p69. exercise 3.1 Production Units vs. Overhead (Hand + SAS)

Production (in 10,000) units	5	6	7	8	9	10	11
Overhead costs (in $1000)	12	11.5	14	15	15.4	15.3	17.5

$y_i = \beta_0 + \beta_1 x_i + \epsilon_i$, $i = 1,...,n$, $\epsilon_i \sim i.i.d\, N(0,\sigma^2)$

-> $n = 7, \sum_{i=1}^{n} x_i = 56, \sum_{i=1}^{n} y_i = 100.7, \sum_{i=1}^{n} x_i y_i = 831.1, \sum_{i=1}^{n} x_i^2 = 476$

--> $\hat{y} = b_o + b_1 x,\ b_1 = \dfrac{\sum_{i=1}^{n} x_i y_i - \frac{1}{n}(\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sum_{i=1}^{n} x_i^2 - \frac{1}{n}(\sum_{i=1}^{n} x_i)^2} = 0.9107,$

$b_0 = \bar{y} - b_1 \bar{x} = 7.1$

$\therefore \hat{y} = 7.1 + 0.9107x$ (Least Square Estimator)

Using SAS (proc reg)

```
/** p69. exercise 3-1 Production Units vs. Overhead **/

* Input data ;

data budget ;
input production overhead @@ ;
cards ;
5 12 6 11.5 7 14 8 15 9 15.4 10 15.3 11 17.5
;
run ;

proc print data=budget ;
run ;

* Simple linear regression (proc reg) ;

proc reg data=budget ;
model overhead=production ;
plot overhead*production / conf pred ;
run ; quit ;
```

```
SAS 시스템                                                    1
                                                  2015년 09월 14일 월요일 오후 07시02분39초

                                    OBS    production    overhead

                                     1          5          12.0
                                     2          6          11.5
                                     3          7          14.0
                                     4          8          15.0
                                     5          9          15.4
```

6	10	15.3
7	11	17.5

The REG Procedure
Model: MODEL1
Dependent Variable: overhead

Number of Observations Read	7
Number of Observations Used	7

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	23.22321	23.22321	40.24	0.0014
Error	5	2.88536	0.57707		
Corrected Total	6	26.10857			

Root MSE	0.75965	R-Square	0.8895
Dependent Mean	14.38571	Adj R-Sq	0.8674
Coeff Var	5.28060		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	7.10000	1.18383	6.00	0.0018
production	1	0.91071	0.14356	6.34	0.0014