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% gda10_02

% factors visualized as vectors in 3D space
% supports Figure 10.3

clear all;

% define 3D region of (x,y,z) space
xmin = 0;
xmax = 1;
Lx = xmax-xmin;

ymin = 0;
ymax = 1;
Ly = ymax-ymin;

zmin = 0;
zmax = 1;
Lz = zmax-zmin;

figure(1);
clf;
set(gca, 'LineWidth',3);
set(gca, 'FontSize',14);
hold on;
axis( [xmin, xmax, ymin, ymax, zmin, zmax]);

% factors
% factor 1
f1 = [1, 0.2, 0.8]';
norm = 1.2*sqrt(f1'*f1);
f1=f1/norm;

% factor 2
f2 = [0.2, 1, 0.8]';
norm = 0.8*sqrt(f2'*f2);
f2=f2/norm;

arrow3(f1, 'r-',3);
arrow3(f2, 'r-',3);

% samples
s1=0.8*f1+(1-0.8)*f2;
s2=0.6*f1+(1-0.6)*f2;
s3=0.4*f1+(1-0.4)*f2;
s4=0.2*f1+(1-0.2)*f2;
arrow3(s1, 'k-',2);
arrow3(s2, 'k-',2);
arrow3(s3, 'k-',2);
arrow3(s4, 'k-',2);

if( 1 )
    % use SVD. The minus signs are just to get the vectors
    % in quadrants that look good in the plot
    S=zeros(4,3);
    S(1,:)=s1';
    S(2,:)=s2';
    S(3,:)=s3';
    S(4,:)=s4';

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[U,LAMBDA,V] = svd(S);
v1 = -V(:,1);
v2 = -V(:,2);
v3 = -V(:,3);
else
% just use the mean vector, and two vectors perpendicular
% to it, one of which is in the F1-F2 plane
v1 = f1+f2;
norm = sqrt(v1'*v1);
v1=v1/norm;

v3 = cross(f1,f2);
norm = sqrt(v3'*v3);
v3=v3/norm;

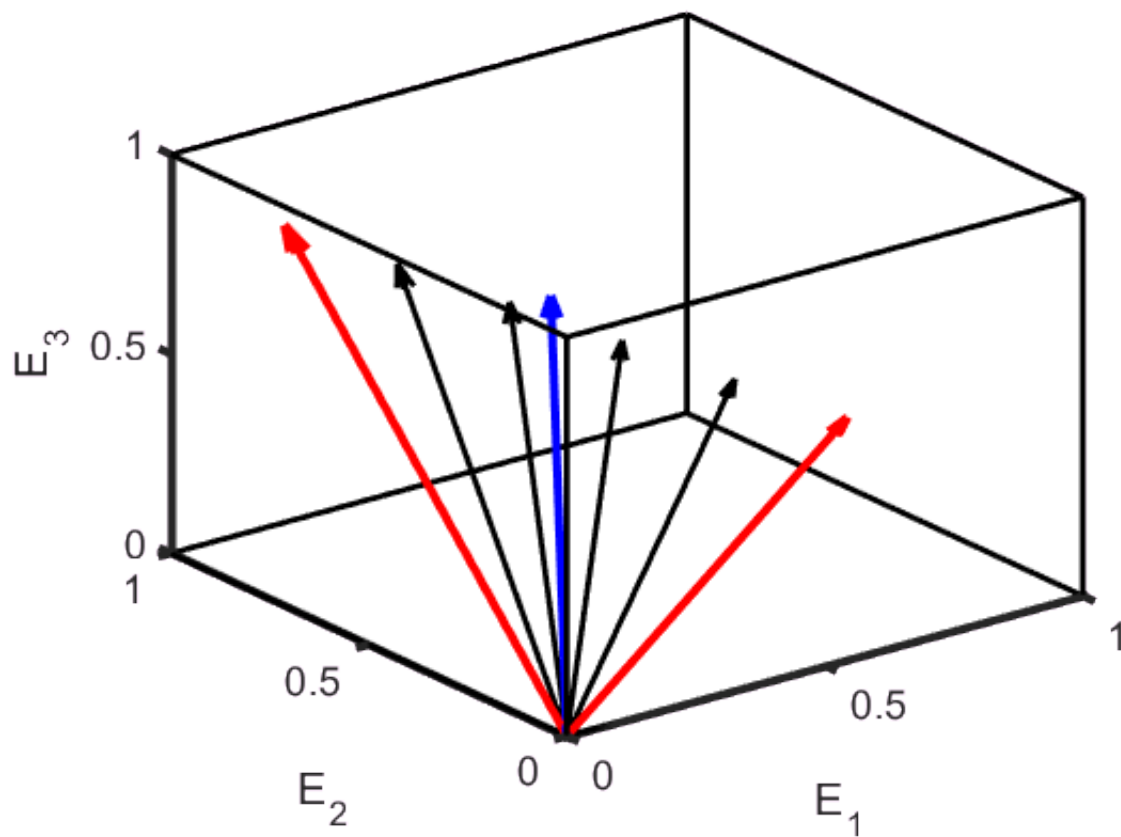
v2 = cross(v1,v3);
norm = sqrt(v2'*v2);
v2=v2/norm;
end

arrow3(v1,'b-',3);
arrow3(v2,'b-',3);
arrow3(v3,'b-',3);

% improvise 3D box
plot3( [xmin,xmin], [ymin,ymin], [zmin,zmax], 'k-', 'LineWidth', 2 );
plot3( [xmin,xmin], [ymin,ymax], [zmin,zmin], 'k-', 'LineWidth', 2 );
plot3( [xmin,xmax], [ymin,ymin], [zmin,zmin], 'k-', 'LineWidth', 2 );
plot3( [xmax,xmax], [ymax,ymax], [zmax,zmin], 'k-', 'LineWidth', 2 );
plot3( [xmax,xmax], [ymax,ymin], [zmax,zmax], 'k-', 'LineWidth', 2 );
plot3( [xmax,xmin], [ymax,ymax], [zmax,zmax], 'k-', 'LineWidth', 2 );
plot3( [xmax,xmin], [ymin,ymin], [zmax,zmax], 'k-', 'LineWidth', 2 );
plot3( [xmax,xmax], [ymin,ymin], [zmax,zmin], 'k-', 'LineWidth', 2 );
plot3( [xmin,xmin], [ymax,ymin], [zmax,zmax], 'k-', 'LineWidth', 2 );
plot3( [xmin,xmin], [ymax,ymax], [zmax,zmin], 'k-', 'LineWidth', 2 );
plot3( [xmax,xmax], [ymax,ymin], [zmin,zmin], 'k-', 'LineWidth', 2 );
plot3( [xmax,xmin], [ymax,ymax], [zmin,zmin], 'k-', 'LineWidth', 2 );
xlabel('E_1');
ylabel('E_2');
zlabel('E_3');

% set view
view(3);

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% Figure 10.3 Eigenvectors v_1 and v_2 lie in the plane of the samples (v_1 is
 % closest to the mean sample). Eigenvector v_3 is normal to the plane. MatLab script and gda10_