[1]

```julia
using Turing, Distributions
using PyPlot, PyCall
```

[11]

```julia
y1 = 10*sin(0:0.2:2pi); y1 += randn(length(y1))
y2 = 10*sin(0:0.2:2pi); y2 += randn(length(y2))
y = [y1'; y2']
N = size(y)[end];  K = 10;
```

[12]

```julia
@model FHMM(y) = begin
    s1 = tzeros(Int, N)
    s2 = tzeros(Int, N)
    m1 = tzeros(Real, K)
    m2 = tzeros(Real, K)
    T1 = Vector{Vector{Real}}(K)
    T2 = Vector{Vector{Real}}(K)
    for i = 1:K
        T1[i] ~ Dirichlet(ones(K)/K)
        T2[i] ~ Dirichlet(ones(K)/K)
        m1[i] ~ Normal(i, 1)
        m2[i] ~ Normal(i, 1)
    end
    s1[1] ~ Categorical(ones(Float64, K)/K)
    s2[1] ~ Categorical(ones(Float64, K)/K)
    for i = 2:N
        s1[i] ~ Categorical(vec(T1[s1[i-1]]))
        s2[i] ~ Categorical(vec(T2[s2[i-1]]))
        y[:,i] ~ MvNormal([m1[s1[i]], m2[s2[i]]], 1*ones(2))
    end
end
```

```
WARNING: Method definition FHMM() in module Main overwritten.
WARNING: Method definition FHMM(Any) in module Main overwritten.
WARNING: Method definition #FHMM(Array{Any, 1}, Main.#FHMM) in module Main
overwritten.
WARNING: Method definition #FHMM(Array{Any, 1}, Main.#FHMM, Any) in module
Main overwritten.
FHMM (generic function with 2 methods)
```

[13]

```julia
g = Gibbs(300, HMC(1, 0.2, 5, :m1, :T1, :m2, :T2), PG(25, 1, :s1,
:s2))
c = sample(FHMM(y), g);
```

```
[Turing]:  Assume - `T1` is a parameter
  in @~(::Any, ::Any) at compiler.jl:49
```

```
[Turing]:  Assume - `T2` is a parameter
  in @~(::Any, ::Any) at compiler.jl:49
[Turing]:  Assume - `m1` is a parameter (ignoring `m1` found in global
scope)
  in @~(::Any, ::Any) at compiler.jl:49
[Turing]:  Assume - `m2` is a parameter
  in @~(::Any, ::Any) at compiler.jl:49
[Turing]:  Assume - `s1` is a parameter (ignoring `s1` found in global
scope)
  in @~(::Any, ::Any) at compiler.jl:49
[Turing]:  Assume - `s2` is a parameter
  in @~(::Any, ::Any) at compiler.jl:49
[Turing]:  Observe - `y` is an observation
  in @~(::Any, ::Any) at compiler.jl:28
[Gibbs] Finished with
  Running time    = 161.52098317899996;
```

[14]

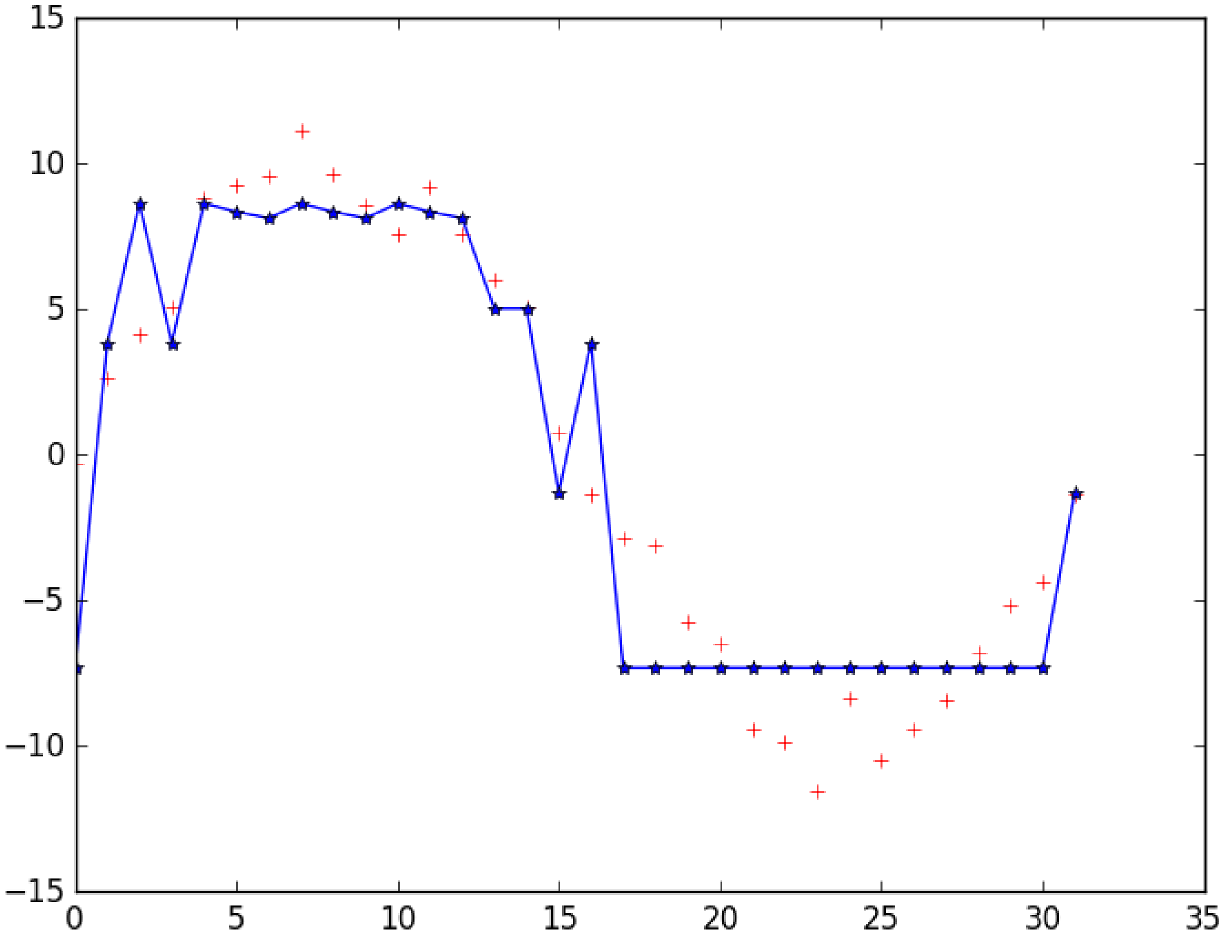
```
describe(c)
```

```
Iterations = 1:300
Thinning interval = 1
Chains = 1
Samples per chain = 300

Empirical Posterior Estimates:
                        Mean                              SD
Naive SE                              MCSE                      ESS
     m1[4]      5.703347310679865778126896    1.029058468979256124598010
0.05941271840770376289064814    0.527824641752570600239380    3.8010255
    s1[14]      4.266666666666666607454772    1.183310172964110895676981
0.06831844468956520255442655    0.480740170061865312867155    6.0586571
     s1[7]      8.000000000000000000000000    0.000000000000000000000000
0.000000000000000000000000000    0.000000000000000000000000 300.0000000
  T1[6][1]      0.065364663057770208687280    0.173040650721244720910974
0.00999050662746586368156976    0.061605782956316704201960    7.8895697
  T1[6][2]      0.000000002182522806865119    0.000000007524508367595289
0.00000000043442769315507315    0.000000002119425235636581   12.6043385
  T1[6][3]      0.000190699856784367342182    0.001057484361183785815871
0.00006105388805932781615734    0.000174171768677273047570   36.8631449
  T1[6][4]      0.540764293272242957399953    0.370058710417452141339112
0.02136534960754817719097431    0.188002018199981496549000    3.8745051
  T1[6][5]      0.092068821493332911320984    0.145928519255251548658592
0.00842518698744629604413525    0.035330559719579629485153   17.0600114
  T1[6][6]      0.032757258456103104105051    0.097246465214988933589702
0.00561452728696134294172904    0.029392862741589590586111   10.9462125
```

[17]

```
m1 = c[:m1][222];
s1 = c[:s1][222];
PyPlot.plot(y[1,:], linestyle="None", marker="+", color = "r")
PyPlot.plot(m1[s1], linestyle="-", marker="*", color = "b")
```




```
1-element Array{Any,1}:
 PyObject <matplotlib.lines.Line2D object at 0x7f0b8425ea10>
```

```
[ ]
```