```
1)
a)

f(theta,n,x) = (n!/(x!*(n-x)!))*(T(10)/(T(5)*T(5)))*(theta^(x+4))*((1 -
theta)^(n-x+4))*((e^-4)*(4^n)/n!)
```

b) Accept-Reject method: Average out the nuisance parameters to marginalize to f(x)

challenge -
'

1. picking candidate distribution is difficult in 3 dimensions
2. Closed form analytical solutions may not be possible

c) I would use metropolis-hastings algorithm to sample from f(x)

challenge -

1. Choosing proposal density in 3 dimensions
2. Difficulty in tuning

```
d) f(x | theta,n) =  (n!/(x!*(n-x)!)) theta^x * (1 -theta)^(n-x)
```

e) f(theta|x,n) = (T(10)/(T(5)*T(5)))*(theta^(4))*((1 -theta)^(4))

f)f(n|theta,x) = (n!/(x!*(n-x)!)) *theta*^x (1 -theta)^(n-x) ((e^-lambda)*(lambda^n)/n!) = [lambda(1-theta)]^x/(n-x)! = [4(1-theta)]^x//(n-x)! =poisson(4(1-theta))

g)

1. initialize x0, theta0,n0 ~ q
2. for iteration i = 1,2..... do
    3. x<i> ~ Binomial(n<i-1>, theta<i-1>)
    4. theta<i> ~ Beta(a+x<i>, b+(n<i-1>-x<i>))
    5. n<i> ~ x<i> + poisson(4(1-theta<i>))
6. Repeat Until convergence

h)

In [1]:
```
using Distributions;
using Gadfly;
using StatsBase;
```

In [2]:
```
N = 10000;
n = 20;
a = 5;
b =5;
lambda = 4;
theta = zeros(N);
x = zeros(N);
n_s =zeros(N);
x[1] = rand(Binomial(n,theta[1]));
theta[1] = rand(Beta(a,b));
n_s[1] = x[1] + rand(Poisson(lambda*(1-theta[1])))
for i=2:N
 x[i] = rand(Binomial(n_s[i-1],theta[i-1]));
 theta[i] = rand(Beta(x[i]+a,n_s[i-1]+b-x[i]));
 z = rand(Poisson(lambda*(1-theta[i-1])))
 n_s[i] = x[i] + z
end
```

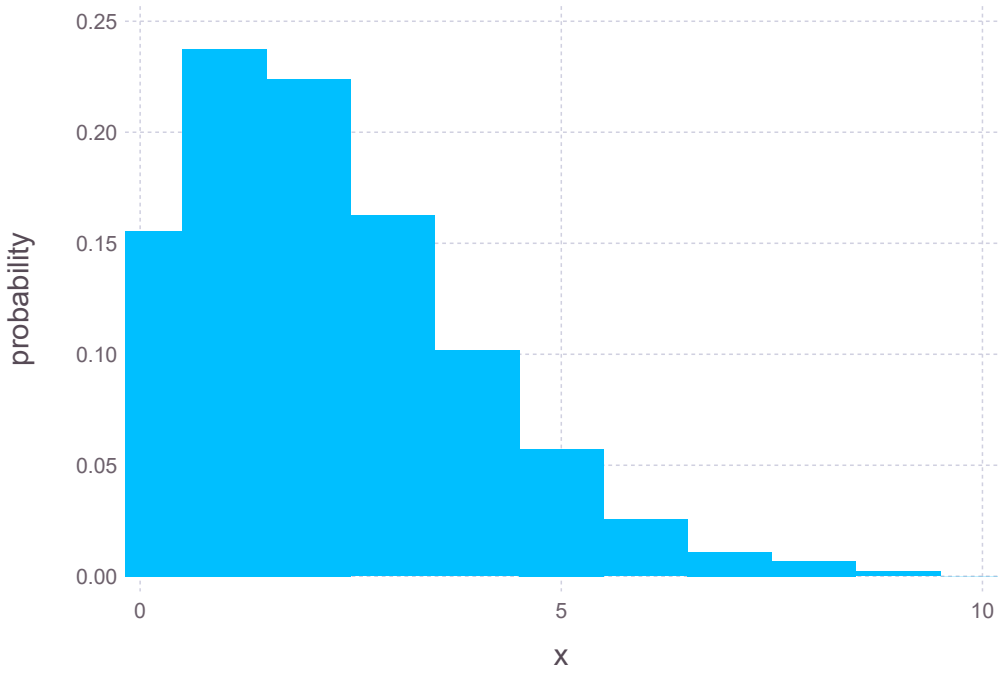
```
WARNING: Binomial(n::Real, p) is deprecated. Please use Binomial(n::Integer, p)
instead.
Stacktrace:
 [1] depwarn(::String, ::Symbol) at ./deprecated.jl:70
 [2] Distributions.Binomial(::Float64, ::Float64) at /users/PES0801/nifaullah/.
julia/v0.6/Distributions/src/deprecates.jl:11
 [3] macro expansion at ./In[2]:13 [inlined]
 [4] anonymous at ./<missing>:?
 [5] include_string(::String, ::String) at ./loading.jl:522
 [6] include_string(::Module, ::String, ::String) at /users/PES0801/nifaullah/.
julia/v0.6/Compat/src/Compat.jl:84
 [7] execute_request(::ZMQ.Socket, ::IJulia.Msg) at /usr/local/julia/0.6.4/sit
e/v0.6/IJulia/src/execute_request.jl:180
 [8] (::Compat.#inner#6{Array{Any,1},IJulia.#execute_request,Tuple{ZMQ.Socket,I
Julia.Msg}})() at /users/PES0801/nifaullah/.julia/v0.6/Compat/src/Compat.jl:125
 [9] eventloop(::ZMQ.Socket) at /usr/local/julia/0.6.4/site/v0.6/IJulia/src/eve
ntloop.jl:8
 [10] (::IJulia.##15#18)() at ./task.jl:335
while loading In[2], in expression starting on line 12
```

i)

In [4]:
```
hist_x = [fit(Histogram,x,collect(0:1:10)).weights; 0]./10150;
plot(x=collect(0:1:10),y=hist_x, Geom.bar,Guide.ylabel("probability"
),Guide.xlabel("x"),
Coord.Cartesian(xmin=0,xmax=10))
```

```
WARNING: Default for keyword argument "closed" has changed from :right to :lef
t.
To avoid this warning, specify closed=:right or closed=:left as appropriate.
Stacktrace:
 [1] depwarn(::String, ::Symbol) at ./deprecated.jl:70
 [2] _check_closed_arg at /users/PES0801/nifaullah/.julia/v0.6/StatsBase/src/hi
st.jl:12 [inlined]
 [3] #fit#108(::Symbol, ::Function, ::Type{StatsBase.Histogram{Int64,N,E} where
E where N}, ::Tuple{Array{Float64,1}}, ::Tuple{Array{Int64,1}}) at /users/PES08
01/nifaullah/.julia/v0.6/StatsBase/src/hist.jl:282
 [4] (::StatsBase.#kw##fit)(::Array{Any,1}, ::StatsBase.#fit, ::Type{StatsBase.
Histogram{Int64,N,E} where E where N}, ::Tuple{Array{Float64,1}}, ::Tuple{Array
{Int64,1}}) at ./<missing>:0
 [5] fit(::Type{StatsBase.Histogram{Int64,N,E} where E where N}, ::Array{Float6
4,1}, ::Array{Int64,1}) at /users/PES0801/nifaullah/.julia/v0.6/StatsBase/src/h
ist.jl:225
 [6] #fit#112(::Array{Any,1}, ::Function, ::Type{StatsBase.Histogram}, ::Array
{Float64,1}, ::Vararg{Any,N} where N) at /users/PES0801/nifaullah/.julia/v0.6/S
tatsBase/src/hist.jl:340
 [7] fit(::Type{StatsBase.Histogram}, ::Array{Float64,1}, ::Array{Int64,1}) at
/users/PES0801/nifaullah/.julia/v0.6/StatsBase/src/hist.jl:340
 [8] include_string(::String, ::String) at ./loading.jl:522
 [9] include_string(::Module, ::String, ::String) at /users/PES0801/nifaullah/.
julia/v0.6/Compat/src/Compat.jl:84
 [10] execute_request(::ZMQ.Socket, ::IJulia.Msg) at /usr/local/julia/0.6.4/sit
e/v0.6/IJulia/src/execute_request.jl:180
 [11] (::Compat.#inner#6{Array{Any,1},IJulia.#execute_request,Tuple{ZMQ.Socket,
IJulia.Msg}})() at /users/PES0801/nifaullah/.julia/v0.6/Compat/src/Compat.jl:12
5
 [12] eventloop(::ZMQ.Socket) at /usr/local/julia/0.6.4/site/v0.6/IJulia/src/ev
entloop.jl:8
 [13] (::IJulia.##15#18)() at ./task.jl:335
while loading In[4], in expression starting on line 1
```

Out[4]:


0.25
0.20
0.15
0.10
0.05
0.00
probability
0
5
10
x