dxy Exploration

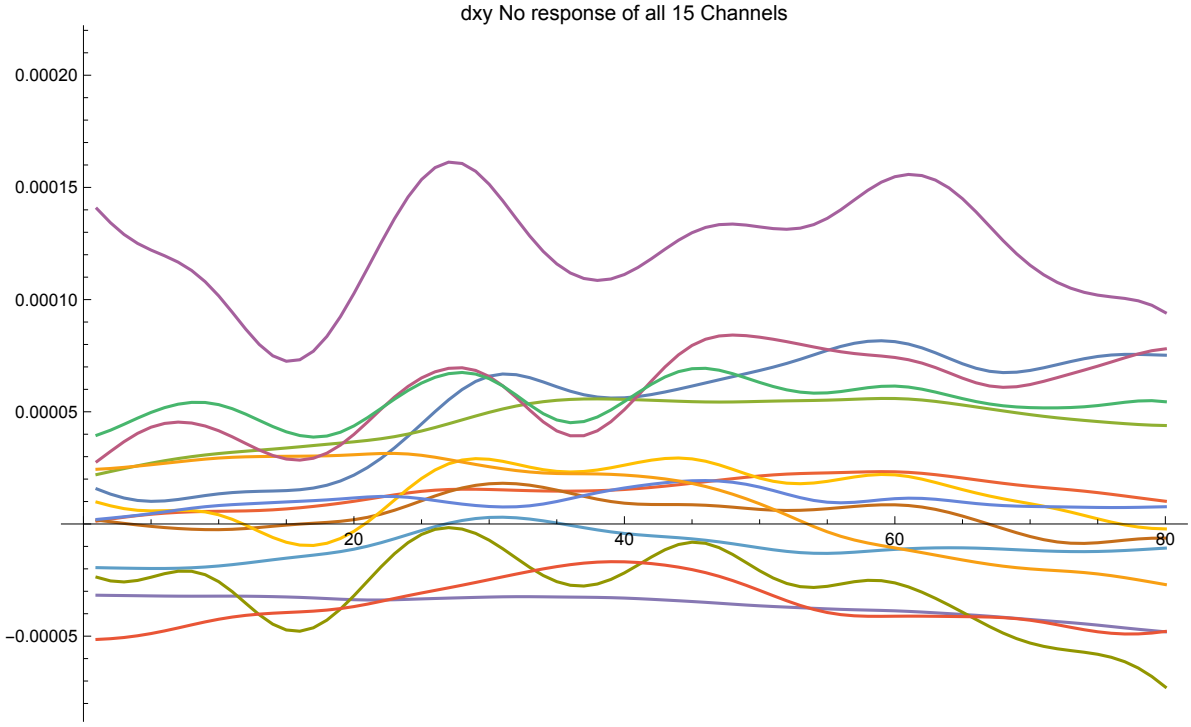
Dataset Load

In[427]:=
```
dxyYesMatlab = Import[
   "/Users/ettoremariotti/Desktop/Semmestre/BCI/Project/BCI-ThoughtRecognition/
     data_students/NIRSdxy_yes_signal.mat"];
numSamplesDxyYes = Dimensions[dxyYesMatlab][[3]];
dxyYesRaw =  Table[Transpose[dxyYesMatlab[[1, 1, x]]], {x, numSamplesDxyYes}];

dxyNoMatlab = Import[
   "/Users/ettoremariotti/Desktop/Semmestre/BCI/Project/BCI-ThoughtRecognition/
     data_students/NIRSdxy_no_signal.mat"];
numSamplesDxyNo = Dimensions[dxyNoMatlab][[3]];
dxyNoRaw =  Table[Transpose[dxyNoMatlab[[1, 1, x]]], {x, numSamplesDxyNo}];

dxyDataFullYes = Table[dxyYesRaw[[x, All, All]] → "Yes", {x, numSamplesDxyYes}];
dxyDataFullNo = Table[dxyNoRaw[[x, All, All]] → "No", {x, numSamplesDxyNo}];

fullDataYesAndNoDxy = Join[dxyDataFullNo, dxyDataFullYes];

dxyYesRaw80 = {};
If[Dimensions[dxyYesRaw[[#]]][[2]] == 81,
    AppendTo[dxyYesRaw80, Transpose@Drop[Transpose@dxyYesRaw[[#]], -1]],
    AppendTo[dxyYesRaw80, dxyYesRaw[[#]]]] & /@ Range[numSamplesDxyYes];

dxyNoRaw80 = {};
If[Dimensions[dxyNoRaw[[#]]][[2]] == 81,
    AppendTo[dxyNoRaw80, Transpose@Drop[Transpose@dxyNoRaw[[#]], -1]],
    AppendTo[dxyNoRaw80, dxyNoRaw[[#]]]] & /@ Range[numSamplesDxyNo];
```

Raw Data Visualization

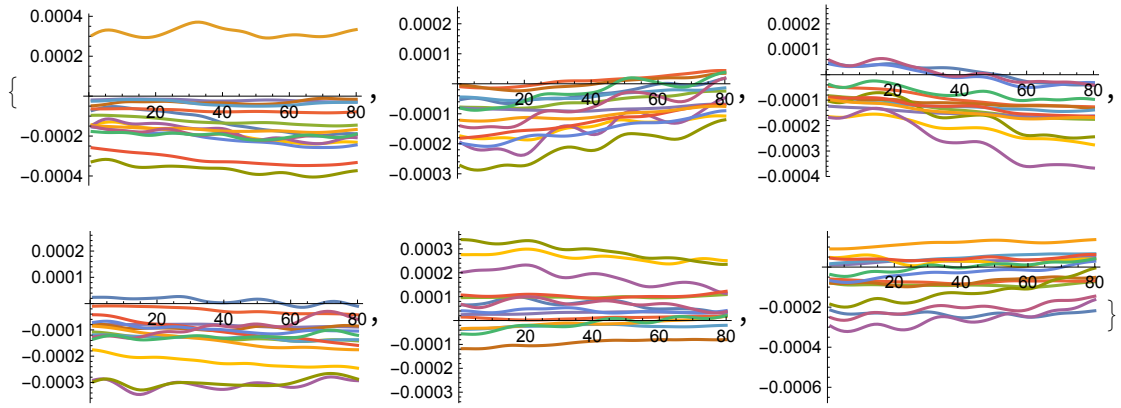
In[469]:=
```
ListLinePlot[dxyNoRaw80[[1]], PlotLabel → "dxy No response of all 15 Channels"]
```

Out[469]=



In[460]:=
```
Table[ListLinePlot[dxyNoRaw80[[x]]], {x, 2, 7}]
```

Out[460]=



Dimensionality Reduction

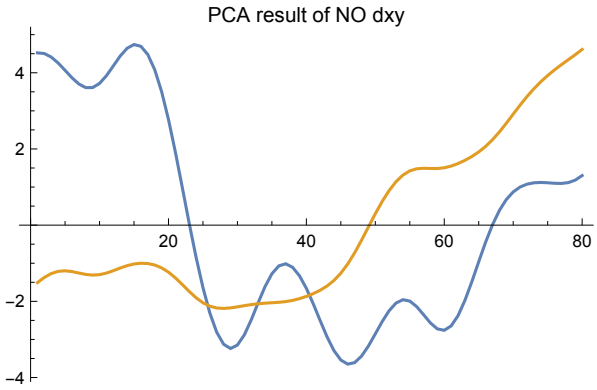
Dimensionality Reduction on Channels

Dimensionality reduction of the channels performed via PCA

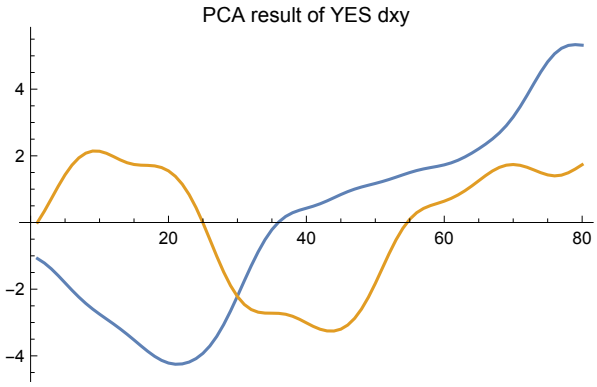
In[453]:=
```
reducedDxyNo80 = Transpose[DimensionReduce[Transpose@#,
      2, Method → "PrincipalComponentsAnalysis"]] & /@ dxyNoRaw80;
reducedDxyYes80 = Transpose[DimensionReduce[Transpose@#, 2,
      Method → "PrincipalComponentsAnalysis"]] & /@ dxyYesRaw80;
```

In[470]:=
```
ListLinePlot[reducedDxyNo80[[1]], PlotLabel → "PCA result of NO dxy"]
ListLinePlot[reducedDxyYes80[[1]], PlotLabel → "PCA result of YES dxy"]
```

Out[470]=

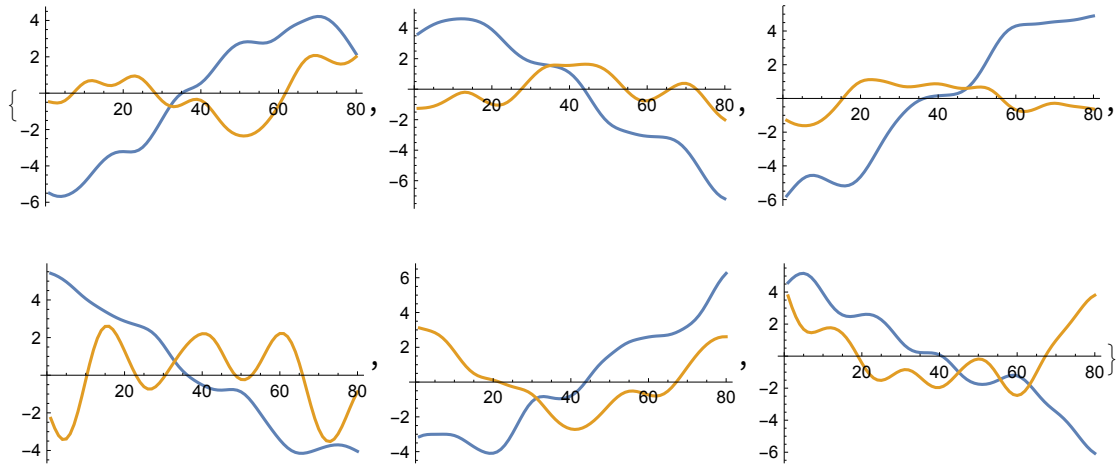


Out[471]=



In[462]:=
```
Table[ListLinePlot[reducedDxyNo80[[x]]], {x, 2, 7}]
```

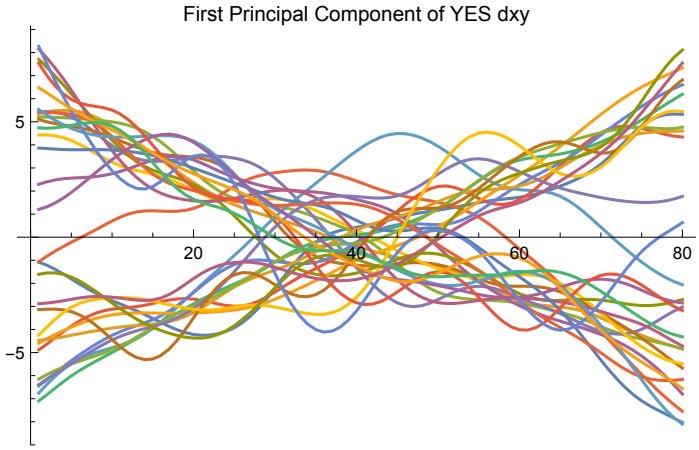
Out[462]=



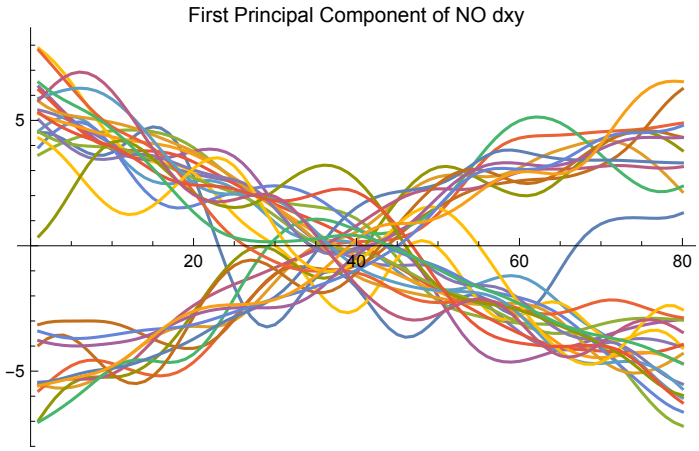
Dataset appearance of Principal Components

In[475]:=
```
featYesDxyFirstComponent = Table[reducedDxyYes80[[x, 1]], {x, 30}];
featNoDxyFirstComponent  = Table[reducedDxyNo80[[x, 1]], {x, 30}];
ListLinePlot[featYesDxyFirstComponent,
 PlotLabel → "First Principal Component of YES dxy"]
ListLinePlot[featNoDxyFirstComponent,
 PlotLabel → "First Principal Component of NO dxy"]
```

Out[477]=



Out[478]=

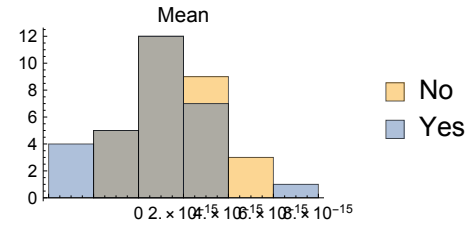


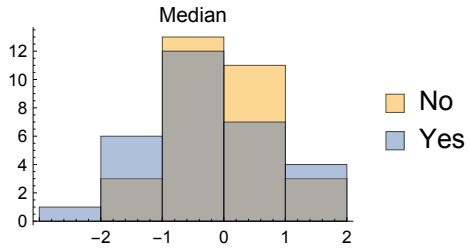
General Statistics

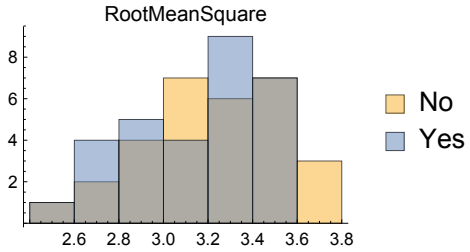
In[483]:=
```
featExplore[f_] :=
 Histogram[{Legended[Table[f[reducedDxyNo80[[x, 1]]], {x, 30}], "No"],
   Legended[Table[f[reducedDxyYes80[[x, 1]]], {x, 30}], "Yes"]}, PlotLabel → f]
```

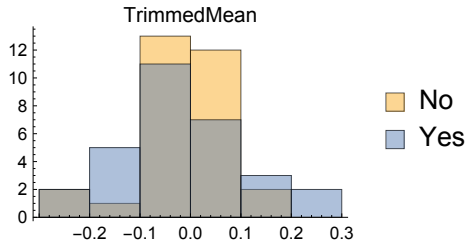
In[486]:=
```
energy = Total@(#^2) &;
stats = {Mean, Median, RootMeanSquare, TrimmedMean, HarmonicMean,
    GeometricMean, ContraharmonicMean, Variance, StandardDeviation,
    MeanDeviation, MedianDeviation, QuartileDeviation, InterquartileRange,
    Skewness, Kurtosis, QuartileSkewness, Entropy, energy};
```

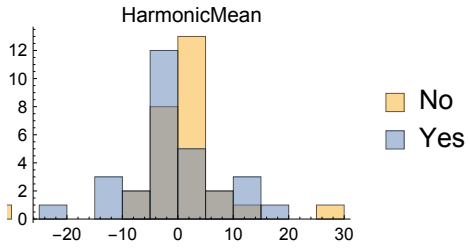
In[488]:=
```
Column[Style[featExplore[#], Larger] & /@ stats]
```

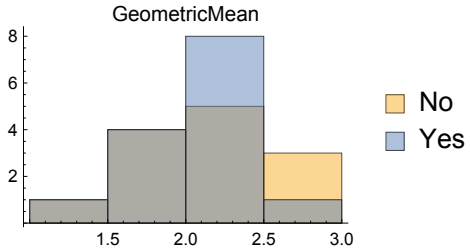

Mean
No
Yes

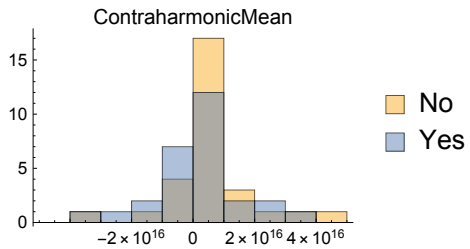

Median
No
Yes


RootMeanSquare
No
Yes

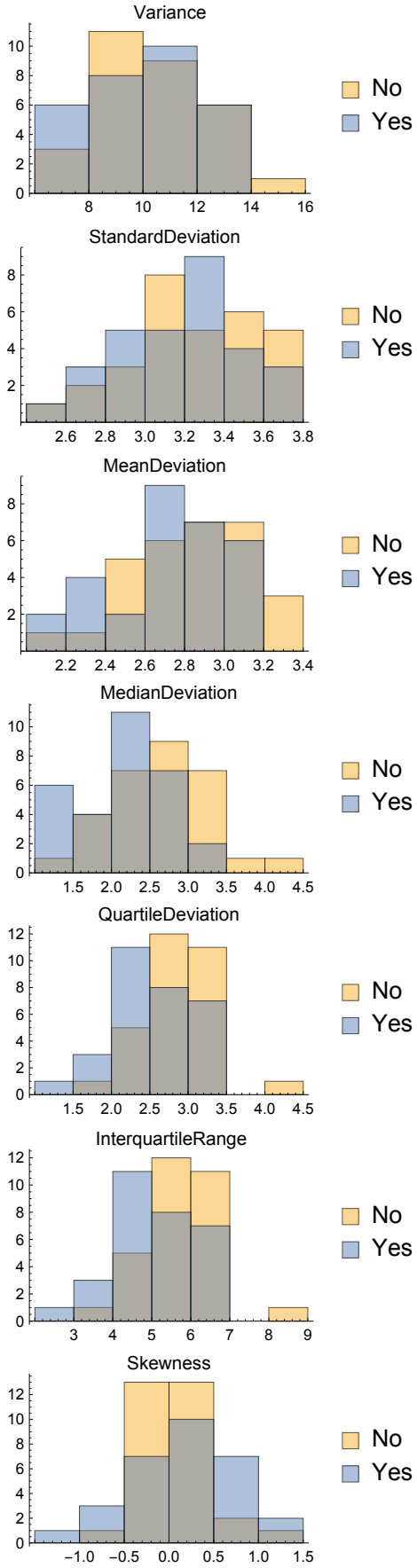

TrimmedMean
No
Yes

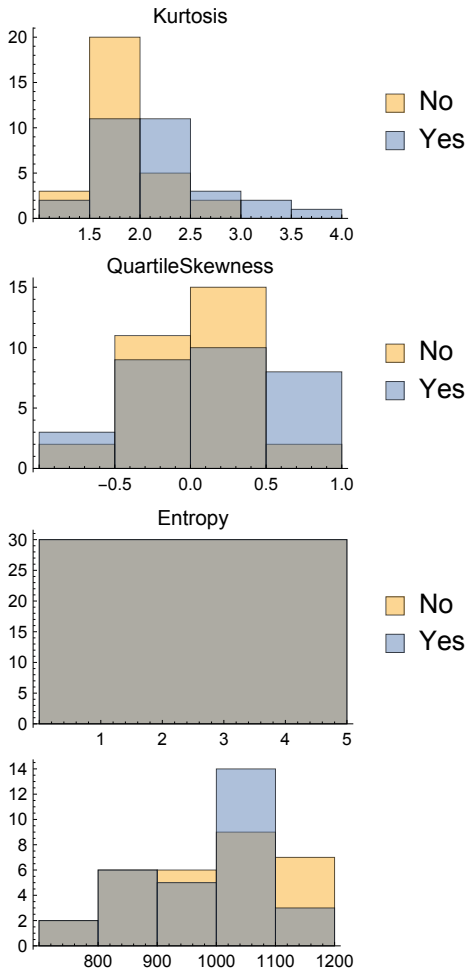

HarmonicMean
No
Yes


GeometricMean
No
Yes


ContraharmonicMean
No
Yes

Out[488]=


Variance
No
Yes
StandardDeviation
No
Yes
MeanDeviation
No
Yes
MedianDeviation
No
Yes
QuartileDeviation
No
Yes
InterquartileRange
No
Yes
Skewness
No
Yes

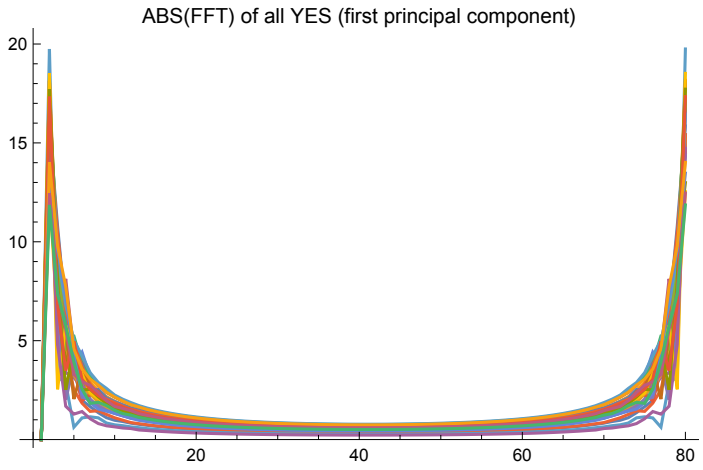


Frequency Transforms

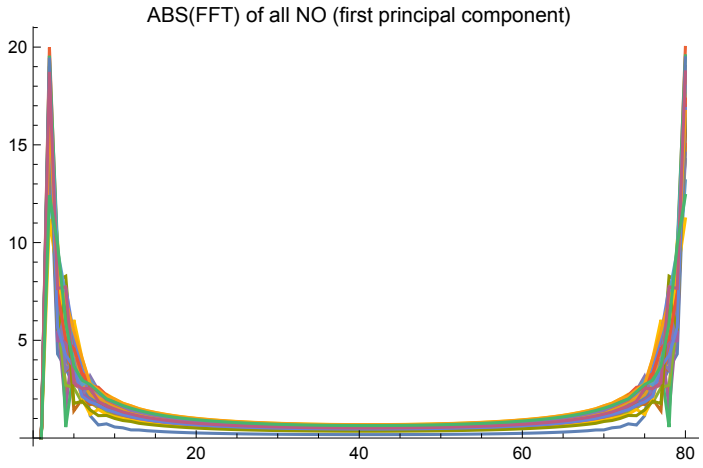
Frequency Transforms

In[502]:=
```
ListLinePlot[
 Table[Abs[Fourier[reducedDxyYes80[[x, 1]] ]], {x, 30}], PlotRange -> All,
 PlotLabel → "ABS(FFT) of all YES (first principal component)"]
ListLinePlot[Table[Abs[Fourier[reducedDxyNo80[[x, 1]] ]], {x, 30}],
 PlotRange -> All, PlotLabel → "ABS(FFT) of all NO (first principal component)"]
```

Out[502]=

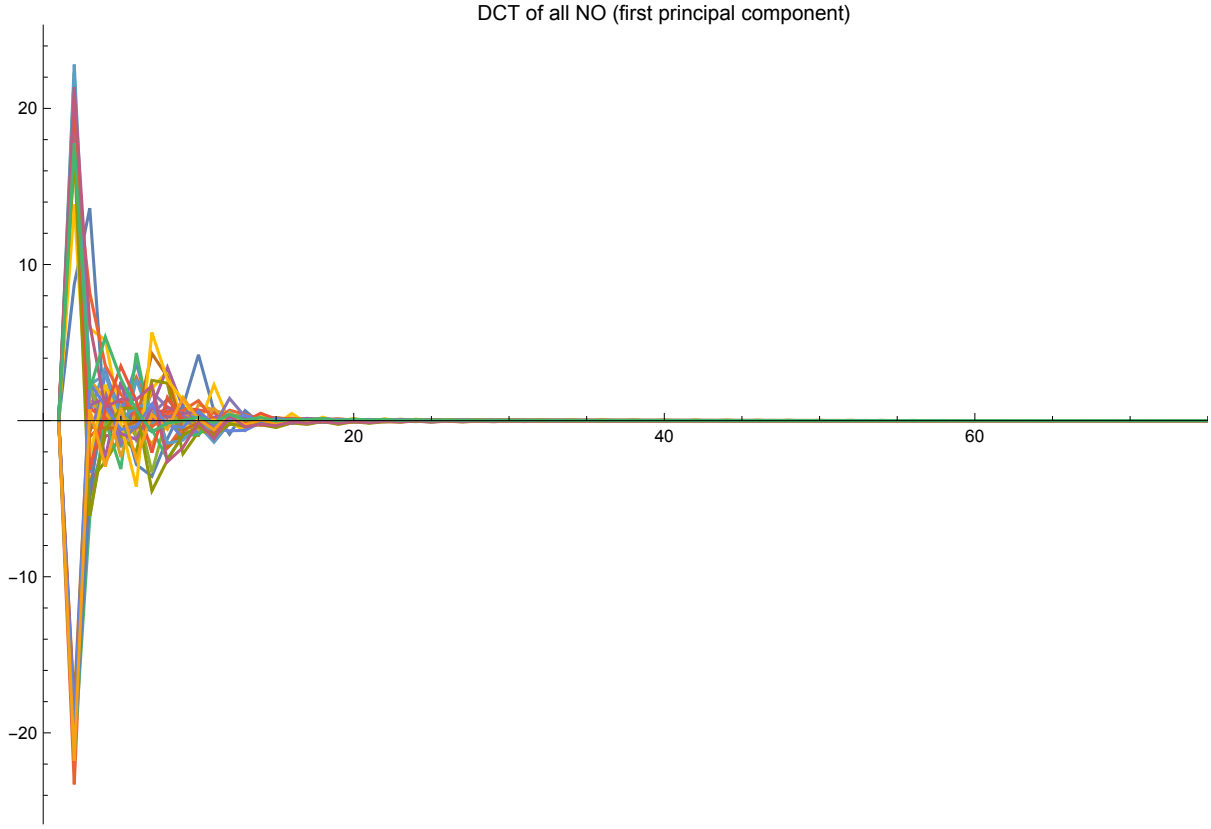


Out[503]=



In[500]:=
```
ListLinePlot[Table[FourierDCT[reducedDxyNo80[[x, 1]] ], {x, 30}],
 PlotRange → Full, PlotLabel → "DCT of all NO (first principal component)"]
ListLinePlot[Table[FourierDCT[reducedDxyYes80[[x, 1]] ], {x, 30}],
 PlotRange → Full, PlotLabel → "DCT of all YES (first principal component)"]
```

Out[500]=



Out[501]=