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% gda05_01
clear all;

% plots a point inside of 3D box
% supports Figure 5.1

% variable x
Nx = 31;
xmin = 0;
xmax = 5;
Dx = (xmax-xmin)/(Nx-1);
x = xmin + Dx*[0:Nx-1]';

% variable y
Ny = 31;
ymin = 0;
ymax = 5;
Dy = (ymax-ymin)/(Ny-1);
y = ymin + Dy*[0:Ny-1]';

% variable z
Nz = 31;
zmin = 0;
zmax = 5;
Dz = (zmax-zmin)/(Nz-1);
z = zmin + Dz*[0:Nz-1]';

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

% (x,y,z) grid
[XX, YY, ZZ] = meshgrid( x, y, z );

% the point is at a randomly chosen point in d-space
% using a Normal distribution with specified mean and variance
rbar = random('Normal', 2.5, 0.5, 3, 1);

% visualize the point in 3D using an isosurface of a normal distribution
sd=0.5;
C = (sd^2)*eye(3,3);
CI = inv(C);
DC = det(C);
norm = ( ((2*pi)^(3/2)) * sqrt(DC) );

% normal distribution
PP = zeros(Nx, Ny, Nz);
for i=1:Nx
for j=1:Ny
for k=1:Nz
    r = [XX(i,j,k), YY(i,j,k), ZZ(i,j,k)]';
    PP(i,j,k) = exp(-0.5*(r-rbar)'*CI*(r-rbar))/norm;
end
end
end

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% get max for scale
maxP=max(max(max(PP)));

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

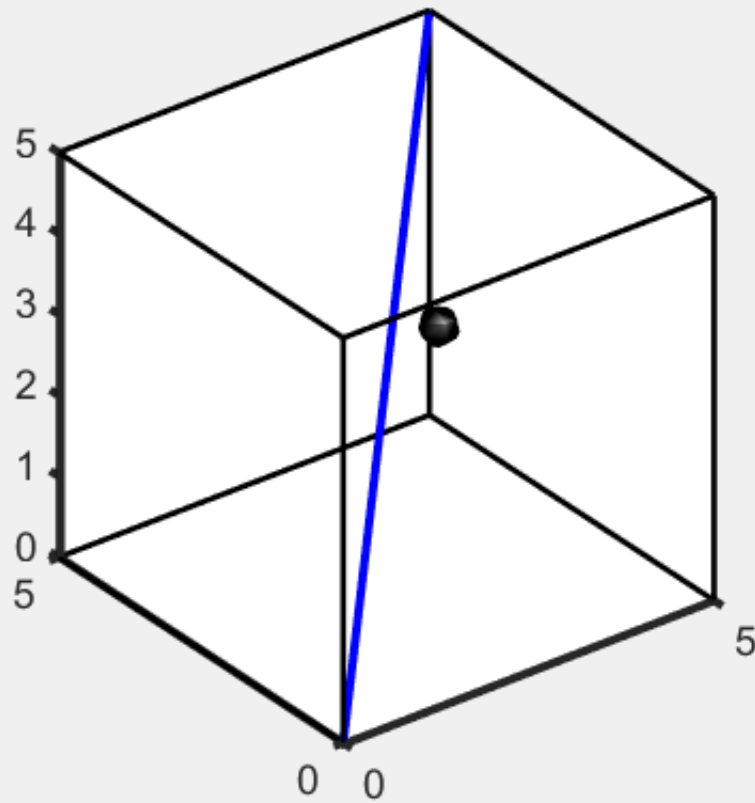
% improvise 3D box
plot3( [xmin,xmin], [ymin,ymin], [zmin,zmax], 'k-', 'LineWidth', 2 );
plot3( [xmin,xmin], [ymin,ymax], [zmin,zmin], 'k-', 'LineWidth', 2 );
plot3( [xmin,xmax], [ymin,ymin], [zmin,zmin], 'k-', 'LineWidth', 2 );
plot3( [xmax,xmax], [ymax,ymax], [zmax,zmin], 'k-', 'LineWidth', 2 );
plot3( [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 );

plot3( [0, 5], [0, 5], [0, 5], 'b-', 'LineWidth', 3 );

% plot isosurface to show point in 3-space
p=patch(isosurface( XX, YY, ZZ, PP, 0.9*maxP ));
isonormals(XX,YY,ZZ,PP,p)
set(p, 'FaceColor', 'black', 'EdgeColor', 'none');

% set view direction & lighting
daspect([1 1 1])
view(3)
camlight; lighting phong

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% Figure 5.1 The data are represented by a single point (black) in a space whose dimensions equal  
 % the number of observations (in this case, 3). These data are realizations of random variables  
 % that have the same mean and variance. Nevertheless, they do not necessarily fall on the line  $d_1 = d_2 = d_3$