Fit a Weibull model using Trinity and JAGS

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It is important to note that the Weibull distribution follows a different parameter convention in MATLAB and JAGS, and we will have to transform parameters in order to compare.

JAGS convention (scale λ and shape k):

$$v\lambda x^{v-1}\exp\left(-\lambda x^{v}\right)$$

MATLAB convention (scale a and shape b):

$$\frac{b}{a}\left(\frac{x}{a}\right)^{b-1}\exp\left(-(x/a)^{b}\right)$$

Preamble

Cleanup first

```
clear all
p = @sprintf;
```

Generate data and make structure

```
rng(0)
P = 20;  % persons
C =  8;  % conditions
I = 50;  % trials per person per condition

cscale = [1 1 1 1 3 3 3 3];  % scale parameters
```

```
cshape = [1 2 3 4 5 6 7 8];  % shape parameters

allscale = repmat(ones(P, 1) * cscale + randn(P, C) / 10, [1, 1, I]);
allshape = repmat(ones(P, 1) * cshape + randn(P, C) / 10, [1, 1, I]);

condition = repmat(1:C, [P, 1, I]);     % condition index
person    = repmat((1:P)', [1, C, I]);  % person index;

y = wblrnd(allscale, allshape);  % MATLAB uses (scale, shape)
                                 % JAGS uses (v, l), v = shape, l = scale^-v
data = struct('N', P * C * I, 'C', C, 'P', P, ...
    'condition', condition(:), 'person', person(:), 'y', y(:));
```

Define some priors

Use JAGS parameter conventions

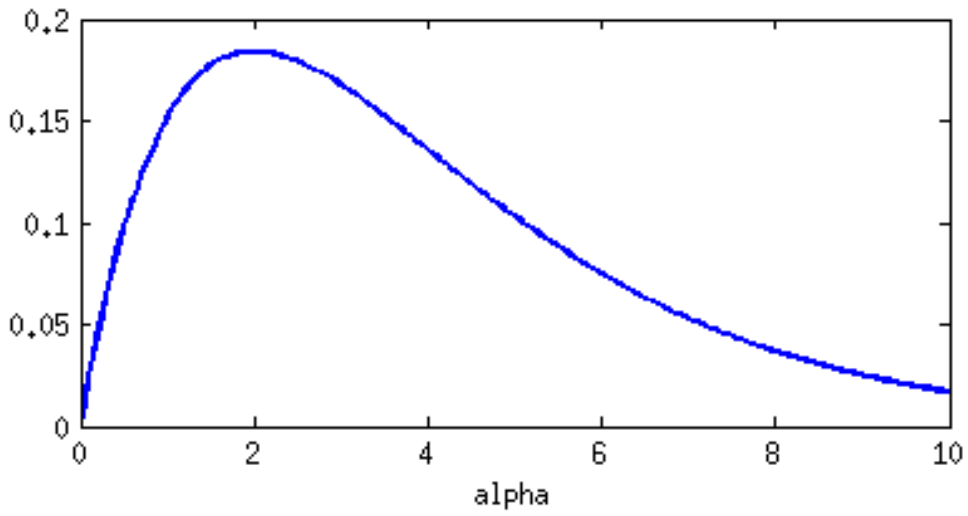
```
prscale = [2.0 0.5];  % gamma distribution (shape, rate)
prshape = [2.0 0.5];  % gamma distribution (shape, rate)
```

Plot the priors

Make sure to transform to MATLAB parameter conventions

Scale α

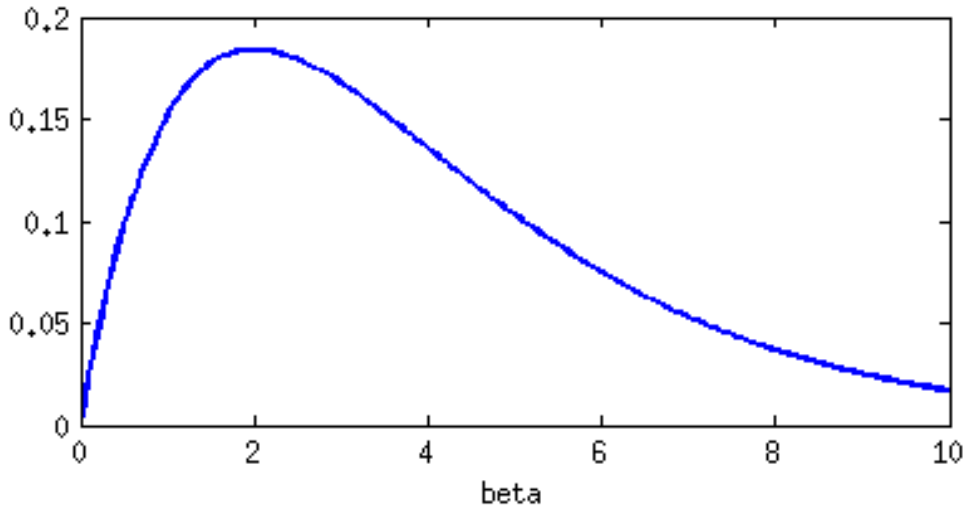
```
figure('windowstyle', 'docked')
xax = linspace( 0.0, 10.0, 200);
plot(xax, gampdf(xax, prscale(1), prscale(2)^-1), 'linewidth', 2)
xlabel alpha
```



Shape β

```
xax = linspace( 0.0, 10.0, 200);
plot(xax, gampdf(xax, prshape(1), prshape(2)^-1), 'linewidth', 2)
```

```
xlabel beta
```



Make all inputs that Trinity needs

Write the JAGS model into a variable (cell variable)

```
model = {
    'model {'
    '  # Priors on precision'
    '  precshape ~ dgamma(0.1, 0.1)'
    '  precscale ~ dgamma(0.1, 0.1)'
    ''
    '  for (c in 1:C) { '
    '    # Priors on means'
  p('    mushape[c] ~ dgamma(%g, %g)', prshape)
  p('    muscale[c] ~ dgamma(%g, %g)', prscale)
  ''
    '    # Random effects'
    '    for (p in 1:P) { '
    '      shape[c,p] ~ dnorm(mushape[c], precshape)'
    '      scale[c,p] ~ dnorm(muscale[c], precscale)'
    '    }'
    '  }'
    ''
    '  # Likelihood'
    '  for (n in 1:N) {'
    '     y[n] ~ dweib(shape[condition[n],person[n]],'
    '                  scale[condition[n],person[n]])'
    '  }'
    '}'
    };
```

List all the parameters of interest (cell variable)

```
parameters = { ...
    'scale', 'shape', ...
```

```
    'mushape', 'muscale', ...
    'precshape', 'precscale'};
```

Write a function that generates a structure with one random value for each *random* parameter

```
generator = @()struct(...
        'mushape', rand(1, C) + 0.1  , ...
        'muscale', rand(1, C) + 0.1  );
```

Tell Trinity which engine to use

```
engine = 'jags';
```

Run Trinity with the CALLBAYES() function

```
tic
% [stats, chains, diagnostics, info] = callbayes(engine, ...
%     'model'         ,         model , ...
%     'data'          ,          data , ...
%     'nchains'       ,            4  , ...
%     'verbosity'     ,            0  , ...
%     'nsamples'      ,          1e3  , ...
%     'nburnin'       ,          5e2  , ...
%     'parallel'      ,      isunix() , ...
%     'workingdir'    ,        'wdir' , ...
%     'monitorparams' ,    parameters , ...
%     'init'          ,     generator );
load /tmp/wbl

fprintf('%s took %f seconds!\n', upper(engine), toc)
```

```
        JAGS took 0.082298 seconds!
```

Inspect the results

First, inspect convergence

```
if any(codatable(chains, @gelmanrubin) > 1.1)
    grtable(chains, 1.1)
    warning('Some chains were not converged!')
else
    disp('Convergence looks good.')
end
```

```
        Convergence looks good.
```

Now check some basic descriptive statistics averaged over all chains

```
disp('Descriptive statistics for all chains:')
```

```
        Descriptive statistics for all chains:
```

Boundary separation α

```
codatable(chains, '^mushape')
```

Estimand	mean	std	plt0
mushape_1	0.9997	0.04408	0
mushape_2	1.998	0.06453	0
mushape_3	3.036	0.08023	0
mushape_4	3.824	0.1065	0
mushape_5	4.778	0.1186	0
mushape_6	5.498	0.1291	0
mushape_7	6.238	0.1527	0
mushape_8	7.376	0.1743	0

A-priori bias 

```
codatable(chains, '^muscale')
```

Estimand	mean	std	plt0
muscale_1	0.9543	0.03819	0
muscale_2	1.096	0.04368	0
muscale_3	0.9436	0.03628	0
muscale_4	0.9787	0.03772	0
muscale_5	0.0254	0.01394	0
muscale_6	0.02372	0.01261	0
muscale_7	0.02232	0.01234	0
muscale_8	0.0225	0.01275	0

Make some figures

Smoothed histograms figure('windowstyle', 'docked')

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