* 1. The random variables for this problem are whether the table is free or not (Y={0 ,1}) and whether it is sunny or not ( X={0 ,1}) . Since x and y can only take two outcomes each, we have model it using Bernoulli’s . Therefore, our parameters are w=(α0 , α1) where α0 , α1 ∈ {0,1} and we can write their probabilities as the following:

P(Y=y| α0) = α0y(1-p)1-y  and P(X=x| α1) = α1x(1-p)1-x

D = {(xi,yi­)} from i to n

Formalizing the problem we get the following:

Argmax(P(D|w)) =

= +

* 1. Once we get our value for w\* (i.e. α0\*, α1\* ) we can evaluate P(D|w) for each of the values of w that we found and find the value of w which gives us our maximum value and that would be the probability of our table being free given that it is sunny.

Therefore P(Y=1|X=1)=

* 1. We would have one extra random variable Z whose values can either be {Morning, Afternoon, Evening} and as it will only have 3 values, it will be a Uniform Distribution and as such will have no extra parameters.

A picture containing timeline

Description automatically generatedA picture containing diagram

Description automatically generated

* 1. Done in Julia
  2. Random Regressor

Standard Deviation of Error: 20.670088906914

Average: 38.366856218335

Mean Regressor

Standard Deviation of Error: 0.44859265614566

Average: 31.651414098074

Stochastic Regressor

Standard Deviation of Error: 0.2677358340251

Average: 11.981075314047

* 1. Done in Julia
  2. Done in Julia
  3. Done in Julia
  4. Mini Batch Approach:

Standard Deviation of Error: 0.26754403226608

Average: 11.976117848765

Stochastic Approach

Standard Deviation of Error: 0.81804193505956

Average: 13.199427112118

From this, we can see that that while we get a larger standard deviation error (especially for the stochastic approach as it is larger by about 0.6) when using adaptive steps, we get a larger average (Not a notable change for Mini batch while for Stochastic, we get a larger difference). This mean we can cover a wider range of data within the distribution.