The Rohwer data

February 22, 2011

The data:

group	SES	SAT	PPVT	Raven	n	s	ns	na	ss
1	Lo	49	48	8	1	2	6	12	16
1	Lo	47	76	13	5	14	14	30	27
1	Lo	11	40	13	0	10	21	16	16
1	Lo	9	52	9	0	2	5	17	8
1	Lo	69	63	15	2	7	11	26	17
1	Lo	35	82	14	2	15	21	34	25
1	Lo	6	71	21	0	1	20	23	18
1	Lo	8	68	8	0	0	10	19	14
1	Lo	49	74	11	0	0	7	16	13
1	Lo	8	70	15	3	2	21	26	25
1	Lo	47	70	15	8	16	15	35	24
1	Lo	6	61	11	5	4	7	15	14
1	Lo	14	54	12	1	12	13	27	21
1	Lo	30	55	13	2	1	12	20	17
1	Lo	4	54	10	3	12	20	26	22
1	Lo	24	40	14	0	2	5	14	8
1	Lo	19	66	13	7	12	21	35	27
1	Lo	45	54	10	0	6	6	14	16
1	Lo	22	64	14	12	8	19	27	26
1	Lo	16	47	16	3	9	15	18	10
1	Lo	32	48	16	0	7	9	14	18
1	Lo	37	52	14	4	6	20	26	26
1	Lo	47	74	19	4	9	14	23	23
1	Lo	5	57	12	0	2	4	11	8
1	Lo	6	57	10	0	1	16	15	17
1	Lo	60	80	11	3	8	18	28	21
1	Lo	58	78	13	1	18	19	34	23
1	Lo	6	70	16	2	11	9	23	11
1	Lo	16	47	14	0	10	7	12	8
1	Lo	45	94	19	8	10	28	32	32
1	Lo	9	63	11	2	12	5	25	14
1	Lo	69	76	16	7	11	18	29	21

```
 1  Lo  35   59    11  2  5 10 23 24
 1  Lo  19   55     8  0  1 14 19 12
 1  Lo  58   74    14  1  0 10 18 18
 1  Lo  58   71    17  6  4 23 31 26
 1  Lo  79   54    14  0  6  6 15 14
 2  Hi  24   68    15  0 10  8 21 22
 2  Hi   8   82    11  7  3 21 28 21
 2  Hi  88   82    13  7  9 17 31 30
 2  Hi  82   91    18  6 11 16 27 25
 2  Hi  90   82    13 20  7 21 28 16
 2  Hi  77  100    15  4 11 18 32 29
 2  Hi  58  100    13  6  7 17 26 23
 2  Hi  14   96    12  5  2 11 22 23
 2  Hi   1   63    10  3  5 14 24 20
 2  Hi  98   91    18 16 12 16 27 30
 2  Hi   8   87    10  5  3 17 25 24
 2  Hi  88  105    21  2 11 10 26 22
 2  Hi   4   87    14  1  4 14 25 19
 2  Hi  14   76    16 11  5 18 27 22
 2  Hi  38   66    14  0  0  3 16 11
 2  Hi   4   74    15  5  8 11 12 15
 2  Hi  64   68    13  1  6 10 28 23
 2  Hi  88   98    16  1  9 12 30 18
 2  Hi  14   63    15  0 13 13 19 16
 2  Hi  99   94    16  4  6 14 27 19
 2  Hi  50   82    18  4  5 16 21 24
 2  Hi  36   89    15  1  6 15 23 28
 2  Hi  88   80    19  5  8 14 25 24
 2  Hi  14   61    11  4  5 11 16 22
 2  Hi  24  102    20  5  7 17 26 15
 2  Hi  24   71    12  0  4  8 16 14
 2  Hi  24  102    16  4 17 21 27 31
 2  Hi  50   96    13  5  8 20 28 26
 2  Hi   8   55    16  4  7 19 20 13
 2  Hi  98   96    18  4  7 10 23 19
 2  Hi  98   74    15  2  6 14 25 17
 2  Hi  50   78    19  5 10 18 27 26
```

The SAS code and output:

```
data rohwer;
    infile "Rohwer.dat" firstobs=2;
    input group SES $ SAT PPVT Raven n s ns na ss;
    if SES='Lo';

proc print;
```

```
proc reg;
    model SAT PPVT Raven = n s ns na ss;
    mtest;
    n: mtest n;
    s: mtest s;
    ns: mtest ns;
    na: mtest na;
    ss: mtest ss;


proc reg;
    model SAT PPVT Raven = ns na;
    mtest;
    ns2: mtest ns;
    na2: mtest na;

proc reg;
    model SAT PPVT Raven = na;
    na3: mtest;

run;
```

Obs	group	SES	SAT	PPVT	Raven	n	s	ns	na	ss
1	1	Lo	49	48	8	1	2	6	12	16
2	1	Lo	47	76	13	5	14	14	30	27
3	1	Lo	11	40	13	0	10	21	16	16
4	1	Lo	9	52	9	0	2	5	17	8
5	1	Lo	69	63	15	2	7	11	26	17
6	1	Lo	35	82	14	2	15	21	34	25
7	1	Lo	6	71	21	0	1	20	23	18
8	1	Lo	8	68	8	0	0	10	19	14
9	1	Lo	49	74	11	0	0	7	16	13
10	1	Lo	8	70	15	3	2	21	26	25
11	1	Lo	47	70	15	8	16	15	35	24
12	1	Lo	6	61	11	5	4	7	15	14
13	1	Lo	14	54	12	1	12	13	27	21
14	1	Lo	30	55	13	2	1	12	20	17
15	1	Lo	4	54	10	3	12	20	26	22
16	1	Lo	24	40	14	0	2	5	14	8
17	1	Lo	19	66	13	7	12	21	35	27
18	1	Lo	45	54	10	0	6	6	14	16
19	1	Lo	22	64	14	12	8	19	27	26
20	1	Lo	16	47	16	3	9	15	18	10
21	1	Lo	32	48	16	0	7	9	14	18

22	1	Lo	37	52	14	4	6	20	26	26
23	1	Lo	47	74	19	4	9	14	23	23
24	1	Lo	5	57	12	0	2	4	11	8
25	1	Lo	6	57	10	0	1	16	15	17
26	1	Lo	60	80	11	3	8	18	28	21
27	1	Lo	58	78	13	1	18	19	34	23
28	1	Lo	6	70	16	2	11	9	23	11
29	1	Lo	16	47	14	0	10	7	12	8
30	1	Lo	45	94	19	8	10	28	32	32
31	1	Lo	9	63	11	2	12	5	25	14
32	1	Lo	69	76	16	7	11	18	29	21
33	1	Lo	35	59	11	2	5	10	23	24
34	1	Lo	19	55	8	0	1	14	19	12
35	1	Lo	58	74	14	1	0	10	18	18
36	1	Lo	58	71	17	6	4	23	31	26
37	1	Lo	79	54	14	0	6	6	15	14

The REG Procedure
Model: MODEL1
Dependent Variable: SAT

Number of Observations Read	37
Number of Observations Used	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	3653.77324	730.75465	1.63	0.1824
Error	31	13930	449.33949		
Corrected Total	36	17583			

Root MSE	21.19763	R-Square	0.2078
Dependent Mean	31.27027	Adj R-Sq	0.0800
Coeff Var	67.78844		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	4.15106	13.79834	0.30	0.7655
n	1	-0.60887	1.67108	-0.36	0.7181
s	1	-0.05016	0.94151	-0.05	0.9579
ns	1	-1.73240	0.91046	-1.90	0.0664
na	1	0.49456	1.03690	0.48	0.6367
ss	1	2.24772	1.10096	2.04	0.0498

The REG Procedure
Model: MODEL1

Dependent Variable: PPVT
Number of Observations Read 37
Number of Observations Used 37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	2883.67590	576.73518	6.47	0.0003
Error	31	2764.75653	89.18569		
Corrected Total	36	5648.43243			

Root MSE	9.44382	R-Square	0.5105
Dependent Mean	62.64865	Adj R-Sq	0.4316
Coeff Var	15.07426		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	33.00577	6.14734	5.37	<.0001
n	1	-0.08057	0.74449	-0.11	0.9145
s	1	-0.72105	0.41945	-1.72	0.0956
ns	1	-0.29830	0.40562	-0.74	0.4676
na	1	1.47042	0.46195	3.18	0.0033
ss	1	0.32396	0.49049	0.66	0.5138

The REG Procedure
Model: MODEL1
Dependent Variable: Raven
Number of Observations Read 37
Number of Observations Used 37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	76.52860	15.30572	1.77	0.1486
Error	31	268.28221	8.65426		
Corrected Total	36	344.81081			

Root MSE	2.94181	R-Square	0.2219
Dependent Mean	13.24324	Adj R-Sq	0.0965
Coeff Var	22.21369		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	11.17338	1.91494	5.83	<.0001

n	1	0.21100	0.23191	0.91	0.3699
s	1	0.06457	0.13066	0.49	0.6247
ns	1	0.21358	0.12635	1.69	0.1010
na	1	-0.03732	0.14390	-0.26	0.7971
ss	1	-0.05214	0.15279	-0.34	0.7352

The REG Procedure
Model: MODEL1
Multivariate Test 1

Multivariate Statistics and F Approximations

S=3 M=0.5 N=13.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.34316907	2.54	15	80.458	0.0039
Pillai's Trace	0.82528864	2.35	15	93	0.0066
Hotelling-Lawley Trace	1.44875712	2.72	15	49.769	0.0042
Roy's Greatest Root	1.05511542	6.54	5	31	0.0003

NOTE: F Statistic for Roy's Greatest Root is an upper bound.

The REG Procedure
Model: MODEL1
Multivariate Test: n

Multivariate Statistics and Exact F Statistics

S=1 M=0.5 N=13.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.96164244	0.39	3	29	0.7642
Pillai's Trace	0.03835756	0.39	3	29	0.7642
Hotelling-Lawley Trace	0.03988755	0.39	3	29	0.7642
Roy's Greatest Root	0.03988755	0.39	3	29	0.7642

The REG Procedure
Model: MODEL1
Multivariate Test: s

Multivariate Statistics and Exact F Statistics

S=1 M=0.5 N=13.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.88820667	1.22	3	29	0.3213
Pillai's Trace	0.11179333	1.22	3	29	0.3213
Hotelling-Lawley Trace	0.12586410	1.22	3	29	0.3213
Roy's Greatest Root	0.12586410	1.22	3	29	0.3213

The REG Procedure
Model: MODEL1
Multivariate Test: ns

Multivariate Statistics and Exact F Statistics

S=1 M=0.5 N=13.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F

Wilks' Lambda	0.77477885	2.81	3	29	0.0570
Pillai's Trace	0.22522115	2.81	3	29	0.0570
Hotelling-Lawley Trace	0.29069088	2.81	3	29	0.0570
Roy's Greatest Root	0.29069088	2.81	3	29	0.0570

The REG Procedure
Model: MODEL1
Multivariate Test: na

Multivariate Statistics and Exact F Statistics

S=1 M=0.5 N=13.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.73254211	3.53	3	29	0.0271
Pillai's Trace	0.26745789	3.53	3	29	0.0271
Hotelling-Lawley Trace	0.36510923	3.53	3	29	0.0271
Roy's Greatest Root	0.36510923	3.53	3	29	0.0271

The REG Procedure
Model: MODEL1
Multivariate Test: ss

Multivariate Statistics and Exact F Statistics

S=1 M=0.5 N=13.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.86103767	1.56	3	29	0.2203
Pillai's Trace	0.13896233	1.56	3	29	0.2203
Hotelling-Lawley Trace	0.16138937	1.56	3	29	0.2203
Roy's Greatest Root	0.16138937	1.56	3	29	0.2203

The REG Procedure
Model: MODEL1
Dependent Variable: SAT

Number of Observations Read	37
Number of Observations Used	37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1705.56004	852.78002	1.83	0.1765
Error	34	15878	466.99227		
Corrected Total	36	17583			

Root MSE	21.61000	R-Square	0.0970
Dependent Mean	31.27027	Adj R-Sq	0.0439
Coeff Var	69.10719		

Parameter Estimates

Parameter	Standard

Variable	DF	Estimate	Error	t Value	Pr > |t|
Intercept	1	12.96360	11.68856	1.11	0.2752
ns	1	-0.83824	0.80914	-1.04	0.3075
na	1	1.32322	0.70976	1.86	0.0709

The REG Procedure
Model: MODEL1
Dependent Variable: PPVT
Number of Observations Read 37
Number of Observations Used 37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2552.00497	1276.00248	14.01	<.0001
Error	34	3096.42746	91.07140		
Corrected Total	36	5648.43243			

Root MSE	9.54313	R-Square	0.4518
Dependent Mean	62.64865	Adj R-Sq	0.4196
Coeff Var	15.23278		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	36.62049	5.16175	7.09	<.0001
ns	1	-0.04141	0.35732	-0.12	0.9084
na	1	1.18805	0.31344	3.79	0.0006

The REG Procedure
Model: MODEL1
Dependent Variable: Raven
Number of Observations Read 37
Number of Observations Used 37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	66.86503	33.43252	4.09	0.0256
Error	34	277.94578	8.17488		
Corrected Total	36	344.81081			

Root MSE	2.85917	R-Square	0.1939
Dependent Mean	13.24324	Adj R-Sq	0.1465
Coeff Var	21.58968		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	10.10329	1.54649	6.53	<.0001
ns	1	0.19540	0.10706	1.83	0.0768
na	1	0.02256	0.09391	0.24	0.8116

The REG Procedure
Model: MODEL1
Multivariate Test 1

Multivariate Statistics and F Approximations
S=2 M=0 N=15

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.46333120	5.00	6	64	0.0003
Pillai's Trace	0.59915258	4.70	6	66	0.0005
Hotelling-Lawley Trace	1.02342563	5.38	6	40.936	0.0004
Roy's Greatest Root	0.86807261	9.55	3	33	0.0001

NOTE: F Statistic for Roy's Greatest Root is an upper bound.
NOTE: F Statistic for Wilks' Lambda is exact.

The REG Procedure
Model: MODEL1
Multivariate Test: ns2

Multivariate Statistics and Exact F Statistics
S=1 M=0.5 N=15

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.86310909	1.69	3	32	0.1884
Pillai's Trace	0.13689091	1.69	3	32	0.1884
Hotelling-Lawley Trace	0.15860209	1.69	3	32	0.1884
Roy's Greatest Root	0.15860209	1.69	3	32	0.1884

The REG Procedure
Model: MODEL1
Multivariate Test: na2

Multivariate Statistics and Exact F Statistics
S=1 M=0.5 N=15

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.68623559	4.88	3	32	0.0066
Pillai's Trace	0.31376441	4.88	3	32	0.0066
Hotelling-Lawley Trace	0.45722550	4.88	3	32	0.0066
Roy's Greatest Root	0.45722550	4.88	3	32	0.0066

The REG Procedure
Model: MODEL1
Dependent Variable: SAT
Number of Observations Read 37

Number of Observations Used 37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1204.38021	1204.38021	2.57	0.1176
Error	35	16379	467.96906		
Corrected Total	36	17583			

Root MSE	21.63259	R-Square	0.0685
Dependent Mean	31.27027	Adj R-Sq	0.0419
Coeff Var	69.17942		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	13.40010	11.69318	1.15	0.2596
na	1	0.79855	0.49777	1.60	0.1176

The REG Procedure
Model: MODEL1
Dependent Variable: PPVT
Number of Observations Read 37
Number of Observations Used 37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	2550.78211	2550.78211	28.82	<.0001
Error	35	3097.65032	88.50429		
Corrected Total	36	5648.43243			

Root MSE	9.40767	R-Square	0.4516
Dependent Mean	62.64865	Adj R-Sq	0.4359
Coeff Var	15.01656		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	36.64205	5.08518	7.21	<.0001
na	1	1.16213	0.21647	5.37	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: Raven
Number of Observations Read 37

Number of Observations Used 37

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	39.63250	39.63250	4.55	0.0401
Error	35	305.17831	8.71938		
Corrected Total	36	344.81081			

Root MSE	2.95286	R-Square	0.1149
Dependent Mean	13.24324	Adj R-Sq	0.0897
Coeff Var	22.29710		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	10.00155	1.59612	6.27	<.0001
na	1	0.14486	0.06795	2.13	0.0401

The REG Procedure
Model: MODEL1
Multivariate Test: na3

Multivariate Statistics and Exact F Statistics

S=1 M=0.5 N=15.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.53681650	9.49	3	33	0.0001
Pillai's Trace	0.46318350	9.49	3	33	0.0001
Hotelling-Lawley Trace	0.86283396	9.49	3	33	0.0001
Roy's Greatest Root	0.86283396	9.49	3	33	0.0001