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% gda05_13
%
% parametric function passing thru distribution p(d1,m1)
% supports Figure 5.13

clear all;

% d1 variable
Nd1 = 101;
dlmin = 0;
dlmax = 5.0;
Dd1 = (dlmax-dlmin)/(Nd1-1);
d1 = dlmin + Dd1*[0:Nd1-1]';

% m1 variable
Nm1 = 101;
mlmin = 0;
mlmax = 5.0;
Dm1 = (mlmax-mlmin)/(Nm1-1);
m1 = mlmin + Dm1*[0:Nm1-1]';

% setup for distribution
P1=zeros(Nd1,Nm1);
dlbar = 2.25;
mlbar = 2.08;
bar = [dlbar, mlbar]';
sd1 = 0.2;
sm1 = 1.0;
C1 = diag( [sd1^2, sm1^2]' );
CI1 = inv(C1);
DC1 = det(C1);
norm1 = (1/(2*pi)) * (1/sqrt(DC1));

% tabulate distribution
for i=[1:Nm1]
for j=[1:Nd1]
    x1=[d1(i), m1(j)]' - bar;
    P1(i,j) = norm1*exp( -0.5 * x1'*CI1*x1 );
end
end

% axis for parametric curve
Ns = 51;
smin = 0;
smax = 5.0;
Ds = (smax-smin)/(Ns-1);
s = sm1 + Ds*[0:Ns-1]';

% parametric curve
dp = 1+s-2*(s/smax).^2;
mp = s;

% P on parametric curve
ipd = 1+floor((dp-dlmin)/Dd1);
ipm = 1+floor((mp-mlmin)/Dm1);
% insure indices in range
i=find(ipd<1);
ipd(i)=1;
i=find(ipd>Nd1);

```

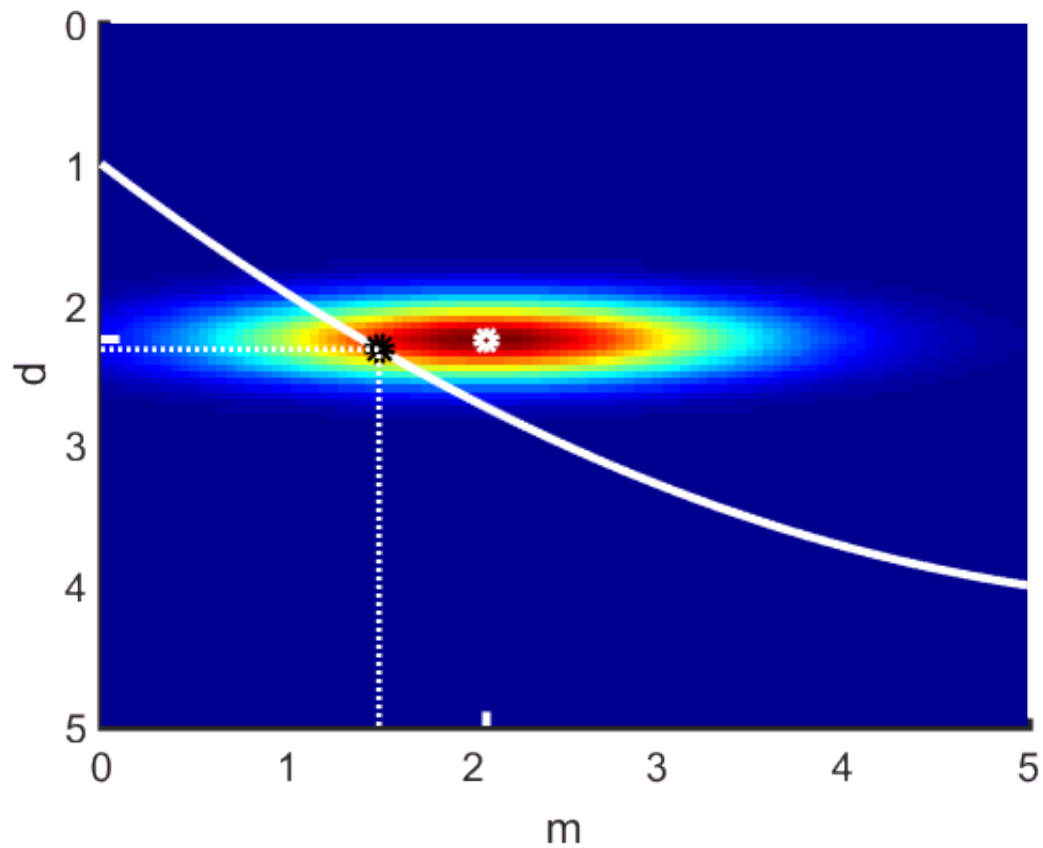
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ipd(i)=Nd1;
i=find(ipm<1);
ipm(i)=1;
i=find(ipm>Nm1);
ipm(i)=Nm1;
Ps=zeros(Ns,1);
% evaluate P at indices
for i = [1:Ns]
    Ps(i) = P1(ipd(i), ipm(i));
end

% maximum along curve
[Pmax, ismax]=max(Ps);
dlsmax = dp(ismax);
mlsmax = mp(ismax);

% plot distribution with parameteric curve superimposed
figure(1);
clf;
set(gca,'LineWidth',3);
set(gca,'FontSize',14);
colormap('jet');
hold on;
axis( [dlmin, dlmax, mlmin, mlmax] );
axis ij;
imagesc( [dlmin, dlmax], [mlmin, mlmax], P1 );
plot( mlbar, dlbar, 'wo', 'LineWidth', 3 );
plot( [mlbar, mlbar], [dlmax, dlmax-0.1], 'w-', 'LineWidth', 3 );
plot( [mlmin, mlmin+0.1], [dlbar, dlbar], 'w-', 'LineWidth', 3 );
plot( mp, dp, 'w-', 'LineWidth', 3 );
plot( mlsmax, dlsmax, 'ko', 'LineWidth', 4);
plot( [mlmin, mlsmax], [dlsmax, dlsmax], 'w:', 'LineWidth', 2);
plot( [mlsmax, mlsmax], [dlmax, dlmax], 'w:', 'LineWidth', 2);
xlabel('m');
ylabel('d');

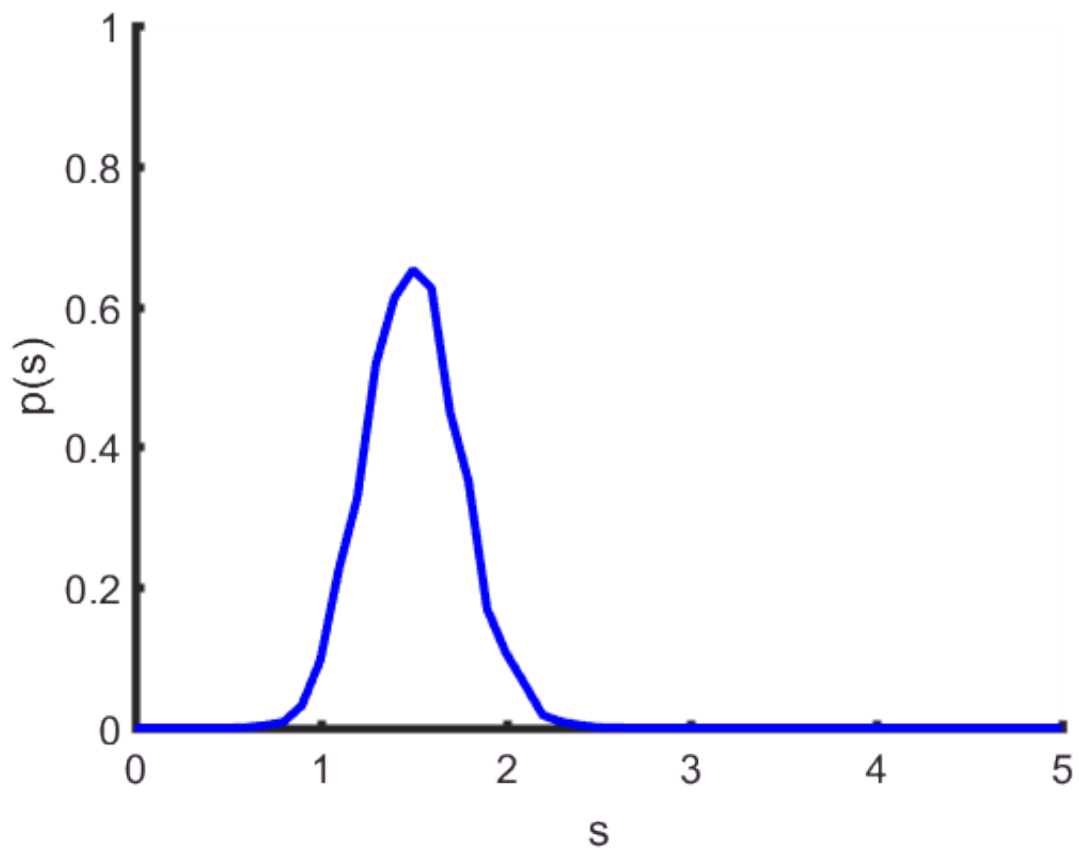
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% Figure 5.13 (A) If the prior model parameter map is much less certain than the observed data
 % the solution is close to dobs but may be far from map.

% plot distribution as a function of arc-length along the curve

```
figure(2);
clf;
set(gca,'LineWidth',3);
set(gca,'FontSize',14);
hold on;
axis( [smin, smax, 0, 1] );
axis xy;
plot( s, Ps, 'b-', 'Linewidth', 3 );
xlabel('s');
ylabel('p(s)');
```



% Figure 5.13 (B) The probability density function p evaluated along the curve. MatLab script