Introduction

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1 Probabilistic modelling

Simplest model

$$y = \beta^T x, \tag{1}$$

where β are the parameters, and x is a series of factors that affect output y. Can think of x as all the factors that affect the price of a house defined by y. This is not ideal because real world has no guarantees. More useful to know the probability that the price of the house, y, is some value given factors of x

$$P(x, y) \tag{2}$$

2 The difficulties of probabilistic modelling

Probabilities are inherently exponentially-sized objects; the only way in which we can manipulate them is by making simplifying assumptions about their structure.

The Conditional Independence simplifying assumption: given the output y, the input variables are independent. Ex. probability of two English words appearing are independent if the email is spam.

Recall:

- $P(A, B) = P(A|B)P(B)$

Relating back to Conditional Independence:

- $P(y, x) = P(y, x_1, x_2, ...x_n) = P(x_1|y)P(x_2|y), ...P(x_n|y)P(y)$
- $P(y, x) = P(y) \prod_{i=1} P(x_i|y)$

"Each factor $P(x_i|y)$ can be completely described by 4 parameters with 2 degrees of freedom to be exact". What does this mean? x_i has 2 possible values, and y_i has two possible values

3 A bird's eye overview of the first part of the course

Graphical model discussion:

- Representation: How to express probability distribution of real-world phenomenon?
- Inference: Given probability model, how to find relevant answers.
- Learning: Fitting model to a data-set.