

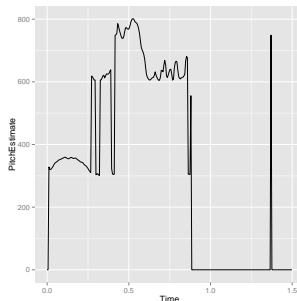
General Idea

- ▶ Pitch analysis using FOSS aubio¹ C-based software
- ▶ aubio gives pitch estimates over time

aubio Output

```
> head(baby_laugh01,5)
```

	V1	V2
1	0.000000	0.0000
2	0.005333	0.0000
3	0.010667	328.1827
4	0.016000	320.3024
5	0.021333	320.4278



¹aubio.org

Statistics

- ▶ Separate each file into **events** based on silence
- ▶ Collection of descriptive statistics on each **event**
- ▶ Create a model clustering based on the descriptive statistics

Sample Statistics

```
> events[1:3,2:9]
```

	Sound.Source	Min	X1Q	Median	Mean	X3Q	Max	Length
1	Adultfemale_cry	149.3	504.3	1848	1419	1897	3596	77
2	Adultfemale_cry	400.6	1110.0	1885	1913	2906	4165	30
3	Adultfemale_cry	149.3	553.3	1840	1424	1898	3602	155

Assumptions

- ▶ Sensitivity (Power, TPR) is the most important measurement
- ▶ False alarms are better than no alarm (within reason)
- ▶ Other sounds don't matter, making the outcome binary
- ▶ Precision is given by PPV

	Cry F	Cry T
Predict F	TN	FN
Predict T	FP	TP

$$TPR = \frac{\sum TP}{\sum TP + \sum FN}$$

$$PPV = \frac{\sum TP}{\sum FP + \sum TP}$$

Supervised Learning Methods

K-Means

Iterative classification based on distance from means

- ▶ Fast
- ▶ Uses euclidean distance from means
- ▶ Simple

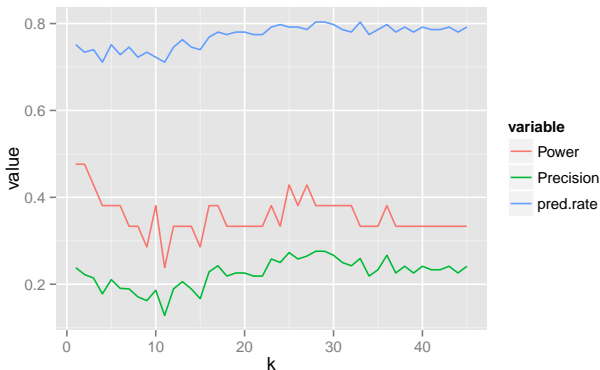
Support Vector Machine

Learns classes with a penalty value, and bounds them based on the kernel

- ▶ Slower
- ▶ Draws more complex boundaries
- ▶ More complex

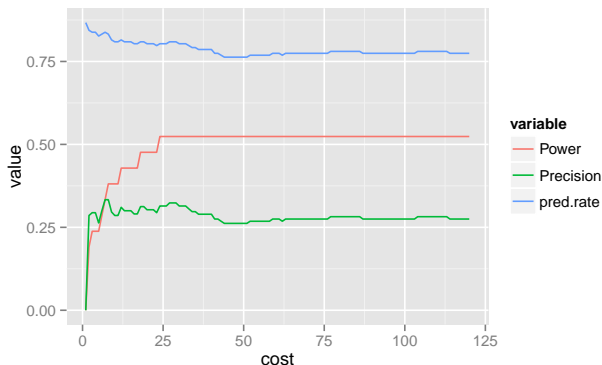
K-Means

- ▶ We want to minimize the “false negative rate” (β), i.e. maximize the power
- ▶ Highest power occurs at $k=1$ or $k=2$



Support Vector Machine

- ▶ The highest power occurs once we set $cost \geq 24$
- ▶ Precision and power are maximized around $cost \approx 27$



Results

- ▶ A SVM model using multiple samplings of each wav file and a high cost has the best prediction
- ▶ Using a SVM, we can get a power of approximately 52.3%²
- ▶ By adding in volume analysis in a similar style, we should be able to further improve the power of the model
- ▶ Other clustering methods (EM, Logistic Regression) could be tried and compared

²tested by LOOCV