The SAS code and output for Example 7.1 on page 99-104

```
DATA eurojobs;
INPUT Country $ Agr Min Man PS Con SI Fin SPS TC;
CARDS;
Belgium 3.3 0.9 27.6 0.9 8.2 19.1 6.2 26.6 7.2
Denmark 9.2 0.1 21.8 0.6 8.3 14.6 6.5 30.2 7.1
France 10.8 0.8 27.5 0.9 8.9 16.8 6.0 22.6 5.7
W_Germany 6.7 1.3 35.8 0.9 7.3 14.4 5.0 22.3 6.1
Ireland 23.2 1.0 20.7 1.3 7.5 16.8 2.8 20.8 6.1
Italy 15.9 0.6 27.6 0.5 10.0 18.1 1.6 20.1 5.7
Luxembourg 7.7 3.1 30.8 0.8 9.2 18.5 4.6 19.2 6.2
Netherlands 6.3 0.1 22.5 1.0 9.9 18.0 6.8 28.5 6.8
United_Kingdom 2.7 1.4 30.2 1.4 6.9 16.9 5.7 28.3 6.4
Austria 12.7 1.1 30.2 1.4 9.0 16.8 4.9 16.8 7.0
Finland 13.0 0.4 25.9 1.3 7.4 14.7 5.5 24.3 7.6
Greece 41.4 0.6 17.6 0.6 8.1 11.5 2.4 11.0 6.7
Norway 9.0 0.5 22.4 0.8 8.6 16.9 4.7 27.6 9.4
Portugal 27.8 0.3 24.5 0.6 8.4 13.3 2.7 16.7 5.7
Spain 22.9 0.8 28.5 0.7 11.5 9.7 8.5 11.8 5.5
Sweden 6.1 0.4 25.9 0.8 7.2 14.4 6.0 32.4 6.8
Switzerland 7.7 0.2 37.8 0.8 9.5 17.5 5.3 15.4 5.7
Turkey 66.8 0.7 7.9 0.1 2.8 5.2 1.1 11.9 3.2
Bulgaria 23.6 1.9 32.3 0.6 7.9 8.0 0.7 18.2 6.7
Czechoslovakia 16.5 2.9 35.5 1.2 8.7 9.2 0.9 17.9 7.0
E_Germany 4.2 2.9 41.2 1.3 7.6 11.2 1.2 22.1 8.4
Hungary 21.7 3.1 29.6 1.9 8.2 9.4 0.9 17.2 8.0
Poland 31.1 2.5 25.7 0.9 8.4 7.5 0.9 16.1 6.9
Rumania 34.7 2.1 30.1 0.6 8.7 5.9 1.3 11.7 5.0
USSR 23.7 1.4 25.8 0.6 9.2 6.1 0.5 23.6 9.3
Yugoslavia 48.7 1.5 16.8 1.1 4.9 6.4 11.3 5.3 4.0
;
PROC FACTOR DATA=eurojobs
   SIMPLE
   METHOD=PRIN
   PRIORS=ONE
   NFACT=9
   SCREE
   ROTATE=NONE;
   VAR Agr Min Man PS Con SI Fin SPS TC;
RUN;
```

The eigenvalues in Table 7.1 are found in the table on the second page of output produced by the above commands. To find the eigenvectors you would need to use PROC PRINCOMP instead.
The FACTOR Procedure
Initial Factor Method: Principal Components
Prior Communality Estimates: ONE

Eigenvalues of the Correlation Matrix: Total = 9 Average = 1

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>Difference</th>
<th>Proportion</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.48715127</td>
<td>0.3875</td>
<td>0.3875</td>
</tr>
<tr>
<td>2</td>
<td>2.13017314</td>
<td>0.2367</td>
<td>0.6241</td>
</tr>
<tr>
<td>3</td>
<td>1.09895761</td>
<td>0.1221</td>
<td>0.7463</td>
</tr>
<tr>
<td>4</td>
<td>0.99448298</td>
<td>0.1044</td>
<td>0.8506</td>
</tr>
<tr>
<td>5</td>
<td>0.54321773</td>
<td>0.0604</td>
<td>0.9171</td>
</tr>
<tr>
<td>6</td>
<td>0.38342767</td>
<td>0.0426</td>
<td>0.9597</td>
</tr>
<tr>
<td>7</td>
<td>0.22575496</td>
<td>0.0251</td>
<td>0.9848</td>
</tr>
<tr>
<td>8</td>
<td>0.13678993</td>
<td>0.0152</td>
<td>1.0000</td>
</tr>
<tr>
<td>9</td>
<td>0.00004563</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

9 factors will be retained by the NFACTOR criterion.

To produce the output on page 101, we would want to restrict the output to four factors:

```sql
PROC FACTOR DATA=eurojobs
SIMPLE
METHOD=PRIN
PRIORS=ONE
NFACT=4
SCREE
ROTATE=NONE;
VAR Agr Min Man PS Con SI Fin SPS TC;
RUN;
```
The fourth page of SAS output contains the following:

```
proc factor data=eurojobs
simple
method=prin
priors=one
nfact=4
scree
rotate=varimax;
var Agr Min Man PS Con SI Fin SPS TC;
run;
```

The only difference between the above output and that given on page 101 is the number of decimal places the results are carried to, and that the signs are reversed for Factor 1. Notice we could simply write each $X_i$ in terms of the factors by adding plus signs between each column.

(The underlines and bold facing were added by me, not by SAS.)
From page 5 of this output we get the following (with the underlining and bold face again provided by me, and not SAS.)

```
   The FACTOR Procedure
   Rotation Method: Varimax

   Orthogonal Transformation Matrix

       1      2      3      4
   1  0.72529  0.57825  0.22713  0.29665
   2 -0.18250  0.21527 -0.74871  0.59983
   3 -0.42590 -0.04667  0.61828  0.65891
   4  0.50917 -0.78557 -0.07472  0.34358

   Rotated Factor Pattern

       Factor1  Factor2  Factor3  Factor4
   Agr   0.68735  0.56893   0.31441  0.26699
   Min  -0.22360  0.13264 -0.55010  0.70099
   Man   0.13317  0.75055 -0.11729  0.48868
   PS   -0.22600  0.02259  0.15751  0.89256
   Con  -0.15587  0.99831  0.03330 -0.10986
   SI    0.52963  0.33280 -0.62170 -0.03434
   Fin  -0.06685 -0.05058  0.91186  0.03206
   SPS   0.93229  0.04105  0.17350 -0.05353
   TC   0.76997  0.23183 -0.33235  0.22918

   Variance Explained by Each Factor

       Factor1  Factor2  Factor3  Factor4
   2.3625204  1.8808081  1.7996322  1.6678043
```

Notice that the reason it looks different is that Factors 2 and 4 are reversed!
The above code uses the option PRIORS=ONE. Some would argue that using PRIORS=ONE is simply performing a “Principal Components Analysis.” Instead, it is probably better to use the option PRIORS=SMC which would result in a “Principal Factors Analysis.” (We could also try the option METHOD=ML which would perform a “Maximum-likelihood Factor Analysis”...)

```
PROC FACTOR DATA=eurojobs
  SIMPLE
  METHOD=PRIN
  PRIORS=SMC
  NFACT=4
  SCREE
  ROTATE=VARIMAX;
VAR  Agr  Min  Man  PS  Con  SI  Fin  SPS  TC;
RUN;
```

<table>
<thead>
<tr>
<th>Factor Pattern</th>
<th>Factor1</th>
<th>Factor2</th>
<th>Factor3</th>
<th>Factor4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agr</td>
<td>-0.69287</td>
<td>-0.55552</td>
<td>-0.31962</td>
<td>-0.28031</td>
</tr>
<tr>
<td>Min</td>
<td>-0.22041</td>
<td>0.10285</td>
<td>-0.52049</td>
<td>0.72892</td>
</tr>
<tr>
<td>Man</td>
<td>0.13611</td>
<td>0.72885</td>
<td>-0.10021</td>
<td>0.52636</td>
</tr>
<tr>
<td>PS</td>
<td>0.22911</td>
<td>0.01556</td>
<td>0.16077</td>
<td>0.83687</td>
</tr>
<tr>
<td>Con</td>
<td>0.15579</td>
<td>0.90630</td>
<td>0.02270</td>
<td>-0.09716</td>
</tr>
<tr>
<td>SI</td>
<td>0.53523</td>
<td>0.33329</td>
<td>0.61674</td>
<td>-0.04404</td>
</tr>
<tr>
<td>Fin</td>
<td>-0.05899</td>
<td>-0.05460</td>
<td>0.91583</td>
<td>0.01280</td>
</tr>
<tr>
<td>SPS</td>
<td>0.93479</td>
<td>0.03791</td>
<td>0.16660</td>
<td>-0.05739</td>
</tr>
<tr>
<td>TC</td>
<td>0.76515</td>
<td>0.22778</td>
<td>-0.33204</td>
<td>0.23788</td>
</tr>
</tbody>
</table>

Notice that is very similar to the output on the previous page.