Question 1

-group 1 can be covered by 3 principal components (89.3%)

-group 2 can be covered by 2 principal components (85.8%)

-the reconstruction error is calculated using the relative error formula:

-for each individual (signals 1 to 30): (sum of original data - sum of approximated vectors)/(sum of original data)

-The average reconstruction error for each group is calculate using the mean(X) function in Matlab

-Group1 is the control group (healthy people), whereas group2 is the experimental group (people with arthritis)

- This is determined by examining the graphs of the mean vectors of the two groups (see meanAll.fig).

- Since the data sets record the knee motion angles while walking, it is assumed that healthy individuals would have larger knee motion angles. The graph shows that group1 has larger knee motion angles than group2.

- In addition, group1 has a much smaller relative error than group2, which may indicate that the walking motions of healthy people are more predicatble than those with osteoarthritis.

Question 2(a)

- The first point from the planar data is connected with the first point from the spatial data, and etc.

- All of the lines from the original data intersect at the same point (5,5,20)

- Deviation is calculated using uniform distribution:

- variance = (1/12)((upper-lower)^2)

- deviation = sqrt(variance)

- deviated planar points = original planar points - deviation matrix

- By minimizing the line errors between two lines (please see the focusPt.m for more info), t and s (from equations of lines) are calculated, and focus points are obtained

- The focus point of all lines is found by calculating the distances from each focus point to each of the lines; the best focus point is the one with the smallest distance to all of the lines

- It is observed that lines in 3D space rarely intersect at the exact point

Question 2(b)

- Slight changes were made to the original code to calculate the differences in the actual and predicted radii and centers

- 5 different radii (110,120,130,140,150 mm) and one center point (500,500,500) were used. The points were first randomly generated on the spheres, and then were used to find the radii and center points (least-squares approximation)

- Differences between original and fitted center points, original and fitted radii were calculated

- It was found that the RMSE of the sphere center was approximately 0.0355 mm

- The RMSE of the sphere radius was approximately 0.070 mm

- RMSE of the sphere center was the mean of RMSEs of the x, y, and z coordinates

    - RMSEcen = rms(diffCenAll)

    - RMSEcenMean = mean(RMSEcen)

- RMSErad = rms(diffRadAll)