Sep 03, 07 4:54 **x8_1.sas** Page 1/1

```
/* x8_1.sas */
/* Purpose:  */

title1 'Example 8.1.';

data a;
  input x1 x2 x3 box$;
  x4=sqrt(x1*x1+x2*x2+x3*x3);
  x5=x4/x3;
  x6=(x1+x2)/x3;
  x7=(2*(x1*x2+x1*x3+x2*x3))/(x1*x2*x3);
  cards;
3.76    3.66    0.54   a
8.59    4.99    1.34   b
6.22    6.14    4.52   c
7.57    7.28    7.07   d
9.03    7.08    2.59   e
5.51    3.98    1.30   f
3.27    0.62    0.44   g
8.74    7.00    3.31   h
9.64    9.49    1.03   i
9.73    1.33    1.00   j
8.59    2.98    1.17   k
7.12    5.49    3.68   l
4.69    3.01    2.17   m
5.51    1.34    1.27   n
1.66    1.61    1.57   o
5.90    5.76    1.55   p
9.84    9.27    1.51   q
8.39    4.92    2.54   r
4.94    4.38    1.03   s
7.23    2.30    1.77   t
9.46    7.31    1.04   u
9.55    5.35    4.25   v
4.94    4.52    4.50   w
8.21    3.08    2.42   x
9.41    6.44    5.11   y
;

proc print data=a;
title2 'List of data.';

proc princomp data=a cov out=b;
  var x1-x7;
title2 'Principal component analysis.';

proc print data=b;
title2 'List of original and transformed data.';

proc plot data=b;
  plot prin2*prin1=box;
title2 'Plot of boxes using transformed variables.';

run;
```

Example 8.1.
List of data. 1

Obs	x1	x2	x3	box	x4	x5	x6	x7
1	3.76	3.66	0.54	a	5.2749	9.7684	13.7407	4.78207
2	8.59	4.99	1.34	b	10.0242	7.4807	10.1343	2.12617
3	6.22	6.14	4.52	c	9.8396	2.1769	2.7345	1.08975
4	7.57	7.28	7.07	d	12.6605	1.7907	2.1004	0.82181
5	9.03	7.08	2.59	e	11.7633	4.5418	6.2201	1.27617
6	5.51	3.98	1.30	f	6.9203	5.3233	7.3000	2.40395
7	3.27	0.62	0.44	g	3.3572	7.6300	8.8409	8.38288
8	8.74	7.00	3.31	h	11.6766	3.5277	4.7553	1.11878
9	9.64	9.49	1.03	i	13.5665	13.1714	18.5728	2.35996
10	9.73	1.33	1.00	j	9.8713	9.8713	11.0600	3.70931
11	8.59	2.98	1.17	k	9.1672	7.8352	9.8889	2.61337
12	7.12	5.49	3.68	l	9.7148	2.6399	3.4266	1.18868
13	4.69	3.01	2.17	m	5.9804	2.7559	3.5484	2.01255
14	5.51	1.34	1.27	n	5.8111	4.5757	5.3937	3.43032
15	1.66	1.61	1.57	o	2.7951	1.7803	2.0828	3.72094
16	5.90	5.76	1.55	p	8.3899	5.4128	7.5226	1.97653
17	9.84	9.27	1.51	q	13.6029	9.0085	12.6556	1.74351
18	8.39	4.92	2.54	r	10.0524	3.9576	5.2402	1.43228
19	4.94	4.38	1.03	s	6.6820	6.4874	9.0485	2.80323
20	7.23	2.30	1.77	t	7.7908	4.4016	5.3842	2.27613
21	9.46	7.31	1.04	u	12.0004	11.5388	16.1250	2.40809
22	9.55	5.35	4.25	v	11.7426	2.7630	3.5059	1.05384
23	4.94	4.52	4.50	w	8.0675	1.7928	2.1022	1.29178
24	8.21	3.08	2.42	x	9.0965	3.7589	4.6653	1.71940
25	9.41	6.44	5.11	y	12.4954	2.4453	3.1018	0.91449

Example 8.1.
Principal component analysis. 2

The PRINCOMP Procedure

Observations	25
Variables	7

Simple Statistics

	x1	x2	x3	x4
Mean	7.100000000	4.773200000	2.348800000	9.133726031
StD	2.323802559	2.417786040	1.665561267	3.018070021

Simple Statistics

	x5	x6	x7
Mean	5.457434379	7.166030086	2.346239743
StD	3.272548980	4.556922981	1.609918779

Covariance Matrix

	x1	x2	x3	x4
x1	5.40005833	3.26016667	0.77845833	6.39141786
x2	3.26016667	5.84568933	1.46498317	6.08371134
x3	0.77845833	1.46498317	2.77409433	2.20393923
x4	6.39141786	6.08371134	2.20393923	9.10874665
x5	2.15225468	1.31380261	-3.83822483	1.61113578
x6	3.03090404	2.87963509	-5.16497028	2.78340555
x7	-1.99570499	-2.37077484	-1.74014908	-3.28322901

Covariance Matrix

	x5	x6	x7
x1	2.15225468	3.03090404	-1.99570499
x2	1.31380261	2.87963509	-2.37077484
x3	-3.83822483	-5.16497028	-1.74014908
x4	1.61113578	2.78340555	-3.28322901
x5	10.70957682	14.76647420	2.25100403
x6	14.76647420	20.76554705	2.61980028
x7	2.25100403	2.61980028	2.59183847

Total Variance 57.195551003

Eigenvalues of the Covariance Matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	34.4760418	15.4769827	0.6028	0.6028
2	18.9990591	16.4593797	0.3322	0.9350
3	2.5396794	1.7344918	0.0444	0.9794
4	0.8051876	0.4654481	0.0141	0.9934

5	0.3397395	0.3064098	0.0059	0.9994
6	0.0333297	0.0308158	0.0006	1.0000
7	0.0025139		0.0000	1.0000

Example 8.1. 3
Principal component analysis.

The PRINCOMP Procedure

Eigenvectors

	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6	Prin7
x1	0.164241	0.422028	-.644940	-.090523	0.224606	0.413948	0.385972
x2	0.142309	0.447329	0.712744	-.050403	0.395326	0.065197	0.329496
x3	-.172871	0.256840	0.130628	0.630138	-.605881	0.279708	0.211383
x4	0.170067	0.649485	-.146410	0.212146	0.033056	-.401252	-.566312
x5	0.546378	-.134949	-.105360	0.164951	-.161317	-.597236	0.512091
x6	0.768208	-.133457	0.148809	-.061835	-.206713	0.465827	-.326117
x7	0.072755	-.313003	-.065601	0.718438	0.596935	0.107102	-.092072

Example 8.1. 4
List of original and transformed data.

Obs	x1	x2	x3	box	x4	x5	x6	x7	Prin1
1	3.76	3.66	0.54	a	5.2749	9.7684	13.7407	4.78207	6.5328
2	8.59	4.99	1.34	b	10.0242	7.4807	10.1343	2.12617	3.9711
3	6.22	6.14	4.52	c	9.8396	2.1769	2.7345	1.08975	-5.4935
4	7.57	7.28	7.07	d	12.6605	1.7907	2.1004	0.82181	-5.7882
5	9.03	7.08	2.59	e	11.7633	4.5418	6.2201	1.27617	-0.2540
6	5.51	3.98	1.30	f	6.9203	5.3233	7.3000	2.40395	-0.5353
7	3.27	0.62	0.44	g	3.3572	7.6300	8.8409	8.38288	1.0404
8	8.74	7.00	3.31	h	11.6766	3.5277	4.7553	1.11878	-2.1431
9	9.64	9.49	1.03	i	13.5665	13.1714	18.5728	2.35996	15.0488
10	9.73	1.33	1.00	j	9.8713	9.8713	11.0600	3.70931	5.8027
11	8.59	2.98	1.17	k	9.1672	7.8352	9.8889	2.61337	3.6093
12	7.12	5.49	3.68	l	9.7148	2.6399	3.4266	1.18868	-4.5223
13	4.69	3.01	2.17	m	5.9804	2.7559	3.5484	2.01255	-5.4315
14	5.51	1.34	1.27	n	5.8111	4.5757	5.3937	3.43032	-2.8927
15	1.66	1.61	1.57	o	2.7951	1.7803	2.0828	3.72094	-8.1010
16	5.90	5.76	1.55	p	8.3899	5.4128	7.5226	1.97653	0.1776
17	9.84	9.27	1.51	q	13.6029	9.0085	12.6556	1.74351	8.1086
18	8.39	4.92	2.54	r	10.0524	3.9576	5.2402	1.43228	-2.0095
19	4.94	4.38	1.03	s	6.6820	6.4874	9.0485	2.80323	1.4424
20	7.23	2.30	1.77	t	7.7908	4.4016	5.3842	2.27613	-2.4098
21	9.46	7.31	1.04	u	12.0004	11.5388	16.1250	2.40809	11.6720
22	9.55	5.35	4.25	v	11.7426	2.7630	3.5059	1.05384	-3.7785
23	4.94	4.52	4.50	w	8.0675	1.7928	2.1022	1.29178	-6.9131
24	8.21	3.08	2.42	x	9.0965	3.7589	4.6653	1.71940	-2.9720
25	9.41	6.44	5.11	y	12.4954	2.4453	3.1018	0.91449	-4.1612

Obs	Prin2	Prin3	Prin4	Prin5	Prin6	Prin7
1	-7.1000	2.05374	0.45457	-0.82238	0.33617	-0.013808
2	0.4447	-0.82561	-0.60050	-0.01033	0.14223	0.017381
3	2.6836	1.49061	0.35887	-0.25426	-0.19076	0.050843
4	6.4709	1.31647	2.16750	-0.91869	-0.06966	-0.077232
5	4.2010	0.07184	-0.44245	0.99070	-0.04676	0.004966
6	-2.7506	0.67745	-0.93550	-0.08002	0.03359	0.039051
7	-10.1224	-0.26933	2.71952	1.37023	0.05692	0.031641
8	4.5530	0.20779	-0.16664	0.82727	-0.02937	0.040811
9	3.1546	1.78624	0.21866	-0.21339	-0.08059	-0.025550
10	-1.8397	-4.40949	0.70857	-0.63218	-0.48520	0.042690
11	-1.2222	-2.26080	-0.36444	-0.44588	0.03363	0.021187
12	2.2900	0.40315	-0.14100	0.03703	0.01106	0.079458
13	-2.9480	0.50410	-0.93626	-0.24982	-0.00481	0.063903
14	-4.6257	-1.31794	-0.32472	-0.01483	-0.03340	-0.064684
15	-7.2834	1.62103	-0.48817	0.25454	-0.15713	-0.068799
16	-0.6791	1.56384	-0.89729	0.29277	-0.20423	0.009295
17	4.8319	1.15633	-0.24185	0.98165	-0.22868	-0.085277
18	2.0013	-0.90547	-0.59373	0.35677	0.12917	0.010624
19	-3.5518	1.44115	-0.75401	-0.20510	0.00589	0.017843
20	-1.6701	-1.87489	-0.65110	-0.14542	0.06261	-0.079698
21	1.6208	0.38374	-0.06448	-0.37538	0.17390	0.033540
22	4.7313	-1.47859	0.35398	0.13244	0.30259	-0.007032
23	0.3355	1.35146	0.28871	-0.91538	-0.16421	0.013273
24	0.4643	-2.06001	-0.55405	-0.04766	0.16631	-0.089916
25	6.0100	-0.62681	0.88580	0.08732	0.24074	0.035493

Example 8.1. 5
Plot of boxes using transformed variables.

Plot of Prin2*Prin1. Symbol is value of box.