```
1          ************************************************************************;
2          *** EXST7034 Multiple Regression Example                               ***;
3          *** Problem from Neter, Kutner, Nachtsheim & Wasserman 1996, #6.18     ***;
4          ************************************************************************;
5
6          OPTIONS LS=132 PS=80 NOCENTER NODATE NONUMBER;
7
8          DATA ONE; INFILE CARDS MISSOVER;
9               TITLE1 'EXST7034 - NKNW 6.18 : Mathematician salaries';
10              LABEL X1 = 'Index of publication quality';
11              LABEL X2 = 'Number of years experience';
12              LABEL X3 = 'Grant support success';
13              LABEL Y = 'Thousands of dollars';
14             INPUT Y X1 X2 X3;
15         CARDS;

NOTE: The data set WORK.ONE has 24 observations and 4 variables.
NOTE: DATA statement used:
      real time           0.06 seconds
      cpu time            0.06 seconds
15       !        RUN;
40         ;
41         PROC REG DATA=ONE; TITLE2 'Multiple Regression Example';
42              MODEL  Y = X1 X2 X3 / XPX I SS1 SS2 COVB; RUN;
NOTE: 24 observations read.
NOTE: 24 observations used in computations.
NOTE: The PROCEDURE REG printed pages 1-2.
NOTE: PROCEDURE REG used:
      real time           0.14 seconds
      cpu time            0.13 seconds


EXST7034 - NKNW 6.18 : Mathematician salaries
Multiple Regression Example

The REG Procedure
Model: MODEL1
```

Model Crossproducts X'X X'Y Y'Y

Variable	Label	Intercept	X1	X2	X3	Y
Intercept	Intercept	24	128.6	599	143.7	948
X1	Index of publication quality	128.6	727.44	3365.3	782.49	5188.17
X2	Number of years experience	599	3365.3	17847	3671.9	24873.7
X3	Grant support success	143.7	782.49	3671.9	899.49	5767.77
Y	Thousands of dollars	948	5188.17	24873.7	5767.77	38135.26

EXST7034 - NKNW 6.18 : Mathematician salaries
Multiple Regression Example

The REG Procedure
Model: MODEL1
Dependent Variable: Y Thousands of dollars

X'X Inverse, Parameter Estimates, and SSE

Variable	Label	Intercept	X1	X2	X3	Y
Intercept	Intercept	1.3044630488	-0.101873528	0.0004420084	-0.121579266	17.846930636
X1	Index of publication quality	-0.101873528	0.035355881	-0.001674335	-0.007647007	1.1031303951
X2	Number of years experience	0.0004420084	-0.001674335	0.0004482371	-0.000443861	0.3215196814
X3	Grant support success	-0.121579266	-0.007647007	-0.000443861	0.0289991653	1.2889408958
Y	Thousands of dollars	17.846930636	1.1031303951	0.3215196814	1.2889408958	61.443003635

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	627.81700	209.27233	68.12	<.0001
Error	20	61.44300	3.07215		
Corrected Total	23	689.26000			

Root MSE	1.75276	R-Square	0.9109
Dependent Mean	39.50000	Adj R-Sq	0.8975
Coeff Var	4.43735		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Type I SS	Type II SS
Intercept	Intercept	1	17.84693	2.00188	8.92	<.0001	37446	244.17168
X1	Index of publication quality	1	1.10313	0.32957	3.35	0.0032	306.73233	34.41851
X2	Number of years experience	1	0.32152	0.03711	8.66	<.0001	263.79445	230.62548
X3	Grant support success	1	1.28894	0.29848	4.32	0.0003	57.29022	57.29022

Covariance of Estimates

Variable	Label	Intercept	X1	X2	X3
Intercept	Intercept	4.0075063923	-0.312970778	0.0013579161	-0.373509763
X1	Index of publication quality	-0.312970778	0.1086185761	-0.005143808	-0.023492755
X2	Number of years experience	0.0013579161	-0.005143808	0.0013770518	-0.001363607
X3	Grant support success	-0.373509763	-0.023492755	-0.001363607	0.0890897911

```
43          PROC REG DATA=ONE; TITLE2 'Sub-models';
44               MODEL  Y = X1;
45               MODEL  Y = X2;
46               MODEL  Y = X3;
47               MODEL  Y = X1 X2;
48               MODEL  Y = X1 X3;
49               MODEL  Y = X2 X3;
50               MODEL  Y = X1 X2 X3;
51          run;

NOTE: 24 observations read.
NOTE: 24 observations used in computations.


EXST7034 - NKNW 6.18 : Mathematician salaries
Sub-models

The REG Procedure
Model: MODEL1
Dependent Variable: Y Thousands of dollars

Analysis of Variance                Sum of           Mean
Source                    DF       Squares         Square    F Value    Pr > F
Model                      1     306.73233      306.73233      17.64    0.0004
Error                     22     382.52767       17.38762
Corrected Total           23     689.26000

Root MSE              4.16985    R-Square     0.4450
Dependent Mean       39.50000    Adj R-Sq     0.4198
Coeff Var            10.55657

Parameter Estimates                                 Parameter       Standard
Variable     Label                             DF      Estimate          Error    t Value    Pr > |t|
Intercept    Intercept                          1      24.34766        3.70666       6.57      <.0001
X1           Index of publication quality       1       2.82781        0.67327       4.20      0.0004

Model: MODEL2
Dependent Variable: Y Thousands of dollars

Analysis of Variance                Sum of           Mean
Source                    DF       Squares         Square    F Value    Pr > F
Model                      1     508.06883      508.06883      61.69    <.0001
Error                     22     181.19117        8.23596
Corrected Total           23     689.26000

Root MSE              2.86984    R-Square     0.7371
Dependent Mean       39.50000    Adj R-Sq     0.7252
Coeff Var             7.26541

Parameter Estimates                                 Parameter       Standard
Variable     Label                             DF      Estimate          Error    t Value    Pr > |t|
Intercept    Intercept                          1      29.04785        1.45400      19.98      <.0001
X2           Number of years experience         1       0.41878        0.05332       7.85      <.0001

Model: MODEL3
Dependent Variable: Y Thousands of dollars

Analysis of Variance                Sum of           Mean
Source                    DF       Squares         Square    F Value    Pr > F
Model                      1     214.76157      214.76157       9.96    0.0046
Error                     22     474.49843       21.56811
Corrected Total           23     689.26000

Root MSE              4.64415    R-Square     0.3116
Dependent Mean       39.50000    Adj R-Sq     0.2803
Coeff Var            11.75734

Parameter Estimates                                 Parameter       Standard
Variable     Label                             DF      Estimate          Error    t Value    Pr > |t|
Intercept    Intercept                          1      25.46502        4.54765       5.60      <.0001
X3           Grant support success              1       2.34405        0.74284       3.16      0.0046
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EXST7034 - NKNW 6.18 : Mathematician salaries
Sub-models

The REG Procedure
Model: MODEL4
Dependent Variable: Y Thousands of dollars

Analysis of Variance                Sum of           Mean
Source                   DF        Squares         Square    F Value    Pr > F
Model                     2      570.52677      285.26339      50.45    <.0001
Error                    21      118.73323        5.65396
Corrected Total          23      689.26000

Root MSE              2.37781    R-Square     0.8277
Dependent Mean       39.50000    Adj R-Sq     0.8113
Coeff Var             6.01976

Parameter Estimates                                 Parameter       Standard
Variable     Label                            DF      Estimate          Error    t Value    Pr > |t|
Intercept    Intercept                         1      23.25083        2.11977      10.97      <.0001
X1           Index of publication quality      1       1.44302        0.43417       3.32      0.0032
X2           Number of years experience        1       0.34125        0.04996       6.83      <.0001

Model: MODEL5
Dependent Variable: Y Thousands of dollars

Analysis of Variance                Sum of           Mean
Source                   DF        Squares         Square    F Value    Pr > F

Model                     2      397.19152      198.59576      14.28    0.0001
Error                    21      292.06848       13.90802
Corrected Total          23      689.26000

Root MSE              3.72935    R-Square     0.5763
Dependent Mean       39.50000    Adj R-Sq     0.5359
Coeff Var             9.44138

Parameter Estimates                                 Parameter       Standard
Variable     Label                            DF      Estimate          Error    t Value    Pr > |t|
Intercept    Intercept                         1      17.52988        4.25869       4.12      0.0005
X1           Index of publication quality      1       2.30413        0.63620       3.62      0.0016
X3           Grant support success             1       1.60732        0.63024       2.55      0.0186

Model: MODEL6
Dependent Variable: Y Thousands of dollars

Analysis of Variance                Sum of           Mean
Source                   DF        Squares         Square    F Value    Pr > F
Model                     2      593.39849      296.69924      65.00    <.0001
Error                    21       95.86151        4.56483
Corrected Total          23      689.26000

Root MSE              2.13655    R-Square     0.8609
Dependent Mean       39.50000    Adj R-Sq     0.8477
Coeff Var             5.40898

Parameter Estimates                                 Parameter       Standard
Variable     Label                            DF      Estimate          Error    t Value    Pr > |t|
Intercept    Intercept                         1      21.02546        2.14819       9.79      <.0001
X2           Number of years experience        1       0.37376        0.04104       9.11      <.0001
X3           Grant support success             1       1.52753        0.35331       4.32      0.0003

Model: MODEL7
Dependent Variable: Y Thousands of dollars

Analysis of Variance                Sum of           Mean
Source                   DF        Squares         Square    F Value    Pr > F
Model                     3      627.81700      209.27233      68.12    <.0001
Error                    20       61.44300        3.07215
Corrected Total          23      689.26000

Root MSE              1.75276    R-Square     0.9109
Dependent Mean       39.50000    Adj R-Sq     0.8975
Coeff Var             4.43735

Parameter Estimates                                 Parameter       Standard
Variable     Label                            DF      Estimate          Error    t Value    Pr > |t|
Intercept    Intercept                         1      17.84693        2.00188       8.92      <.0001
X1           Index of publication quality      1       1.10313        0.32957       3.35      0.0032
X2           Number of years experience        1       0.32152        0.03711       8.66      <.0001
X3           Grant support success             1       1.28894        0.29848       4.32      0.0003
```