Elementary tests

```
/********************** heat2.sas ****************************/
title2 'Standard elementary tests';
options pagesize=35;
%include 'heatread.sas'; /* Basically the data step from heat1.sas */

proc means   mean std n t prt;
     title3 'Matched t-test on Damper in Versus out';
     var diff;

proc ttest;
     title3 'Two-sample t-test: Does consumption depend on Damper Type?';
     class damper;
     var dampin dampout diff ;

proc glm; /* One-way Analysis of Variance:    model DV=IV */
     title2 'Average energy consumption as a function of chimney shape';
     class shape;
     model consume=shape;
     means shape;

proc freq; /* Crosstabs, chisquare test of independence*/
     title2 'Relationship between damper type and other cat vars';
     tables damper * (typfurn shape liner house housecat)
               / nopercent nocol chisq expected;

proc plot; /* Scatterplot */
     title2 'Energy consumption as a function of house age';
     plot consume * age
          consume * age = house;

proc corr ;
     title2 'Correlation matrix of quantitative variables';
     var area height age dampin -- diff;

proc reg;  /*  Simple regression:    model DV=IV */
     model consume=age;
```

```
/res/jbrunner/442s04 > cat heat2.lst

                                Furnace Data                                1
                                                  22:29 Saturday, January 3, 2004
                    Matched t-test on Damper in Versus out

            Analysis Variable : DIFF consumpt w/ damper out minus in

                    Mean       Std Dev   N             T  Prob>|T|
            ----------------------------------------------------------
               0.7746667     0.6191099  90    11.8704824    0.0001
            ----------------------------------------------------------
```

```
                                Furnace Data                                2
                                                  22:21 Saturday, January 3, 2004
          Two-sample t-test: Does consumption depend on Damper Type?

                                TTEST PROCEDURE

Variable: DAMPIN       Energy consumpt with damper in

DAMPER       N         Mean      Std Dev    Std Error      Minimum      Maximum
-------------------------------------------------------------------------------
   TVD      40   9.90775000   3.01986796   0.47748305   4.00000000  18.26000000
   EVD      50  10.14300000   2.76701950   0.39131565   2.97000000  16.06000000

Variances        T       DF    Prob>|T|
---------------------------------------
Unequal    -0.3811     80.2      0.7042
Equal      -0.3848     88.0      0.7013

For H0: Variances are equal, F' = 1.19    DF = (39,49)    Prob>F' = 0.5578
```

```
                                TTEST PROCEDURE

Variable: DAMPOUT      Energy consumpt with damper out

DAMPER       N         Mean      Std Dev    Std Error      Minimum      Maximum
-------------------------------------------------------------------------------
   TVD      40  10.56925000   3.24044820   0.51235985   4.29000000  20.55000000
   EVD      50  11.00820000   2.97987720   0.42141827   3.20000000  17.63000000

Variances        T       DF    Prob>|T|
---------------------------------------
Unequal    -0.6617     80.3      0.5101
Equal      -0.6679     88.0      0.5059

For H0: Variances are equal, F' = 1.18    DF = (39,49)    Prob>F' = 0.5739
```

Furnace Data 4
22:21 Saturday, January 3, 2004
Two-sample t-test: Does consumption depend on Damper Type?

TTEST PROCEDURE

Variable: DIFF consumpt w/ damper out minus in

DAMPER	N	Mean	Std Dev	Std Error	Minimum	Maximum
TVD	40	0.66150000	0.51063334	0.08073822	-0.38000000	2.29000000
EVD	50	0.86520000	0.68545007	0.09693728	-0.87000000	3.98000000

Variances	T	DF	Prob>|T|
Unequal	-1.6147	87.6	0.1100
Equal	-1.5636	88.0	0.1215

For H0: Variances are equal, F' = 1.80 DF = (49,39) Prob>F' = 0.0596

Furnace Data 5
Average energy consumption as a function of chimney shape
22:21 Saturday, January 3, 2004

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SHAPE	3	Rectangular Round Square

Number of observations in data set = 90

NOTE: Due to missing values, only 89 observations can be used in this analysis.

General Linear Models Procedure

Dependent Variable: CONSUME Aver Energy Consumpt

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	61.64218819	30.82109410	3.83	0.0254
Error	86	691.42928934	8.03987546		
Corrected Total	88	753.07147753			

R-Square	C.V.	Root MSE	CONSUME Mean
0.081854	27.35425	2.8354674	10.365730

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SHAPE	2	61.64218819	30.82109410	3.83	0.0254

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SHAPE	2	61.64218819	30.82109410	3.83	0.0254

General Linear Models Procedure

Level of SHAPE	N	CONSUME Mean	CONSUME SD
Rectangular	18	10.9913889	3.63628964
Round	39	9.4258974	2.40561046
Square	32	11.1592187	2.82123575

TABLE OF DAMPER BY TYPFURN

DAMPER(Type of damper) TYPFURN(Type of furnace)

Frequency Expected Row Pct	Forced air	Gravity	Forced water	Total
TVD	31 33.778 77.50	4 3.1111 10.00	5 3.1111 12.50	40
EVD	45 42.222 90.00	3 3.8889 6.00	2 3.8889 4.00	50
Total	76	7	7	90

STATISTICS FOR TABLE OF DAMPER BY TYPFURN

Statistic	DF	Value	Prob
Chi-Square	2	2.933	0.231
Likelihood Ratio Chi-Square	2	2.952	0.229
Mantel-Haenszel Chi-Square	1	2.898	0.089
Phi Coefficient		0.181	
Contingency Coefficient		0.178	
Cramer's V		0.181	

Sample Size = 90
WARNING: 67% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.

TABLE OF DAMPER BY SHAPE

DAMPER(Type of damper) SHAPE(Chimney shape)

Frequency / Expected / Row Pct	Round	Square	Rectangular	Total
TVD	15	14	10	39
	17.09	14.022	7.8876	
	38.46	35.90	25.64	
EVD	24	18	8	50
	21.91	17.978	10.112	
	48.00	36.00	16.00	
Total	39	32	18	89

Frequency Missing = 1

STATISTICS FOR TABLE OF DAMPER BY SHAPE

Statistic	DF	Value	Prob
Chi-Square	2	1.462	0.481
Likelihood Ratio Chi-Square	2	1.457	0.483
Mantel-Haenszel Chi-Square	1	1.363	0.243
Phi Coefficient		0.128	
Contingency Coefficient		0.127	
Cramer's V		0.128	

Effective Sample Size = 89
Frequency Missing = 1

TABLE OF DAMPER BY LINER

DAMPER(Type of damper) LINER(Type of Chimney liner)

Frequency / Expected / Row Pct	Unlined	Tile	Metal	Total
TVD	11	18	10	39
	10.517	17.528	10.955	
	28.21	46.15	25.64	
EVD	13	22	15	50
	13.483	22.472	14.045	
	26.00	44.00	30.00	
Total	24	40	25	89

Frequency Missing = 1

STATISTICS FOR TABLE OF DAMPER BY LINER

Statistic	DF	Value	Prob
Chi-Square	2	0.210	0.900
Likelihood Ratio Chi-Square	2	0.211	0.900
Mantel-Haenszel Chi-Square	1	0.170	0.680
Phi Coefficient		0.049	
Contingency Coefficient		0.049	
Cramer's V		0.049	

Effective Sample Size = 89
Frequency Missing = 1

TABLE OF DAMPER BY HOUSE

DAMPER(Type of damper) HOUSE(Type of house)

Frequency / Expected / Row Pct	Ranch	Two-story	tri-level	Bi-level	1.5 stories	Total
TVD	14	20	2	2	2	40
	16.889	17.778	1.3333	2.6667	1.3333	
	35.00	50.00	5.00	5.00	5.00	
EVD	24	20	1	4	1	50
	21.111	22.222	1.6667	3.3333	1.6667	
	48.00	40.00	2.00	8.00	2.00	
Total	38	40	3	6	3	90

STATISTICS FOR TABLE OF DAMPER BY HOUSE

Statistic	DF	Value	Prob
Chi-Square	4	2.889	0.576
Likelihood Ratio Chi-Square	4	2.909	0.573
Mantel-Haenszel Chi-Square	1	0.795	0.373
Phi Coefficient		0.179	
Contingency Coefficient		0.176	
Cramer's V		0.179	

Sample Size = 90
WARNING: 60% of the cells have expected counts less
than 5. Chi-Square may not be a valid test.

TABLE OF DAMPER BY HOUSECAT

DAMPER(Type of damper) HOUSECAT(Recoded House Type)

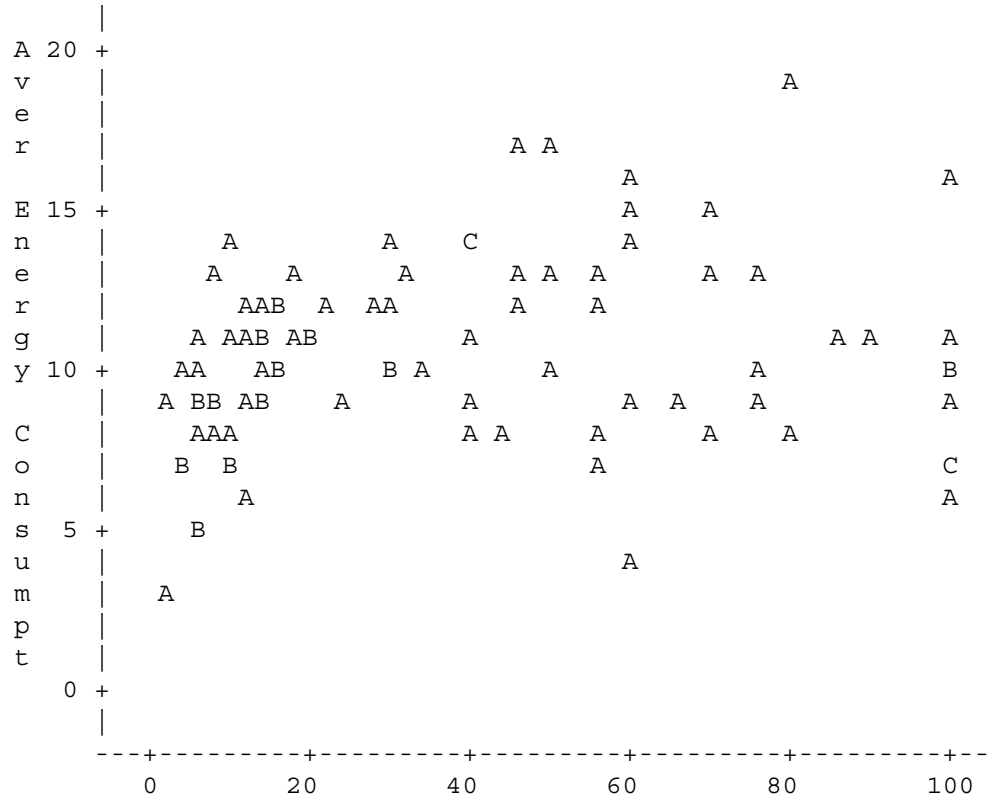
Frequency Expected Row Pct	Ranch	Two Story	Other	Total
TVD	14 16.889 35.00	20 17.778 50.00	6 5.3333 15.00	40
EVD	24 21.111 48.00	20 22.222 40.00	6 6.6667 12.00	50
Total	38	40	12	90

STATISTICS FOR TABLE OF DAMPER BY HOUSECAT

Statistic	DF	Value	Prob
Chi-Square	2	1.539	0.463
Likelihood Ratio Chi-Square	2	1.549	0.461
Mantel-Haenszel Chi-Square	1	1.192	0.275
Phi Coefficient		0.131	
Contingency Coefficient		0.130	
Cramer's V		0.131	

Sample Size = 90

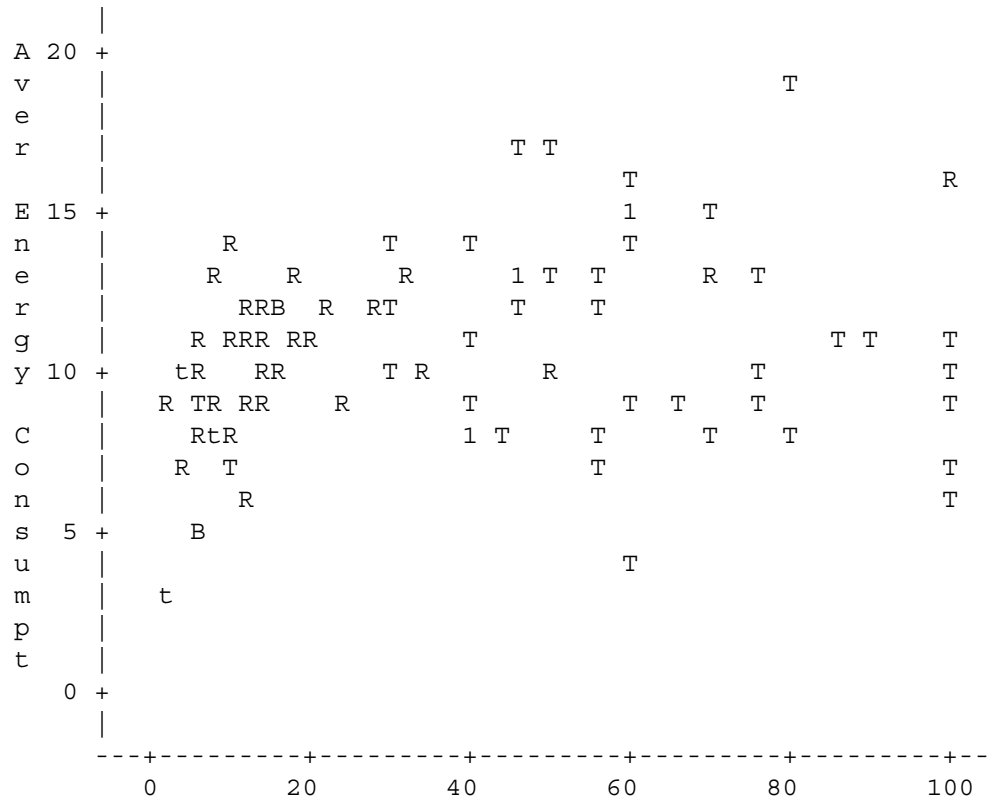
Plot of CONSUME*AGE. Legend: A = 1 obs, B = 2 obs, etc.



Energy consumption as a function of house age

22:21 Saturday, January 3, 2004

Plot of CONSUME*AGE. Symbol is value of HOUSE.



NOTE: 16 obs hidden.

Correlation Analysis

8 'VAR' Variables: AREA HEIGHT AGE DAMPIN DAMPOUT DAMPER CONSUME DIFF

Simple Statistics

Variable	N	Mean	Std Dev	Sum
AREA	89	62.561798	32.530739	5568.000000
HEIGHT	90	21.966667	5.925473	1977.000000
AGE	90	38.566667	31.093209	3471.000000
DAMPIN	90	10.038444	2.867990	903.460000
DAMPOUT	90	10.813111	3.088407	973.180000
DAMPER	90	1.555556	0.499688	140.000000
CONSUME	90	10.425778	2.964117	938.320000
DIFF	90	0.774667	0.619110	69.720000

Simple Statistics

Variable	Minimum	Maximum	Label
AREA	28.000000	168.000000	Chimney area
HEIGHT	14.000000	39.000000	Chimney height in feet
AGE	1.000000	99.000000	House age in yrs (99=99+)
DAMPIN	2.970000	18.260000	Energy consumpt with damper in
DAMPOUT	3.200000	20.550000	Energy consumpt with damper out
DAMPER	1.000000	2.000000	Type of damper
CONSUME	3.085000	19.405000	Aver Energy Consumpt
DIFF	-0.870000	3.980000	consumpt w/ damper out minus in

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0
/ Number of Observations

	AREA	HEIGHT	AGE	DAMPIN
AREA	1.00000	0.54409	0.48488	0.26655
Chimney area	0.0	0.0001	0.0001	0.0116
	89	89	89	89
HEIGHT	0.54409	1.00000	0.57519	0.15719
Chimney height in feet	0.0001	0.0	0.0001	0.1390
	89	90	90	90
AGE	0.48488	0.57519	1.00000	0.14627
House age in yrs (99=99+)	0.0001	0.0001	0.0	0.1689
	89	90	90	90
DAMPIN	0.26655	0.15719	0.14627	1.00000
Energy consumpt with damper in	0.0116	0.1390	0.1689	0.0
	89	90	90	90
DAMPOUT	0.25148	0.15111	0.15973	0.98111
Energy consumpt with damper out	0.0174	0.1551	0.1326	0.0001
	89	90	90	90
DAMPER	-0.03647	-0.02403	-0.07256	0.04099
Type of damper	0.7344	0.8221	0.4967	0.7013
	89	90	90	90

	AREA	HEIGHT	AGE	DAMPIN
CONSUME	0.26001	0.15477	0.15398	0.99491
Aver Energy Consumpt	0.0139	0.1453	0.1473	0.0001
	89	90	90	90
DIFF	0.02034	0.02562	0.11921	0.26177
consumpt w/ damper out minus in	0.8499	0.8106	0.2631	0.0127
	89	90	90	90

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0
/ Number of Observations

	DAMPOUT	DAMPER	CONSUME	DIFF
AREA	0.25148	-0.03647	0.26001	0.02034
Chimney area	0.0174	0.7344	0.0139	0.8499
	89	89	89	89
HEIGHT	0.15111	-0.02403	0.15477	0.02562
Chimney height in feet	0.1551	0.8221	0.1453	0.8106
	90	90	90	90
AGE	0.15973	-0.07256	0.15398	0.11921
House age in yrs (99=99+)	0.1326	0.4967	0.1473	0.2631
	90	90	90	90
DAMPIN	0.98111	0.04099	0.99491	0.26177
Energy consumpt with damper in	0.0001	0.7013	0.0001	0.0127
	90	90	90	90
DAMPOUT	1.00000	0.07102	0.99561	0.44355
Energy consumpt with damper out	0.0	0.5059	0.0001	0.0001
	90	90	90	90
DAMPER	0.07102	1.00000	0.05683	0.16441
Type of damper	0.5059	0.0	0.5947	0.1215
	90	90	90	90

	DAMPOUT	DAMPER	CONSUME	DIFF
CONSUME	0.99561	0.05683	1.00000	0.35771
Aver Energy Consumpt	0.0001	0.5947	0.0	0.0005
	90	90	90	90
DIFF	0.44355	0.16441	0.35771	1.00000
consumpt w/ damper out minus in	0.0001	0.1215	0.0005	0.0
	90	90	90	90

Simple regression of average consumption on age

Model: MODEL1
Dependent Variable: CONSUME Aver Energy Consumpt

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	18.53927	18.53927	2.137	0.1473
Error	88	763.41382	8.67516		
C Total	89	781.95310			

Root MSE	2.94536	R-square	0.0237
Dep Mean	10.42578	Adj R-sq	0.0126
C.V.	28.25076		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	9.859672	0.49633897	19.865	0.0001
AGE	1	0.014679	0.01004103	1.462	0.1473

Variable	DF	Variable Label
INTERCEP	1	Intercept
AGE	1	House age in yrs (99=99+)