```
data air_pol;
input  ID Height Age INI_Height  INI_Age  Log_FEV1;
L_Height = log(Height);
L_INI_Height = log(INI_Height);
L_Age = log(Age);
L_INI_Age = log(INI_Age);
datalines;
    1    1.20     9.3415     1.20     9.3415     0.21511
……….
   300     1.63     17.8645     1.44     11.9617    1.16938
;
   run;

*Start with the fixed effect analysis.  This analysis is greatly simplified using
the absorb term;

proc glm data=air_pol;
absorb ID;
model Log_FEV1 = L_Age Height/solution;
run;
quit;
```

The GLM Procedure

Dependent Variable: Log_FEV1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	300	208.6461864	0.6954873	172.21	<.0001
Error	1692	6.8333959	0.0040387		
Corrected Total	1992	215.4795823			

R-Square	Coeff Var	Root MSE	Log_FEV1 Mean
0.968288	7.788000	0.063550	0.816004

Source	DF	Type I SS	Mean Square	F Value	Pr > F
ID	298	65.0614168	0.2183269	54.06	<.0001
L_Age	1	138.3949317	138.3949317	34267.6	<.0001
Height	1	5.1898380	5.1898380	1285.04	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
L_Age	1	0.86651269	0.86651269	214.56	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Height	1	5.18983798	5.18983798	1285.04	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
L_Age	0.311246221	0.02124882	14.65	<.0001
Height	1.467778605	0.04094508	35.85	<.0001

Solution for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept	-2.1339	0.08428	297	-25.32	<.0001
Height	1.4506	0.04039	1691	35.91	<.0001
L_Age	0.3192	0.02098	1691	15.21	<.0001

```
*Now we'll center the covariates and fit them to a longitudinal and cross sectional
model;

proc means data=air_pol_trans nway;
class id;
var age;
output out=two mean=mage;
run;
```

Analysis Variable : Age						
ID	N Obs	N	Mean	Std Dev	Minimum	Maximum
1	7	7	12.7016571	2.5792330	9.3415000	16.3723000
2	8	8	13.1957500	4.0681923	6.5873000	17.6318000
3	9	9	11.4652222	3.2554368	6.9131000	16.0164000
299	6	6	15.4528833	1.8728064	12.9555000	17.9904000
300	7	7	14.9482714	2.1421772	11.9617000	17.8645000

```
proc sort data=air_pol_trans;
by ID;
proc sort data=two;
by ID;

data three;
merge air_pol_trans two;
by ID;
cage = age - mage;
run;

*We'll analyze a version of the outcome that has already been corrected for height;

proc mixed data = three;
class ID;
model Log_FEV1_HT = cage mage/ solution;
random intercept /subject=ID g;
contrast 'Longitudinal vs. Cross sectional' cage 1 mage -1;
run;
```

Model Information	
Data Set	WORK.THREE
Dependent Variable	Log_FEV1_HT
Covariance Structure	Variance Components
Subject Effect	ID
Estimation Method	REML
Residual Variance Method	Profile

Model Information	
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Containment

Class Level Information		
Class	**Levels**	**Values**
ID	299	1 2 3 4 5 …….300

Dimensions	
Covariance Parameters	2
Columns in X	3
Columns in Z per Subject	1
Subjects	299
Max Obs per Subject	12

Number of Observations	
Number of Observations Read	1993
Number of Observations Used	1993
Number of Observations Not Used	0

Iteration History			
Iteration	**Evaluations**	**-2 Res Log Like**	**Criterion**
0	1	-2921.88193214	
1	2	-4468.05875634	0.00001361
2	1	-4468.11540864	0.00000002
3	1	-4468.11549096	0.00000000

Covariance Parameter Estimates		
Cov Parm	**Subject**	**Estimate**
Intercept	ID	0.009336
Residual		0.004190

Fit Statistics	
-2 Res Log Likelihood	-4468.1
AIC (Smaller is Better)	-4464.1
AICC (Smaller is Better)	-4464.1
BIC (Smaller is Better)	-4456.7

Solution for Fixed Effects					
Effect	**Estimate**	**Standard Error**	**DF**	**t Value**	**Pr > |t|**
Intercept	-0.3483	0.03517	297	-9.90	<.0001
cage	0.02982	0.000480	1693	62.18	<.0001
mage	0.02923	0.002901	1693	10.08	<.0001

Type 3 Tests of Fixed Effects				
Effect	**Num DF**	**Den DF**	**F Value**	**Pr > F**
cage	1	1693	3865.92	<.0001
mage	1	1693	101.52	<.0001

Contrasts				
Label	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Longitudinal vs. Cross sectional	1	1693	0.04	0.8413

Now we'll refit the model with a single covariate:

```
proc mixed data = three;
class ID;
model Log_FEV1_HT =  age/ solution;
random intercept /subject=ID g;
run;
```

Model Information	
Data Set	WORK.THREE
Dependent Variable	Log_FEV1_HT
Covariance Structure	Variance Components

Model Information	
Subject Effect	ID
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Containment

Class Level Information		
Class	**Levels**	**Values**
ID	299	1 2 3 4 ……. 300

Fit Statistics	
-2 Res Log Likelihood	-4477.9
AIC (Smaller is Better)	-4473.9
AICC (Smaller is Better)	-4473.9
BIC (Smaller is Better)	-4466.5

Solution for Fixed Effects					
Effect	**Estimate**	**Standard Error**	**DF**	**t Value**	**Pr > |t|**
Intercept	-0.3552	0.008179	298	-43.42	<.0001
Age	0.02981	0.000473	1693	62.99	<.0001