```
data one;
  input salinity container weight;
  cards;
0 1 11.29
0 1 11.08
0 1 11.10
0 2 7.37
0 2 6.55
0 2 8.50
6 3 5.64
6 3 5.98
6 3 5.69
6 4 4.20
6 4 3.34
6 4 4.21
12 5 4.83
12 5 4.77
12 5 5.66
12 6 3.28
12 6 2.61
12 6 2.69
;

proc glm;
  class salinity container;
  model weight=salinity container(salinity) / clparm;
  random container(salinity);
  test h=salinity e=container(salinity);
  estimate 'Control Mean' intercept 1 salinity 1 0 0;
  estimate 'Control - 6 bars' salinity 1 -1 0;
  lsmeans salinity / adjust=tukey pdiff cl;
run;
```

The GLM Procedure

Class Level Information

Class	Levels	Values
salinity	3	0 6 12
container	6	1 2 3 4 5 6
Number of observations	18	

Dependent Variable: weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	131.5119611	26.3023922	96.43	<.0001
Error	12	3.2730667	0.2727556		
Corrected Total	17	134.7850278			

R-Square	Coeff Var	Root MSE	weight Mean
0.975716	8.641126	0.522260	6.043889

Source	DF	Type I SS	Mean Square	F Value	Pr > F
salinity	2	98.57221111	49.28610556	180.70	<.0001
container(salinity)	3	32.93975000	10.97991667	40.26	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
salinity	2	98.57221111	49.28610556	180.70	<.0001
container(salinity)	3	32.93975000	10.97991667	40.26	<.0001

Source	Type III Expected Mean Square
salinity	Var(Error) + 3 Var(container(salinity)) + Q(salinity)
container(salinity)	Var(Error) + 3 Var(container(salinity))

Least Squares Means
Adjustment for Multiple Comparisons: Tukey

salinity	weight LSMEAN	LSMEAN Number
0	9.31500000	1
6	4.84333333	2
12	3.97333333	3

Least Squares Means for effect salinity
Pr > |t| for H0: LSMean(i)=LSMean(j)

i/j	1	2	3
1		<.0001	<.0001
2	<.0001		0.0340
3	<.0001	0.0340	

salinity	weight LSMEAN	95% Confidence Limits	
0	9.315000	8.850451	9.779549
6	4.843333	4.378785	5.307882
12	3.973333	3.508785	4.437882

Least Squares Means for Effect salinity

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	4.471667	3.667266	5.276067
1	3	5.341667	4.537266	6.146067
2	3	0.870000	0.065599	1.674401

Tests of Hypotheses Using the Type III MS for container(salinity) as an Error Term

Source	DF	Type III SS	Mean Square	F Value	Pr > F
salinity	2	98.57221111	49.28610556	4.49	0.1254

Parameter	Estimate	Standard Error	t Value	Pr > |t|	95% Confidence Limits	
Control Mean	9.31500000	0.21321177	43.69	<.0001	8.85045146	9.77954854
Control - 6 bars	4.47166667	0.30152698	14.83	<.0001	3.81469582	5.12863752

```
proc mixed;
  class salinity container;
  model weight=salinity;
  random container(salinity);
  estimate 'Control Mean' intercept 1 salinity 1 0 0 / cl;
  estimate 'Control - 6 bars' salinity 1 -1 0 / cl;
  lsmeans salinity / adjust=tukey pdiff cl;
run;
```

The Mixed Procedure

Model Information

Data Set	WORK.ONE
Dependent Variable	weight
Covariance Structure	Variance Components
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Containment

Class Level Information

Class	Levels	Values
salinity	3	0 6 12
container	6	1 2 3 4 5 6

Dimensions

Covariance Parameters	2
Columns in X	4

Columns in Z	6
Subjects	1
Max Obs Per Subject	18
Observations Used	18
Observations Not Used	0
Total Observations	18

Iteration History

Iteration	Evaluations	-2 Res Log Like	Criterion
0	1	61.16387800	
1	1	39.54148651	0.00000000

Convergence criteria met.

Covariance Parameter Estimates

Cov Parm	Estimate
container(salinity)	3.5691
Residual	0.2728

Fit Statistics

-2 Res Log Likelihood	39.5
AIC (smaller is better)	43.5
AICC (smaller is better)	44.5
BIC (smaller is better)	43.1

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
salinity	2	3	4.49	0.1254

Estimates

Label	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Control Mean	9.3150	1.3528	3	6.89	0.0063	0.05	5.0099	13.6201
Control - 6 bars	4.4717	1.9131	3	2.34	0.1015	0.05	-1.6167	10.5600

Least Squares Means

Effect	salinity	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
salinity	0	9.3150	1.3528	3	6.89	0.0063	0.05	5.0099	13.6201
salinity	6	4.8433	1.3528	3	3.58	0.0373	0.05	0.5382	9.1485
salinity	12	3.9733	1.3528	3	2.94	0.0606	0.05	-0.3318	8.2785

Differences of Least Squares Means

Effect	salinity	_salinity	Estimate	Standard Error	DF	t Value	Pr > |t|	Adjustment	Adj P
salinity	0	6	4.4717	1.9131	3	2.34	0.1015	Tukey	0.1929
salinity	0	12	5.3417	1.9131	3	2.79	0.0683	Tukey	0.1326
salinity	6	12	0.8700	1.9131	3	0.45	0.6802	Tukey	0.8960

Differences of Least Squares Means

Effect	salinity	_salinity	Alpha	Lower	Upper	Adj Lower	Adj Upper
salinity	0	6	0.05	-1.6167	10.5600	-3.5226	12.4660
salinity	0	12	0.05	-0.7467	11.4300	-2.6526	13.3360
salinity	6	12	0.05	-5.2184	6.9584	-7.1243	8.8643

```
proc means data=one noprint;
  var weight;
  by salinity container;
  output out=two mean=y;
run;

proc print;
run;
```

Obs	salinity	container	_TYPE_	_FREQ_	y
1	0	1	0	3	11.1567
2	0	2	0	3	7.4733
3	6	3	0	3	5.7700
4	6	4	0	3	3.9167
5	12	5	0	3	5.0867
6	12	6	0	3	2.8600

```
proc glm;
  class salinity;
  model y=salinity;
  estimate 'Control Mean' intercept 1 salinity 1 0 0 / cl;
  estimate 'Control - 6 bars' salinity 1 -1 0 / cl;
  lsmeans salinity / adjust=tukey pdiff cl;
run;
```

Class Level Information

Class	Levels	Values
salinity	3	0 6 12
Number of observations	6	

Dependent Variable: y

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	32.85740370	16.42870185	4.49	0.1254
Error	3	10.97991667	3.65997222		
Corrected Total	5	43.83732037			

R-Square	Coeff Var	Root MSE	y Mean
0.749530	31.65355	1.913105	6.043889

Source	DF	Type I SS	Mean Square	F Value	Pr > F
salinity	2	32.85740370	16.42870185	4.49	0.1254

Source	DF	Type III SS	Mean Square	F Value	Pr > F
salinity	2	32.85740370	16.42870185	4.49	0.1254

Least Squares Means
Adjustment for Multiple Comparisons: Tukey

salinity	y LSMEAN	LSMEAN Number
0	9.31500000	1
6	4.84333333	2
12	3.97333333	3

Least Squares Means for effect salinity
Pr > |t| for H0: LSMean(i)=LSMean(j)

i/j	1	2	3
1		0.1929	0.1326
2	0.1929		0.8960
3	0.1326	0.8960	

salinity	y LSMEAN	95% Confidence Limits	
0	9.315000	5.009883	13.620117
6	4.843333	0.538216	9.148451
12	3.973333	-0.331784	8.278451

Least Squares Means for Effect salinity

i	j	Difference Between Means	Simultaneous 95% Confidence Limits for LSMean(i)-LSMean(j)	
1	2	4.471667	-3.522648	12.465981
1	3	5.341667	-2.652648	13.335981
2	3	0.870000	-7.124314	8.864314