparison of the three accounting measures.



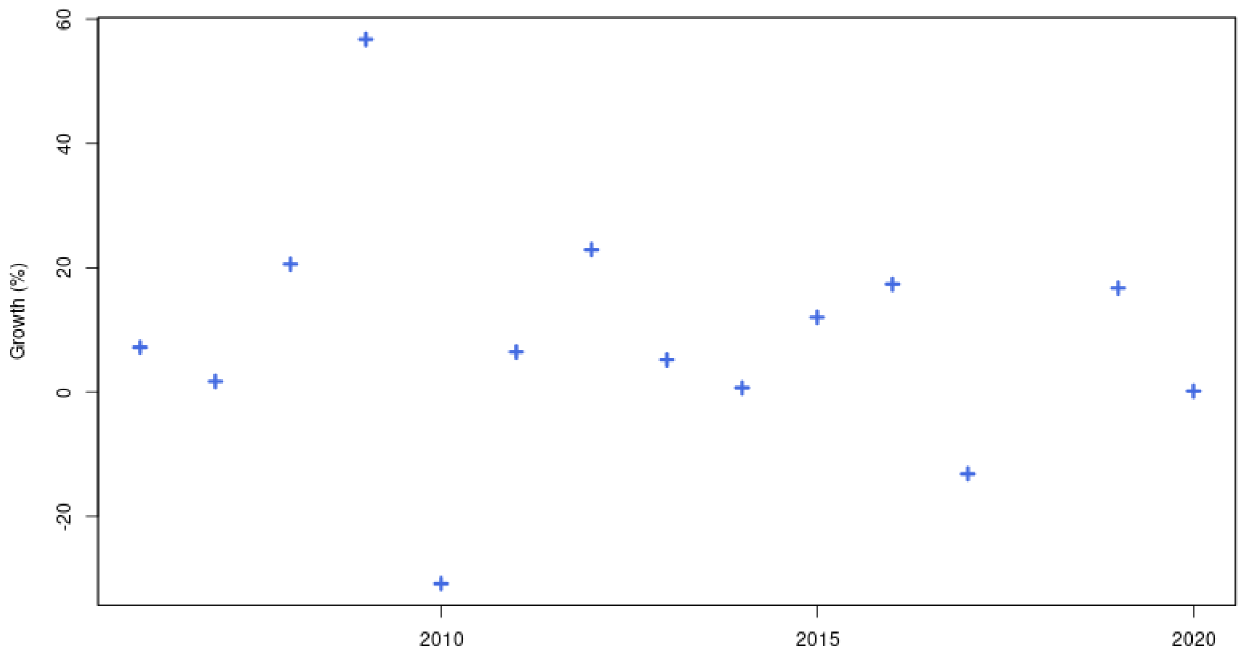
First use revenue to estimate growth.
An R snippet that does this:

```
dRevenue <- diff(revenue)/as.matrix(revenue[1:(n-1)]) # divide by earlier date
```

Produces estimates of the percentage change in revenue (on the right)

```
            Revenue DeltaRevenue
2004-12-31  43066.0           NA
```

```
2005-12-31  46171.0    7.2098639
2006-12-31  46969.0    1.7283576
2007-12-31  56631.0   20.5710149
2008-12-31  88775.0   56.7604316
2009-12-31  61418.0  -30.8161081
2010-12-31  65374.0    6.4411085
2011-12-31  80352.0   22.9112491
2012-12-31  84509.0    5.1734867
2013-12-31  85092.0    0.6898674
2014-12-31  95343.0   12.0469609
2015-12-31 111897.0   17.3625751
2016-12-31  97170.0  -13.1612108
2018-12-31 113419.7   16.7229381
2019-12-31 113582.0    0.1430808
```



Doing the various estimates (for the technically minded)

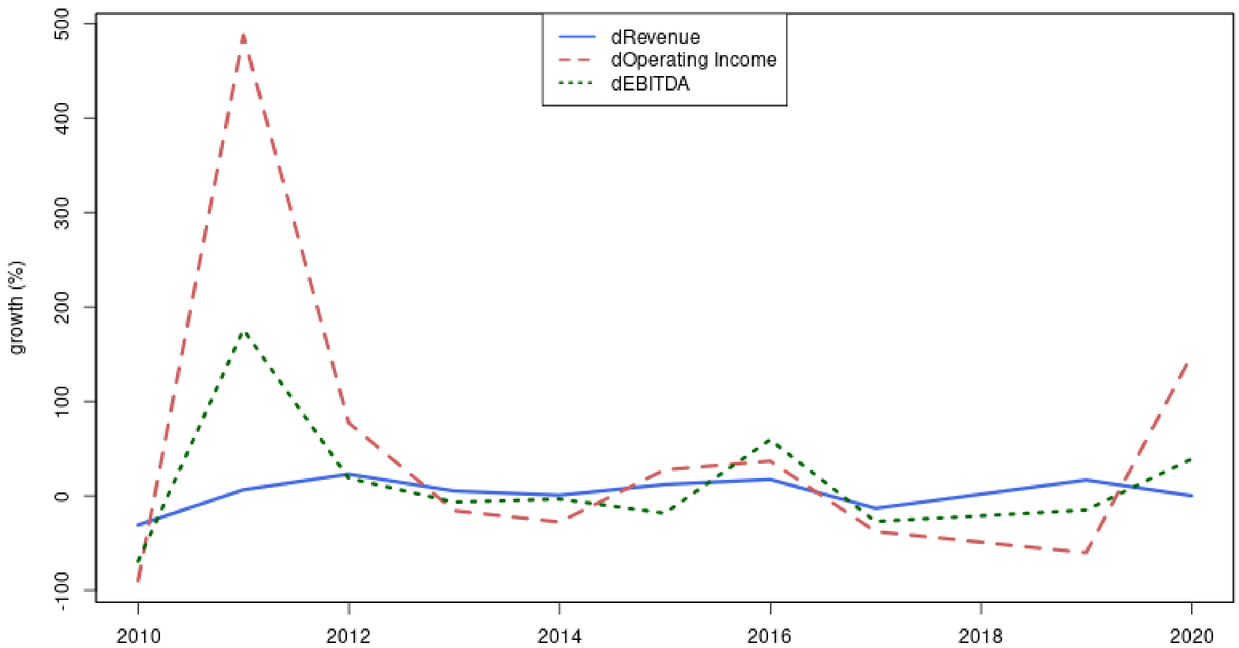
```
> mean(dRevenue)
[1] 0.08841687
> time <- 1:n
> regr <- lm(as.matrix(Revenue)~time)
> summary(regr)
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  37736.2     4880.9   7.731 3.24e-06 ***
time          5197.7      536.8   9.682 2.61e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Residual standard error: 8983 on 13 degrees of freedom
Multiple R-squared:  0.8782,Adjusted R-squared:  0.8688
F-statistic: 93.74 on 1 and 13 DF,  p-value: 2.614e-07

> b <- regr$coefficients[2]
> print(b)
    time
5197.714
> m <- mean(Revenue)
> print(m)
[1] 79317.91
> growth <- b/m
> print("trend regression")
[1] "trend regression"
> growth
      time
0.06553014
> regr <- lm(log(Revenue)~time)
> summary(regr)
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 10.669106   0.069055 154.501  < 2e-16 ***
time         0.070225   0.007595   9.246 4.43e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1271 on 13 degrees of freedom
Multiple R-squared:  0.868,Adjusted R-squared:  0.8579
F-statistic: 85.49 on 1 and 13 DF,  p-value: 4.433e-07

> print("log regression")
[1] "log regression"
> print(regr$coefficients[2])
      time
0.07022456
```

The three estimates are summarized as

	growth(%)
arith mean	8.84
trend regr	6.55
log regr	7.02

Next, make comparison of the three sources of growth estimates
Calculate the annual growth estimates using the three methods



Calculating the averages of these three

	Growth(%)
Revenue	3.75
OI	54.69
EBITDA	15.37