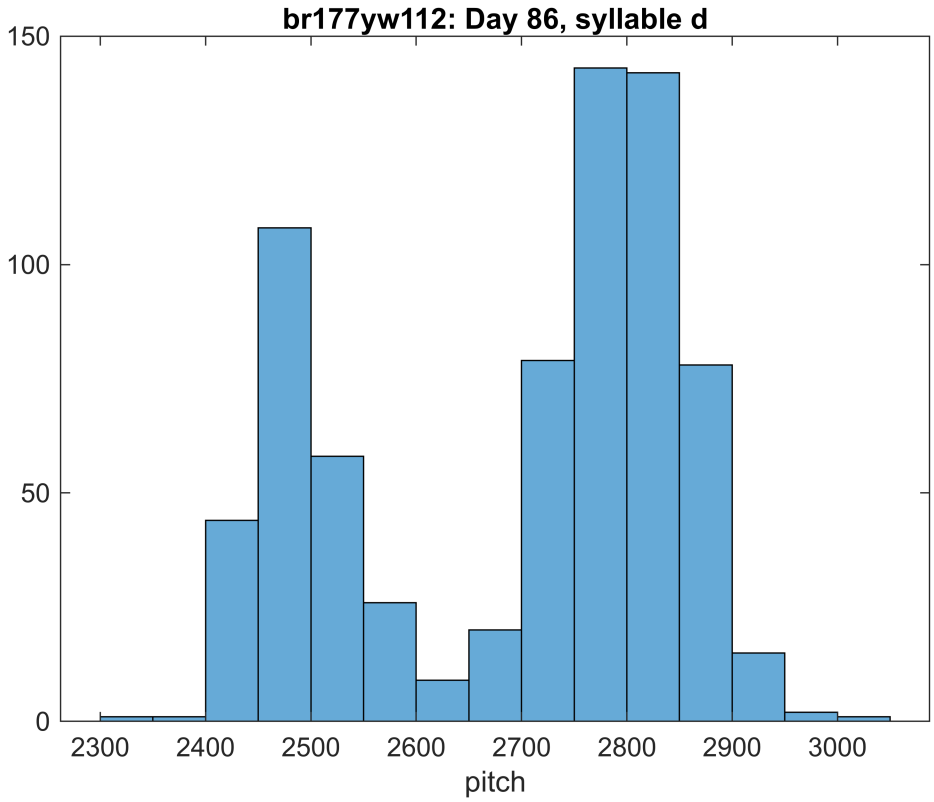
Syllable splitting - br177yw112, syllable 'd'

DAY 86

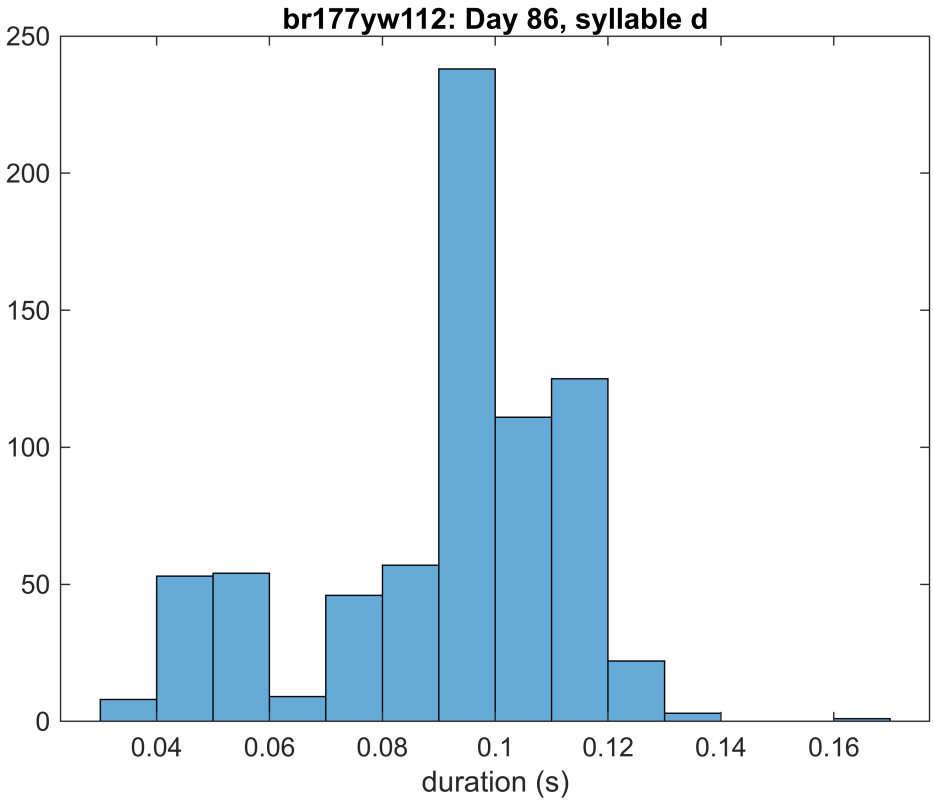
```
datetime
```

```
ans = datetime
   08-Jan-2024 13:14:27
```

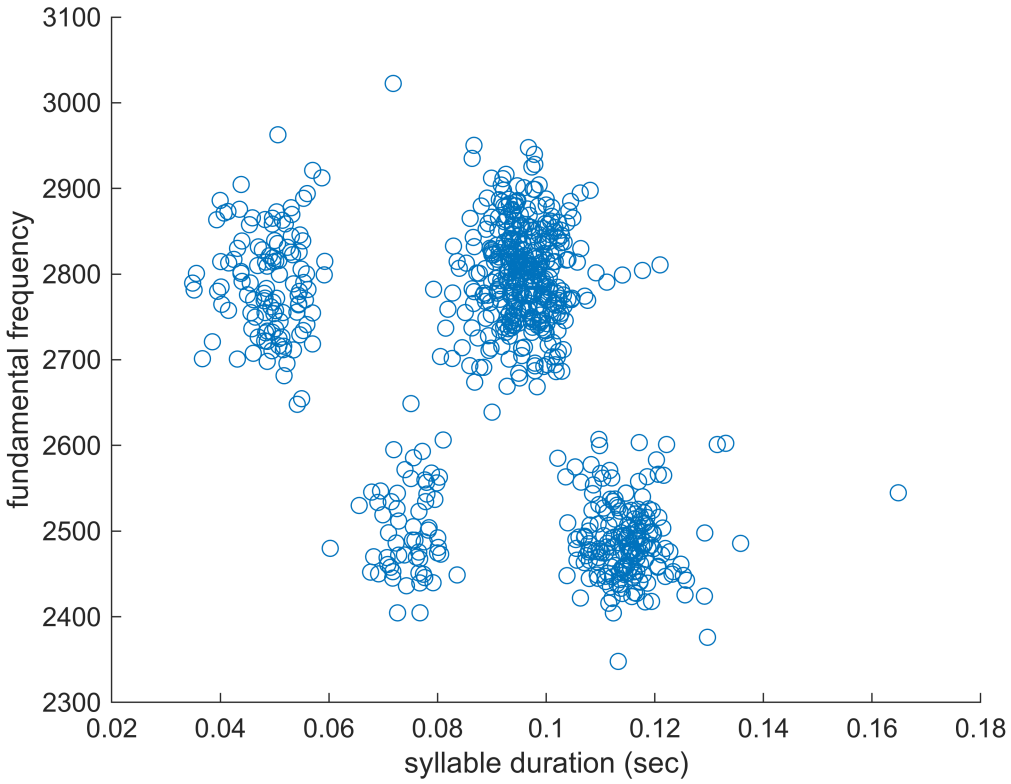
```
load('J:\MINI DATASET\br177yw112_day86_ch6\compile_cases\br177yw112_d_day86_ch6_premotor_40ms_spiketimes_acoustics_2024-01-08.mat')
f1 = neuralcase.weighted_avg_pitch;
durs = neuralcase.syl_ons_offs(:,2) - neuralcase.syl_ons_offs(:,1);

figure;histogram(f1); title('br177yw112: Day 86, syllable d'); xlabel('pitch')
```




```
figure;histogram(durs); title('br177yw112: Day 86, syllable d'); xlabel('duration (s)')
```



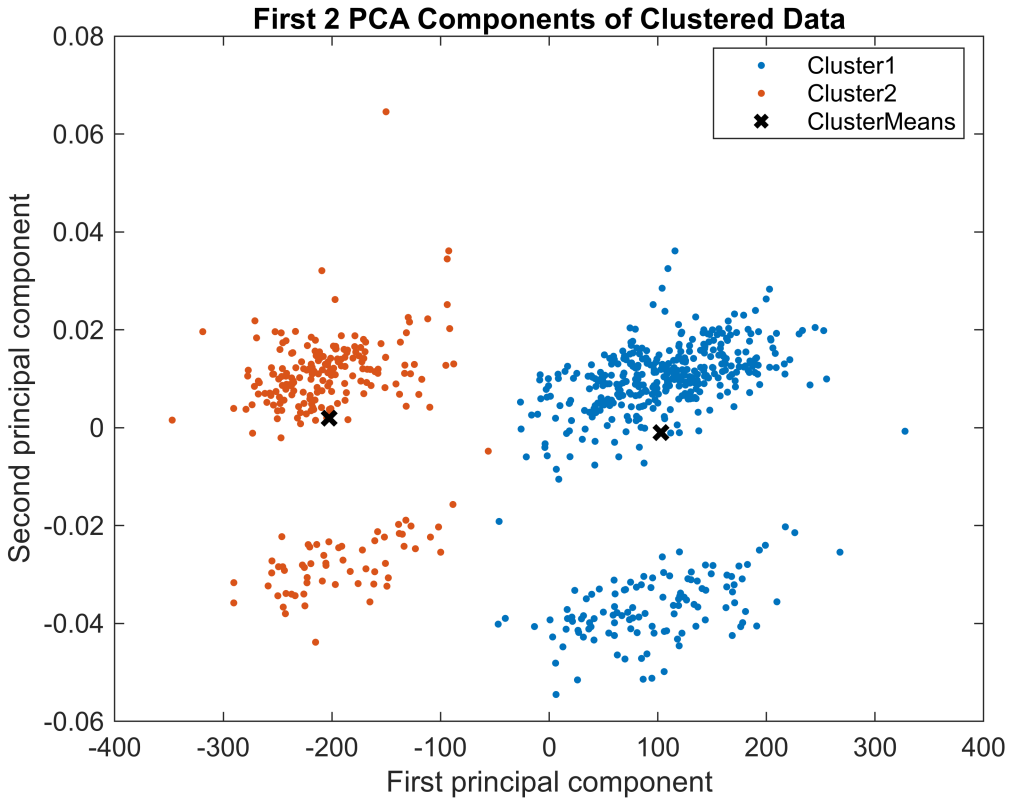

```
figure;scatter(durs,f1)
xlabel('syllable duration (sec)')
ylabel('fundamental frequency')
```



Clustering using k-means

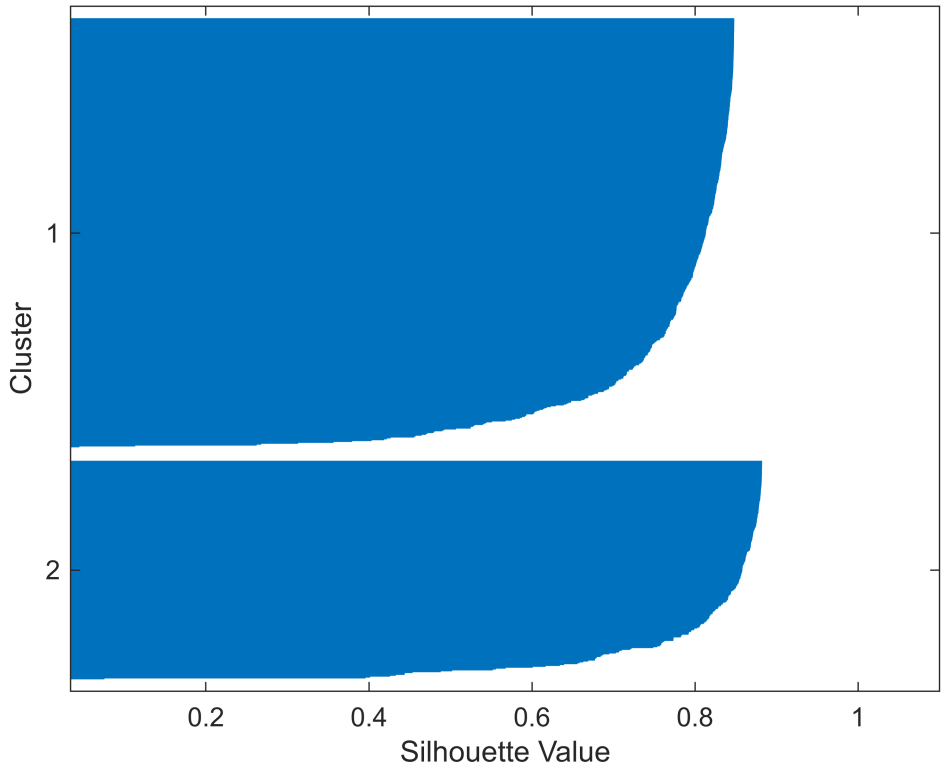
```
%create matrix of k-means
acoustics = table(f1, durs);
X(:,1) = f1;
X(:,2) = durs;
rng('default')

% Perform k-means clustering using specified number of clusters (K value)
K = 2;
[clusterIndices,centroids] = kmeans(X,K);

% Display results

% Display 2D scatter plot (PCA)
figure
[~,score] = pca(X);
clusterMeans = grpstats(score,clusterIndices,"mean");
h2 = gscatter(score(:,1),score(:,2),clusterIndices);
for i = 1:numel(h2)
    h2(i).DisplayName = strcat("Cluster",h2(i).DisplayName);
end
clear h2 i score
hold on
h2 = scatter(clusterMeans(:,1),clusterMeans(:,2),50,"kx","LineWidth",2);
```

```
hold off
h2.DisplayName = "ClusterMeans";
clear h2 clusterMeans
legend;
title("First 2 PCA Components of Clustered Data");
xlabel("First principal component");
ylabel("Second principal component");
```




```
% Matrix plot
figure
selectedCols = sort([2,1]);
[~,ax] = gplotmatrix(X(:,selectedCols),[],clusterIndices,[],[],[],[],"grpbars");
title("Comparison of Columns in Clustered Data");
clear K
clusterMeans = grpstats(X,clusterIndices,"mean");
hold(ax,"on");
for i = 1 : size(selectedCols,2)
  for j = 1 : size(selectedCols,2)
      if i ~= j

scatter(ax(j,i),clusterMeans(:,selectedCols(i)),clusterMeans(:,selectedCols(j)), ...
            50,"kx","LineWidth",1.5,"DisplayName","ClusterMeans");
          xlabel(ax(size(selectedCols,2),i),("Column" + selectedCols(i)));
          ylabel(ax(i,1),("Column" + selectedCols(i)));
      end
   end
```

```
end
clear ax clusterMeans i j selectedCols

% silhouette plot to measure how close each point in one cluster is to points in
the neighboring clusters
[silh3,h] = silhouette(X,clusterIndices,'cityblock');
xlabel('Silhouette Value')
ylabel('Cluster')
```




```
% save k-means results
filename =
'br177yw112_d_day86_ch6_premotor_40ms_spiketimes_acoustics_2024-01-08.mat';
save(filename, 'clusterIndices', 'centroids','acoustics','silh3', '-append')
```

Calculate fano factor with combined and split 'd' distributions

```
% all 'd', no split
allspikes = neuralcase.spiketrains;
ntrials = length(allspikes);
onsets = neuralcase.syl_ons_offs(:,1);

preonset = 0.01;
postonset = 0.03;
motor_window = preonset + postonset;
```

```
motorWinOn = onsets - preonset;
motorWinOff = onsets + postonset;
 % for each trial in curr case, caculate spike count, mean isi & mean ifr
    for j = 1:ntrials
        spk = allspikes{j};
        spks_wn{j,1} = spk(spk >= motorWinOn(j) & spk <= motorWinOff(j));
        n_spikes(j,1) = length(spks_wn{j}); %spk count

        if n_spikes(j,1) > 1
            mean_isi_case(j) = mean(diff(spks_wn{j,1})); % mean isi
            mean_ifr_case(j) = 1/mean_isi_case(j); % mean ifr
        end
    end


ff = var(n_spikes)/ mean(n_spikes)
```

```
ff = 3.4364
```

split 'd'

```
% split d1, d2
d1 = allspikes(clusterIndices==1);
d2 = allspikes(clusterIndices==2);
ntrials_d1 = length(d1);
ntrials_d2 = length(d2);
onsets_d1 = onsets(clusterIndices ==1);
onsets_d2 = onsets(clusterIndices ==2);

preonset = 0.01;
postonset = 0.03;
motor_window = preonset + postonset;


motorWinOn_d1 = onsets_d1 - preonset;
motorWinOff_d1 = onsets_d1 + postonset;
motorWinOn_d2 = onsets_d2 - preonset;
motorWinOff_d2 = onsets_d2 + postonset;

clearvars n_spikes spks spks_wn
 % for each trial in curr case, caculate spike count, mean isi & mean ifr
    for j = 1:ntrials_d1
        spk = d1{j};
        spks_wn{j,1} = spk(spk >= motorWinOn_d1(j) & spk <= motorWinOff_d1(j));
        n_spikes(j,1) = length(spks_wn{j}); %spk count

        if n_spikes(j,1) > 1
```

```
            mean_isi_case(j) = mean(diff(spks_wn{j,1})); % mean isi
            mean_ifr_case(j) = 1/mean_isi_case(j); % mean ifr
        end
    end

ff_d1 = var(n_spikes)/ mean(n_spikes)
```

```
ff_d1 = 1.5472
```

```
clearvars n_spikes spks spks_wn
 % for each trial in curr case, caculate spike count, mean isi & mean ifr
    for jj = 1:ntrials_d2
        spk = d2{jj};
        spks_wn{jj,1} = spk(spk >= motorWinOn_d2(jj) & spk <= motorWinOff_d2(jj));
        n_spikes(jj,1) = length(spks_wn{jj}); %spk count

        if n_spikes(jj,1) > 1
            mean_isi_case(jj) = mean(diff(spks_wn{jj,1})); % mean isi
            mean_ifr_case(jj) = 1/mean_isi_case(jj); % mean ifr
        end
    end

ff_d2 = var(n_spikes)/ mean(n_spikes)
```

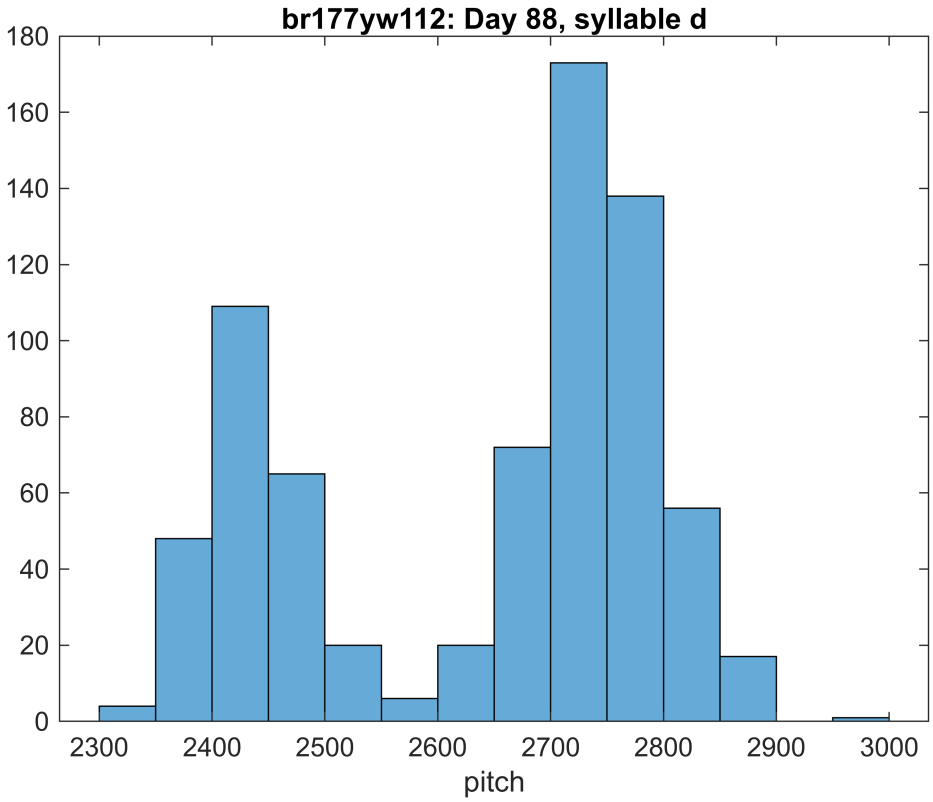
```
ff_d2 = 1.4209
```

DAY 88

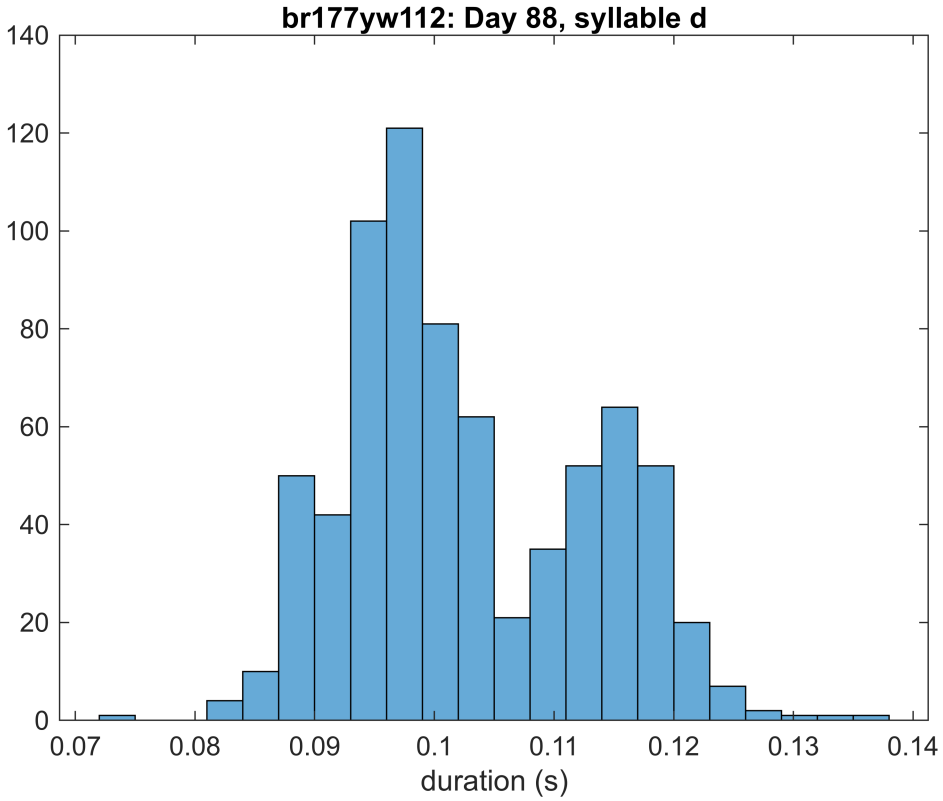
```
datetime
```

```
ans = datetime
   08-Jan-2024 10:50:19
```

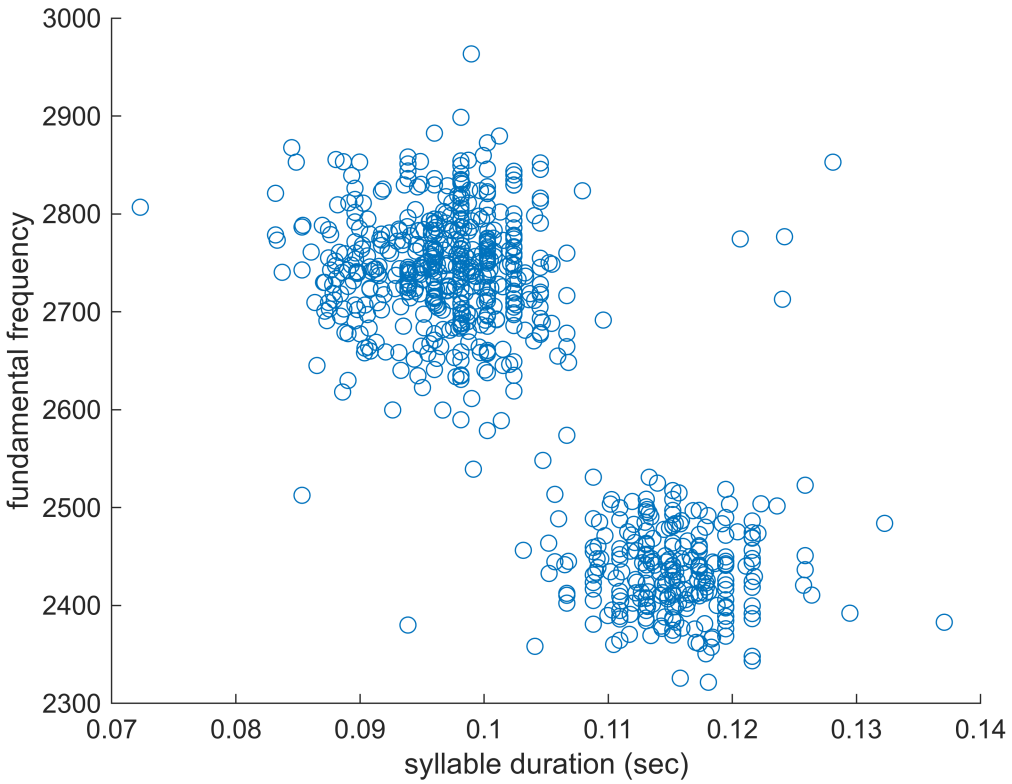
```
load('J:\MINI
DATASET\br177yw112_day88_ch6\compile_cases\br177yw112_d_day88_ch6_premotor_40ms_spik
etimes_acoustics_2023-12-02.mat')
f1 = clean_trials_table.pitch_wgt_avg;
durs = clean_trials_table.seq_ons_offs(:,2) - clean_trials_table.seq_ons_offs(:,1);

figure;histogram(f1); title('br177yw112: Day 88, syllable d'); xlabel('pitch')
```




```
figure;histogram(durs); title('br177yw112: Day 88, syllable d'); xlabel('duration
(s)')
```



```
figure;scatter(durs,f1)
xlabel('syllable duration (sec)')
ylabel('fundamental frequency')
```

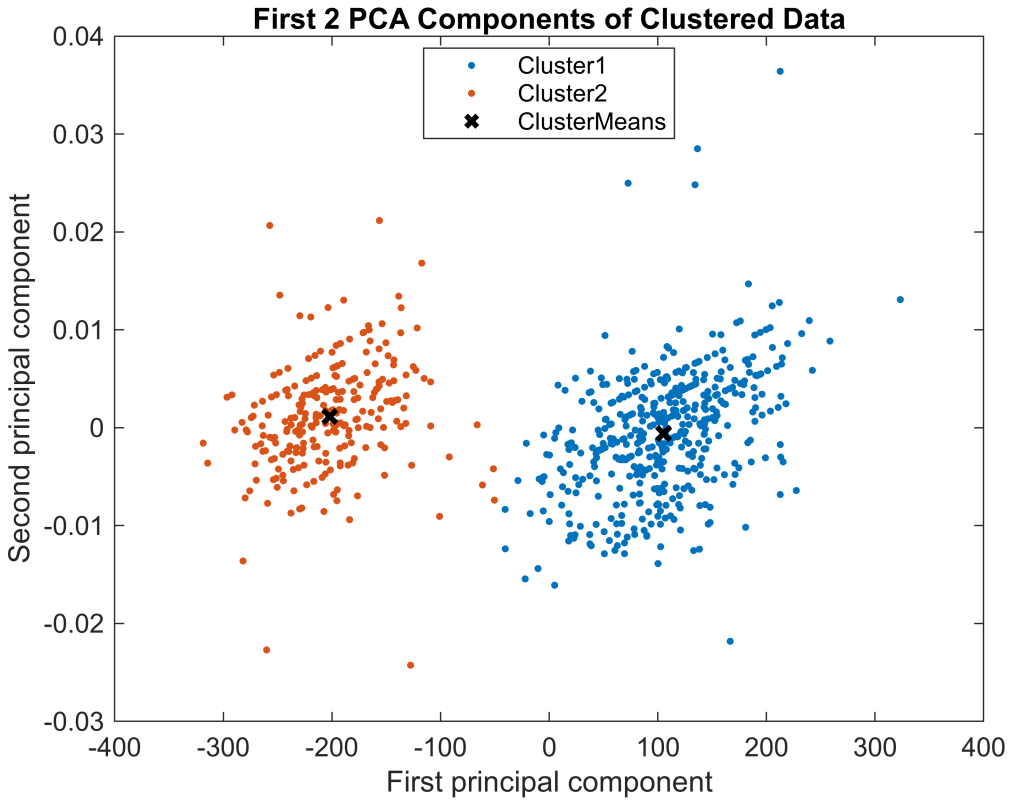



```
save('br177yw112_d_day88_ch6_premotor_40ms_spiketimes_acoustics_2024_01_08.mat','f1'
,'durs')
```

Clustering using k-means

```
%create matrix of k-means
acoustics = table(f1, durs);
X(:,1) = f1;
X(:,2) = durs;
rng('default')

% Perform k-means clustering using specified number of clusters (K value)
K = 2;
[clusterIndices,centroids] = kmeans(X,K);

% Display results

% Display 2D scatter plot (PCA)
figure
[~,score] = pca(X);
```

```
clusterMeans = grpstats(score,clusterIndices,"mean");
h2 = gscatter(score(:,1),score(:,2),clusterIndices);
for i = 1:numel(h2)
    h2(i).DisplayName = strcat("Cluster",h2(i).DisplayName);
end
clear h2 i score
hold on
h2 = scatter(clusterMeans(:,1),clusterMeans(:,2),50,"kx","LineWidth",2);
hold off
h2.DisplayName = "ClusterMeans";
clear h2 clusterMeans
legend;
title("First 2 PCA Components of Clustered Data");
xlabel("First principal component");
ylabel("Second principal component");
```




```
% Matrix plot
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[~,ax] = gplotmatrix(X(:,selectedCols),[],clusterIndices,[],[],[],[],"grpbars");
title("Comparison of Columns in Clustered Data");
clear K
clusterMeans = grpstats(X,clusterIndices,"mean");
hold(ax,"on");
for i = 1 : size(selectedCols,2)
  for j = 1 : size(selectedCols,2)
```
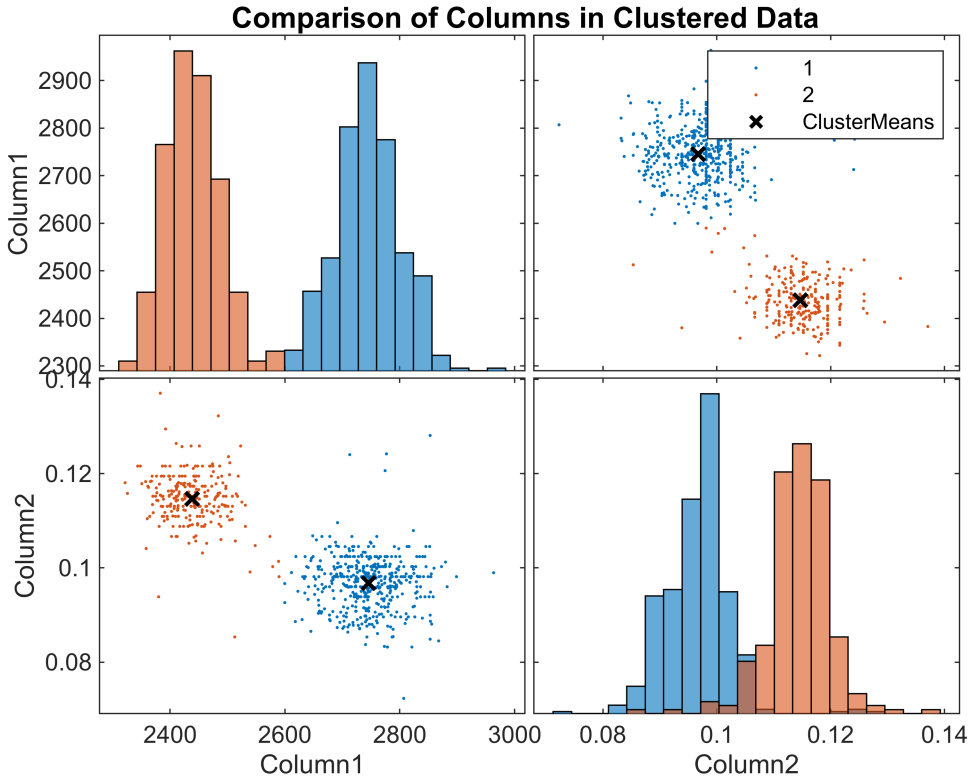
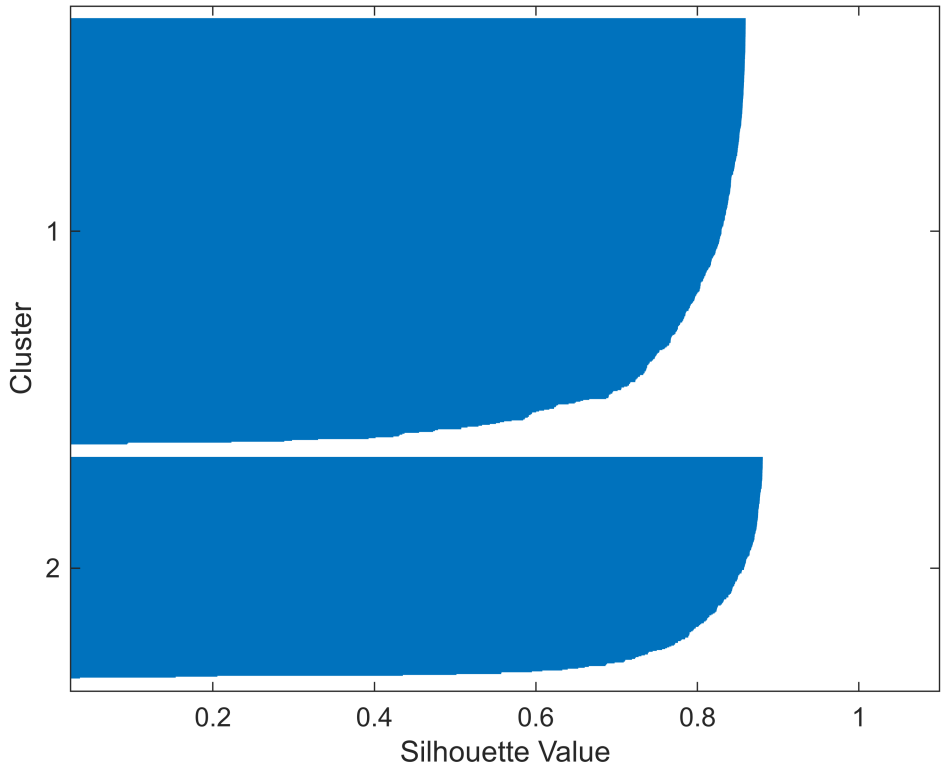

```
        if i ~= j

scatter(ax(j,i),clusterMeans(:,selectedCols(i)),clusterMeans(:,selectedCols(j)), ...
            50,"kx","LineWidth",1.5,"DisplayName","ClusterMeans");
          xlabel(ax(size(selectedCols,2),i),("Column" + selectedCols(i)));
          ylabel(ax(i,1),("Column" + selectedCols(i)));
        end
    end
end
```




```
clear ax clusterMeans i j selectedCols

% silhouette plot to measure how close each point in one cluster is to points in
the neighboring clusters
[silh3,h] = silhouette(X,clusterIndices,'cityblock');
xlabel('Silhouette Value')
ylabel('Cluster')
```




```
% save k-means results
filename =
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save(filename, 'clusterIndices', 'centroids','acoustics','silh3', '-append')
```

Calculate fano factor with combined and split 'd' distributions

```
allspikes = neuralcase.spiketrains;
ntrials = length(allspikes);
onsets = neuralcase.syl_ons_offs(:,1);

preonset = 0.01;
postonset = 0.03;
motor_window = preonset + postonset;


motorWinOn = onsets - preonset;
motorWinOff = onsets + postonset;
 % for each trial in curr case, caculate spike count, mean isi & mean ifr
    for jj = 1:ntrials
        spk = allspikes{jj};
        spks_wn{jj,1} = spk(spk >= motorWinOn(jj) & spk <= motorWinOff(jj));
        n_spikes(jj,1) = length(spks_wn{jj}); %spk count
```

```
        if n_spikes(jj,1) > 1
            mean_isi_case(jj) = mean(diff(spks_wn{jj,1})); % mean isi
            mean_ifr_case(jj) = 1/mean_isi_case(jj); % mean ifr
        end
    end


ff = var(n_spikes)/ mean(n_spikes)
```

```
ff = 1.3707
```