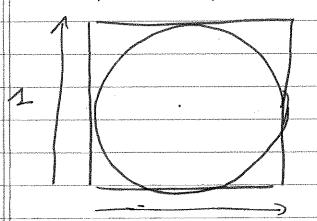
Biometry in Pharmacutics Probability & Buyes

U. Buffalo, March 6th

I/ Buffon's needle +. For this lecture, we'll consider a simplified needle experiment. The goal is to measure n.

Originally proposed in 1733.

Simplified Experiment



What are the odd Re needle falls in the circle?

P= Tr2/A2 = 11/4

Is this experiment practical?

- Uhat conditions, when dropping the needle ment be met

- D Noedle can hit any point with the same probability

x~ U(0,1)

by ~ U(0, 1)

What are the odds the needle hits a specific point? Say (20, 60)?
- o Simpler problem:

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what are the odds the needle falls in box A?

Where N is the total number of outcomes. But a point has dimension O. Thus

Thus

This does not mean the event is impossible! Hints at some counter-inhuitive results when we deal with continuous spaces.

Probability measure: maps a set to [0;1] Example of sets/events manue o a point (20, yo) o the box A 1/16 11/4 o the circle o the whole space

Our prob. measure is the area of the set.

al 25 de de la recurso esse que primisio recultura que que posicioles de puedan secundo de conseguencia de con	Suppose à is anknown (which it is!)
	Or suppose ue have a complicated shape:
	How can we measure the area? Using probability.
	Jahine variable
	Let A = { noodle falls in circle } RC the complement.
	Then X = MANDE 100 (mues/failure) Suppose we drop n needles.
	Xx, 111, Xn ~ Bernouilli (p) (dewrity)
	$\beta \propto p^{\alpha}(1-p)^{1-2\alpha}$ (Talk about independence)
	Assigns probability mass to n=1 and n=0_
	1-11/4 If we drop a lot of needles, the average of X converges to P!
	STRONG LAW OF LARGE # !

	X ····································	E { X}	roughly speaking	4/		
Expecto	ution value:	1 lim 1	- Zxj = x a.			
p=E(x	$Y = 4\beta(X=1) +$	en e)	robubility 1.		
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Central	Limit Theorem	an harrina mengra kadi sebagai ngarapan seri at an akkan malakha akada akada akada akada na kada na akada na a				
Tell	s us something	about the	rate of course			
Tells us something about the rate of convergence. How much variance will I have?						
				And the second section of the section of the second section of the section of the second section of the section of th		
a the manufacturing species and a species of a section in the distribution of a species of the confidence of the species of th	$(X_n - \mu) -$	a N(c), \(\frac{1}{2}\n\)			
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Proportion		ત્વી તું - ખાળામાં આ માં આ માં આ પણ કરવા કેટ્સ ને દિવસ નાનું તે કિંમોના માટે તે ક્લાકાનો કર્યા છે. કરવા કરવા હોય કે તે હોય કે તે કેટ્સ ના સ્થાપના સ	room met met met de la barre la meta tronocomo de la metalo de que la delet de la metalo meneralizar a compres que d	ga at an ilanumijer Unidenskie ang mijan 1750 senerang karanesin kara manjuri at 6 seneka 4 a Gerama		
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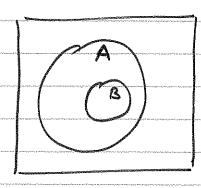
Pa continuous distributions:

$$M = \int_{R} n \rho_{0,0} dn$$

More generally, for any random function f(X):

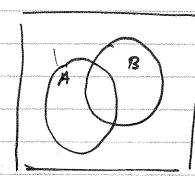
$$E\{f(x)\} = \int_{\mathbb{R}} f(x) p(x) dx$$

Conditional Probability



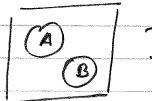
$$\frac{P(BIA) = \frac{P(B)}{P(A)}}{P(A)}$$

What about P(AIB)?



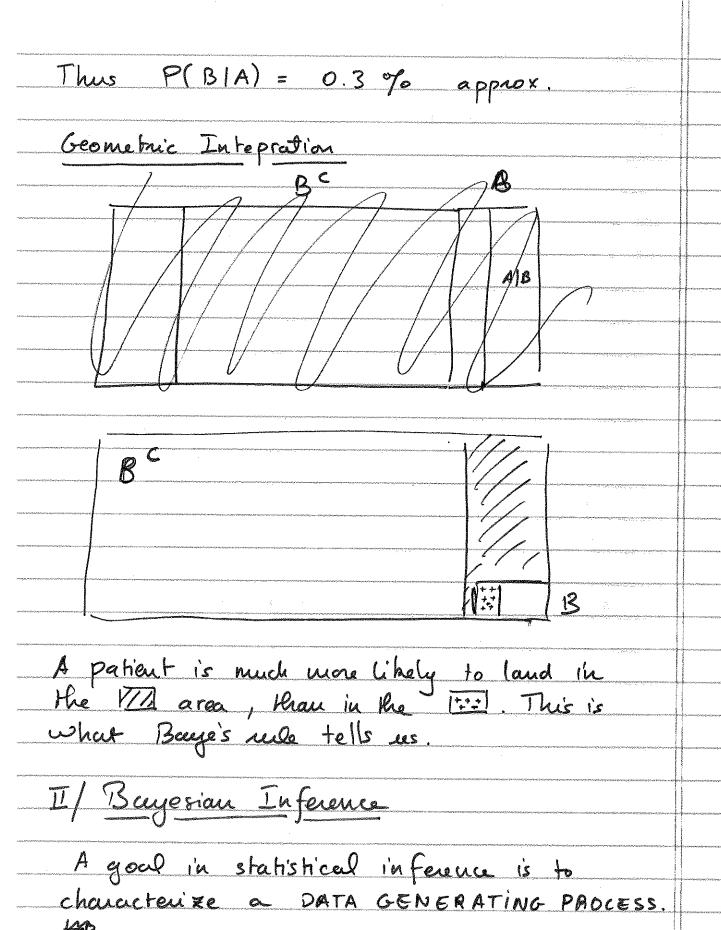
$$\frac{P(B|A) = \frac{P(A \cap B)}{P(A)}}{P(A)}$$

What about



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Baye's Theorem
   P(B/A) = P(A1B)p(B)
               P(A)
Proof:
      P(ANB) = P(A) P(BIA)
               = P(B)P(AIB)
Thus
     P(A)P(BIA) = P(B)P(AIB)
        P(B/A) = P(B) P(A1B)
Example: Mamograus
Lit B = { patient has break cancer }

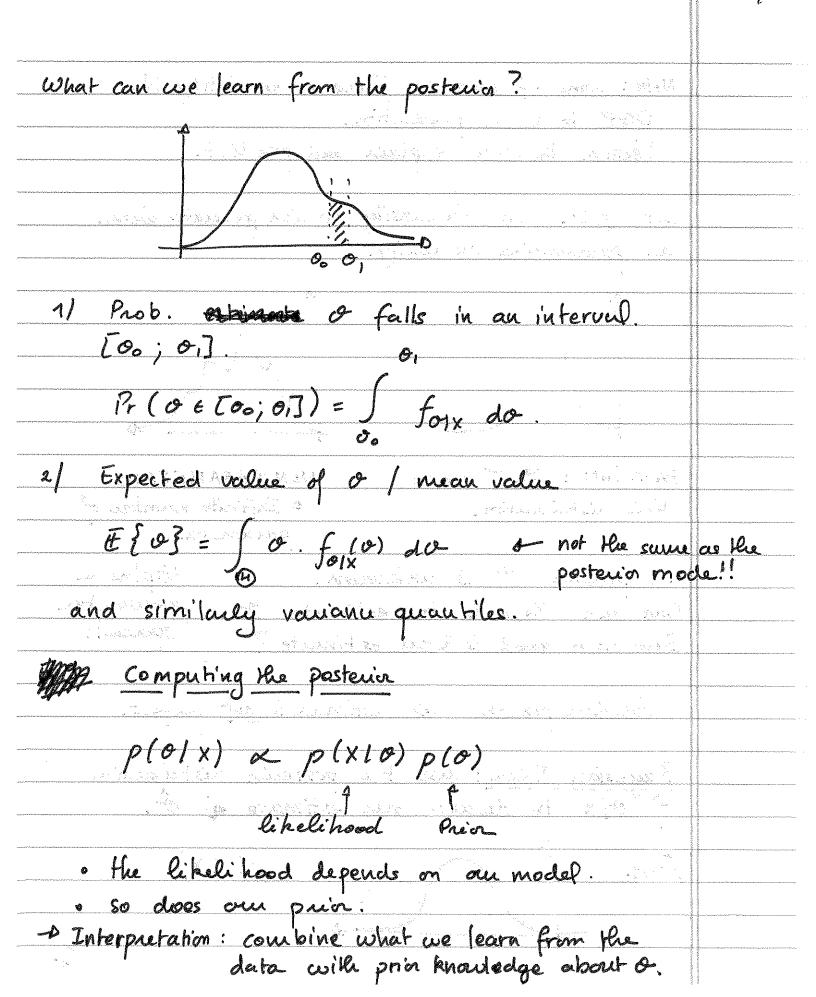
A = { Test is positive }
Pr(B|B) = 0.25 and Pr(BC|B) = 0.2
Pr(A/BC) = 0.1 and Pr(BC/BC) = 0.9
           0.1
 P(BIB) = P(AIB)P(B)
                  P(A)
P(A) = P(AIB) + P(AIBC)
and P(B) = 0.04 %
```



Note: some of statistics focusor on emulating the DGP to make prediction.

Tension between explain and predict. Lef f(.) be the density which generates data. Can parametrize the density. GAUSSIAN: pt, V control NON-PARAMETRIC - Infinite number of Huis distribution. paramaters. In practice & 13 unknown. Explose a parameter Can use X1,111, Xn to estimate O. But how good is Born estimate? Random process => estimate is not perfect. Bayesian Idea: ux the posterior distribution of OIX to describe our estimate of ô. MOSX)

the forest is building to the control of the con-



The pria: - Prior knowledge:
· h is around 3.14
· A parameter hous a mechanishic
interpretation à can use expert knowldge.
a annual
V of gut - o w/ some vaviation.
V~ N(Vo, To?)
· A regularization device
-o can help model fitting process
- o makes au parameter search
more targeted exploration of target
space.
Eig Immitation game / code Breaking.
Example: $\times 2, \dots, \times n \stackrel{iid}{\sim} N(\sigma, \sigma^2), \Gamma is$ $\sigma n N(\mu, \tau^2) \text{known}.$
Their main and their Challingal many soll
togesler: The form of the f
$P_{\alpha} = \frac{1}{\sqrt{2\pi}} e^{-\frac{\pi}{2}} \left(\frac{1}{\sqrt{2\pi}} \left(\frac{1}{\sqrt{2\pi}} - \frac{1}{\sqrt{2\pi}} \right) \right)$
JA T
Produces a posteria $N\left(\frac{M/T + \sum_{i} x_i/\sigma^2}{1/T^2 + n/\sigma^2}, \frac{1}{1/T^2 + n/\sigma^2}\right)$
1/22+11/02 1/22+1/02/

 $N\left(\frac{1/\zeta' + \chi/\sigma^2/n}{1/\zeta' + \chi/\sigma^2/n}\right)$ The mean is a compromise or a weighted average between u and X.
The weighting is 1/VAR => How uncurrainty is penalized. As n - 0 +00, the data/likelihood dominates the priority section of the section Var = 1/2 + N/T? goes to 0, if we have strong prior (low variance) or a bot of data. FOR Questions, time allowing. Feulle topics - In practice rend to estimate pos Feu'n disfribution. - MCMC etc.