---------- Standardized Data ----------

Obs	school	x1	x2	x3	x4	x5	x6
1	Harvard	1.23256	0.74715	-1.27742	-0.42288	0.84139	1.13494
2	Princeto	1.00185	0.74715	-1.27742	-1.16046	0.19633	0.91413
3	Yale	1.00185	0.95297	-1.02396	-0.42288	1.11793	1.02453
4	Stanford	0.86342	0.69569	-0.97327	-0.17702	0.62822	0.69333
5	MIT	1.04799	0.90152	-0.46636	-0.66874	0.51869	0.47252
6	Duke	0.44814	0.69569	-0.46636	-0.17702	0.29096	0.91413
7	CalTech	1.37099	1.21026	-0.71981	-1.65218	2.50865	-0.63150
8	Dartmout	0.67885	0.64423	-0.82120	-0.66874	0.33096	0.91413
9	Brown	0.40199	0.64423	-0.87189	0.06884	-0.32472	0.80373
10	JohnsHop	0.35585	-0.07616	0.24332	-1.40632	2.17007	0.03091
11	UChicago	0.21742	-0.07616	0.54746	0.06884	0.76202	0.03091
12	UPenn	0.17128	0.18113	-0.16221	-0.42288	0.01144	0.36212
13	Cornell	0.12514	0.33550	-0.31429	0.06884	-0.38295	0.36212
14	Northwes	-0.05943	0.43841	-0.01014	-0.42288	0.04603	0.25172
15	Columbia	0.40199	-0.02470	-0.77051	-0.17702	0.28576	0.14132
16	NotreDam	-0.10557	0.23258	0.14194	0.06884	-0.85034	0.80373
17	UVir	-0.38243	0.02676	0.24332	0.31470	-0.97325	0.58292
18	Georgeto	-0.10557	-0.12761	-0.77051	-0.17702	-0.50344	0.58292
19	Carnegie	-0.05943	-0.74509	1.00368	-0.91460	-0.16374	-1.62512
20	UMichiga	-0.79771	-0.59072	1.45991	0.80642	-0.82621	-0.18989
21	UCBerkel	-0.24400	0.95297	0.04055	1.05228	-0.84909	-0.96271
22	UWiscons	-1.67442	-1.87713	1.51060	0.56056	-1.07668	-1.73553
23	PennStat	-1.71134	-1.98004	0.75023	1.29814	-1.19259	-0.74190
24	Purdue	-2.41270	-2.49461	2.57511	1.54400	-1.27017	-1.95633
25	TexasA&M	-1.76671	-1.41402	1.40921	3.01917	-1.29526	-2.17713

---------- Part A: Hierarchical Clustering Wtih Average Linkage ----------

The CLUSTER Procedure
Average Linkage Cluster Analysis

Eigenvalues of the Covariance Matrix				
	Eigenvalue	Difference	Proportion	Cumulative
1	4.61208506	3.82526891	0.7687	0.7687
2	0.78681615	0.50025429	0.1311	0.8998
3	0.28656186	0.12278175	0.0478	0.9476
4	0.16378011	0.03947391	0.0273	0.9749
5	0.12430620	0.09785557	0.0207	0.9956
6	0.02645063		0.0044	1.0000

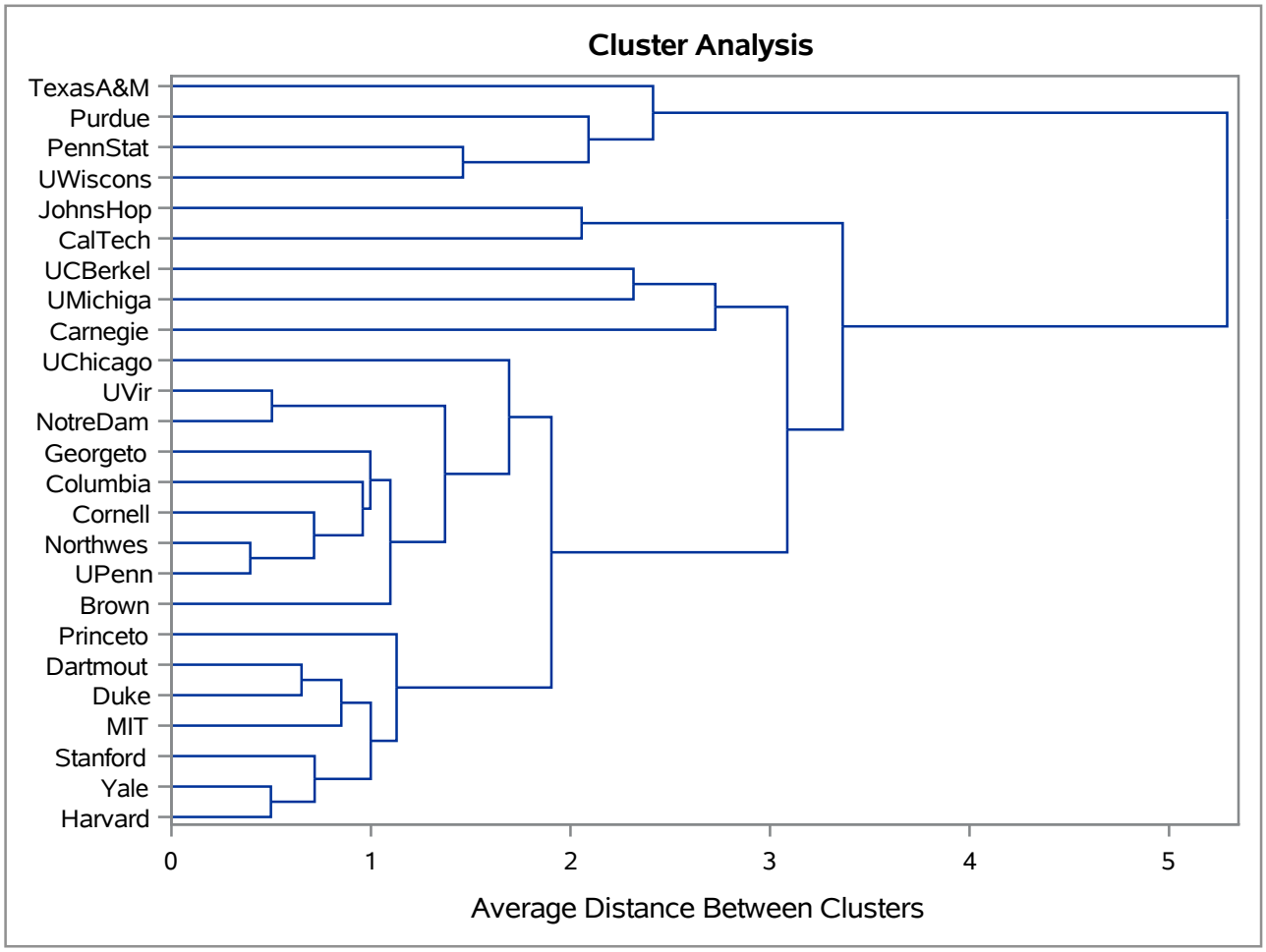
Root-Mean-Square Total-Sample Standard Deviation	1

Cluster History					
Number of Clusters	Clusters Joined		Freq	RMS Distance	Tie
24	UPenn	Northwes	2	0.3949	
23	Harvard	Yale	2	0.4985	
22	NotreDam	UVir	2	0.5036	
21	Duke	Dartmout	2	0.6521	
20	CL24	Cornell	3	0.7147	
19	CL23	Stanford	3	0.7177	
18	MIT	CL21	3	0.8513	
17	CL20	Columbia	4	0.9586	
16	CL17	Georgeto	5	0.9968	
15	CL19	CL18	6	0.999	
14	Brown	CL16	6	1.0972	
13	CL15	Princeto	7	1.1285	
12	CL14	CL22	8	1.3712	
11	UWiscons	PennStat	2	1.4611	
10	CL12	UChicago	9	1.6924	
9	CL13	CL10	16	1.9044	
8	CalTech	JohnsHop	2	2.0559	
7	CL11	Purdue	3	2.0906	
6	UMichiga	UCBerkel	2	2.3157	
5	CL7	TexasA&M	4	2.4139	
4	Carnegie	CL6	3	2.7258	
3	CL9	CL4	19	3.0866	

---------- Part A: Hierarchical Clustering Wtih Average Linkage ----------

The CLUSTER Procedure
Average Linkage Cluster Analysis

Cluster History					
Number of Clusters	Clusters Joined		Freq	RMS Distance	Tie
2	CL3	CL8	21	3.3643	
1	CL2	CL5	25	5.2914	



---------- PCA to see how many cluster to use for k-mean clustering ----------

The PRINCOMP Procedure

Observations	25
Variables	6

Simple Statistics

	x1	x2	x3	x4	x5	x6
Mean	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000
StD	1.000000000	1.000000000	1.000000000	1.000000000	1.000000000	1.000000000

Correlation Matrix

		x1	x2	x3	x4	x5	x6
x1	Average SAT	1.0000	0.9225	-.8858	-.8126	0.7790	0.7477
x2	Top 10%	0.9225	1.0000	-.8592	-.6434	0.6115	0.7459
x3	% Accepted	-.8858	-.8592	1.0000	0.6317	-.5584	-.8195
x4	Student Faculty Ratio	-.8126	-.6434	0.6317	1.0000	-.7818	-.5609
x5	Estimated Annual Expense	0.7790	0.6115	-.5584	-.7818	1.0000	0.3936
x6	Graduation Rate %	0.7477	0.7459	-.8195	-.5609	0.3936	1.0000

Eigenvalues of the Correlation Matrix

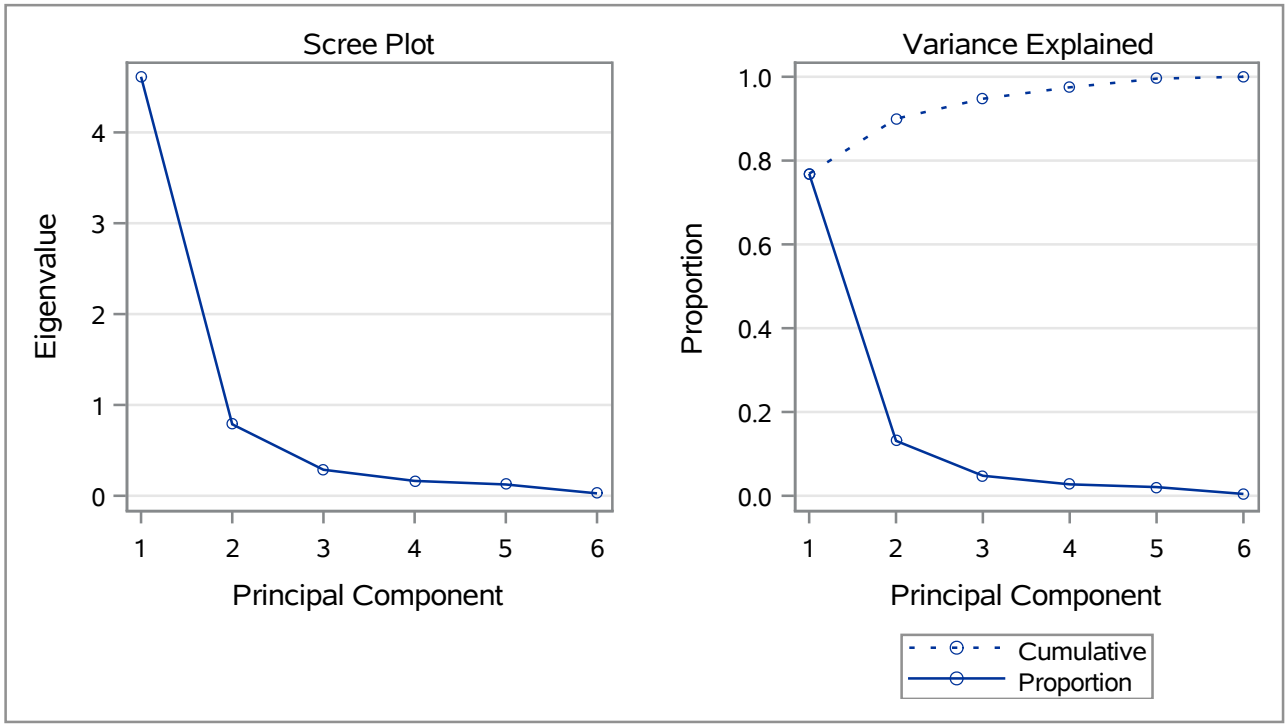
	Eigenvalue	Difference	Proportion	Cumulative
1	4.61208506	3.82526891	0.7687	0.7687
2	0.78681615	0.50025429	0.1311	0.8998
3	0.28656186	0.12278175	0.0478	0.9476
4	0.16378011	0.03947391	0.0273	0.9749
5	0.12430620	0.09785557	0.0207	0.9956
6	0.02645063		0.0044	1.0000

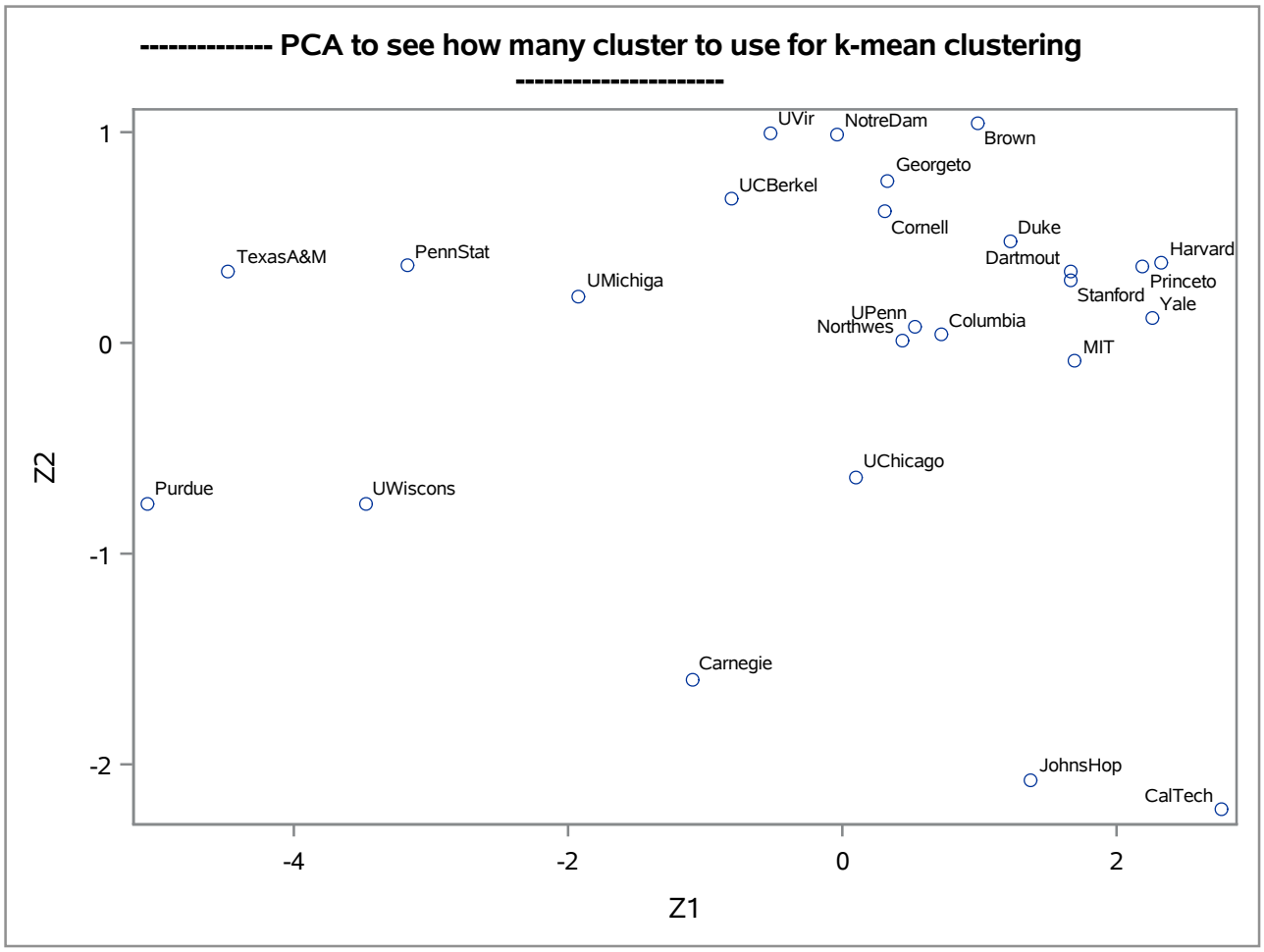
Eigenvectors

		Prin1	Prin2	Prin3	Prin4	Prin5	Prin6
x1	Average SAT	0.457749	-.039680	0.187039	-.131240	0.020646	0.858055
x2	Top 10%	0.427144	0.199932	0.497809	-.374896	0.482016	-.396075
x3	% Accepted	-.424308	-.320893	-.156279	-.061287	0.801094	0.216934
x4	Student Faculty Ratio	-.390648	0.432564	0.606081	0.507391	0.076824	0.172048
x5	Estimated Annual Expense	0.362523	-.634486	0.204741	0.623401	0.072548	-.173763
x6	Graduation Rate %	0.379404	0.515554	-.532473	0.438633	0.338110	-.003538

---------- PCA to see how many cluster to use for k-mean clustering ----------

The PRINCOMP Procedure




---------- PCA to see how many cluster to use for k-mean clustering ----------
UVir
NotreDam
Brown
Georgeto
UCBerkel
Cornell
Duke
Dartmout
Harvard
Princeto
Stanford
Yale
TexasA&M
PennStat
UMichiga
UPenn
Northwes
Columbia
MIT
UChicago
Purdue
UWiscons
Carnegie
JohnsHop
CalTech
1
0
-1
-2
-4
-2
0
2
Z1
Z2

--------- Part B: K-mean Clustering, Seeds=first 3 observations with Radius r=1.5 ----------

The FASTCLUS Procedure
Replace=NONE Radius=1.5 Maxclusters=3 Maxiter=10 Converge=0.02

Initial Seeds						
Cluster	**x1**	**x2**	**x3**	**x4**	**x5**	**x6**
1	1.232560743	0.747147830	-1.277417094	-0.422879796	0.841393297	1.134936246
2	1.370988499	1.210255988	-0.719814394	-1.652181530	2.508651168	-0.631501491
3	0.401994205	0.644234905	-0.871887858	0.068840897	-0.324716668	0.803729170

Minimum Distance Between Initial Seeds =	1.60505

Iteration History				
		Relative Change in Cluster Seeds		
Iteration	**Criterion**	**1**	**2**	**3**
1	1.0566	0.3528	0.6405	1.3235
2	0.7228	0.2147	0	0.2621
3	0.6772	0.2498	0	0.4461
4	0.6121	0.1140	0	0.3330
5	0.5837	0.0715	0	0.2120
6	0.5730	0.0916	0	0.2764
7	0.5639	0	0	0

Convergence criterion is satisfied.

Criterion Based on Final Seeds =	0.5639

Cluster Summary						
Cluster	**Frequency**	**RMS Std Deviation**	**Maximum Distance from Seed to Observation**	**Radius Exceeded**	**Nearest Cluster**	**Distance Between Cluster Centroids**
1	17	0.5116	2.3526	> Radius	2	2.8166
2	2	0.5935	1.0280		1	2.8166
3	6	0.8258	2.6781	> Radius	1	4.1582

Statistics for Variables				
Variable	**Total STD**	**Within STD**	**R-Square**	**RSQ/(1-RSQ)**
x1	1.00000	0.60488	0.664607	1.981578
x2	1.00000	0.51417	0.757661	3.126453
x3	1.00000	0.57444	0.697514	2.305942
x4	1.00000	0.74026	0.497680	0.990762

--------- Part B: K-mean Clustering, Seeds=first 3 observations with Radius r=1.5 ----------

The FASTCLUS Procedure
Replace=NONE Radius=1.5 Maxclusters=3 Maxiter=10 Converge=0.02

Statistics for Variables				
Variable	**Total STD**	**Within STD**	**R-Square**	**RSQ/(1-RSQ)**
x5	1.00000	0.57695	0.694871	2.277300
x6	1.00000	0.57185	0.700242	2.336026
OVER-ALL	1.00000	0.60112	0.668763	2.018982

Pseudo F Statistic =	22.21

Approximate Expected Over-All R-Squared =	0.34659

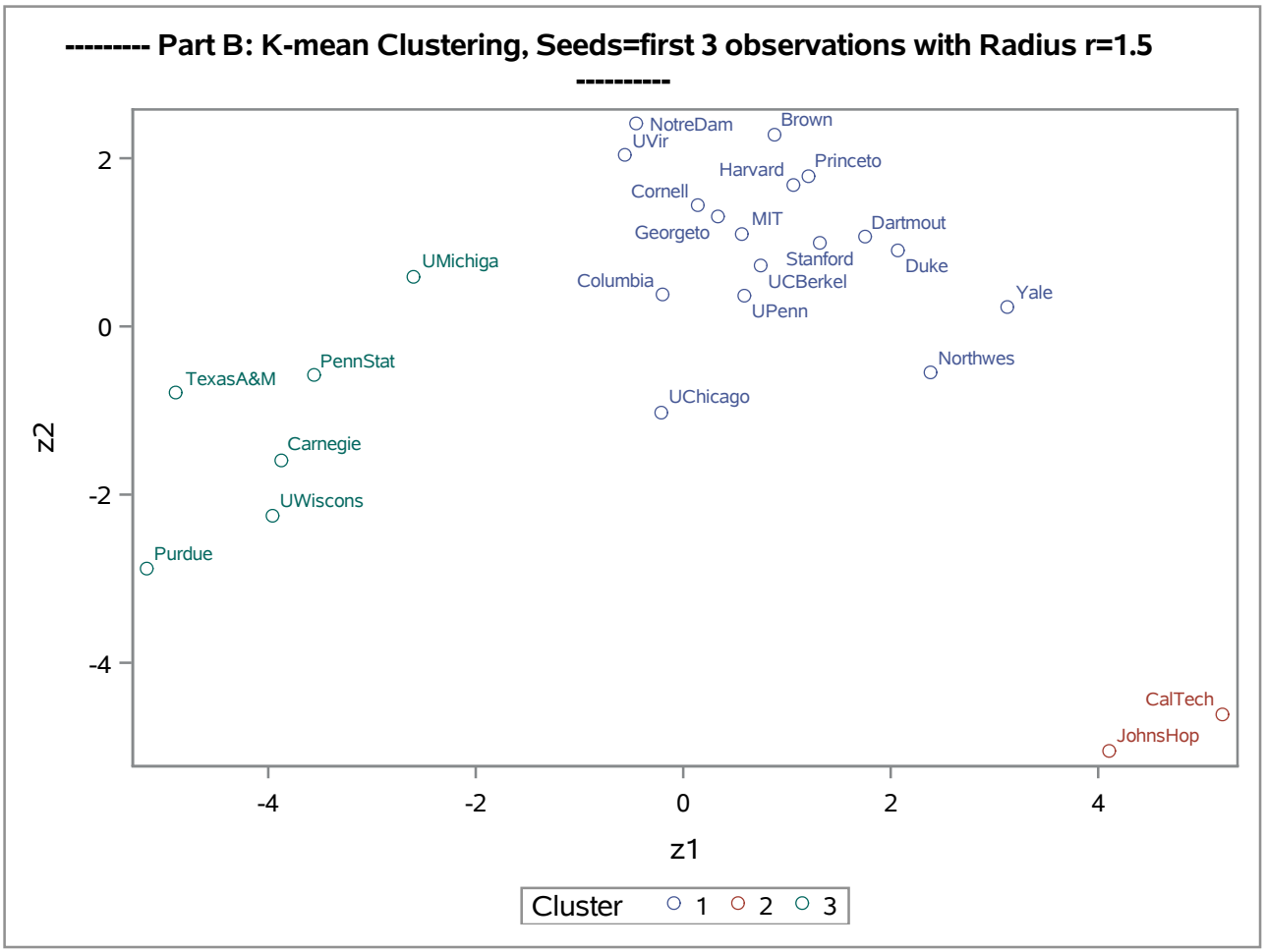
Cubic Clustering Criterion =	12.073

WARNING: The two values above are invalid for correlated variables.

Cluster Means						
Cluster	**x1**	**x2**	**x3**	**x4**	**x5**	**x6**
1	0.393851395	0.468677564	-0.484249617	-0.191481823	0.067408029	0.530970402
2	0.863420059	0.567050212	-0.238248426	-1.529251357	2.339360369	-0.300294415
3	-1.403718973	-1.516936502	1.451456725	1.052282284	-0.970776205	-1.404318001

Cluster Standard Deviations						
Cluster	**x1**	**x2**	**x3**	**x4**	**x5**	**x6**
1	0.502624751	0.372863597	0.549754036	0.479826153	0.629396603	0.500047199
2	0.717810172	0.909630332	0.681037123	0.173849518	0.239413344	0.468397538
3	0.835711735	0.743541426	0.626126394	1.291644595	0.430706882	0.771237721

--------- Part B: K-mean Clustering, Seeds=first 3 observations with Radius r=1.5 ----------



--------- Part B: K-mean Clustering, Seeds=first 3 observations with Radius r=1.5 ----------

Obs	school	CLUSTER	DISTANCE
1	Duke	1	0.50179
2	UPenn	1	0.56667
3	Cornell	1	0.64648
4	Brown	1	0.69071
5	Columbia	1	0.72467
6	Northwes	1	0.75043
7	Dartmout	1	0.81831
8	Stanford	1	0.92317
9	Georgeto	1	1.00782
10	MIT	1	1.02490
11	NotreDam	1	1.29680
12	Princeto	1	1.47603
13	UChicago	1	1.48078
14	Yale	1	1.51533
15	Harvard	1	1.55803
16	UVir	1	1.63375
17	UCBerkel	1	2.35262
18	CalTech	2	1.02797
19	JohnsHop	2	1.02797
20	UWiscons	3	0.75447
21	PennStat	3	1.16158
22	UMichiga	3	1.66774
23	Purdue	3	1.96790
24	TexasA&M	3	2.17147
25	Carnegie	3	2.67807

-------- Part C: Use Average Linkage to get cluster centriods as seeds ----------

Obs	school	CLUSTER
1	UPenn	1
2	Northwes	1
3	Harvard	1
4	Yale	1
5	NotreDam	1
6	UVir	1
7	Duke	1
8	Dartmout	1
9	Cornell	1
10	Stanford	1
11	MIT	1
12	Columbia	1
13	Georgeto	1
14	Brown	1
15	Princeto	1
16	UChicago	1
17	UMichiga	1
18	UCBerkel	1
19	Carnegie	1
20	UWiscons	2
21	PennStat	2
22	Purdue	2
23	TexasA&M	2
24	CalTech	3
25	JohnsHop	3

-------- Part C: Use Average Linkage to get cluster centriods as seeds ----------

The MEANS Procedure

CLUSTER=1

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
x1	Average SAT	19	0.3072805	0.5540257	-0.7977130	1.2325607
x2	Top 10%	19	0.3490373	0.5026612	-0.7450896	0.9529737
x3	% Accepted	19	-0.3036133	0.7531194	-1.2774171	1.4599053
x4	Student Faculty Ratio	19	-0.1770194	0.5374047	-1.1604608	1.0522823
x5	Estimated Annual Expense	19	0.0082095	0.6290930	-0.9732488	1.1179293
x6	Graduation Rate %	19	0.3795517	0.6965594	-1.6251227	1.1349362

CLUSTER=2

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
x1	Average SAT	4	-1.8912923	0.3496703	-2.4127035	-1.6744221
x2	Top 10%	4	-1.9414523	0.4433923	-2.4946093	-1.4140236
x3	% Accepted	4	1.5612876	0.7552812	0.7502291	2.5751107
x4	Student Faculty Ratio	4	1.6054681	1.0309535	0.5605616	3.0191651
x5	Estimated Annual Expense	4	-1.2086753	0.0982505	-1.2952618	-1.0766812
x6	Graduation Rate %	4	-1.6527233	0.6334120	-2.1771345	-0.7419038

CLUSTER=3

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
x1	Average SAT	2	0.8634201	0.7178102	0.3558516	1.3709885
x2	Top 10%	2	0.5670502	0.9096303	-0.0761556	1.2102560
x3	% Accepted	2	-0.2382484	0.6810371	-0.7198144	0.2433175
x4	Student Faculty Ratio	2	-1.5292514	0.1738495	-1.6521815	-1.4063212
x5	Estimated Annual Expense	2	2.3393604	0.2394133	2.1700696	2.5086512
x6	Graduation Rate %	2	-0.3002944	0.4683975	-0.6315015	0.0309127

-------- Part C: Use Average Linkage to get cluster centriods as seeds ----------

The FASTCLUS Procedure
Replace=FULL Radius=0 Maxclusters=3 Maxiter=50 Converge=0.02

Initial Seeds						
Cluster	**x1**	**x2**	**x3**	**x4**	**x5**	**x6**
1	0.307280476	0.349037307	-0.303613336	-0.177019450	0.008209498	0.379551687
2	-1.891292293	-1.941452315	1.561287560	1.605468064	-1.208675301	-1.652723308
3	0.863420059	0.567050212	-0.238248426	-1.529251357	2.339360369	-0.300294415

Minimum Distance Between Initial Seeds =	2.843603

Iteration History				
		Relative Change in Cluster Seeds		
Iteration	**Criterion**	**1**	**2**	**3**
1	0.5733	0.0524	0.1716	0
2	0.5639	0	0	0

Convergence criterion is satisfied.

Criterion Based on Final Seeds =	0.5639

Cluster Summary						
Cluster	**Frequency**	**RMS Std Deviation**	**Maximum Distance from Seed to Observation**	**Radius Exceeded**	**Nearest Cluster**	**Distance Between Cluster Centroids**
1	18	0.5751	2.8518		3	2.7765
2	5	0.7028	1.9523		1	4.4267
3	2	0.5935	1.0280		1	2.7765

Statistics for Variables				
Variable	**Total STD**	**Within STD**	**R-Square**	**RSQ/(1-RSQ)**
x1	1.00000	0.52548	0.746877	2.950651
x2	1.00000	0.54325	0.729474	2.696505
x3	1.00000	0.64350	0.620416	1.634466
x4	1.00000	0.59951	0.670534	2.035216
x5	1.00000	0.54739	0.725333	2.640773
x6	1.00000	0.72382	0.519743	1.082220
OVER-ALL	1.00000	0.60115	0.668730	2.018683

Pseudo F Statistic =	22.21

-------- Part C: Use Average Linkage to get cluster centriods as seeds ----------

The FASTCLUS Procedure
Replace=FULL Radius=0 Maxclusters=3 Maxiter=50 Converge=0.02

Approximate Expected Over-All R-Squared =	0.34659

Cubic Clustering Criterion =	12.071

WARNING: The two values above are invalid for correlated variables.

Cluster Means

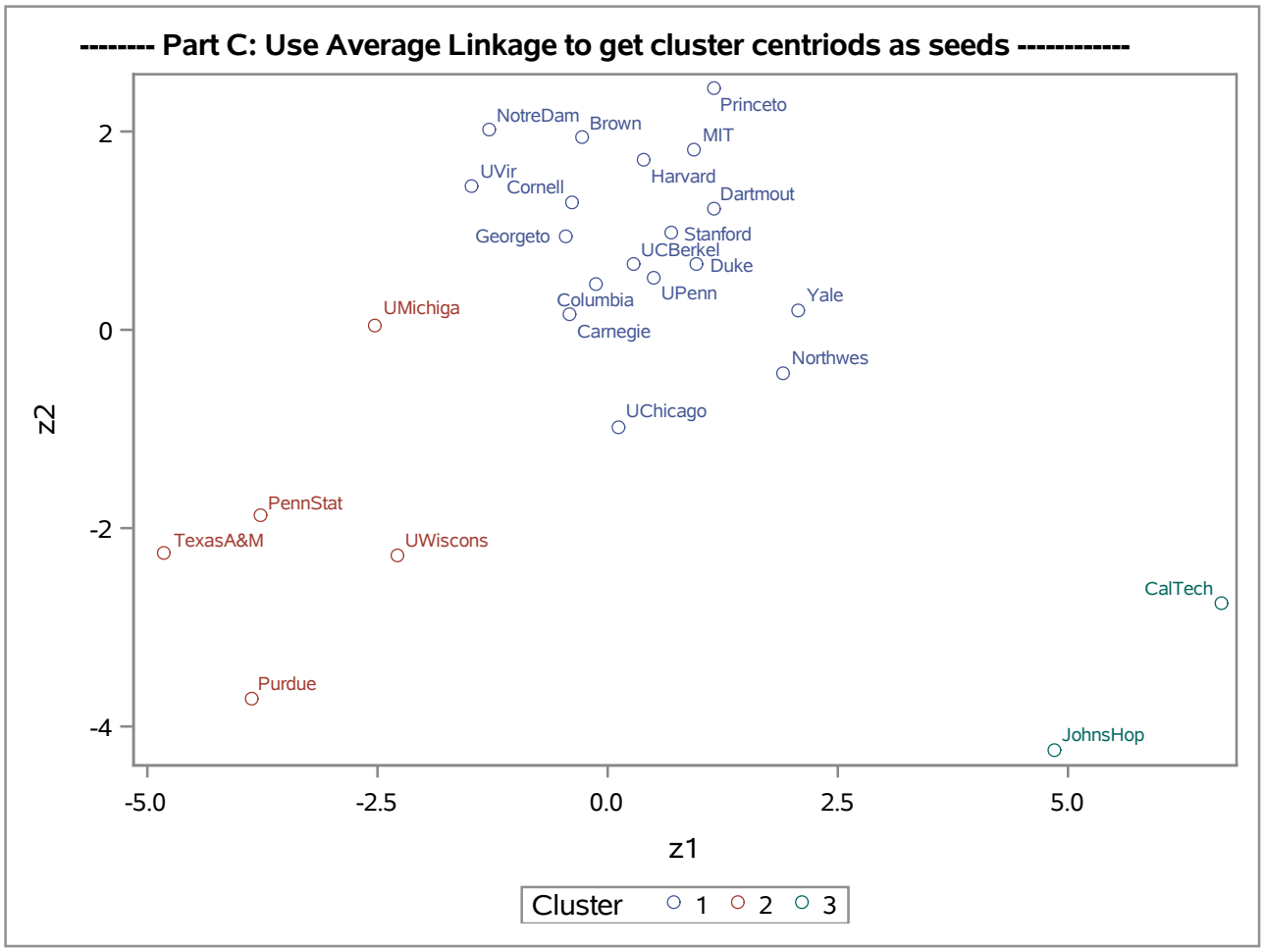
Cluster	x1	x2	x3	x4	x5	x6
1	0.368669004	0.401246057	-0.401586591	-0.231655082	0.054566204	0.411187451
2	-1.672576438	-1.671305889	1.541011098	1.445658839	-1.132182480	-1.360157058
3	0.863420059	0.567050212	-0.238248426	-1.529251357	2.339360369	-0.300294415

Cluster Standard Deviations

Cluster	x1	x2	x3	x4	x5	x6
1	0.4991850421	0.4611890454	0.6383168971	0.4957217415	0.6130303011	0.7025679606
2	0.5752261367	0.7157813978	0.6556622100	0.9616880183	0.1910382923	0.8537465142
3	0.7178101718	0.9096303320	0.6810371232	0.1738495184	0.2394133443	0.4683975384

-------- Part C: Use Average Linkage to get cluster centriods as seeds ----------

Obs	school	CLUSTER	DISTANCE
1	UPenn	1	0.43075
2	Cornell	1	0.59614
3	Northwes	1	0.63242
4	Duke	1	0.63955
5	Columbia	1	0.66926
6	Brown	1	0.81828
7	Dartmout	1	0.92288
8	Georgeto	1	0.99224
9	Stanford	1	1.03439
10	MIT	1	1.06121
11	NotreDam	1	1.26965
12	UChicago	1	1.37364
13	Princeto	1	1.55672
14	UVir	1	1.58262
15	Yale	1	1.62363
16	Harvard	1	1.67705
17	UCBerkel	1	2.28647
18	Carnegie	1	2.85180
19	UWiscons	2	0.98523
20	PennStat	2	1.06292
21	Purdue	2	1.63680
22	TexasA&M	2	1.80621
23	UMichiga	2	1.95228
24	CalTech	3	1.02797
25	JohnsHop	3	1.02797


-------- Part C: Use Average Linkage to get cluster centriods as seeds ----------
Princeto
NotreDam
Brown
MIT
Harvard
UVir
Cornell
Dartmout
Georgeto
Stanford
UCBerkel
Duke
UPenn
Columbia
Yale
UMichiga
Carnegie
Northwes
UChicago
PennStat
TexasA&M
UWiscons
CalTech
Purdue
JohnsHop
2
0
-2
-4
z2
-5.0
-2.5
0.0
2.5
5.0
z1
Cluster 1 2 3