```
begin
    using Distributions
    using StatsPlots
    using Soss
end
```

An example from the first chapter of the book **Probabilistic Programming and Bayesian Methods for Hackers**. We have some text message counts for each day of a two month period. We suspect there is a change in the behaviour of incoming messeges and the data is modeled as two Poisson distributions. We are going to estimate the parameters μ1 and μ2 from the two Poisson distributions and the day of the change in the behavior.

```
data = Float64[13.0, 24.0, 8.0, 24.0, 7.0, 35.0, 14.0, 11.0, 15.0, 11.0, 22.0,
```

First, we define the model

```
@model begin
        μ2 ~ Exponential()
        μ1 ~ Exponential()
        x ~ For(eachindex(x)) do j
                if j < τ
                    Poisson(μ1)
                else
                    Poisson(μ2)
                end
            end
        N = length(x)
        τ ~ Uniform(0, N)
    end
```

```
begin
    m = @model begin
        N = length(x)
        μ1 ~ Exponential()
        μ2 ~ Exponential()
        τ ~ Uniform(0, N)
        x ~ For(eachindex(x)) do j
            if j < τ
                Poisson(μ1)
            else
                Poisson(μ2)
            end
        end
    end
end
```

```
1461.0
```

```
begin
    n_samp = length(data)
    total_count = sum(data)
end
```

Using Hamiltonian Monte-Carlo, we sample from the posterior distribution.

```
post = NamedTuple[(τ = 44.3197, μ2 = 22.6477, μ1 = 16.6084), (τ = 44.545, μ2 = 22.1
```

```
post = dynamicHMC(m(N=n_samp), (x=data,))
```

```
# We have to play with the parameters from the initialization
# https://tamaspapp.eu/DynamicHMC.jl/stable/interface/#DynamicHMC.mcmc_with_warmup
```

total_post = 1000

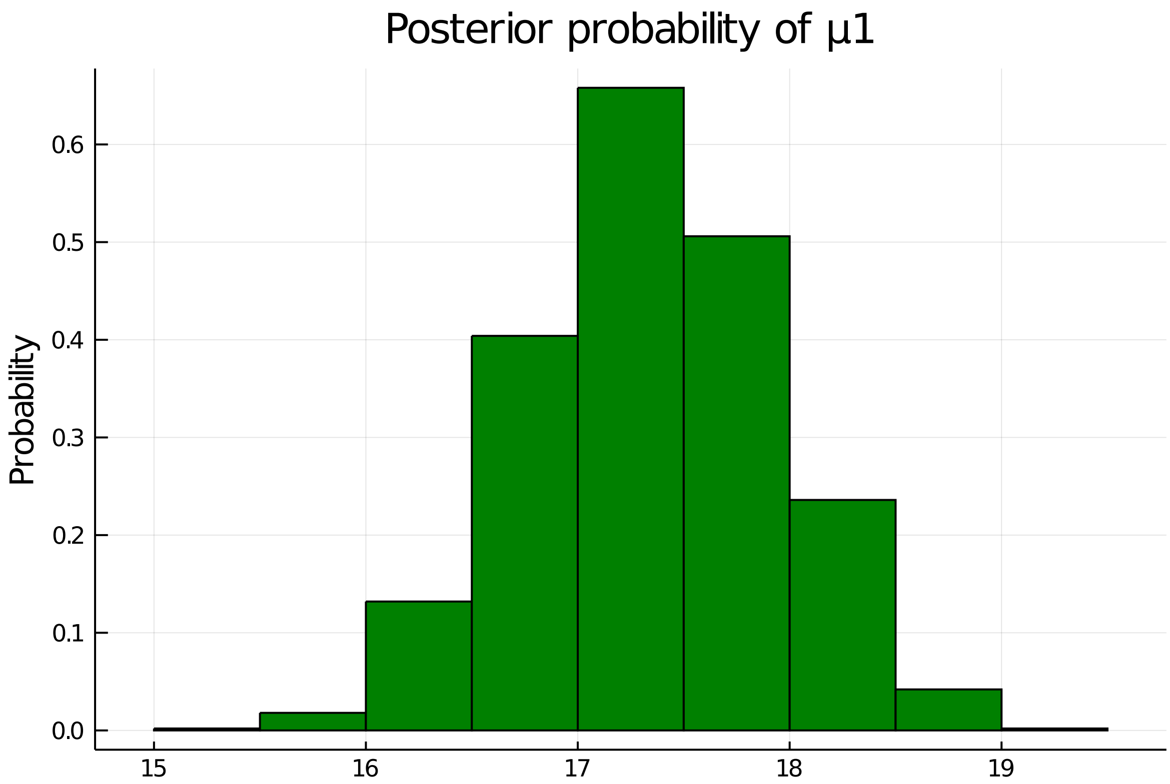
```
total_post = length(post)
```

Float64[44.3197, 44.545, 45.8371, 44.543, 43.8289, 44.6194, 45.6281, 44.8221, 45.

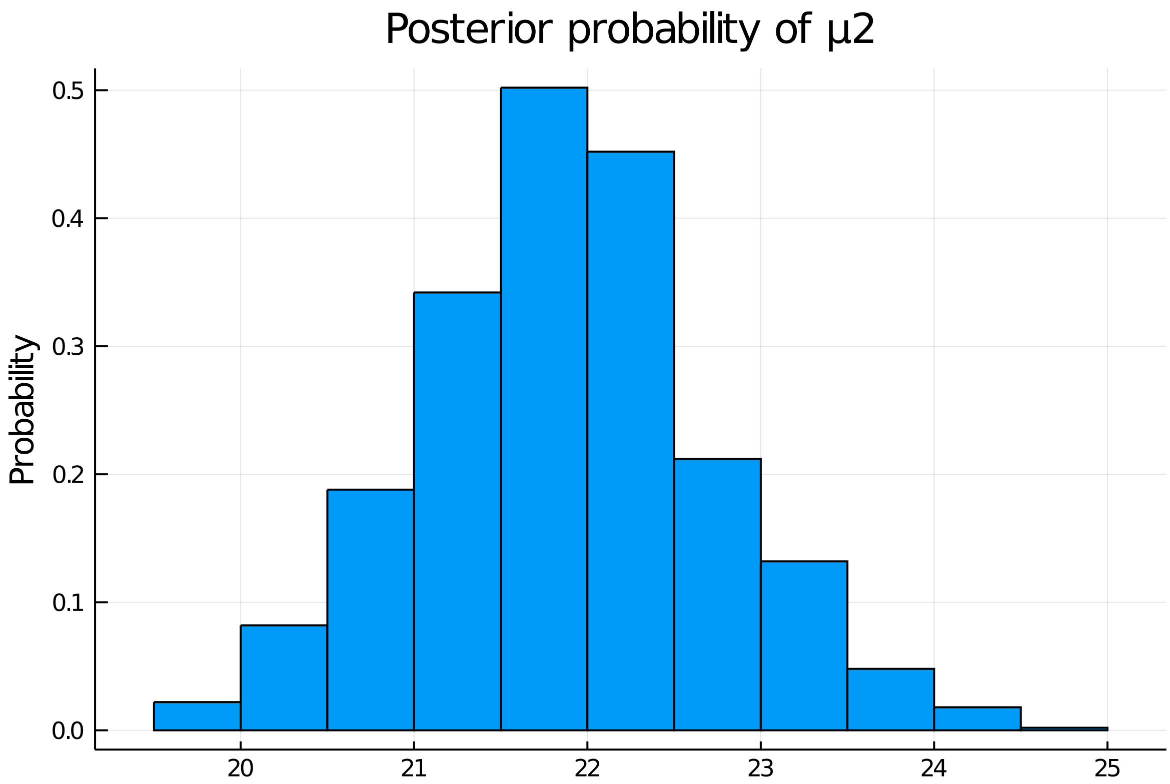
```
begin
    post_μ1 = [i.μ1 for i in post]
    post_μ2 = [i.μ2 for i in post]
    post_τ = [i.τ for i in post]
end
```

An histogram of the results in shown

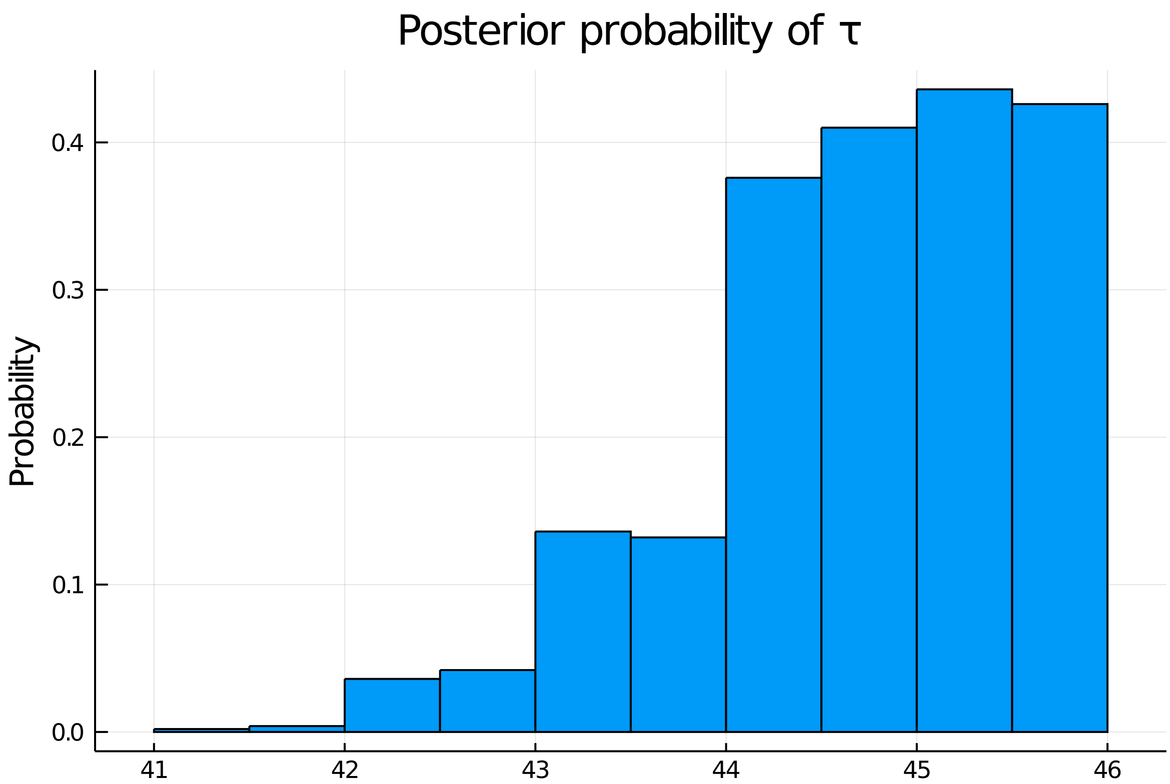
```
md"
An histogram of the results in shown
"
```




```
histogram(post_μ1, bins=10, normed=true, color="green", ylabel="Probability", legend=false,
title="Posterior probability of μ1")
```




```
histogram(post_μ2, bins=10, normed=true, ylabel="Probability", legend=false, title="Posterior probability of μ2")
```




```
histogram(post_τ, bins=10, normed=true, ylabel="Probability", legend=false, title="Posterior probability of τ")
```