**Introduction: Baby Cry Types**

It has been claimed that babies cry uniquely for any and every reason, including diaper changes and hunger. However, data and models will confess to anything when under enough pressure. Here, you will investigate whether 5 different baby cry samples are acoustically distinct.

1. Summary Statistics of Demographics. Are babies similar in all 5 groups?
2. Unsupervised learning:
   1. How many cry types/clusters exist in the data based on acoustic features?
   2. When the data is clustered into categories, how well do these categories map to parent labels (confusion matrix)?
   3. Which type of cry is the most separable and unique? Rank categories from most to least unique/separable.
   4. How many dimensions are the cry acoustics?
3. Supervised learning:
   1. Using 5 parent labels, what is the average cross-validated accuracy?
   2. Using cluster labels of N categories, what is the average cross-validated accuracy?
   3. Does adding demographic information to the classifier improve accuracy?

Data:

Demographics\_students.xlsx: This contains demographic information

**ID:** Participant ID

**Reason:** Parent Label

**Age:** Baby's Age

**Gender:** Baby's Gender

Filtered\_full\_data\_odd.csv

**ParentFile** Parent Label. Remove unnecessary parts - e.g. gemaps\_part\_diaper.csv = diaper

**Filename**: Filename/ID. First portion of Filename corresponds to User ID in demographics file.

Remaining columns: Acoustic features

| **Feature Name** | **Category** | **Description** |
| --- | --- | --- |
| **shimmerLocaldB\_sma3nz\_amean** | Voice Quality | Average local amplitude perturbation (shimmer) in dB |
| **shimmerLocaldB\_sma3nz\_stddevNorm** | Voice Quality | Variability (normalized std. dev.) of local shimmer |
| **HNRdBACF\_sma3nz\_amean** | Voice Quality | Harmonics-to-noise ratio in dB – reflects voice clarity |
| **alphaRatioV\_sma3nz\_amean** | Spectral Balance | Ratio of energy <1kHz to 1–5kHz in voiced segments (timbre) |
| **alphaRatioV\_sma3nz\_stddevNorm** | Spectral Balance | Normalized variability of alpha ratio |
| **loudness\_sma3\_amean** | Loudness | Mean perceived loudness |
| **loudness\_sma3\_stddevNorm** | Loudness | Normalized standard deviation of loudness (dynamic range) |
| **loudness\_sma3\_percentile20.0** | Loudness | Loudness value at 20th percentile |
| **loudness\_sma3\_percentile50.0** | Loudness | Loudness value at 50th percentile (median) |
| **loudness\_sma3\_percentile80.0** | Loudness | Loudness value at 80th percentile |
| **loudness\_sma3\_meanRisingSlope** | Loudness Dynamics | Mean slope of increasing loudness – reflects energy bursts |
| **F0semitoneFrom27.5Hz\_sma3nz\_percentile20.0** | Pitch (F0) | 20th percentile of pitch in semitones from 27.5 Hz |
| **F0semitoneFrom27.5Hz\_sma3nz\_percentile50.0** | Pitch (F0) | 50th percentile (median) of pitch in semitones |
| **F0semitoneFrom27.5Hz\_sma3nz\_percentile80.0** | Pitch (F0) | 80th percentile of pitch in semitones |
| **F0semitoneFrom27.5Hz\_sma3nz\_pctlrange0.2** | Pitch (F0) | Pitch range between 90th and 10th percentiles |
| **F0semitoneFrom27.5Hz\_sma3nz\_stddevNorm** | Pitch (F0) | Normalized pitch variability |
| **F1amplitudeLogRelF0\_sma3nz\_amean** | Formant | Mean log-amplitude of F1 relative to F0 |
| **F1amplitudeLogRelF0\_sma3nz\_stddevNorm** | Formant | Variability in F1 amplitude relative to F0 |
| **F2amplitudeLogRelF0\_sma3nz\_amean** | Formant | Mean log-amplitude of F2 relative to F0 |
| **F2amplitudeLogRelF0\_sma3nz\_stddevNorm** | Formant | Variability in F2 amplitude relative to F0 |
| **F3amplitudeLogRelF0\_sma3nz\_amean** | Formant | Mean log-amplitude of F3 relative to F0 |
| **F3amplitudeLogRelF0\_sma3nz\_stddevNorm** | Formant | Variability in F3 amplitude relative to F0 |
| **MeanUnvoicedSegmentLength** | Temporal | Average duration of unvoiced (silent or voiceless) segments |
| **StddevUnvoicedSegmentLength** | Temporal | Variability in unvoiced segment lengths |
| **slopeV500.1500\_sma3nz\_amean** | Spectral Slope | Average spectral slope between 500–1500 Hz in voiced frames |