```
/* x5_1.sas */
/* Purpose:  */

title1 'Example 5.1';

data a;
  input group$ rep strength;
cards;
A 1 3210
A 2 3000
A 3 3315
B 1 3225
B 2 3320
B 3 3165
B 4 3145
C 1 3220
C 2 3410
C 3 3320
C 4 3370
D 1 3545
D 2 3600
D 3 3580
D 4 3485
;
proc print;
title2 'List of data.';

proc varcomp method=type1;
  class group;
  model strength = group;

proc glm;
  class group;
  model strength = group /solution;
  means group;
  lsmeans group;

run;
```

Example 5.1 1
List of data.

Obs	group	rep	strength
1	A	1	3210
2	A	2	3000
3	A	3	3315
4	B	1	3225
5	B	2	3320
6	B	3	3165
7	B	4	3145
8	C	1	3220
9	C	2	3410
10	C	3	3320
11	C	4	3370
12	D	1	3545
13	D	2	3600
14	D	3	3580
15	D	4	3485

Example 5.1 2
List of data.

Variance Components Estimation Procedure

Class Level Information

Class	Levels	Values
group	4	A B C D

Number of Observations Read 15
Number of Observations Used 15

Dependent Variable: strength

Type 1 Analysis of Variance

Source	DF	Sum of Squares	Mean Square
group	3	324050	108017
Error	11	97794	8890.340909
Corrected Total	14	421843	.

Type 1 Analysis of Variance

Source	Expected Mean Square
group	Var(Error) + 3.7333 Var(group)
Error	Var(Error)
Corrected Total	.

Type 1 Estimates

Variance Component	Estimate
Var(group)	26551.7
Var(Error)	8890.3

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Example 5.1 3
List of data.

The GLM Procedure

Class Level Information

Class	Levels	Values
group	4	A B C D

Number of Observations Read 15
Number of Observations Used 15

```
                             Example 5.1                                    4
                            List of data.

                          The GLM Procedure

Dependent Variable: strength

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

 Model                        3  324049.5833   108016.5278     12.15   0.0008

 Error                       11   97793.7500     8890.3409

 Corrected Total             14  421843.3333


             R-Square     Coeff Var      Root MSE    strength Mean

             0.768175      2.833759      94.28860         3327.333


 Source                      DF     Type I SS    Mean Square   F Value   Pr > F

 group                        3  324049.5833   108016.5278     12.15   0.0008


 Source                      DF   Type III SS    Mean Square   F Value   Pr > F

 group                        3  324049.5833   108016.5278     12.15   0.0008


                                            Standard
     Parameter           Estimate              Error    t Value    Pr > |t|

     Intercept        3552.500000 B     47.14430217      75.35      <.0001
     group     A      -377.500000 B     72.01411110      -5.24      0.0003
     group     B      -338.750000 B     66.67211152      -5.08      0.0004
     group     C      -222.500000 B     66.67211152      -3.34      0.0066
     group     D         0.000000 B       .               .          .

NOTE: The X'X matrix has been found to be singular, and a generalized inverse
      was used to solve the normal equations.  Terms whose estimates are
      followed by the letter 'B' are not uniquely estimable.

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                             Example 5.1                                    5
                            List of data.

                          The GLM Procedure

                Level of          -----------strength----------
                group        N             Mean          Std Dev

                A            3       3175.00000       160.390149
                B            4       3213.75000        78.567911
                C            4       3330.00000        82.056891
                D            4       3552.50000        50.414945
```



```
                             Example 5.1                                    6
                            List of data.

                          The GLM Procedure
                         Least Squares Means

                                     strength
                         group         LSMEAN

                         A         3175.00000
                         B         3213.75000
                         C         3330.00000
                         D         3552.50000
```