```
> Val_Propre:=(Matrice)-
>evalf(eigenvalues(inverse(multiply(transpose(Matrice),Matrice))));
```

$$Val\_Propre := Matrice \rightarrow evalf(eigenvalues(inverse(multiply(transpose(Matrice), Matrice))))$$

```
> Fct_Trace:=(Matrice)-
>trace(inverse(multiply(transpose(Matrice),Matrice)));
```

$$Fct\_Trace := Matrice \rightarrow trace(inverse(multiply(transpose(Matrice), Matrice)))$$

```
> Fct_Det:=(Matrice)-
>det(inverse(multiply(transpose(Matrice),Matrice)));
```

$$Fct\_Det := Matrice \rightarrow det(inverse(multiply(transpose(Matrice), Matrice)))$$

```
> Aeff:=(Matrice,n,p)->evalf(100*(1/(n*Fct_Trace(Matrice)/p)));
```

$$Aeff := (Matrice, n, p) \rightarrow evalf\left(\frac{100\ p}{n\ Fct\_Trace(Matrice)}\right)$$

```
> Deff:=(Matrice,n,p)->evalf(100*(1/(n*Fct_Det(Matrice)^(1/p))));
```

$$Deff := (Matrice, n, p) \rightarrow evalf\left(\frac{100}{n\ Fct\_Det(Matrice)^{\left(\frac{1}{p}\right)}}\right)$$

```
> Poids:=matrix(4,1,[y1,y2,y3,y4]);
```

$$Poids := \begin{bmatrix} y1 \\ y2 \\ y3 \\ y4 \end{bmatrix}$$

```
> Plan1:=matrix(4,4,[[1,0,0,0],[1,1,0,0],[1,0,1,0],[1,0,0,1]]);
```

$$Plan1 := \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{bmatrix}$$

```
> multiply(inverse(Plan1),Poids);
```

$$\begin{bmatrix} y1 \\ -y1+y2 \\ -y1+y3 \\ -y1+y4 \end{bmatrix}$$

```
> Plan2:=matrix(4,4,[[1,0,0,0],[1,1,1,0],[1,1,0,1],[1,0,1,1]]);
```

$$Plan2 := \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \end{bmatrix}$$

```
> multiply(inverse(Plan2),Poids);
```

$$\begin{bmatrix} y1 \\ -\frac{1}{2}y1+\frac{1}{2}y2+\frac{1}{2}y3-\frac{1}{2}y4 \\ -\frac{1}{2}y1+\frac{1}{2}y2-\frac{1}{2}y3+\frac{1}{2}y4 \\ -\frac{1}{2}y1-\frac{1}{2}y2+\frac{1}{2}y3+\frac{1}{2}y4 \end{bmatrix}$$

```
> Plan3:=matrix(4,4,[[1,1,1,1],[1,-1,-1,1],[1,1,-1,-1],[1,-1,1,-1]]);
```

$$Plan3 := \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & -1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 1 & -1 \end{bmatrix}$$

```
> multiply(inverse(Plan3),Poids);
```

$$\begin{bmatrix} \frac{1}{4}y1+\frac{1}{4}y2+\frac{1}{4}y3+\frac{1}{4}y4 \\ \frac{1}{4}y1-\frac{1}{4}y2+\frac{1}{4}y3-\frac{1}{4}y4 \\ \frac{1}{4}y1-\frac{1}{4}y2-\frac{1}{4}y3+\frac{1}{4}y4 \\ \frac{1}{4}y1+\frac{1}{4}y2-\frac{1}{4}y3-\frac{1}{4}y4 \end{bmatrix}$$

```
> Fct_Trace(Plan1);Fct_Det(Plan1);Val_Propre(Plan1);
```

$$7\ 1\ 4.791287848, 0.208712152, 1., 1.$$

```
> Fct_Trace(Plan2);Fct_Det(Plan2);Val_Propre(Plan2);
```

$$4\ \frac{1}{4}\ 1.866025404, 0.1339745960, 1., 1.$$

```
> Fct_Trace(Plan3);Fct_Det(Plan3);Val_Propre(Plan3);
```

$$1\ \frac{1}{256}\ 0.2500000000, 0.2500000000, 0.2500000000, 0.2500000000$$

```
> Aeff(Plan1,4,4);Aeff(Plan2,4,4);Aeff(Plan3,4,4);
```

$$14.28571429\ 25.\ 100.$$

```
> Deff(Plan1,4,4);Deff(Plan2,4,4);Deff(Plan3,4,4);
```

$$25.\ 35.35533905\ 100.0000000$$

```
> PlanA:=matrix(16,4,[[1,1,-1,1],[1,0.33,0,-1],[1,-1,-1,-1],[1,-
0.33,1,0],[0.33,1,0,0],[0.33,0.33,-1,0],[0.33,-1,-1,-1],[0.33,-
0.33,1,1],[-1,1,-1,-1],[-1,0.33,1,-1],[-1,-1,0,1],[-1,-.33,-1,0],[-
0.33,1,1,-1],[-0.33,0.33,-1,1],[-0.33,-1,1,0],[-0.33,-0.33,0,-1]]);
```

$$PlanA := \begin{bmatrix} 1 & 1 & -1 & 1 \\ 1 & 0.33 & 0 & -1 \\ 1 & -1 & -1 & -1 \\ 1 & -.33 & 1 & 0 \\ 0.33 & 1 & 0 & 0 \\ 0.33 & 0.33 & -1 & 0 \\ 0.33 & -1 & -1 & -1 \\ 0.33 & -.33 & 1 & 1 \\ -1 & 1 & -1 & -1 \\ -1 & 0.33 & 1 & -1 \\ -1 & -1 & 0 & 1 \\ -1 & -.33 & -1 & 0 \\ -.33 & 1 & 1 & -1 \\ -.33 & 0.33 & -1 & 1 \\ -.33 & -1 & 1 & 0 \\ -.33 & -.33 & 0 & -1 \end{bmatrix}$$

```
> Fct_Trace(PlanA);Fct_Det(PlanA);Val_Propre(PlanA);
```

0.4017643147 0.00009727484059

0.08158411517, 0.09010781479, 0.1139811121, 0.1160912726

```
> Aeff(PlanA,16,4);Deff(PlanA,16,4);
```

62.22553644 62.93321019

```
> PlanB:=matrix(16,4,[[-1,-0.33,-1,-1],[-0.33,-1,0,-1],[0.33,-1,-
1,1],[0.33,1,1,-1],[1,-1,1,0],[1,-0.33,0,1],[0.33,-0.33,-1,0],[-
1,0.33,1,1],[-1,1,0,0],[1,1,-1,-1],[-0.33,1,-1,1],[-0.33,0.33,-
1,0],[1,0.33,-1,-1],[-0.33,-0.33,1,-1],[-1,-1,-1,-1],[0.33,0.33,0,-
1]]);
```

$$PlanB := \begin{bmatrix} -1 & -.33 & -1 & -1 \\ -.33 & -1 & 0 & -1 \\ 0.33 & -1 & -1 & 1 \\ 0.33 & 1 & 1 & -1 \\ 1 & -1 & 1 & 0 \\ 1 & -.33 & 0 & 1 \\ 0.33 & -.33 & -1 & 0 \\ -1 & 0.33 & 1 & 1 \\ -1 & 1 & 0 & 0 \\ 1 & 1 & -1 & -1 \\ -.33 & 1 & -1 & 1 \\ -.33 & 0.33 & -1 & 0 \\ 1 & 0.33 & -1 & -1 \\ -.33 & -.33 & 1 & -1 \\ -1 & -1 & -1 & -1 \\ 0.33 & 0.33 & 0 & -1 \end{bmatrix}$$

```
> Fct_Trace(PlanB);Fct_Det(PlanB);Val_Propre(PlanB);
```

$$0.3932808106 \quad 0.00008885854989$$

$$0.07692307693, 0.09090909091, 0.1127243214, 0.1127243214$$

```
> Aeff(PlanB,16,4);Deff(PlanB,16,4);
```

$$63.56781040 \quad 64.37321682$$