

More generative modeling

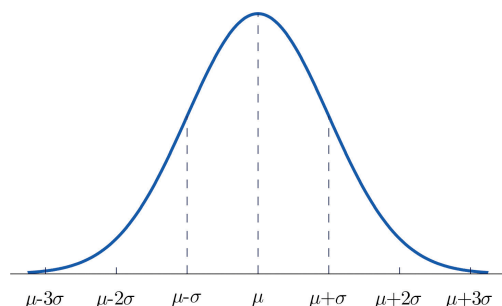
Topics we'll cover

- ① Beyond Gaussians
- ② A variety of univariate distributions
- ③ Moving to higher dimension

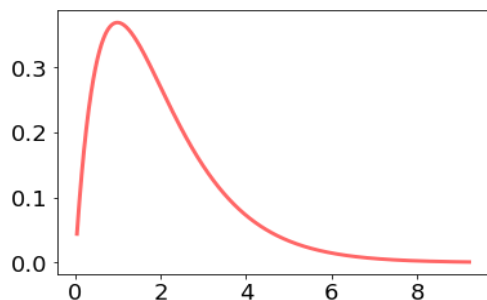
Classification with generative models

- Fit a **distribution** to each class separately
- Use Bayes' rule to classify new data

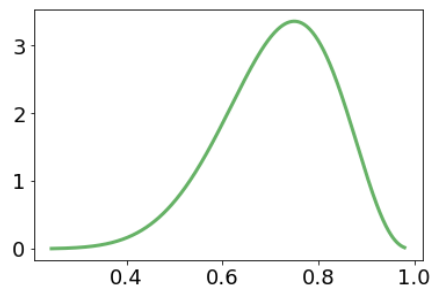
What distribution to use? Are Gaussians enough?



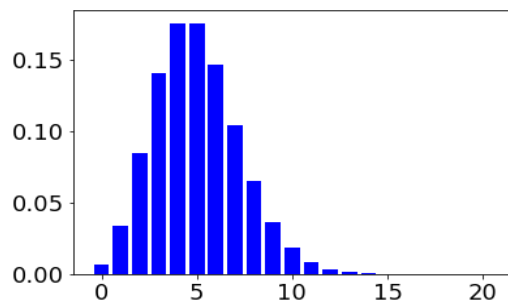
Exponential families of distributions



GAMMA



BETA



POISSON

It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way – in short, the period was so far like the present period, that some of its noisiest authorities insisted on its being received, for good or for evil, in the superlative degree of comparison only.



1	despair
2	evil
0	happiness
1	foolishness

CATEGORICAL

Multivariate distributions

We've described a variety of distributions for **one-dimensional** data.
What about higher dimensions?

① **Naive Bayes:** Treat coordinates as independent.

For $x = (x_1, \dots, x_d)$, fit separate models \Pr_i to each x_i , and assume

$$\Pr(x_1, \dots, x_d) = \Pr_1(x_1)\Pr_2(x_2) \cdots \Pr_d(x_d).$$

This assumption is typically inaccurate.

② **Multivariate Gaussian.**

Model correlations between features: we've seen this in detail.

③ **Graphical models.**

Arbitrary dependencies between coordinates.