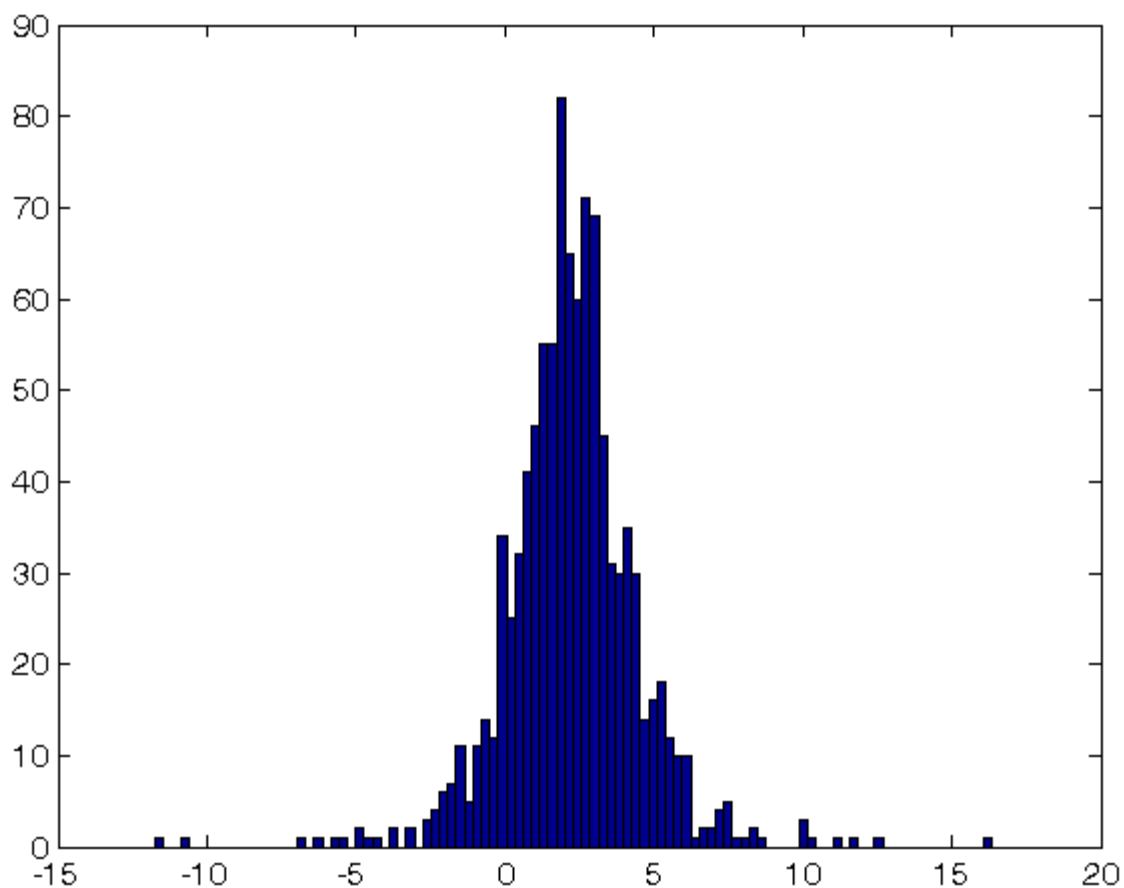


this was used (once) to generate the data set

```
%nuvec = 3.75 * ones(1000,1);
%tvec = 2.2 + 1.5 * trnd(nuvec);
%save 'tdist2.txt' tvec -ascii;

load 'events20130204.txt';
data = events20130204;
% what does the distribution look like? what is its sample mean and stdev?
hist(data,100)
sampmu = mean(data)
sampsd = std(data)
```

```
sampmu =
    2.2368
sampsd =
    2.2364
```



suppose it is Student t. write a function that computes the probability of the data (or maybe its logarithm) given the parameters μ , σ , ν

```
probs = @(x,mu,sig,nu) tpdf((x-mu)./sig,nu) ./ sig;
logprob = @(parms) sum(log(probs(events20130204,parms(1),parms(2),parms(3))));
% what is the log probability that the data is Normal with mu=sampmu and
% sig=sampsig?
normlogprob = logprob([sampmu sampsd 1000000])
% what is the log probability of, say, mu=2.0, sig=1.2, nu=5 ?
otherlogprob = logprob([2.0 1.2 5.0])
% which of these is more likely, and by what odds ratio?
```

```
oddsratio = exp(otherlogprob - normlogprob)
```

```
normlogprob =
-2.2233e+003
otherlogprob =
-2.2082e+003
oddsratio =
3.7640e+006
```

find the MAP (maximum a posteriori) estimate for mu, sig, nu

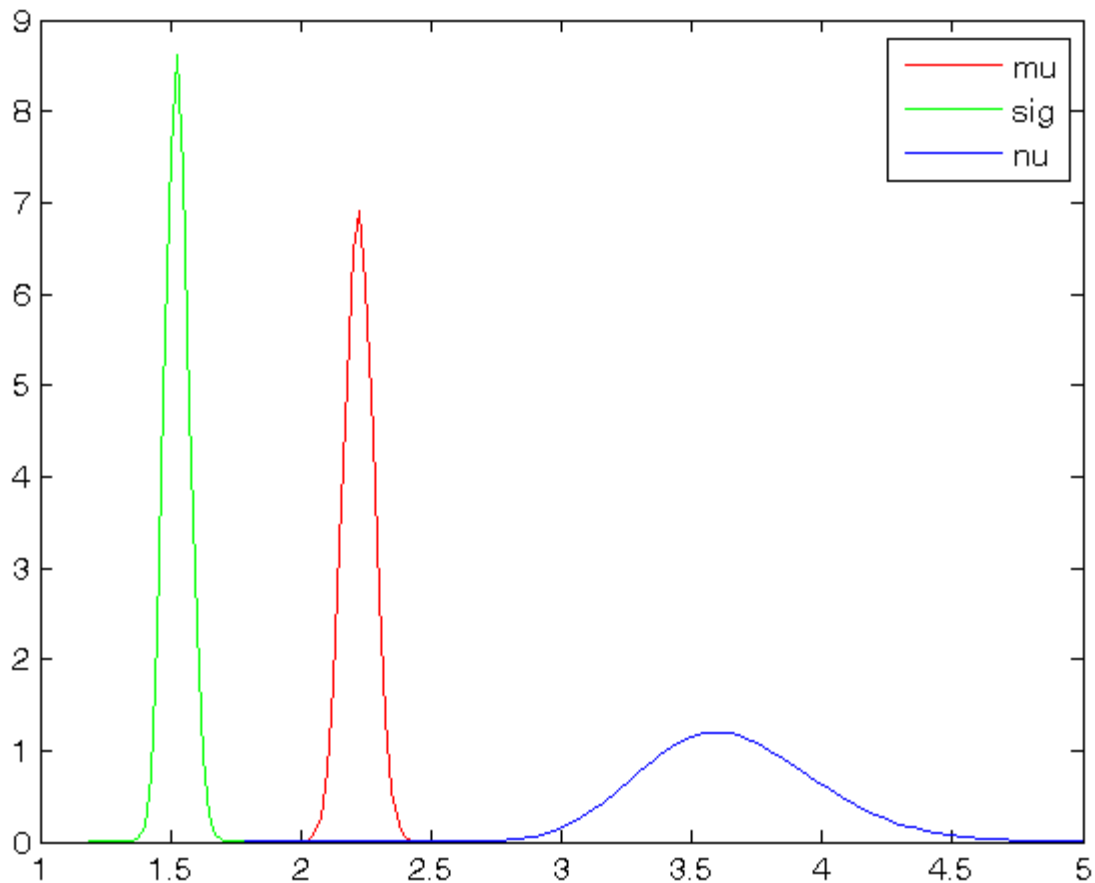
```
neglogprob = @(arg) -logprob(arg);
[xmax, fmax] = fminsearch(neglogprob,[2.0,1.2,5.0]);
mapmu = xmax(1)
mapsig = xmax(2)
mapnu = xmax(3)
maplog = -fmax
% how much more likely is it than the previous mu=2.0, sig=1.2, nu=5 ?

oddsratio = exp(-fmax - otherlogprob)
```

```
mapmu =
2.2209
mapsig =
1.5235
mapnu =
3.5947
maplog =
-2.1336e+003
oddsratio =
2.4313e+032
```

starting with the MAP values, allow in turn each of mu, sig, and nu to vary (one at a time), and graph its Bayes posterior distribution

```
modelprob3 = @(mu,sig,nu) exp(logprob([mu sig nu]) - maplog);
del = 0.025;
xplot = 1.:del:5;
% plot for mu, fixing sig and nu
yplot = arrayfun(@(mu) modelprob3(mu,mapsig,mapnu), xplot);
yplot = yplot / (del * sum(yplot));
plot(xplot,yplot,'-r')
hold on;
% plot for sig, fixing mu and nu
yplot = arrayfun(@(sig) modelprob3(mapmu,sig,mapnu), xplot);
yplot = yplot / (del * sum(yplot));
plot(xplot,yplot,'-g')
% plot for nu, fixing mu and sig
yplot = arrayfun(@(nu) modelprob3(mapmu,mapsig,nu), xplot);
yplot = yplot / (del * sum(yplot));
plot(xplot,yplot,'-b')
legend('mu','sig','nu');
hold off;
```



now again compute Bayes posteriors for each parameter, but marginalize over the other two instead of fixing them!

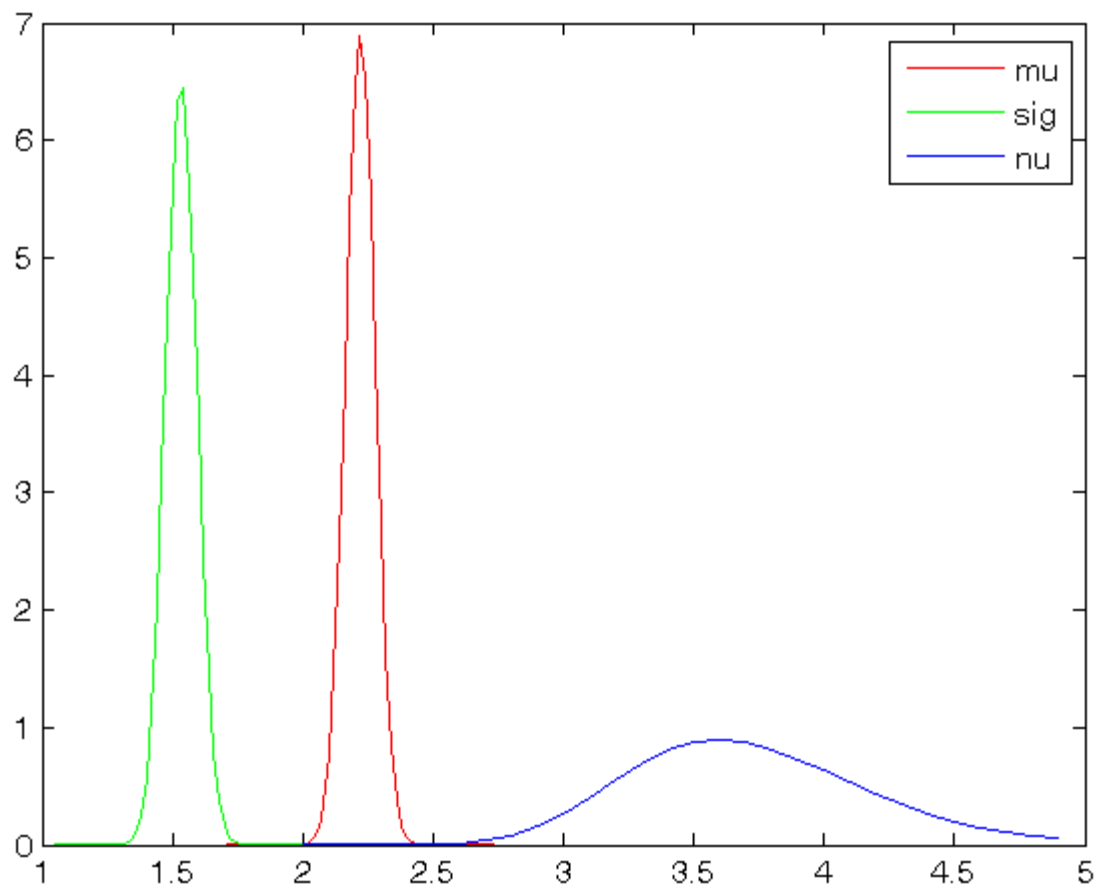
```
delmu = 0.02;
delsig = 0.02;
delnu = 0.1;
rangemu = 1.5:delmu:3;
rangesig = 1:delsig:2.1;
rangenu = 2:delnu:4.9;
[x y z] = ndgrid(rangemu,rangesig,rangenu);
start = cputime;
allprobs = arrayfun(modelprob3,x,y,z); % this takes 51 seconds on my machine
elapsed = cputime - start
```

```
elapsed =
    52.1511
```

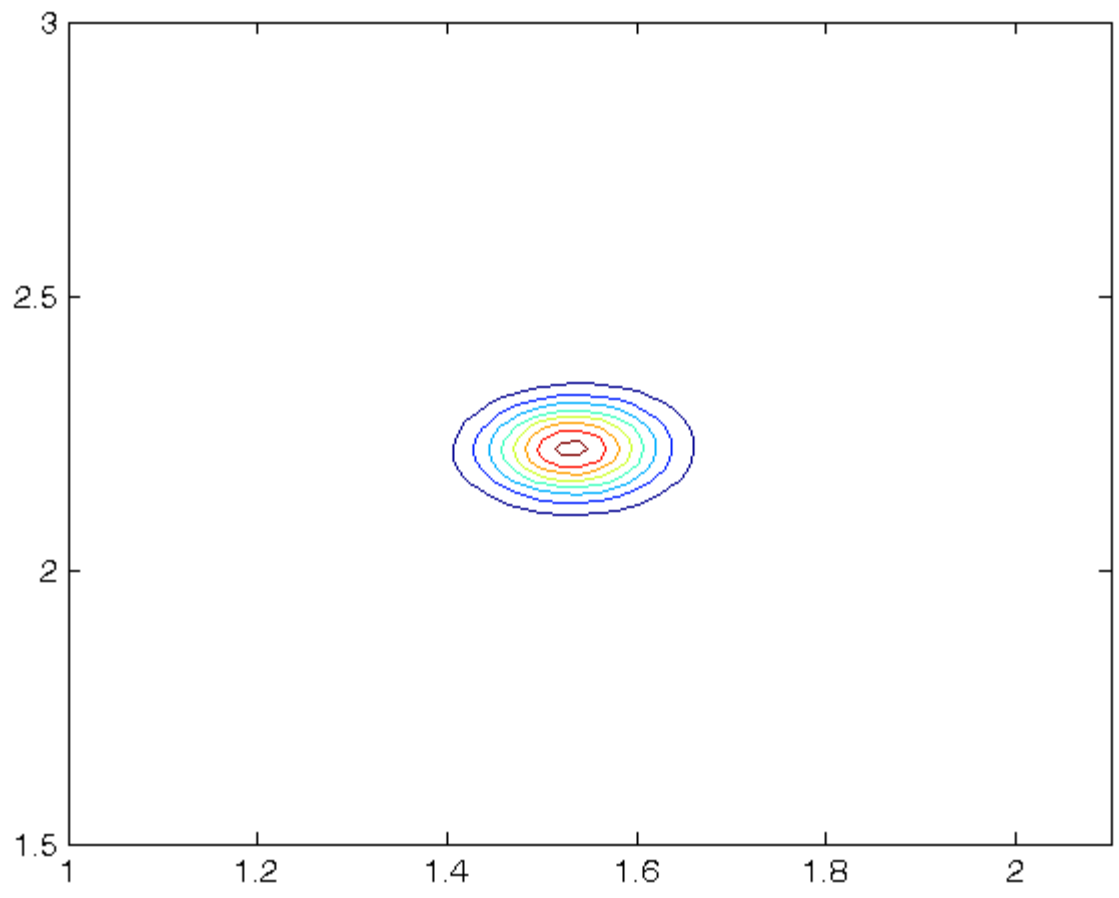
plot for mu, marginalizing over sig and nu

```
mus = sum(sum(allprobs,3),2);
mus = mus / (delmu * sum(mus));
plot(rangemu,mus,'-r')
hold on;
% plot for sig, marginalizing over mu and nu
sigs = sum(squeeze(sum(allprobs,1)),2);
sigs = sigs / (delsig * sum(sigs));
plot(rangesig,sigs,'-g');
% plot for nu, marginalizing over mu and sig
nus = sum(squeeze(sum(allprobs,1)),1);
nus = nus / (delnu * sum(nus));
```

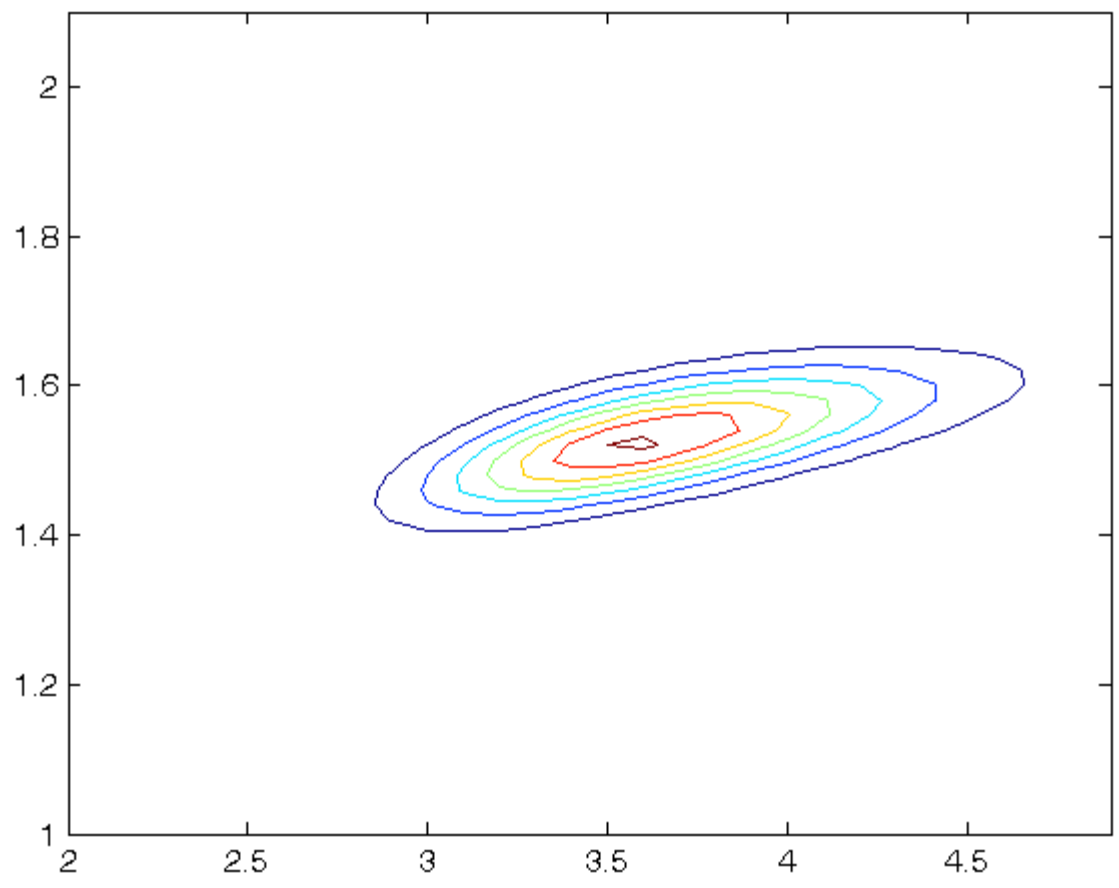
```
plot(rangenu,nus, '-b');  
legend('mu', 'sig', 'nu');  
hold off;
```



```
contour(rangesig,rangemu,squeeze(sum(allprobs,3)))
```



```
contour(rangenu, rangesig, squeeze(sum(allprobs, 1)))
```



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