3.3.1 Nasser Abbasi

$$P(\theta|D) = \underbrace{P(D|\theta)}_{\text{likhood}} \frac{\overset{\text{prior}}{P(\theta)}}{P(D) \rightarrow \text{normalizatn}}$$

$$P(k) = \binom{N}{k} (1-\theta)^{N-k} \theta^k \Rightarrow D = \{H\}$$

$$P(k=1|N=1,\theta) = \frac{N!}{k!(N-k)!} (1-\theta)^0 \theta^1 = \theta \Rightarrow \text{likhood}$$

$$\therefore P(D|\theta) = \theta \Rightarrow \text{likehood}$$

3.3.2 $D = \{H\} \Rightarrow P(\theta) = ? = \text{Constant} = C$

$$P(D) = \int_0^1 P(\theta) P(D|\theta) \, d\theta$$

$$P(D) = \int_0^1 C \, P(D|\theta) \, d\theta = C \int_0^1 P(D|\theta) \, d\theta$$

$$= \int_0^1 C\theta \, d\theta = \left[\frac{C\theta^2}{2} \right]_0^1 = \frac{C}{2} \approx \text{constan } C$$

3.3.3

$$P(\theta|D) = P(D|\theta) \frac{P(\theta)}{P(D)}$$

$$P(\theta|D) = \frac{\theta \, C}{[C/2]} = 2\theta$$

$$\therefore P(\theta|D) = 2\theta \Rightarrow \text{we will plot this vs } \theta$$

3.3.4

Nasser Alrashi

$$p(\theta|D) = p(D|\theta) \frac{p(\theta)}{p(D)}$$

$D = [H, T]$, $p(\theta) = c$

$$P(k=1 \mid N=2, \theta) = \frac{N!}{k!\,(N-k)!} (1-\theta)^{N-k} \theta^{k}$$

$$P(D|\theta) = 2(1-\theta)\theta = 2\theta(1-\theta)$$

$$\therefore p(D|\theta) = 2\theta(1-\theta) = 2(\theta - \theta^2)$$

$$p(D) = \int_0^1 p(\theta)\, p(D|\theta)\, d\theta$$

$$p(D) = \int_0^1 c\,[2(\theta-\theta^2)]\, d\theta = 2c\left[\frac{\theta^2}{2} - \frac{\theta^3}{3}\right]_0^1$$

$$p(D) = 2c\left[\frac{1}{2} - \frac{1}{3}\right] = 2c\left(\frac{1}{6}\right) = \frac{c}{3}$$

$$\therefore p(\theta|D) = p(D|\theta) \frac{p(\theta)}{p(D)}$$

$$p(\theta|D) = 2(\theta - \theta^2) \times \frac{c}{c/3}$$

$$p(\theta|D) = 6(\theta - \theta^2) = 6\theta(1-\theta)$$

$$\therefore p(\theta|D) = 6\theta(1-\theta)$$

$\therefore$ we will plot $p(\theta|D)$ vs θ

$6\theta(1-\theta)$ vs θ

3.3.5 Nasser Alrasbi

expect value

$$p(\theta) \propto e^{(\theta-0.5)^2/-0.1}$$ → Gaussian

$p(\theta|D)$?

$D = [H, T]$

$$p(\theta|D) = p(D|\theta)\frac{p(\theta)}{p(D)}$$

$p(D|\theta) = 2\theta(1-\theta)$ from 3.3.4

$$p(\theta) \propto e^{\frac{(\theta-0.5)^2}{-0.1}}$$

$\therefore$ $p(D)$ is constant so it will not effect equation

$p(D) =$ constan

$\therefore$

$$p(\theta|D) = 2\theta(1-\theta)\frac{e^{-\frac{(\theta-0.5)^2}{0.1}}}{c}$$

$$\therefore p(\theta|D) = \frac{2}{c}\theta(1-\theta)\, e^{-\frac{(\theta-0.5)^2}{0.1}}$$

we will plot $p(\theta|D)$ vs θ for $D = [H, T]$