```
function [gain,temps] = rbanque(p,i)
     % Simulates the game until loss
    fortune = i; % fortune de dÃ©part
    temps = 0;
    while (fortune ~=0)
        u = rand();
        if u<p
            fortune = fortune + 1;
        else
            fortune = fortune − 1;
        end
        temps = temps+1;
    end
    gain = fortune;
end
function [x] = rimarkov(m,n,fhandle)
    % Estimate of the integral of f on a markov chain
    traj = rmarkov(m,n);
    if ischar(fhandle)
        fhandle = str2func(fhandle);
    end
    x = sum(fhandle(traj))/n;
end
function [x] = rmarkov(m,n)
    % Simulates a markov chain of length n with matrix m
    x = ones(1,n);
    for i = 2:n
        x(i) = rproba(m(x(i−1),:));
    end
end
function [m] = rmarkovmat(n)
    % Generates a random stochastic matrix of size n suitable for rmarkov
    m = rand(n,n);
    col = sum(m,2);
    m = m ./ (col * ones(1,n));
end
function [gain,temps] = rmarkovruine(p,a,i)
    % Simulates the game until win or loss
    fortune = i+1; % fortune de dÃ©part
    m = ruinemat(p,a);
    temps = 0;
    while (fortune ~=1) && (fortune ~= (a+1))
        fortune = rproba(m(fortune,:));
        temps = temps+1;
    end
    gain = fortune − 1;
end
function [x] = rproba(p)
    % Simulates a random variable on [1,length(p)] with law p
    u = rand();
    cdf = cumsum(p);
    x = sum(cdf<u)+1;
end
function [m] = ruinemat(p,a)
    % Creates a stochastic matrix suitable for rmarkov
    m = zeros(a+1,a+1);
    m(1,1)=1; m(a+1,a+1) = 1;
    for i=2:a
        m(i,i+1) = p; m(i,i−1) = 1−p;
    end
end
```



```
% TP2 Introduction aux Chaines de Markov

%%%%%%%%%%%%%%
% 1 Chaines de Markov GÃ©nÃ©riques

% test de rproba
p = [0.4 0.1 0.3 0.2];
echantillon = zeros(1,1000);
for i = 1:1000
    echantillon(i)=rproba(p);
end
hist(echantillon);

% test de rmarkovmat
rmarkovmat(1)
rmarkovmat(4)

% Simulation d'une chaine de markov
m = rmarkovmat(3);
traj = rmarkov(m,100);
plot(traj)
title('Trajectoire d''une chaine de Markov sur 3 Ã©tats')

% Loi invariante
[V,D] = eig(m');
loi_invar = V(:,1) / sum(V(:,1));
n = 2000;
traj = rmarkov(m,n);
x = 1:n;
plot(cumsum(traj==1)./x,'r')
hold on
plot(cumsum(traj==2)./x,'g')
plot(cumsum(traj==3)./x,'b')
plot(x,loi_invar(1)*ones(1,n),'r')
plot(x,loi_invar(2)*ones(1,n),'g')
plot(x,loi_invar(3)*ones(1,n),'b')
hold off
title('Convergence vers la loi invariante')

% IntÃ©gration par rapport Ã  une chaine de markov
f = @sin;
sum(f(1:3) * loi_invar)
rimarkov(m,10000,'sin')
f = inline('(x==1)*1','x');
loi_invar(1)
rimarkov(m,10000,f)

%%%%%%%%%%%%%
% 2 Ruine du joueur

% Test de ruinemat
ruinemat(0.2,1)
ruinemat(0.3,3)

% Simulation du jeu
p = 0.5;
a = 30;
i = 12;
[gain,temps] = rmarkovruine(p,a,i)
n=1000;
egain = zeros(1,n); etemps = zeros(1,n);
```

```
for i = 1:n
    [g,t] = rmarkovruine(p,a,10);
    egain(i) = g; etemps(i) = t;
end
mean(egain)
mean(etemps)

% Simulation du jeu contre la banque
p = 0.49;
i = 12;
[gain,temps] = rbanque(p,i)
n=1000;
egain = zeros(1,n); etemps = zeros(1,n);
for i = 1:n
    [g,t] = rbanque(p,12);
    egain(i) = g; etemps(i) = t;
end
mean(egain)
mean(etemps)
```