02_Exercise3_MaxL_

April 22, 2018

GIVEN: Samples $0, 1, 0, 0, 1, 0$ from a binomial distribution which has the form:P(x=0)=(1-μ), P(x=1)=μ

REQUESTED: What is the maximum likelihood estimate of μ .Hint: you can use SymPy to compute the derivities symboliclly

```
In [2]: import sympy as sp
        import numpy as np
        import matplotlib.pyplot as plt
        sp.init_printing(use_latex=True)
```

Maximum likelihood estimation:

$$L(p \mid y, N) = \binom{N}{y}.p^y.(1-p)^{N-y}$$

where,

p = Probability of success N = Number of trials y = Number of successes in N trials
Since $\binom{N}{y}$ is a constant, this has been ignored.
Taking log on both the sides,

$$\ln L(p \mid y, N) = y.\ln(p) + (N-y)\ln(1-p)$$

$$\frac{\partial[\ln L(p \mid y, N)]}{\partial p} = \frac{y}{p} - \frac{N-y}{1-p} = 0$$

$$\frac{y}{p} = \frac{(N-y)}{(1-p)}$$

$$y(1-p) = p(N-y)$$

$$y - yp = pN - yp$$

$$pN = y - yp + yp$$

$$p = \frac{y}{N}$$

```
In [3]: samples = [0,1,0,0,1,0]
        success = sum(samples)
        failures = len(samples)-success
```

In [4]:
```
mu = sp.Symbol('mu')
eq = mu**success * (1-mu) **failures
eq_prime = sp.diff(eq,mu)
print eq_prime
sp.solve(eq_prime)
```

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-4*mu**2*(-mu + 1)**3 + 2*mu*(-mu + 1)**4
```

Out[4]:

$$\left[0, \quad \frac{1}{3}, \quad 1\right]$$

Reference : http://www.montana.edu/rotella/documents/502/binom_like.pdf