Lesson Plan 4/3
Tuesday, April 3, 2018  12:11 PM

Admin
- Project 2 due on Friday
- HW4 released (due on Tuesday)
- Final project posted
- Grades for Project 1 and HW3 almost done (looking good!)

HDSC:

Project 2 Questions?
Final Project Description
HW4
- Discussion
- Example derivation
Bayes Rule
Data Analysis with Geometry
- Preliminaries
- Geometry and distances
- KNN classifier
- Some vector algebra

1790

Proj 2 Problem 2
\[ \text{Click rate } P_A \]

\[ \text{Click rate } P_B \]

Part 1) Known \( P_A = 0.5 \)

Part 2) Known \( P_A = 0.75 \)

Part 3) \[ \text{Both } P_A \text{ and } P_B \text{ are estimated} \]

Hypothesis: \( P_B \leq P_A \)

Estimate \( \hat{P}_B = 0.6 \)
if $P(X > \hat{\theta}_B) \leq 0.05$
then Reject

\[ \text{Approximately as } \mathcal{N}(0.5, \text{var}(X)) \]

\[ \text{pnorm}(0.6, \text{mean} = 0.5, \text{sd} = \ldots) \]
\[ \text{qnorm}(-0.95, \text{mean} = 0.5, \text{sd} = \ldots) \]

\[ \rightarrow \theta \rightarrow \]

\[ \text{Joint & Conditional Probability} \]
\[ p(x, y) \]

(a) \[ p(x = x, y = y) > 0 \quad \forall (x, y) \in D_x \times D_y \]

(b) \[ \sum_{(x, y) \in D_x \times D_y} p(x = x, y = y) = 1 \]

Conditional

\[ p(x = x | y = 0) = \frac{p(x = x, y = 0)}{p(y = 0)} \]

T. done and done
\[ P(X=x \mid Y=y) = P(Y=y \mid X=x) \text{ for all } y \in D, \]

Easier to think about - \( P(Y=y \mid X=x) \) than the opposite \( P(X=x \mid Y=y) \)

**Sentiment Analysis**

- \( X \) : \{positive vs. negative\}
- \( Y \) : word frequency

**Bayes Rule:**

\[
A : 0.11 \quad 0.11 \quad 0.11
\]
Using Bayes' rule for exchanging conditional probabilities:

\[
p(X = x | Y = y) = \frac{p(Y = y | X = x) p(X = x)}{p(Y = y)}
\]

\[
p(X = x | Y = y) = \frac{p(X = x, Y = y)}{p(Y = y)}
\]

\[
= \frac{p(Y = y | X = x) p(X = x)}{p(Y = y)}
\]

\[
\mathbb{E}[X - x | Y = y] = \int p(y | x) \frac{p(x)}{p(y)}
\]
\[
p_{\theta | y} \propto n^{-1} \left[ y - 1 \right] (1 - y)^{n - y - 1}
\]

posterior distribution

\[
p(y | x) \propto \text{constant}
\]

Start thinking about data as geometric objects

\[
p(\text{default} = \text{yes} | \text{student, balance, income})
\]

outcome: 10

predictors: \(x_1, x_2, \ldots, x_n\)
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