```
clear all; clf
Temps = readtable('Temperaturas.txt');
Temps = table2array(Temps);
```

Punto 1

```
%Distribución empírica
A = zeros(35,1);
A2 = zeros(35,1);
hold on
title("Distribuciones empíricas para las temperaturas año a año")
xlabel("Temperatura")
ylabel("Probabilidad")
for i = 1:35
    temp = Temps(:,i);
    [F,t] = ecdf(temp);
    tq1 = t(find(t>=0)); tq2 = t(find(t<0));
    Fq1 = F(find(t>=0)); Fq2 = F(find(t<0));
    A(i) = trapz(tq1,1-Fq1) - trapz(tq2,Fq2);
    A2(i) = sum(F);
    plot(t,F)
end
```

```
%Tabla de doble entrada con la media
```

```
means = mean(Temps,1);

doubletable = zeros(36,36);

doubletable(1,2:36) = means;

doubletable(2:36,1) = means;

for i = 2:36
    for j = 2:36
        valori = means(i-1);
        valorj = means(j-1);
        doubletable(i,j) = i-1;
        if valorj > valori
            doubletable(i,j) = j-1;
        end

        if i == j
            doubletable(i,j) = 0;
        end
    end
end

array2table(doubletable)
```

```
ans = 36×36 table
```

...

	doubletable1	doubletable2	doubletable3	doubletable4	doubletable5
1	0	4.6899	6.1499	5.5096	6.8115
2	4.6899	0	2	3	4
3	6.1499	2	0	2	4
4	5.5096	3	2	0	4
5	6.8115	4	4	4	0
6	5.2323	5	2	3	4
7	5.2630	6	2	3	4
8	-5.0592	1	2	3	4
9	3.1000	1	2	3	4
10	2.2463	1	2	3	4
11	4.0808	1	2	3	4
12	4.1195	1	2	3	4
13	6.1307	12	2	12	4
14	5.8126	13	2	13	4

⋮

```
%Tabla de doble entrada con la estimación empírica de la media
doubletable2 = zeros(36,36);

doubletable2(1,2:36) = means;

doubletable2(2:36,1) = means;

for i = 2:36
    for j = 2:36
        valori = A2(i-1);
        valorj = A2(j-1);
        doubletable2(i,j) = i-1;
        if valorj > valori
            doubletable2(i,j) = j-1;
        end

        if i == j
            doubletable2(i,j) = 0;
        end



    end
end

array2table(doubletable2)
```

```
ans = 36×36 table
```

	doubletable21	doubletable22	doubletable23	doubletable24	doubletable25
1	0	4.6899	6.1499	5.5096	6.8115
2	4.6899	0	2	3	1
3	6.1499	2	0	3	2
4	5.5096	3	3	0	3
5	6.8115	1	2	3	0
6	5.2323	5	2	3	5
7	5.2630	6	6	6	6
8	-5.0592	7	7	7	7
9	3.1000	8	8	8	8
10	2.2463	9	9	9	9
11	4.0808	10	10	10	10
12	4.1195	11	11	11	11
13	6.1307	12	2	3	12

	doubletable21	doubletable22	doubletable23	doubletable24	doubletable25
14	5.8126	13	13	13	13

⋮

Punto 2

```
temp = Temps(:,1);
[F,t] = ecdf(temp);
tq1 = t(find(t>=0)); tq2 = t(find(t<0));
Fq1 = F(find(t>=0)); Fq2 = F(find(t<0));
estimator = trapz(tq1,1-Fq1) - trapz(tq2,Fq2)
```

```
estimator = 4.6625
```

```
clf
hold on
plot(1:35,A)
plot(1:35, mean(Temps,1))
```

Punto 3

```
[minimum, minindex] = min(means);
[maximum, maxindex] = max(means);
```

```
clf
hold on
title("Distribución empírica para los años con mayor y menos temperatura " + ...
    "promedio")
xlabel("Temperatura")
ylabel("Probabilidad")
ecdf(Temps(:,minindex),'Bounds','on');
ecdf(Temps(:,maxindex),'Bounds','on');
legend({'Año con mayor media','Año con menor media'})
```

Punto 4

```
n = 100
```

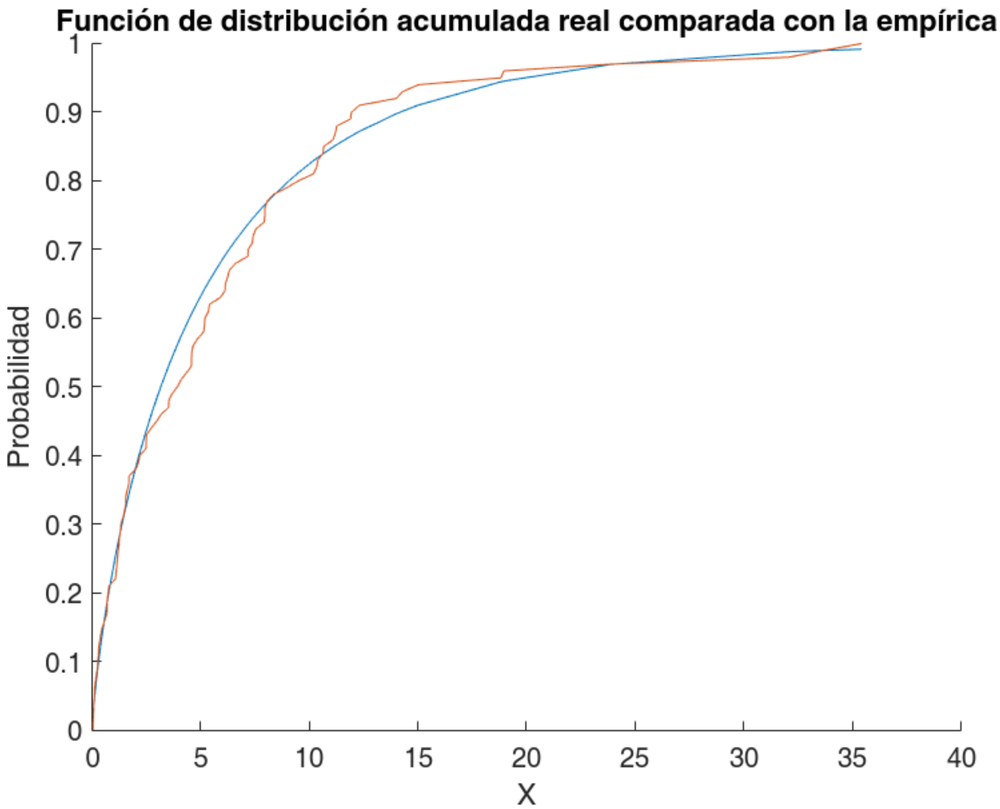
```
n = 100
```

```
X = wblrnd(5, 0.8,n,1);
[F,t] = ecdf(X);
WeibulF = wblcdf(t,5,0.8);
min(abs(WeibulF-F))
```

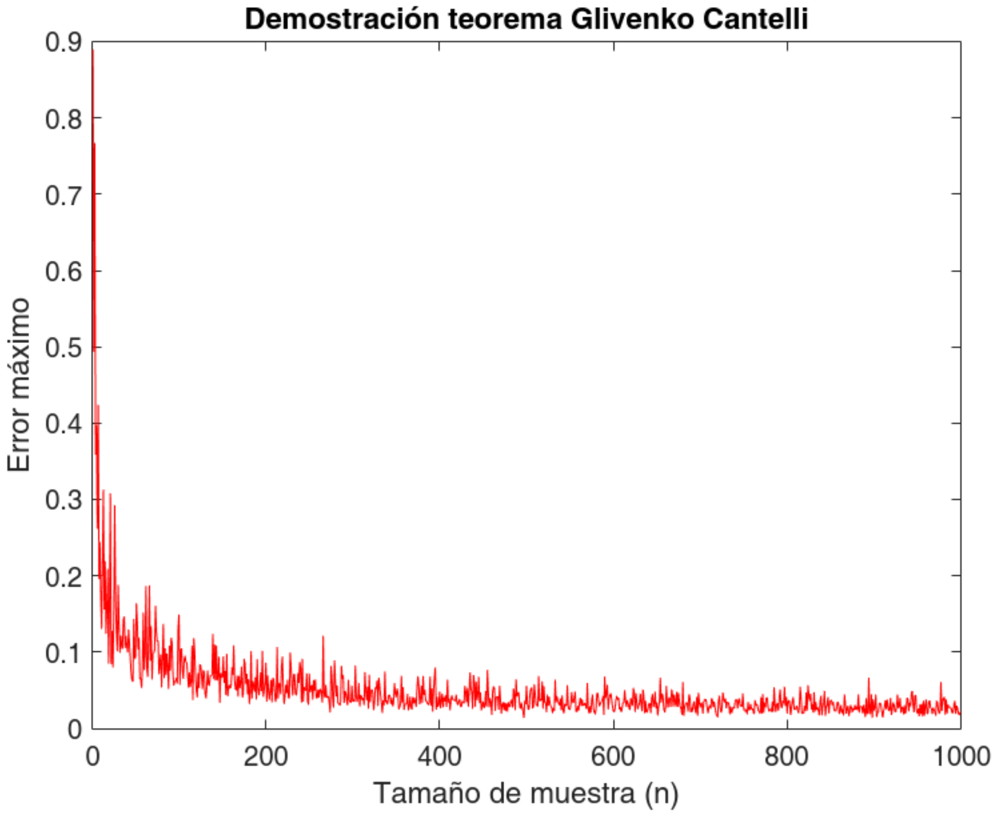
```
ans = 3.8950e-05
```

```
clf
hold on
plot(t,WeibulF)
plot(t,F)
```

```
title("Función de distribución acumulada real comparada con la empírica")
xlabel("X")
ylabel("Probabilidad")
```




```
maxs = zeros(991,1);
for i = 1:1000
    X = wblrnd(5, 0.8,i,1);
    [F,t] = ecdf(X);
    WeibulF = wblcdf(t,5,0.8);
    maxs(i) = max(abs(WeibulF-F));
end
clf
plot(maxs,'r')
title("Demostración teorema Glivenko Cantelli")
xlabel("Tamaño de muestra (n)")
ylabel("Error máximo")
```



Punto 7

```
clf; clear all
syms i;
n=1000; N = 1000;
j = 5;

weibul = wblrnd(1,1,N,n);
weibulSort = sort(weibul);
ithValue = weibulSort(j,:);
[F,t] = ecdf(ithValue);
```

```
x = zeros(length(t),1);
for k=1:length(t)
    x(k) = double(symsum(nchoosek(n,i)*(wblcdf(t(k))^(i)*(1-wblcdf(t(k)))^(n-i)),i,j,n));
end
```

```
clf
plot(t,x,'r')
hold on
plot(t,F,'b')
legend({"Theoretical", "Empirical"})
xlabel('x'); ylabel('CDF(x)'); title("Comparison between a theorical and empirical CDF")
```

Punto 12

```
clf
[minimum, minindex] = min(means); minYear = Temps(:,minindex);
maxTemp = max(minYear)
```

```
maxTemp = 5
```

```
m = bootstrp(1000,@max,minYear);
mean(m)
```

```
ans = 4.9306
```

```
hist(m) %esperamos que se vea normal
```

```
%Varianza
var(m)
```

```
ans = 0.0145
```

```
%Intervalo de confianza
CIB = [prctile(m,2.5) prctile(m,97.5)] %Intervalo de confianza con bootstrap
```

```
CIB = 1×2
    4.6000    5.0000
```

```
%Sesgo
jack = jackknife(@max,minYear);
n = length(minYear);

jbias = (n-1)*(mean(jack)-max(minYear))
```

```
jbias = -0.0997
```

Punto 13

```
clf
N = 1000;
n = 10;
unif = rand(N,n);
```

```
mins = min(unif(:,:));
m = bootstrp(100,@min,mins);
var(mins)
```

```
ans = 5.9454e-07
```

```
hist(m)
```

```
mean(mins) %Sample mean value
```

```
ans = 0.0010
```

```
-1/(N+1) %Expected mean value
```

```
ans = -9.9900e-04
```

```
%Sesgo Varianza
m1 = jackknife(@min,mins);
bias = 1/(N+1) %Known minimum bias estimate
```

```
bias = 9.9900e-04
```

```
jbias = (n-1)*(mean(m1)-min(mins)) %jackknife bias estimate
```

```
jbias = 1.7626e-04
```

Punto 14

```
%Bootstrap Parametrico
n =100;
B = 10000;
samples = zeros(B,1);
for i=1:B
    samp = normrnd(2,1,[n 1]);
    samples(i) = mean(samp);
end
LI = prctile(samples,2.5);
LS = prctile(samples,97.5);
ci_p = [LI LS]
```

```
ci_p = 1×2
    1.8041    2.1944
```

```
variance = var(samples)
```

```
variance = 0.0099
```

```
%Non parametic Bootstrap
n = 100;
B = 10000;
samples2 = normrnd(2,1,[n 1]);
[ci_np, ~] = bootci(B, @mean, samples2)
```

```
ci_np = 2×1
   19.7164
   21.1425
```

```
%Bootstrap Robusto
B = 10000;
n_cont = 11;
n = 100;

muestras = normrnd(2,1,[n 1]) + rand([n 1]);
[ci_nr,~] = bootci(B,@mean,muestras)
```

```
ci_nr = 2×1
    2.4575
    2.7981
```

```
[winsorized,r]=winsor(muestras,[47.5;57.5]);
min(winsorized), max(winsorized)
```

```
ans = 2.5170
ans = 2.7174
```

Punto 15

```
clf
[minimum, minindex] = min(means); minYear = Temps(:,minindex);
[maximum, maxindex] = max(means); maxYear = Temps(:,maxindex);
clf
dist = mahal(maxYear,minYear);
p = prctile(dist,95);
idx = find(dist>p);
plot(minYear, maxYear, '.')
hold on
plot(Temps(idx,minindex), Temps(idx,maxindex), '+')
title("Detección de outliers Mahalanobis clásica")
xlabel("Temperaturas más calurosas en media")
ylabel("Temperatura más frías en media")
legend('','Outliers')
```

```
clf
X = minYear; Y =maxYear; m = mean(X,1); m2 = mean(Y,1)
```

```
m2 = 9.9592
```

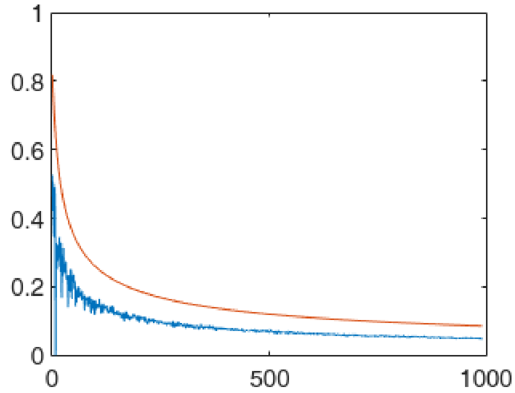
```
[rx,cx] = size(X); [ry,cy] = size(Y);
M = m(ones(ry,1),:);
C = X - m(ones(rx,1),:);
covarian = corr([X,Y])*std(X)*std(Y);
x_minus_mu = [Y,X]-[maximum minimum];
left_term = x_minus_mu/covarian;
```

```
mahal_nueva = sqrt(left_term* x_minus_mu');
dist = diag(mahal_nueva);
p = prctile(dist,95);
idx = find(dist>p);
plot(minYear, maxYear, '.')
hold on
plot(Temps(idx,mint), Temps(idx,maxt), '+')
title("Detección de outliers Mahalanobis clásica")
xlabel("Temperaturas más calurosas en media")
ylabel("Temperatura más frías en media")
legend('','Outliers')
```

Punto 16.1

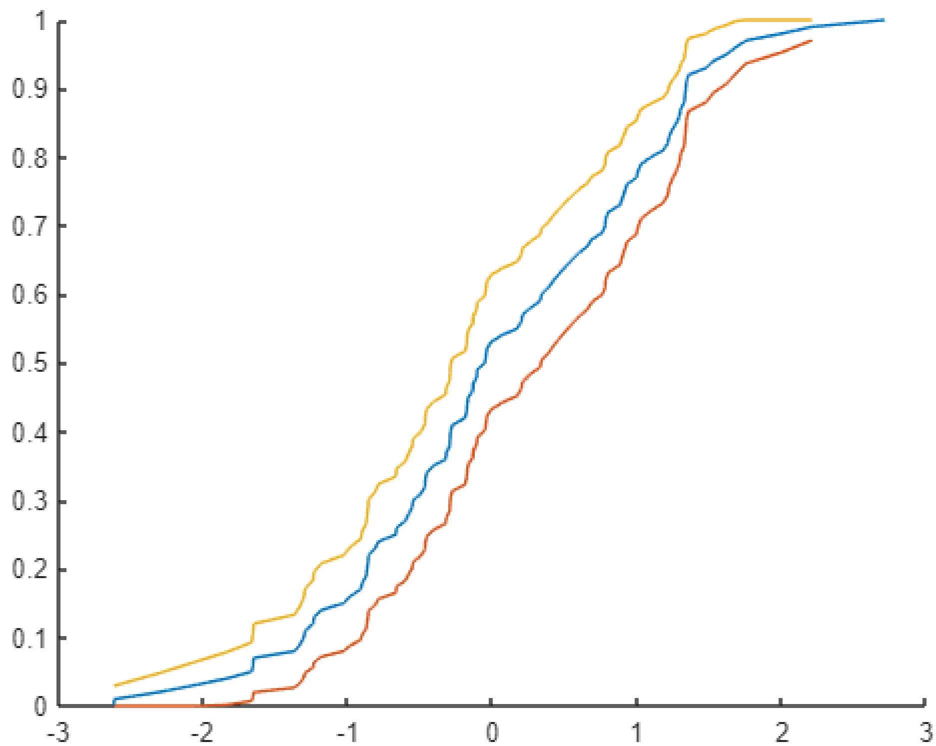
```
clf
N=1000;
sizenorm = zeros(n,1); sizenopar = zeros(n,1);
for n=11:N
    X = binornd(1,0.2, n,1);
    pn = 1/n*sum(X);
    CInorm = [pn + norminv(0.025)*sqrt(pn*(1-pn)/n);
              pn + norminv(0.975)*sqrt(pn*(1-pn)/n)];
    sizenorm(n-10) = CInorm(2)-CInorm(1);
    CInopar =  [pn - sqrt(1/(2*n)*log(2/0.05));
                 pn + sqrt(1/(2*n)*log(2/0.05))];
    sizenopar(n-10) = CInopar(2)-CInopar(1);
```

```
end
plot(sizenorm)
hold on
plot(sizenopar)
```



punto 16.2

```
clf
N = 100;
X = randn(N,1);
[Fout,x,Flo,Fup] = ecdf(X,"Bounds","on");
hold on
plot(x,Fout), plot(x,Flo), plot(x,Fup)
```



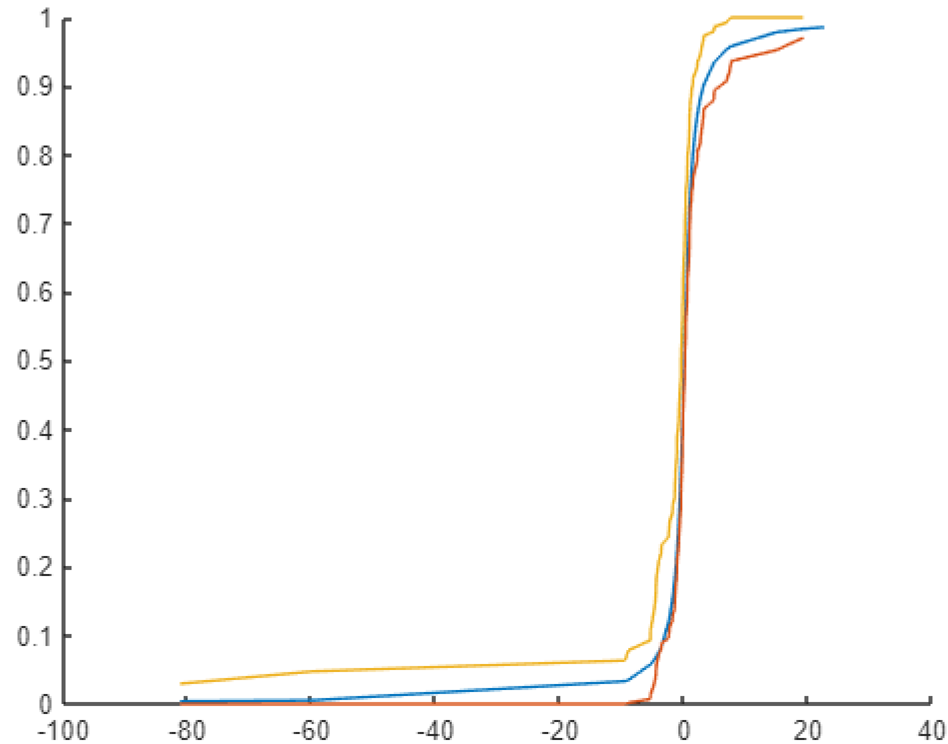
```
N = 100;
alpha = 0.05;
sumsMat = 0;
sumsWasser = 0;
epsilon= sqrt(1/(2*N)*log(2/alpha));
for i=1:1000
    X = randn(N,1);
    [F,x,Flo,Fup] = ecdf(X,"Bounds","on");
    Up=zeros(length(F),1); Lo=zeros(length(F),1);
    normal = normcdf(x,0,1);
    for j= 1:length(F)
    Up(j)= min(F(j)+epsilon,1);
    Lo(j) = max(F(j)-epsilon,0);
    end
    if sum(normal>Fup) + sum(normal<Flo)>=1
        sumsMat = sumsMat+1;
    end
    if sum(normal>Up) + sum(normal<Lo)>=1
        sumsWasser = sumsWasser+1;
    end
end
1 - sumsMat/1000
```

```
ans = 0.4020
```

```
1- sumsWasser/1000
```

```
ans = 0.9560
```

```
%Cauchy Distribution
clf
N = 100;
X = trnd(1,N,1);
outBounds = 0;
[Fout,x,Flo,Fup,D] = ecdf(X,"Bounds","on");
hold on
plot(x,tcdf(x,1)), plot(x,Flo), plot(x,Fup)
```




```
N = 100;
alpha = 0.05;
sumsMat = 0;
sumsWasser = 0;
epsilon= sqrt(1/(2*N)*log(2/alpha));
for i=1:1000
    X = trnd(1,[N 1]);
    [F,x,Flo,Fup] = ecdf(X,"Bounds","on");
    Up=zeros(length(F),1); Lo=zeros(length(F),1);
    normal = tcdf(x,1);
    for j= 1:length(F)
    Up(j)= min(F(j)+epsilon,1);
    Lo(j) = max(F(j)-epsilon,0);
    end
    if sum(normal>Fup) + sum(normal<Flo)>=1
        sumsMat = sumsMat+1;
    end
    if sum(normal>Up) + sum(normal<Lo)>=1
        sumsWasser = sumsWasser+1;
    end
end
1 - sumsMat/1000
```

```
ans = 0.4190
```

```
1- sumsWasser/1000
```

```
ans = 0.9660
```

punto 16.4

```
%%
%Exercise 16.4
clf
LSAT = [576 635 558 578 666 580 555 661 651 605 653 575 545 572 594]';
GPA = [3.39 3.3 2.81 3.03 3.44 3.07 3 3.43 3.36 3.13 3.12 2.74 2.76 2.88 3.96]';
n = length(LSAT)
```

```
n = 15
```

```
X = [LSAT GPA];

plot(GPA,LSAT,'o','color','#D95319')
title('Correlation')
xlabel('GPA')
ylabel('LSAT')
```

```
% correlation coefficient
GPAbar = mean(GPA); LSATbar =  mean(LSAT);
p = sum((GPA-GPAbar).*(LSAT -LSATbar))/(sqrt(sum((GPA-GPAbar).^2)).*sqrt(sum((LSAT-LSATbar).^2
```

```
p = 0.5459
```

```
p = corr(GPA,LSAT)
```

```
p = 0.5459
```

```

%Standard error using influence function
sqrt((LSAT'*GPA - (GPA'*GPA+LSAT'*LSAT)*p/2)/n)
```

```
ans = 0.0000e+00 + 3.1128e+02i
```

```

%Standard error using jackknife
```

```

%Standard error using bootstrap
boot = bootstrp(1000,@corr,X);
BootstrapExpected = mean(boot);
BootstrapExpected = BootstrapExpected(2)
```

```
BootstrapExpected = 0.5682
```

```
std(boot)/sqrt(n)
```

```
ans = 1×4
         0    0.0504    0.0504         0
```

```
m = 100;
boots = zeros(m,1);
for i = 1:m
    boot = bootstrp(1000,@corr,X);
    BootstrapExpected = mean(boot);
    boots(i) = BootstrapExpected(2);
end

std(boots)
```

punto 16.6