

# Singular Value Decomposition

This program computes the *Singular Value Decomposition* of a  $m \times n$  matrix  $A$ , that is it finds an orthogonal  $m \times m$  matrix  $U$ , a  $m \times n$  matrix  $D$ , whose non-zero elements are located on its main diagonal, and a orthogonal  $n \times n$  matrix  $V$  such that  $UDV^t = A$ . The program also computes the generalized inverse or pseudo-inverse matrix of  $A$ .

The use of the program will be explained in the following example. We store in  $a$  the matrix

$$a = \begin{bmatrix} 3 & 1 & 2 & 1 & 2 \\ 1 & 2 & 3 & 0 & 5 \\ 2 & 1 & 5 & 0 & 2 \\ 1 & 2 & 1 & 1 & 1 \end{bmatrix}$$

Then we run the program using the instruction

$$svd(a, "u", "d", "v", "g")$$

The following screens show the result of the computation.

matrix u					
F1	F2	F3	F4	F5	F6
Algebra	Calc	Other	PrgmIO	Clean Up	
prog\svd(a, "u", "d", "v", "g") Done					
u					
.427976	.28051	-.646554	.565791		
.637218	-.734848	.202517	.113746		
.591241	.614482	.48218	-.20087		
.247435	-.061026	-.55539	-.791577		
MAIN RAD AUTO FUNC 2/30					

matrix d					
F1	F2	F3	F4	F5	F6
Algebra	Calc	Other	PrgmIO	Clean Up	
.591241	.614482	.48218	-.20087		
.247435	-.061026	-.55539	-.791577		
d					
9.22278	0	0	0	0	0
0	2.79526	0	0	0	0
0	0	2.31325	0	0	0
0	0	0	1.33254	0	0
MAIN RAD AUTO FUNC 3/30					

matrix v					
F1	F2	F3	F4	F5	F6
Algebra	Calc	Other	PrgmIO	Clean Up	
0	0	0	1.33254	0	0
v					
.363346	.455994	-.57416	.463627		
.302351	-.249263	-.376146	-.743497		
.647445	.489351	.505762	-.242473		
.073233	.07852	-.519592	-.16944		
.593309	-.695922	.055528	.380472		
MAIN RAD AUTO FUNC 4/30					

matrix u * d * v <sup>t</sup>					
F1	F2	F3	F4	F5	F6
Algebra	Calc	Other	PrgmIO	Clean Up	
.647445	.489351	.505762	-.242473		
.073233	.07852	-.519592	-.16944		
.593309	-.695922	.055528	.380472		
u * d * v <sup>t</sup>					
3.	1.	2.	1.	2.	
1.	2.	3.	9.E-12	5.	
2.	1.	5.	2.496E-11	2.	
1.	2.	1.	1.	1.	
MAIN RAD AUTO FUNC 5/30					

matrix g					
F1	F2	F3	F4	F5	F6
Algebra	Calc	Other	PrgmIO	Clean Up	
1.	2.	1.	1.	1.	
g					
.419952	-.105463	-.066033	-.137767		
-.221536	-.009976	-.001742	.545527		
-.165162	-.060333	.291053	.029295		
.084561	-.075534	-.060808	.225653		
.103721	.261283	-.160728	-.208234		
MAIN RAD AUTO FUNC 6/30					

matrix a * g * a					
F1	F2	F3	F4	F5	F6
Algebra	Calc	Other	PrgmIO	Clean Up	
-.165162	-.060333	.291053	.029295		
.084561	-.075534	-.060808	.225653		
.103721	.261283	-.160728	-.208234		
a * g * a					
3.	1.	2.	1.	2.	
1.	2.	3.	1.05E-12	5.	
2.	1.	5.	3.7E-12	2.	
1.	2.	1.	1.	1.	
MAIN RAD AUTO FUNC 7/30					