1. simple linear regression in matrix terms

a.

 

|  |  |  |
| --- | --- | --- |
| X =  | 1 | 349.1 |
| 1 | 351.5 |
| 1 | 217.7 |
| 1 | 231.8 |
| 1 | 319.1 |
| 1 | 414.5 |
| 1 | 367.8 |
| 1 | 300.2 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| X` =  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 349.1 | 351.5 | 217.7 | 231.8 | 319.1 | 414.5 | 367.8 | 300.2 |

b.



|  |  |
| --- | --- |
|  | 300 |
|  | 370 |
|  | 191 |
| Y =  | 195 |
|  | 373 |
|  | 466.275 |
|  | 332.5 |
|  | 315 |

c.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| X'X =  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 349.1 |  | 8 | 2551.7 |
|  | 349.1 | 351.5 | 217.7 | 231.8 | 319.1 | 414.5 | 367.8 | 300.2 | 1 | 351.5 | = | 2551.7 | 845579.5 |
|  |  |  |  |  |  |  |  |  |  | 1 | 217.7 |  |  |  |
|  |  |  |  |  |  |  |  |  |  | 1 | 231.8 |  |  |  |
|  |  |  |  |  |  |  |  |  |  | 1 | 319.1 |  |  |  |
|  |  |  |  |  |  |  |  |  |  | 1 | 414.5 |  |  |  |
|  |  |  |  |  |  |  |  |  |  | 1 | 367.8 |  |  |  |
|  |  |  |  |  |  |  |  |  |  | 1 | 300.2 |  |  |  |

|  |  |
| --- | --- |
| 8 | 2551.7 |
| 2551.7 | 845579.5 |

X`X =

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| X'Y =  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |   |   | 300 |  = | 2542.775 |
| 349.1 | 351.5 | 217.7 | 231.8 | 319.1 | 414.5 | 367.8 | 300.2 |   | 370 | 850718.5 |
|  |  |  |  |  |  |  |  |  |   | 191 |  |  |
|  |  |  |  |  |  |  |  |  |   | 195 |  |  |
|  |  |  |  |  |  |  |  |  |   | 373 |  |  |
|  |  |  |  |  |  |  |  |  |   | 466.275 |  |  |
|  |  |  |  |  |  |  |  |  |   | 332.5 |  |  |
|  |  |  |  |  |  |  |  |  |   | 315 |  |  |

|  |
| --- |
| 2542.775 |
| 850718.5 |

 X`Y =

|  |  |
| --- | --- |
| 3.336102 | -0.010067333 |
| -0.01007 | 3.15627E-05 |

 XX-1 =

X\*(X’X)-1 =

|  |  |
| --- | --- |
| -0.178404255 | 0.000951222 |
|  |  |
| -0.202565854 | 0.001026973 |
| 1.144443329 | -0.003196123 |
| 1.002493931 | -0.002751088 |
| 0.123615742 | 4.33988E-06 |
| -0.836807846 | 0.003015426 |
| -0.366663385 | 0.001541446 |
| 0.313888339 | -0.000592196 |

The Hat Matrix

X(X`X)-1X` =

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 0.153667 | 0.15595 | 0.028677 | 0.042089 | 0.125131 | 0.215877 | 0.171455 | 0.107153 |
| 0.15595 | 0.158415 | 0.021006 | 0.035486 | 0.125141 | 0.223114 | 0.175155 | 0.105731 |
| 0.028677 | 0.021006 | 0.448647 | 0.403582 | 0.124561 | -0.18035 | -0.03109 | 0.184967 |
| 0.042089 | 0.035486 | 0.403582 | 0.364792 | 0.124622 | -0.13783 | -0.00936 | 0.176617 |
| 0.125131 | 0.125141 | 0.124561 | 0.124622 | 0.125001 | 0.125415 | 0.125212 | 0.124919 |
| 0.215877 | 0.223114 | -0.18035 | -0.13783 | 0.125415 | 0.413086 | 0.272266 | 0.068423 |
| 0.171455 | 0.175155 | -0.03109 | -0.00936 | 0.125212 | 0.272266 | 0.20028 | 0.096079 |
| 0.107153 | 0.105731 | 0.184967 | 0.176617 | 0.124919 | 0.068423 | 0.096079 | 0.136111 |

|  |
| --- |
| -81.5103 |
| 1.252051 |

β = (X`X)-1(X`Y)

|  |  |
| --- | --- |
| 3.336102 | -0.010067333 |
| 0.01007 | 3.15627E-05 |

|  |
| --- |
| 2542.775 |
| 850718.5 |

 =

d.



The regression model; price = -81.51 + 1.252\*assess

e.

H2,3 = 0.021006

2. Multiple linear regression

a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| X =  |  | 1 | 349.1 | 6126 |
|  | 1 | 351.5 | 9903 |
|  | 1 | 217.7 | 5200 |
|  | 1 | 231.8 | 4600 |
|  | 1 | 319.1 | 6095 |
|  | 1 | 414.5 | 8566 |
|  | 1 | 367.8 | 9000 |
|  | 1 | 300.2 | 6210 |

b.





c.



d.

dm "out; clear; log; clear";

Data BaseJr; /\* Creates SAS dataset named BaseJr \*/

Input PRICE ASSESS LOT\_SIZE; /\* Inputs a subset, n=8, of Baseball Data \*/

Datalines;

300 349.1 6162

370 351.5 9903

191 217.7 5200

195 231.8 4600

373 319.1 6095

466.275 414.5 8566

332.5 367.8 9000

315 300.2 6210

;

Proc IML; /\* Opens the Matrix Language procedure \*/

use BaseJr; /\* Identifies the SAS file to import \*/

read all; /\* Imports all components of SAS dataset

 BaseJr with their names! \*/

one\_vec = j(8,1); /\* "j(n,1)" creates a vector of length n

 filled with 1's. \*/

X = one\_vec || ASSESS || LOT\_SIZE; /\* "||" sandwiches columns into a matrix \*/

print X;

Y = PRICE;

mat1 = t(X) \* X; /\* \*/

mat2= inv(t(X) \* X);

mat3 = inv(t(X) \* X) \* t(X);

print mat1, mat2, mat3;

b = inv(t(X) \* X) \* (t(X)\*Y); /\* computes b vector in one go! \*/

print b;

run;

Proc Reg; /\*gets the slope coefficients for comparison\*/

Model Won\_2010 = Won\_2009 RS\_2009;

run;