

# Tips !

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## 1 Tips: Centering an array

It's very easy to center a data set using high level templated expressions and statistical functors.

Listing 1: Example

```
#include "STKpp.h"
using namespace STK;
int main(int argc, char *argv[])
{
    CArrayXX A(100, 5);
    Law::Normal law(1,2);
    A.rand(law);
    // call column statistical functions
    stk_cout << _T("min(A) =") << Stat::min(A);
    stk_cout << _T("max(A) =") << Stat::max(A);
    stk_cout << _T("max(A.abs()) =") << Stat::max(A.abs());
    stk_cout << _T("mean(A) =") << Stat::mean(A);
    // center the array
    stk_cout << _T("\nCentering...\n\n");
    A -= Const::VectorX(100) * Stat::mean(A);
    // call column statistical functions with all the columns of A
    centered
    stk_cout << _T("min(A) =") << Stat::min(A);
    stk_cout << _T("max(A) =") << Stat::max(A);
    stk_cout << _T("max(A.abs()) =") << Stat::max(A.abs());
    stk_cout << _T("mean(A) =") << Stat::mean(A);
}
```

Listing 1: Output

```
min(A) =-3.03568 -6.61451 -4.40302
        -3.51961 -3.35881
max(A) =5.50908 5.11638 5.73466
        5.73621 5.29701
max(A.abs()) =5.50908 6.61451
        5.73466 5.73621 5.29701
mean(A) =0.882758 1.00008 0.668893
        1.27236 1.34981

Centering...

min(A) =-3.91843 -7.61459 -5.07191
        -4.79197 -4.70862
max(A) =4.62633 4.1163 5.06576
        4.46386 3.9472
max(A.abs()) =4.62633 7.61459
        5.07191 4.79197 4.70862
mean(A) =-1.93179e-16 -2.0095e-16
        -1.57652e-16 -2.33147e-16
        -2.77556e-16
```

the expression

```
Const::Vector<Real>(100)mean(A)
```

represents the matrix multiplication of a column vector of 1 with 100 rows and of row vector with the mean of each column of A.

### Note:

For each column of the array **A** we can get the maximal value in absolute value using `max(A.abs())`. It is possible to use functors mixed with unary or binary operators.

## 2 Tips: Compute the mean for each column of an array

You can easily get the mean of a whole vector or a matrix containing missing values using the expression

```
CArray<Real> A(100, 20);
Law::Normal law(1,2);
A.rand(law);
Real m = A.meanSafe();
```

In some cases you may want to get the mean for each column of an array with missing values. You can get it in a @c PointX vector using either the code

```
PointX m;
m = meanByCol(A.safe()); // mean(A.safe()); is shorter
```

or the code

```
Array2DPoint<Real> m;
m.move(Stat::mean(A.safe()));
```

The method `A.safe()` will replace any missing (or NaN) values by zero. In some cases it's not sufficient, Suppose you know your data are all positive and you want to compute the log-mean of your data. In this case, you will rather use

```
m = Stat::mean(A.safe(1.).log());
```

and all missing (or NaN) values will be replaced by one.

#### Note:

You can also compute the variance. If you want to compute the mean of each row, you will have to use the functor `Stat::meanByRow`. In this latter case, you get a `VectorX` as result.

### 3 Tips: Compute the mean and the variance of multidimensionnal data

You can easily compute the mean and the variance matrix of multidimensional data. Assume we are handling this kind of data

```
// values (b,g,r,ir)
typedef CArrayVector<double, 4> Spectrum;
```

repeated in space and time. The data are stored in an array

```
// array of values
typedef CArray<Spectrum> ArraySpectrum;
ArraySpectrum datait;
```

and we want to compute at each time the (multidimensional) mean of this data set. This can be used using the following code :

```
// array of mean values
typedef CArrayPoint<Spectrum> PointSpectrum;
PointSpectrum mut(datait.cols());
for (int t= datait.beginCols(); t< datait.endCols(); ++t)
{
    mut[t] = 0.;
    for (int i=datait_.beginRows(); i< datait_.endRows(); ++i)
    { mut[t] += datait_(i,t);}
    mut[t]/= data.sizeRows();
}
```

The variance matrix (using numerical correction) can be computed using the following code :

```
// covariances values (b,g,r,ir)
typedef CArraySquare<double, 4> CovSpectrum;
// array of mean values
typedef CArrayPoint<CovSpectrum> PointCov;
PointSpectrum sigmat(datait.cols());
for (int t= datait.beginCols(); t< datait.endCols(); ++t)
{
    CovSpectrum var; var=0.0;
    Spectrum sum = 0.0;
    for (int i=datait_.beginRows(); i< datait_.endRows(); ++i)
    {
        Spectrum dev;
        sum += (dev = datait(i,t) - mut[t]);
        var += devdev.transpose();
    }
    sigmat[t] = (var - ((sumsum.transpose())/datait.sizeCols()) )/datait.sizeCols();
}
```

STK++ handles transparently the multidimensional nature of the data.