```
> with(linalg):
  Warning: new definition for   norm
  Warning: new definition for   trace
```

¡¡¡¡¡¡¡¡ Antes de ejecutar el archivo se debe ingresar el numero de observaciones para lo cual asignarle a "n" el numero de observaciones!!!!!!!!!!

```
>
```

Lectura de archivo y creacion del arreglo en el cual se guardaran las observaciones.
Cada columna es una

observacion, ya sea de tres o cuatro componentes.

```
> with(stats):

> n := 53;
                                        n := 53
> c:=array(1..4,1..n);
                                  c := array( 1 .. 4, 1 .. 53, [ ])
> observar:=array(1..n,1..4);
                                observar := array( 1 .. 53, 1 .. 4, [ ])
>

>   line := readline(`casos.txt`);
                                line := 0.5825 0.0971 0.2546 0.0658
>   numcaso := 1;
                                        numcaso := 1
>  while  line <>0 do

>        temp := sscanf(line,`%f %f %f %f`);

>        c[1,numcaso]:= temp[1];

>

>        c[2,numcaso]:= temp[2];

>        c[3,numcaso]:= temp[3];

>        c[4,numcaso]:= temp[4];

>        observar[numcaso,1] := temp[1];

>        observar[numcaso,2] := temp[2];
```

Calculo de la ecuacion de la elipsoide

```
> equ:=var1[1,1]-nro;
```

$$equ := 734.6982887 - 796.9853291\,x + 591.8605861\,x^2 - 385.1228167\,y + 32.96739452\,y\,x + 211.2148003\,z - 1237.622054\,z\,x + 182.9289405\,y^2 - 403.6639980\,z\,y + 877.1166116\,z^2$$

Obteniendo coeficientes de la ecuación del elipsoide.

Teniendo la ecuación general de la elipse de la forma

a*x^2+b*y^2+c*z^2+d*x*y+e*x*z+f*z*y+g*x+h*y+i*z+j=0

```
> a:=coeff(equ,x,2);
```

$$a := 591.8605861$$

```
> b:=coeff(equ,y,2);
```

$$b := 182.9289405$$

```
> c:=coeff(equ,z,2);
```

$$c := 877.1166116$$

```
> d:=coeff(coeff(equ, x,1),y,1);
```

$$d := 32.96739452$$

```
> e:=coeff(coeff(equ, x,1),z,1);
```

$$e := -1237.622054$$

```
> f:=coeff(coeff(equ,y,1),z);
```

$$f := -403.6639980$$

```
> g:=tcoeff(coeff(equ, x,1));
```

$$g := -796.9853291$$

```
> h:=tcoeff(coeff(equ,y,1));
```

$$h := 385.1228167$$

```
> i:=tcoeff(coeff(equ,z,1));
```

$$i := 211.2148003$$

```
> j:=tcoeff(equ);
```

$$j := 734.6982887$$

Calculo del grafico de la elipsoide

```
> with(plots):
```

Resolucion de la ecuacion de la elipsoide

```
> zetas:=solve(equ=0,z);
```

$$zetas := -.1204029188 + .7055059941\,x + .2301085127\,y - .1140099260\,10^{-10}\left(-.6332631506\,10^{22} - .5683470239\,10^{22}\,x - .3804275254\,10^{22}\,y - .1362036647\,10^{22}\,x^2 + .2208754838\,10^{22}\,y\,x - .1197138566\,10^{22}\,y^2\right)^{1/2}, -.1204029188 - .7055059941\,x + .2301085127\,y - .1140099260\,10^{-10}\left(-.6332631506\,10^{22} - .5683470239\,10^{22}\,x - .3804275254\,10^{22}\,y - .1362036647\,10^{22}\,x^2 - .2208754838\,10^{22}\,y\,x\right.$$

$$-.1197138566\,10^{22}\,y^2\Big)^{1/2}$$

Ecuacion de mitad superior de la elipsoide

```
> zetas[1];
```

$$-.1204029188 + .7055059941\,x + .2301085127\,y + .1140099260\,10^{-10}\Big(-.6332631506\,10^{22} + .5683470239\,10^{22}\,x - .3804275254\,10^{22}\,y - .1362036647\,10^{22}\,x^2 + .2208754838\,10^{22}\,y\,x - .1197138566\,10^{22}\,y^2\Big)^{1/2}$$

Ecuacion de la mitad inferior de la elipsoide.

```
> zetas[2];
```

$$-.1204029188 + .7055059941\,x + .2301085127\,y - .1140099260\,10^{-10}\Big(-.6332631506\,10^{22} + .5683470239\,10^{22}\,x - .3804275254\,10^{22}\,y - .1362036647\,10^{22}\,x^2 + .2208754838\,10^{22}\,y\,x - .1197138566\,10^{22}\,y^2\Big)^{1/2}$$

Buscando los extremos de las x y los extremos de las y,para graficar elipsoide

```
>

> Determinante := e**2*x**2 + 2*e*x*f*y + 2*e*x*i + f**2*y**2 + 2*f*y*i + i**2 -4*c*a*x*
> *2 -4*c*b*y**2 -4*c*d*x*y -4*c*g*x -4*c*h*y -4*c*j;
```

$$Determinante := -544814.658\,x^2 + 883501.9351\,y\,x + .2273388096\,10^7\,x - 478855.4267\,y^2 - .1521710102\,10^7\,y - .2533052602\,10^7$$

```
> Discriminante2 := -e*(x**2)*f*c*d -e*x*f*c*h -f*i*c*d*x -f*i*c*h +c^2*d^2*x^2 +2*c^
> 2*d*x*h +c**2*h**2 +f**2*c*a*x**2 +f**2*c*g*x +f**2*c*j +c*b*e**2*x**2 +2*c*b*e*x*i
>  + c*b*i**2 -4*c**2*b*a*x**2 -4*c**2*b*g*x -4*c**2*b*j:

> extremox:=solve(Discriminante2=0,x);
```

$$extremox := 2.546610078,\ 3.787203612$$

```
>

> BuscaY:=solve(Determinante=0,x):

>

> Discriminante3 := -e*f*y**2*c*d -e*f*y*c*g -e*i*c*d*y -e*i*c*g +c**2*d**2*y**2 +2*c*
> *2*d*y*g +c**2*g**2+e**2*c*b*y**2 +e**2*c*h*y +e**2*c*j +c*a*f**2*y**2 +2*c*a*f*y*
> i +c*a*i**2 -4*c**2*a*b*y**2 -4*c**2*a*h*y -4*c**2*a*j:

> extremoy:=solve(Discriminante3=0,y);
```

$$extremoy := .6709734897,\ 1.994253052$$

CASOS.TXT

Reducción de una ecuacion cuadrática a la forma canónica.
(pensando principalmente hacia el elipsoide)

```
> #FREstimada := b0 + b1*x + b11*x^2;

> #with(liesymm);

> #Primeraderivada := Diff(FREstimada,x);

> #PD := dvalue(Primeraderivada);

> #xm := solve(PD=0,x);

> #Funcion Ajustada de 2Orden

> #ytongo := b0 + (x')*b + (x')*B*x;

> with(linalg);
  Warning: new definition for   norm
  Warning: new definition for   trace
```

[*BlockDiagonal*, *GramSchmidt*, *JordanBlock*, *Wronskian*, *add*, *addcol*, *addrow*, *adj*, *adjoint*, *angle*, *augment*, *backsub*, *band*, *basis*, *bezout*, *blockmatrix*, *charmat*, *charpoly*, *col*, *coldim*, *colspace*, *colspan*, *companion*, *concat*, *cond*, *copyinto*, *crossprod*, *curl*, *definite*, *delcols*, *delrows*, *det*, *diag*, *diverge*, *dotprod*, *eigenvals*, *eigenvects*, *entermatrix*, *equal*, *exponential*, *extend*, *ffgausselim*, *fibonacci*, *frobenius*, *gausselim*, *gaussjord*, *genmatrix*, *grad*, *hadamard*, *hermite*, *hessian*, *hilbert*, *htranspose*, *ihermite*, *indexfunc*, *innerprod*, *intbasis*, *inverse*, *ismith*, *iszero*, *jacobian*, *jordan*, *kernel*, *laplacian*, *leastsqrs*, *linsolve*, *matrix*, *minor*, *minpoly*, *mulcol*, *mulrow*, *multiply*, *norm*, *normalize*, *nullspace*, *orthog*, *permanent*, *pivot*, *potential*, *randmatrix*, *randvector*, *rank*, *ratform*, *row*, *rowdim*, *rowspace*, *rowspan*, *rref*, *scalarmul*, *singularvals*, *smith*, *stack*, *submatrix*, *subvector*, *sumbasis*, *swapcol*, *swaprow*, *sylvester*, *toeplitz*, *trace*, *transpose*, *vandermonde*, *vecpotent*, *vectdim*, *vector*]

```
> k := 3;
```

$$k := 3$$

```
> XM := matrix(k,1,[x1,x2, x3]);b:= matrix(k,1,[b1,b2,b3]);
```

$$XM := \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix}$$

$$b := \begin{bmatrix} b1 \\ b2 \\ b3 \end{bmatrix}$$

```
> BM:= matrix(k,k,[b11,b12/2,b13/2,b21/2,b22,b23/2,b31/2,b32/2,b33]);
>
```

$$BM := \begin{bmatrix} b11 & \frac{1}{2} b12 & \frac{1}{2} b13 \\ \frac{1}{2} b21 & b22 & \frac{1}{2} b23 \\ \frac{1}{2} b31 & \frac{1}{2} b32 & b33 \end{bmatrix}$$

```
>

>

> #xo := -((B)^-1)*b/2;

> #ytongo := ytongoo + lambda1*w1**2+ ...+lambdak*wk**2;

> #ejemplo :

> ytongo :=   591.8605861*x1^2 +182.9289405*x2^2 +877.1166116*x3^2 +32.96739452*x1*x2 -1237.6
> 22054*x1*x3 -403.6639980*x2*x3 -796.9853291*x1 +385.1228167*x2 +211.2148003*x3 +734.6982877
> ;
```

$$ytongo := 591.8605861\ x1^2 + 182.9289405\ x2^2 + 877.1166116\ x3^2 + 32.96739452\ x1\ x2 - 1237.622054\ x1\ x3 - 403.6639980\ x2\ x3 - 796.9853291\ x1 + 385.1228167\ x2 + 211.2148003\ x3 + 734.6982877$$

```
>

>

> sort(ytongo,[x1,x2,x3],plex);
```

$$591.8605861\ x1^2 + 32.96739452\ x1\ x2 - 1237.622054\ x1\ x3 - 796.9853291\ x1 + 182.9289405\ x2^2 - 403.6639980\ x2\ x3 + 385.1228167\ x2 + 877.1166116\ x3^2 + 211.2148003\ x3 + 734.6982877$$

```
> b0 := tcoeff(ytongo);
```

$$b0 := 734.6982877$$

```
> b1 := tcoeff(coeff(ytongo,x1,1));b2 := tcoeff(coeff(ytongo,x2,1));b3 := tcoeff(coeff(ytongo,x3,1));
```

$$b1 := -796.9853291$$

$$b2 := 385.1228167$$

$$b3 := 211.2148003$$

```
> b := matrix(3,1,[b1,b2,b3]);
```

$$b := \begin{bmatrix} -796.9853291 \\ 385.1228167 \\ 211.2148003 \end{bmatrix}$$

```
> b11 := coeff(ytongo,x1,2);b12 :=coeff(coeff(ytongo,x1,1),x2,1);b13 :=coeff(coeff(ytongo,x1,1),x3,1)
> ;
```

$$b11 := 591.8605861$$

$$b12 := 32.96739452$$

$$b13 := -1237.622054$$

```
> b21 :=b12;b22 :=coeff(ytongo,x2,2);b23 :=coeff(coeff(ytongo,x2,1),x3,1);
```

$$b21 := 32.96739452$$

$$b22 := 182.9289405$$

$$b23 := -403.6639980$$

```
> b31 :=b13;b32 :=b23;b33 :=coeff(ytongo,x3,2);
```

$$b31 := -1237.622054$$

$$b32 := -403.6639980$$

$$b33 := 877.1166116$$

```
> B:= matrix(3,3,[b11,b12/2,b13/2,b21/2,b22,b23/2,b31/2,b32/2,b33]);
```

$$B := \begin{bmatrix} 591.8605861 & 16.48369726 & -618.8110270 \\ 16.48369726 & 182.9289405 & -201.8319990 \\ -618.8110270 & -201.8319990 & 877.1166116 \end{bmatrix}$$

```
> ValoresCaracteristicos := evalf(Eigenvals(B));
```

$$ValoresCaracteristicos := [13.72031710 \quad 245.0934456 \quad 1393.092377]$$

```
>
> Valores := eigenvects(B);
```

$$Valores := [13.7203170, 1, \{[.5745614312 \quad .6034970794 \quad .5528747044]\}],$$
$$[1393.092378, 1, \{[-.6071213758 \quad -.1387588954 \quad .7823999012]\}],$$
$$[245.0934457, 1, \{[-.5488923374 \quad .7851988571 \quad -.2866704669]\}]$$

```
> singularvals(B);
```

$$[13.72028535, 245.0934455, 1393.092376]$$

```
>
>          lambda[1] := Valores[3][1];
```

$$\lambda_1 := 245.0934457$$

```
>          lambda[2] := Valores[1][1];
```

$$\lambda_2 := 13.7203170$$

```
>          lambda[3] := Valores[2][1];
```

$$\lambda_3 := 1393.092378$$

```
> #Condiciones para los lambdas. Deben tener el mismo signo para que sea elipsoide
> error:= 0; n := 1;
```

$$error := 0$$

$$n := 1$$

```
> positivo := 0; negativo := 0;
```

$$positivo := 0$$

$$negativo := 0$$

```
> while (n<=k) do
```

```
>      if ( Valores[n][1] >= 0) then positivo   := 1;
>      else                                negativo := 1;
>     fi;
>     if (positivo = 1 and negativo = 1) then    error := 1;
>     fi;
>      n := n +1;
> od;
```

$$n := 2$$

$$n := 3$$

$$n := 4$$

```
> if ( error = 0 and det(B) <> 0) then
>           XO := scalarmul(multiply(evalm(B^(-1)),b),-1/2);
>           YO := b0 + scalarmul(multiply(transpose(XO),b),1/2)[1,1]; # ytongo0 := b0 + (x')*b/2
>          if (YO>=0 and positivo=0) then     YO := YO*(-1);
>          elif (YO<0 and positivo=1) then
>                    YO := YO*(-1);      #lambdas negativos;
>          else error :=1;
>          fi;
>
>          a:= sqrt(YO/lambda[1]);evalf(a);
>          b:= sqrt(YO/lambda[2]);evalf(b);
>          c:= sqrt(YO/lambda[3]);evalf(c);
> else
>        if (error = 1) then
>             printf(`lambdas de diferentes signos cada una de ellas u otro error de signos \n`);     #
> quit;
>         elif (det(B)=0) then
>             printf(`no es un elipsoide /n`);     #   quit;
>        else
>         fi;
```

```
> fi;
```

$$XO := \begin{bmatrix} 3.166906743 \\ 1.332613227 \\ 2.420514413 \end{bmatrix}$$

$$YO := -15.0567048$$

$$a := .2478558188$$

$$.2478558188$$

$$b := 1.047569620$$

$$1.047569620$$

$$c := .1039620919$$

$$.1039620919$$

```
> #Obteniendo los valores de la matriz M, obteniendo valores l,m,n (estan desordenados) en Valore
> s.

> z1 := 1;
```

$$z1 := 1$$

```
> while (z1 <= k) do  ;
>       z2 := 1;encontrado := false;
>       while (z2<= k and not(encontrado)) do   ;
>             if (lambda[z1] = Valores[z2][1]) then
>                   TM[z1,1] := Valores[z2][3][1];
>                   encontrado := true;
>              fi;
>             z2 := z2 +1;
>       od;
>      z1 := z1 + 1;
> od;
```

$$z2 := 1$$

$$encontrado := \text{false}$$

$$z1 := 2$$

$$z2 := 1$$

$$encontrado := \text{false}$$

$$z1 := 3$$

$$z2 := 1$$

$encontrado := \text{false}$

$z1 := 4$

```
> eval(TM);
```

```
table([
  (1, 1) = [-.5488923374   .7851988571   -.2866704669]
  (2, 1) = [.5745614312    .6034970794   .5528747044]
  (3, 1) = [-.6071213758   -.1387588954  .7823999012]
  ])
```

```
>
```

```
> V1 := vector([TM[1,1][1],TM[1,1][2],TM[1,1][3]]);
```

$V1 := [-.5488923374 \quad .7851988571 \quad -.2866704669]$

```
> V1n := normalize(V1);
```

$V1n := [-.5488923374 \quad .7851988571 \quad -.2866704669]$

```
> V2 := vector([TM[2,1][1],TM[2,1][2],TM[2,1][3]]);
```

$V2 := [.5745614312 \quad .6034970794 \quad .5528747044]$

```
> V2n := normalize(V2);
```

$V2n := [.5745614306 \quad .6034970788 \quad .5528747038]$

```
> V3 := vector([TM[3,1][1],TM[3,1][2],TM[3,1][3]]);
```

$V3 := [-.6071213758 \quad -.1387588954 \quad .7823999012]$

```
> V3n := normalize(V3);
```

$V3n := [-.6071213752 \quad -.1387588953 \quad .7823999004]$

```
> M := transpose(matrix([V1n,V2n,V3n]));
```

$$M := \begin{bmatrix} -.5488923374 & .5745614306 & -.6071213752 \\ .7851988571 & .6034970788 & -.1387588953 \\ -.2866704669 & .5528747038 & .7823999004 \end{bmatrix}$$

```
>

>
```