

## Question 1

Problem 1:

$$\hat{p} = \bar{X}$$

Problem 2:

$$\hat{p} = \frac{\bar{X}}{N} = \frac{3+6+2+8+0+3}{10} = \frac{160}{6}$$

Problem 3:

$\tilde{x}$  = smallest  $X_1$

$\hat{x}$  = largest  $X_1$

Problem 4:

$$\hat{N} = \frac{\sum x_i}{n}$$

Problem 5:

$$\sigma^2 = \sqrt{\frac{\sum x_i - N}{n}}$$

Problem 6:

$\hat{\mu}$  = Sample mean

$\overline{\sigma}$  = sample standard deviation

## QUESTION 2

### PROBLEM 1:

COIN: 60 H , 40 T

THUMBTACK: 70H, 30T

Beta:(1,1) (40,60) (30,70) (100,100) (1000,1000) (100000,100000)

MLE COIN:

HEADS: 60/100

TAILS: 40/100

MLE THUMBTACK:

HEADS: 70/100

TAILS: 30/100

MAP COIN:

FOR Beta(1,1)

$$(60+1-1)/(100+2-2) = 60/100$$

FOR Beta(40,60)

$$(60+40-1)/(100+100-2) = 99/198$$

FOR Beta(30,70)

$$(60+30-1)/(100+100-2) = 89/198$$

FOR Beta(100,100)

$$(60+100-1)/(100+200-2) = 159/298$$

FOR Beta(1000,1000)  
 $(60+1000-1)/(100+2000-2)=1059/2098$

FOR Beta(100000,100000)  
 $(60+100000-1)/(100+200000-2)=100059/200098$

MAP THUMBTACK:

FOR Beta(1,1)  
 $(70+1-1)/(100+2-2) = 70/100$

FOR Beta(40,60)  
 $(70+40-1)/(100+100-2) = 109/198$

FOR Beta(30,70)  
 $(70+30-1)/(100+100-2) = 99/198$

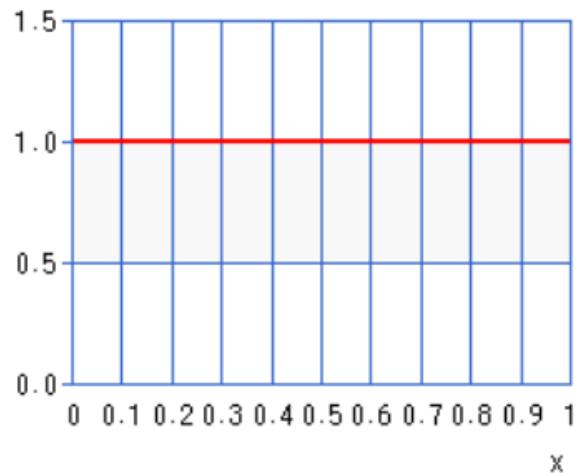
FOR Beta(100,100)  
 $(70+100-1)/(100+200-2)=169/298$

FOR Beta(1000,1000)  
 $(70+1000-1)/(100+2000-2)=1069/2098$

FOR Beta(100000,100000)  
 $(70+100000-1)/(100+200000-2)=100069/200098$

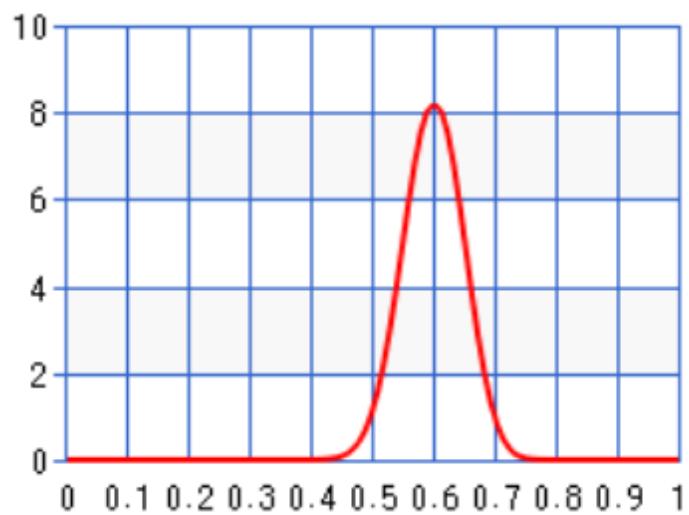
## PROBLEM 2:

Beta(1,1):



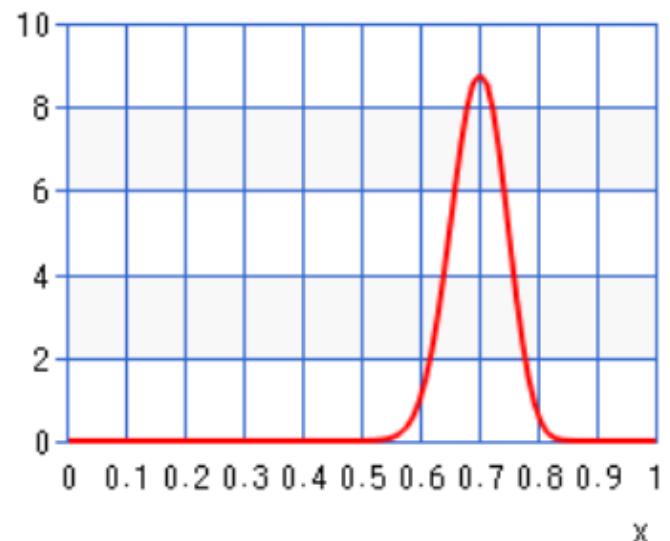
COIN:

Dominated  
by data prior  
is insignificant

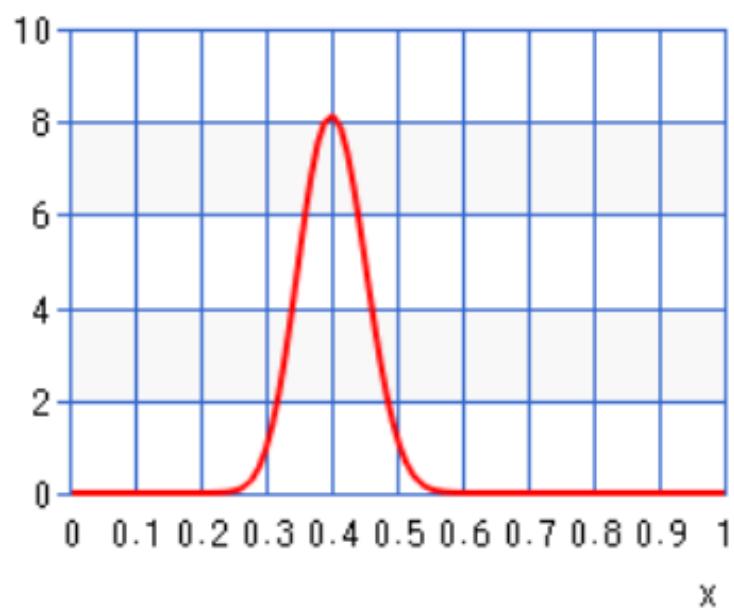


THUMBTACK:

Dominated  
by data prior  
is insignificant

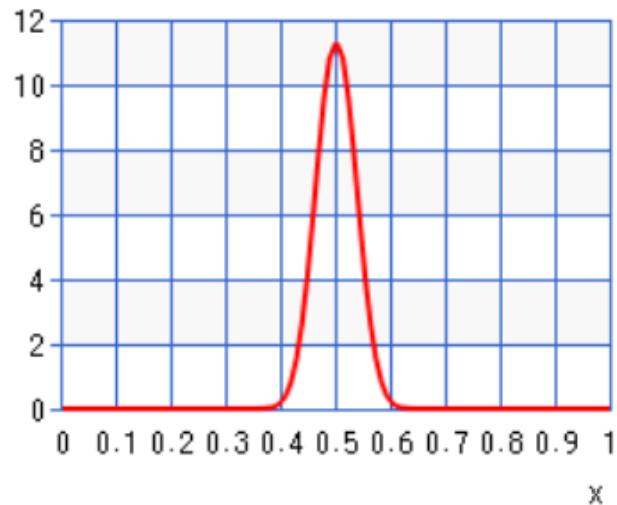


Beta(40,60):



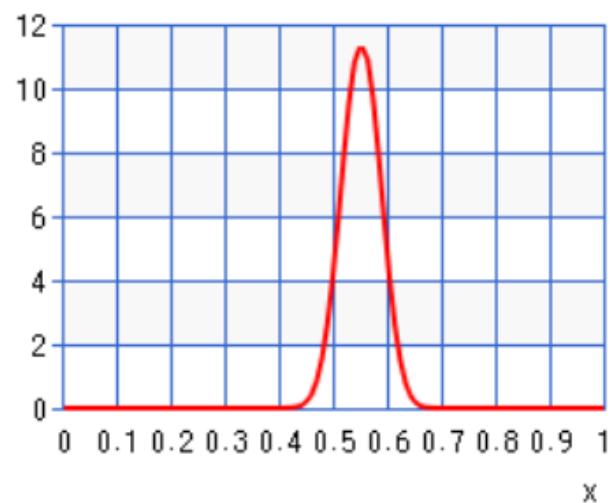
COIN:

Data and prior  
are of equal  
strength and  
are opposite of  
each other  
thus the result  
is centered

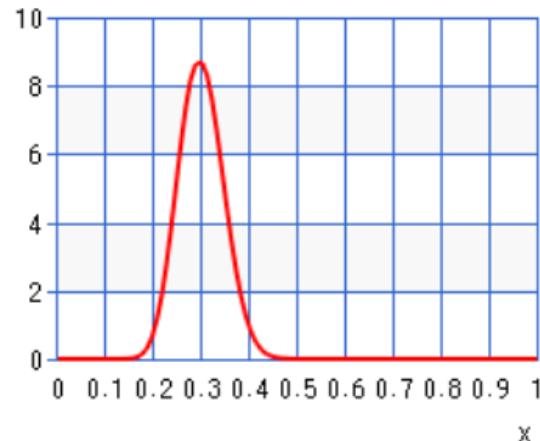


THUMBTACK:

Data and prior  
are of equal  
strength and  
are opposite of  
each other  
but data is fur-  
ther from the  
center the re-  
sult is more to  
ward center

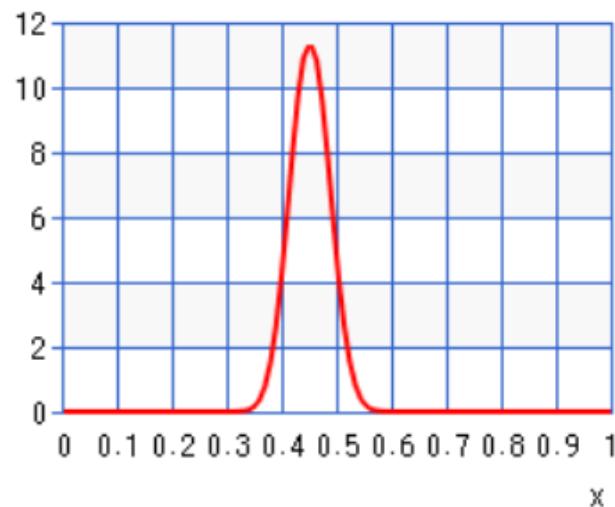


Beta(30,70):



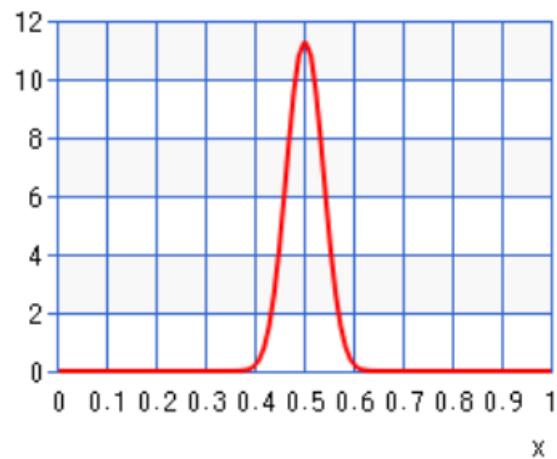
COIN:

Data and prior  
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each other  
but prior is fur-  
ther from the  
center the re-  
sult is more to  
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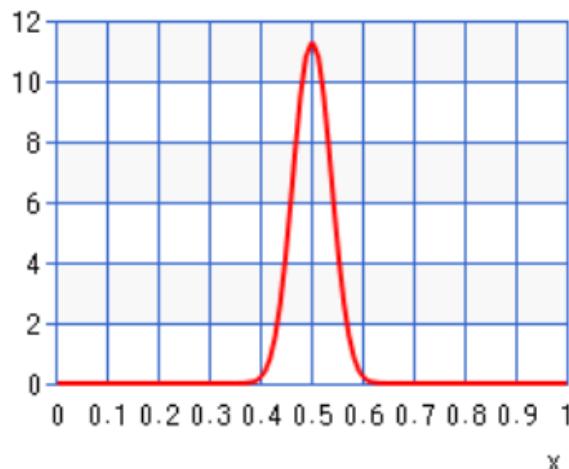


THUMBTACK:

Data and prior  
are of equal  
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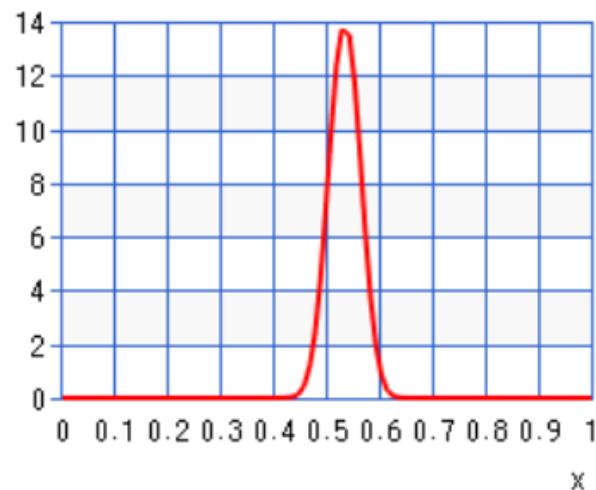


Beta(100,100):



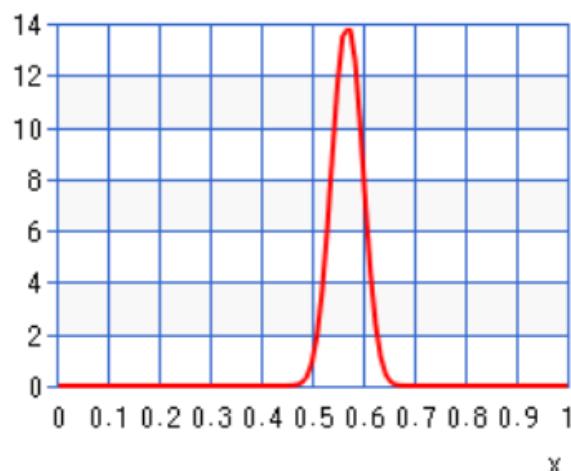
COIN:

Data is dominated by the prior which rests at the center pulling the data to center

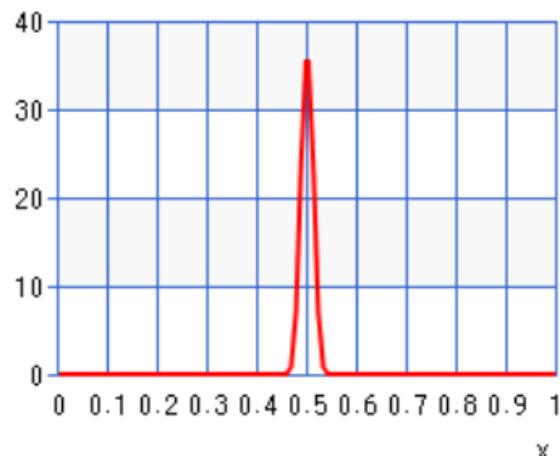


THUMBTACK:

Data is dominated by the prior which rests at the center pulling the data to center

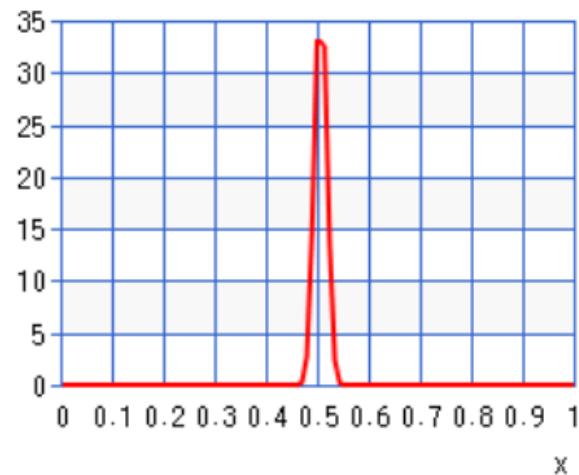


Beta(1000,1000):



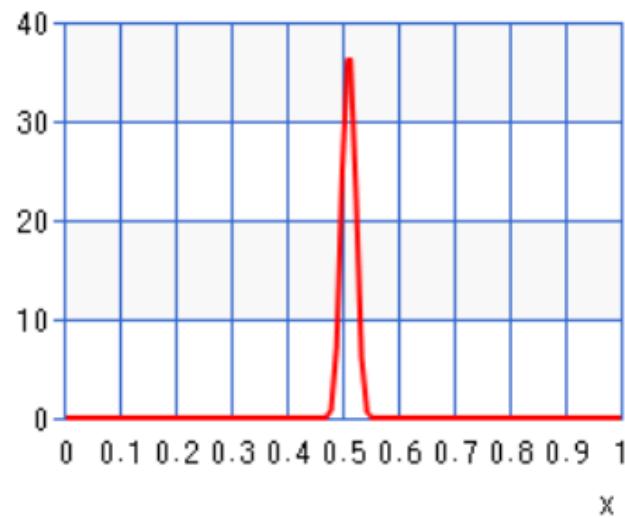
COIN:

Data is dominated by the prior which rests at the center pulling the data to center

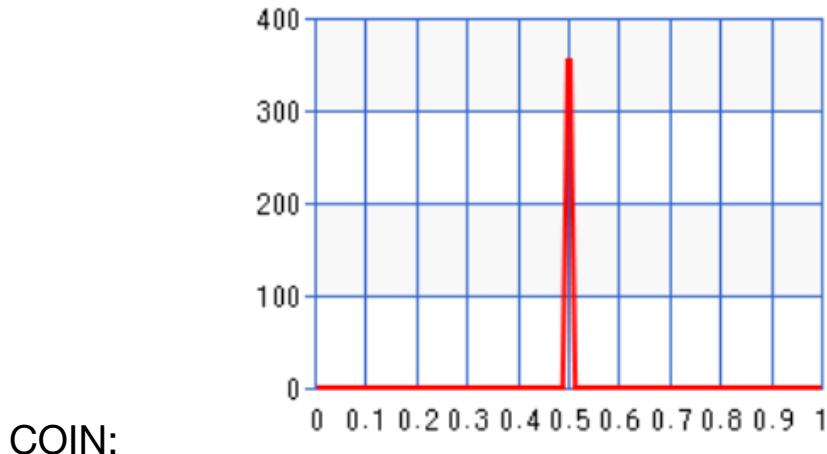


THUMBTACK:

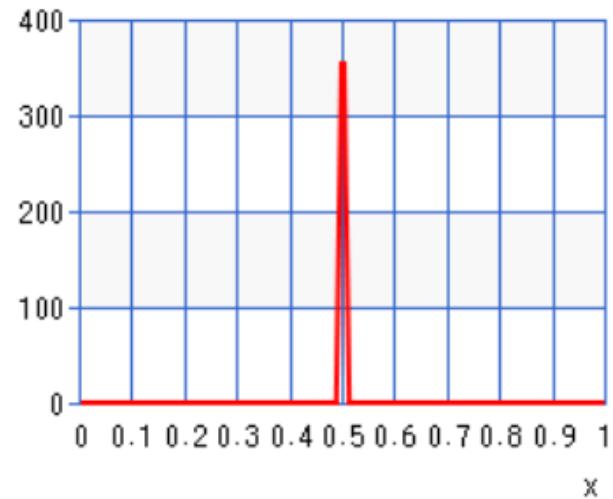
Data is dominated by the prior which rests at the center pulling the data to center



Beta(100000,100000):

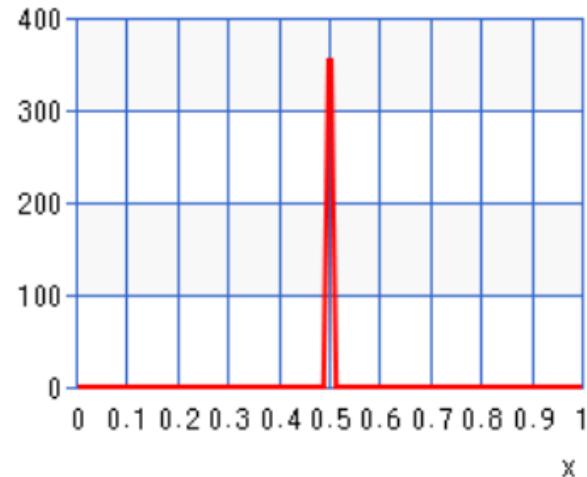


Data is heavily dominated by the prior which rests at the center pulling the data to center



THUMBTACK:

Data is heavily dominated by the prior which rests at the center pulling the data to center



## PROBLEM 3:

True as more data is gathered data will start being the dominant force in the estimation and eventually will make prior insignificant for MAP estimate making it similar to MLE value.

## PROBLEM 4:

True as bigger the prior gets the MAP estimate will be dominated by the prior making them get closer till data becomes insignificant