

Exploratory Factor Analysis of the Twin Data

```
label
  progmat = 'Progressive matrices (M)'
  reason  = 'Reasoning Ability (R)'
  verbal  = 'Verbal Ability (V)'
  total   = 'Total Psych test score (T)'
  headlng = 'Head Length (L)'
  headbrd = 'Head breadth (B)'
  headcir = 'Head Circumference (C)'
  cephal  = 'Cephalic index (I): head breadth/length'
  headar  = 'Head area (E): Cephalic index * headcir'
  bizyg   = 'Bizygomatic Breadth (Z): Dist betw eyes?'
  weight  = 'Weight of twin (W)'
  height  = 'Height of twin (S)'
  pondrl  = 'Height/weight**1/3 (P)';

/***** twinfac1.sas *****/

TITLE2 'Exploratory Factor Analysis';

%include 'twinread.sas';

proc factor simple corr method=ml nfactor=2 rotate=varimax;
  var progmat reason verbal /* mental */
      headlng headbrd headcir bizyg height weight; /* physical */
```

Twin Data

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The FACTOR Procedure

Means and Standard Deviations from 74 Observations

Variable	Mean	Std Dev
progmat	37.9865	8.642034
reason	53.3514	16.510630
verbal	74.7230	24.217641
headlng	186.3784	7.088874
headbrd	146.8784	6.166531
headcir	543.4865	16.591170
bizyg	130.5541	5.888558
height	1651.1351	83.548989
weight	121.7095	21.808476

Correlations

	progmat	reason	verbal	headlng	headbrd
progmat	1.00000	0.55032	0.61360	0.31380	0.16095
reason	0.55032	1.00000	0.75374	0.15817	0.07281
verbal	0.61360	0.75374	1.00000	0.27770	0.14672
headlng	0.31380	0.15817	0.27770	1.00000	0.30018
headbrd	0.16095	0.07281	0.14672	0.30018	1.00000
headcir	0.33140	0.25887	0.31487	0.83358	0.67752
bizyg	0.18434	0.21728	0.24734	0.45409	0.80457
height	0.28396	0.14031	0.22415	0.59151	0.46087
weight	0.22900	0.14521	0.15569	0.56948	0.49422

Correlations

	headcir	bizyg	height	weight
progmat	0.33140	0.18434	0.28396	0.22900
reason	0.25887	0.21728	0.14031	0.14521
verbal	0.31487	0.24734	0.22415	0.15569
headlng	0.83358	0.45409	0.59151	0.56948
headbrd	0.67752	0.80457	0.46087	0.49422
headcir	1.00000	0.72474	0.61149	0.69145
bizyg	0.72474	1.00000	0.66308	0.65697
height	0.61149	0.66308	1.00000	0.66769
weight	0.69145	0.65697	0.66769	1.00000

Twin Data

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The FACTOR Procedure
Initial Factor Method: Maximum Likelihood

Prior Communality Estimates: SMC

progmat	reason	verbal	headlng	headbrd
0.45915496	0.65218538	0.64730716	0.86455862	0.81350040
headcir	bizyg	height	weight	
0.92119668	0.79997089	0.62380170	0.60818565	

Preliminary Eigenvalues: Total = 34.2040852 Average = 3.80045391

	Eigenvalue	Difference	Proportion	Cumulative
1	25.9921147	21.3392395	0.7599	0.7599
2	4.6528752	0.8099972	0.1360	0.8959
3	3.8428780	2.8054203	0.1124	1.0083
4	1.0374577	0.9141814	0.0303	1.0386
5	0.1232764	0.1192130	0.0036	1.0422
6	0.0040633	0.3647915	0.0001	1.0424

7	-0.3607281	0.0766780	-0.0105	1.0318
8	-0.4374061	0.2130398	-0.0128	1.0190
9	-0.6504459		-0.0190	1.0000

2 factors will be retained by the NFACTOR criterion.

Iteration	Criterion	Ridge	Change	Communalities			
1	2.4624138	0.0000	0.3498	0.40014	0.30234	0.41197	0.61032
				0.66318	0.97217	0.73835	0.49057
				0.55038			
2	2.3336477	0.0000	0.1649	0.44002	0.46060	0.51228	0.77522
				0.63289	0.87180	0.67471	0.45745
				0.56393			
3	2.0079966	0.0000	0.2474	0.48736	0.61763	0.75964	0.57021
				0.48998	0.96741	0.63163	0.50783
				0.56674			
4	1.9460303	0.0000	0.1463	0.46456	0.68353	0.82938	0.71653
				0.51976	0.89637	0.60128	0.44558
				0.55136			
5	1.9271433	0.0000	0.1000	0.46505	0.68397	0.83148	0.61650
				0.46899	0.95520	0.59638	0.48506
				0.55596			
6	1.9183528	0.0000	0.0780	0.46435	0.68339	0.83228	0.69447
				0.50281	0.91660	0.59385	0.44858
				0.54703			
7	1.9130477	0.0000	0.0554	0.46473	0.68403	0.83152	0.63908
				0.47685	0.94764	0.59255	0.47123
				0.55008			

Twin Data

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The FACTOR Procedure
Initial Factor Method: Maximum Likelihood

Iteration	Criterion	Ridge	Change	Communalities			
8	1.9103859	0.0000	0.0421	0.46439	0.68366	0.83196	0.68122
				0.49579	0.92616	0.59181	0.45190
				0.54580			
9	1.9088365	0.0000	0.0306	0.46462	0.68401	0.83154	0.65067
				0.48160	0.94288	0.59144	0.46479
				0.54782			
10	1.9080256	0.0000	0.0230	0.46443	0.68379	0.83181	0.67368
				0.49204	0.93096	0.59118	0.45443
				0.54568			
11	1.9075647	0.0000	0.0168	0.46456	0.68398	0.83158	0.65684
				0.48424	0.94006	0.59107	0.46165
				0.54690			
12	1.9073179	0.0000	0.0126	0.46446	0.68385	0.83174	0.66945
				0.48999	0.93347	0.59098	0.45603
				0.54579			
13	1.9071797	0.0000	0.0093	0.46453	0.68396	0.83161	0.66018

				0.48570	0.93845	0.59094	0.46004
				0.54649			
14	1.9071047	0.0000	0.0069	0.46448	0.68388	0.83170	0.66711
				0.48887	0.93482	0.59090	0.45697
				0.54589			
15	1.9070631	0.0000	0.0051	0.46452	0.68394	0.83163	0.66200
				0.48651	0.93755	0.59089	0.45919
				0.54629			
16	1.9070403	0.0000	0.0038	0.46449	0.68390	0.83168	0.66581
				0.48825	0.93555	0.59087	0.45751
				0.54597			
17	1.9070278	0.0000	0.0028	0.46451	0.68393	0.83165	0.66300
				0.48695	0.93705	0.59086	0.45873
				0.54618			
18	1.9070209	0.0000	0.0021	0.46449	0.68391	0.83167	0.66510
				0.48791	0.93595	0.59085	0.45780
				0.54601			
19	1.9070171	0.0000	0.0015	0.46450	0.68392	0.83165	0.66355
				0.48720	0.93678	0.59084	0.45848
				0.54613			
20	1.9070150	0.0000	0.0012	0.46449	0.68391	0.83167	0.66471
				0.48772	0.93617	0.59084	0.45797
				0.54603			
21	1.9070138	0.0000	0.0008	0.46450	0.68392	0.83166	0.66386
				0.48733	0.93663	0.59084	0.45834
				0.54610			

Convergence criterion satisfied.

The FACTOR Procedure
Initial Factor Method: Maximum Likelihood

Significance Tests Based on 74 Observations

Test	DF	Chi-Square	Pr > ChiSq
H0: No common factors	36	490.5715	<.0001
HA: At least one common factor			
H0: 2 Factors are sufficient	19	129.3591	<.0001
HA: More factors are needed			

Chi-Square without Bartlett's Correction	139.21201
Akaike's Information Criterion	101.21201
Schwarz's Bayesian Criterion	57.43477
Tucker and Lewis's Reliability Coefficient	0.54000

Squared Canonical Correlations

Factor1	Factor2
0.95761280	0.86804173

Eigenvalues of the Weighted Reduced Correlation
Matrix: Total = 29.1701845 Average = 3.24113161

	Eigenvalue	Difference	Proportion	Cumulative
1	22.5920286	16.0138755	0.7745	0.7745
2	6.5781531	5.3370482	0.2255	1.0000
3	1.2411049	0.7245865	0.0425	1.0425
4	0.5165184	0.4444988	0.0177	1.0603
5	0.0720196	0.0831900	0.0025	1.0627
6	-0.0111704	0.3229722	-0.0004	1.0623
7	-0.3341426	0.3404424	-0.0115	1.0509
8	-0.6745851	0.1351570	-0.0231	1.0278
9	-0.8097420		-0.0278	1.0000

Factor Pattern

	Factor1	Factor2
progmatt	0.42881	0.52973
reason	0.37446	0.73736
verbal	0.45175	0.79220
headlng	0.80639	-0.11832
headbrd	0.66507	-0.21258
headcir	0.95701	-0.14400
bizyg	0.75642	-0.13628
height	0.66779	-0.10979
weight	0.71347	-0.19215

Twin Data

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The FACTOR Procedure
Initial Factor Method: Maximum Likelihood

Variance Explained by Each Factor

Factor	Weighted	Unweighted
Factor1	22.5920286	4.06376784
Factor2	6.5781531	1.59937394

Final Communalities Estimates and Variable Weights

Total Communalities: Weighted = 29.170182 Unweighted = 5.663142

Variable	Communalities	Weight
progmatt	0.46449409	1.8674146
reason	0.68392047	3.1637681
verbal	0.83165645	5.9402206
headlng	0.66427090	2.9749409
headbrd	0.48750360	1.9505690
headcir	0.93660411	15.7799995
bizyg	0.59073481	2.4440025
height	0.45800209	1.8461595
weight	0.54595524	2.2031098

The FACTOR Procedure
Rotation Method: Varimax

Orthogonal Transformation Matrix

	1	2
1	0.92969	0.36834
2	-0.36834	0.92969

Rotated Factor Pattern

	Factor1	Factor2
progmatt	0.20354	0.65044
reason	0.07653	0.82345
verbal	0.12819	0.90290
headlng	0.79328	0.18703
headbrd	0.69661	0.04734
headcir	0.94277	0.21862
bizyg	0.75343	0.15192
height	0.66128	0.14391
weight	0.73408	0.08415

Variance Explained by Each Factor

Factor	Weighted	Unweighted
Factor1	20.4194016	3.61090172
Factor2	8.7507802	2.05224006

Final Communalities Estimates and Variable Weights

Total Communalities: Weighted = 29.170182 Unweighted = 5.663142

Variable	Communalities	Weight
progmatt	0.46449409	1.8674146
reason	0.68392047	3.1637681
verbal	0.83165645	5.9402206
headlng	0.66427090	2.9749409
headbrd	0.48750360	1.9505690
headcir	0.93660411	15.7799995
bizyg	0.59073481	2.4440025
height	0.45800209	1.8461595
weight	0.54595524	2.2031098