The Reverend Bayes' First XI:
A Bayesian Approach to Cricket

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References

arXiv: 0801.4408
http://www.physics.usyd.edu.au/~brewer/cricket.pdf

The Case of Mike Hussey

- Test career: 2188 runs, dismissed 28 times, average = 78.14
- Bradman averaged 99.94, next best over a long career is ~60
- Hussey looks like the 2nd best batsman ever, but it's "early days"
- Let's put error bars on that 78.14

What is Bayesian?

- Probability = 'plausibility'
- The rules of probability theory are the only consistent way of combining uncertainties
- Cox, R. T. 1961. The Algebra of Probable Inference. John Hopkins University Press
- Jaynes, E. T., 2003. Probability Theory: The Logic of Science. Cambridge University Press

$$P(A) + P(\sim A) = 1$$

$$P(H|D) = P(H)\frac{P(D|H)}{P(D|H) + P(D|\sim H)}$$

What about ”statistics”?

- Not allowed to calculate the probability of a hypothesis, or the probability distribution for a fixed but unknown quantity.

Usually Good Enough: Maximum Likelihood, Confidence Intervals (sometimes), common sense plus experience with the particular problem, 'number of sigmas' folklore

Silly: Anything involving p-values (these answer the wrong question and usually exaggerate the evidence against the null hypothesis)

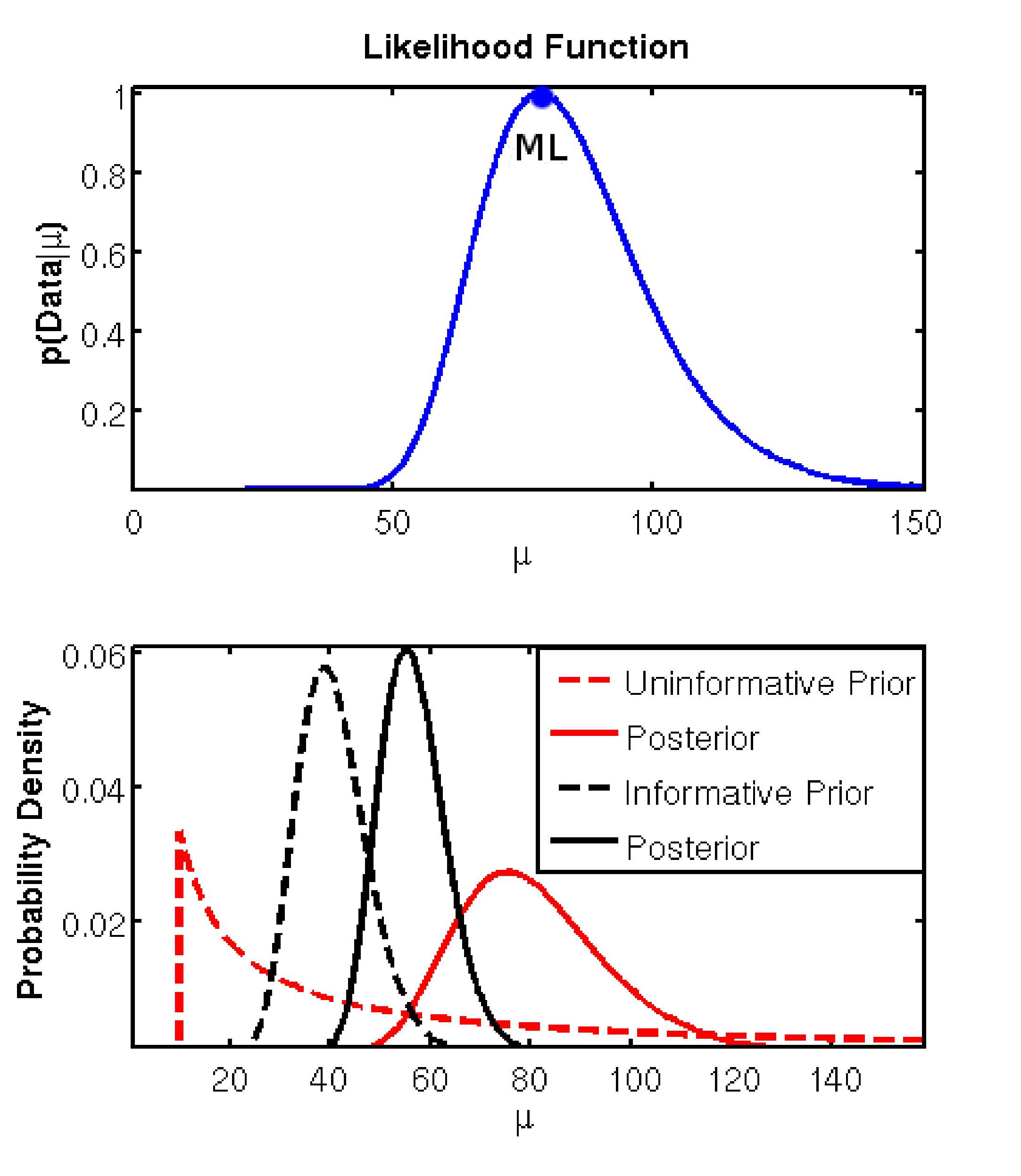
A Model

- Consider a sequence of scores $\{x_1, x_2, ..., x_N, ...\}$
- Each x can be any non-negative integer
- If all we knew was that the mean of all of the x's was μ, we would assign independent geometric (discrete exponential) distributions for each x.
- $p(\{x_1, x_2, ..., x_N\} \mid \mu)$
- Can invert using Bayes's theorem.
- $p(\mu \mid \{x_1, x_2, ..., x_N\}) \propto p(\mu)\, p(\{x_1, x_2, ..., x_N\} \mid \mu)$

Two Prior Distributions

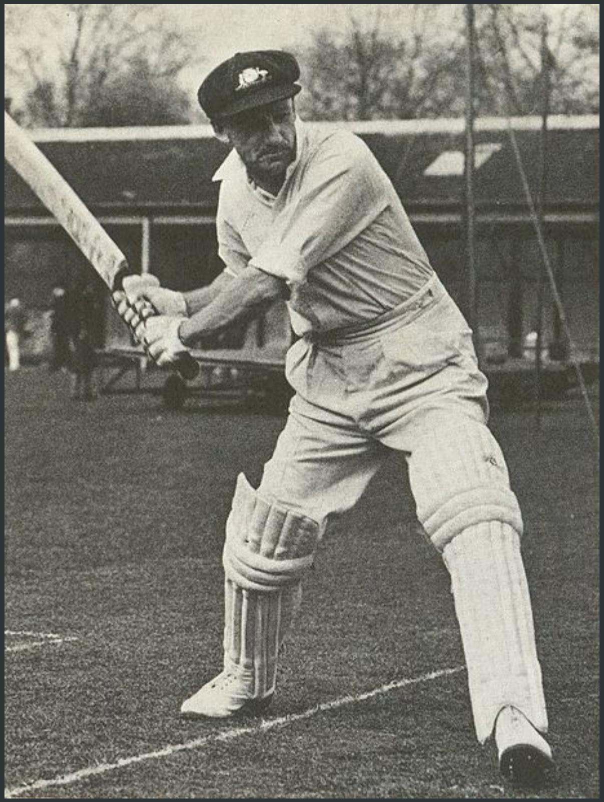
- ***Noninformative:*** How long is a piece of string? Twice the length from the middle to one end.
- ==> Jeffreys' Scale Invariant Prior (uniform distribution for log(μ). I added cutoff at $\mu = 10$
- ***Informative***:
- log(μ) ~ Normal(Mean log(40), Sd 0.175)

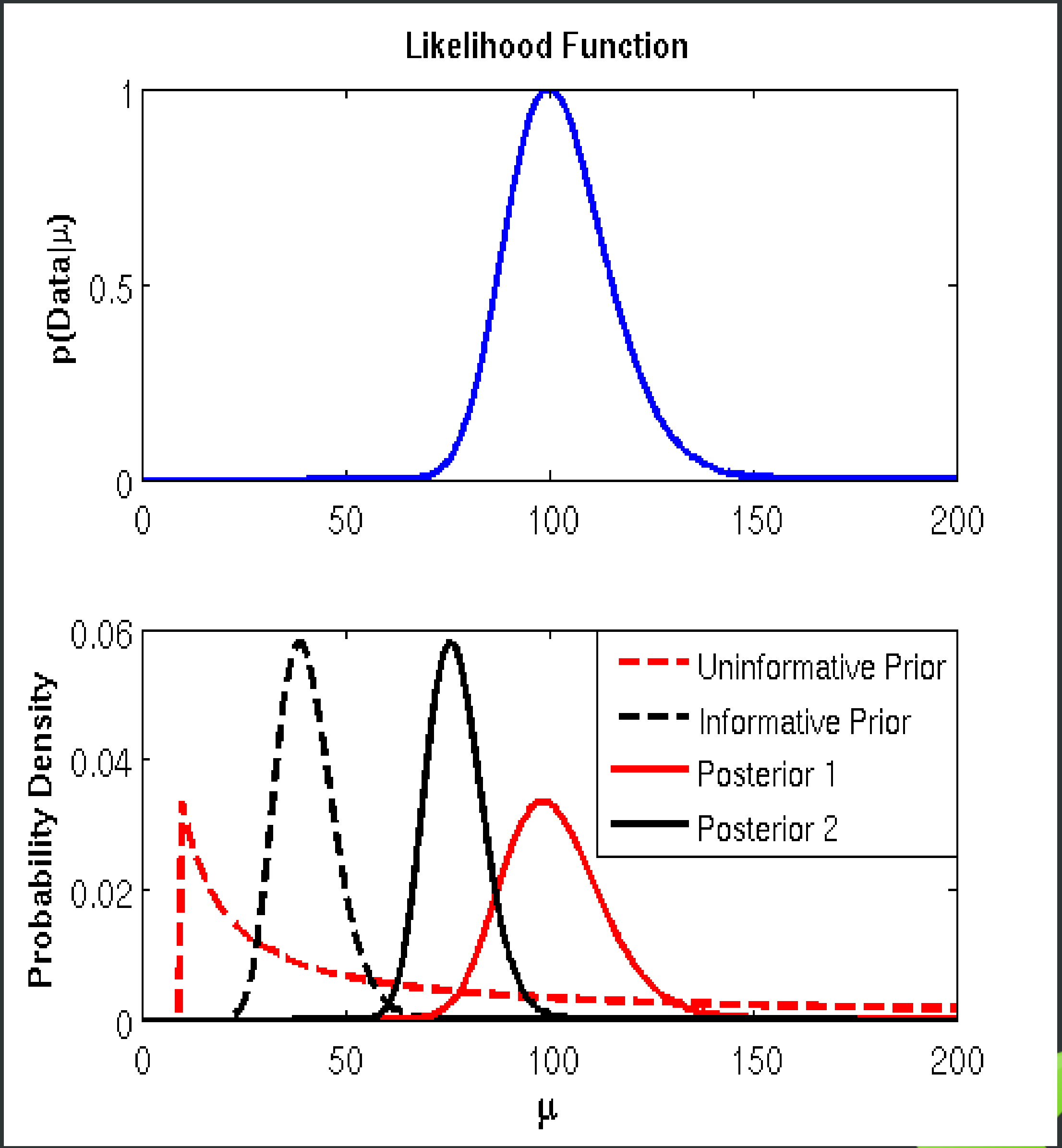
78.14?
No, only 56.5 ± 6.8



The Same for Bradman

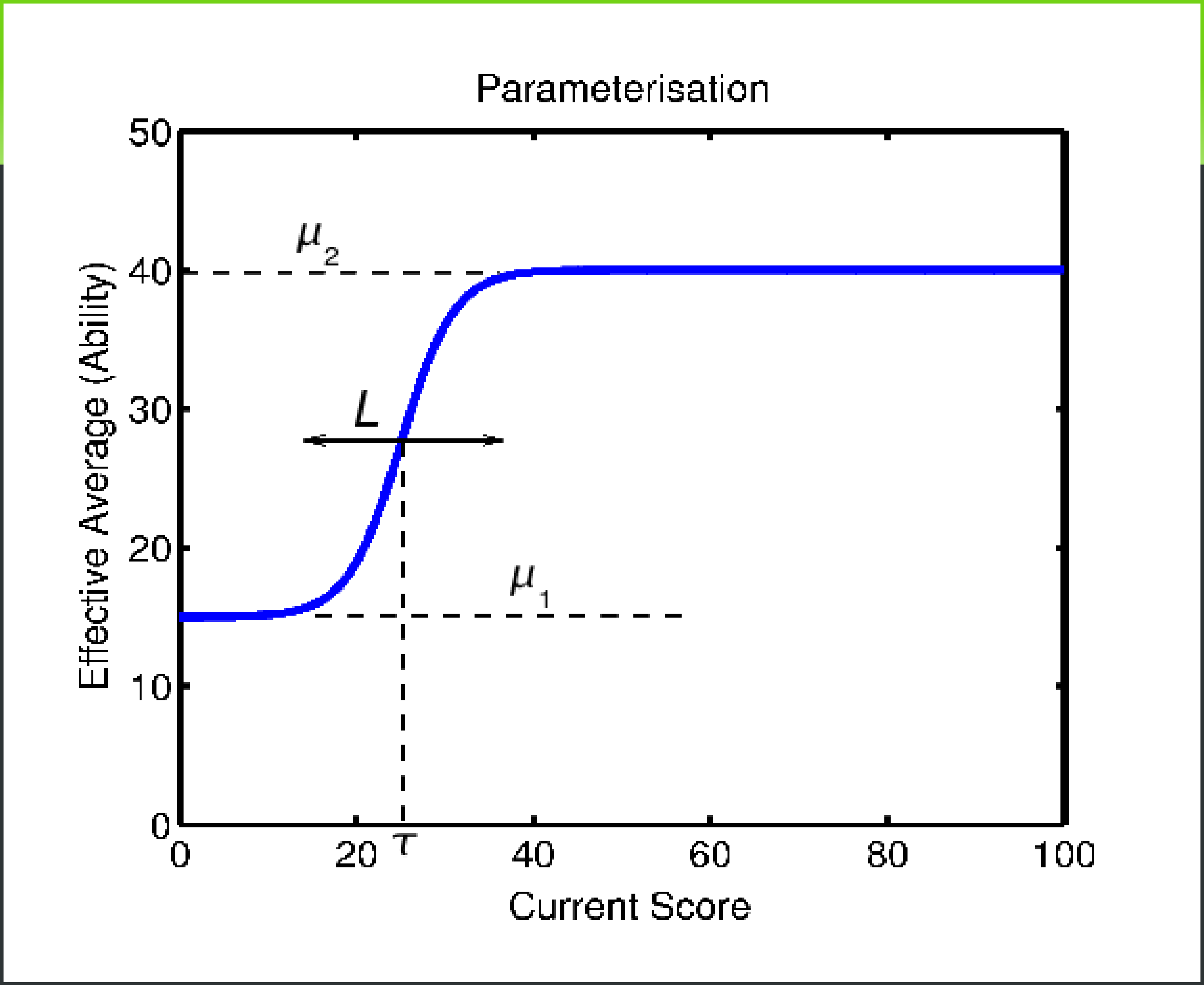
77.0 ± 7.0

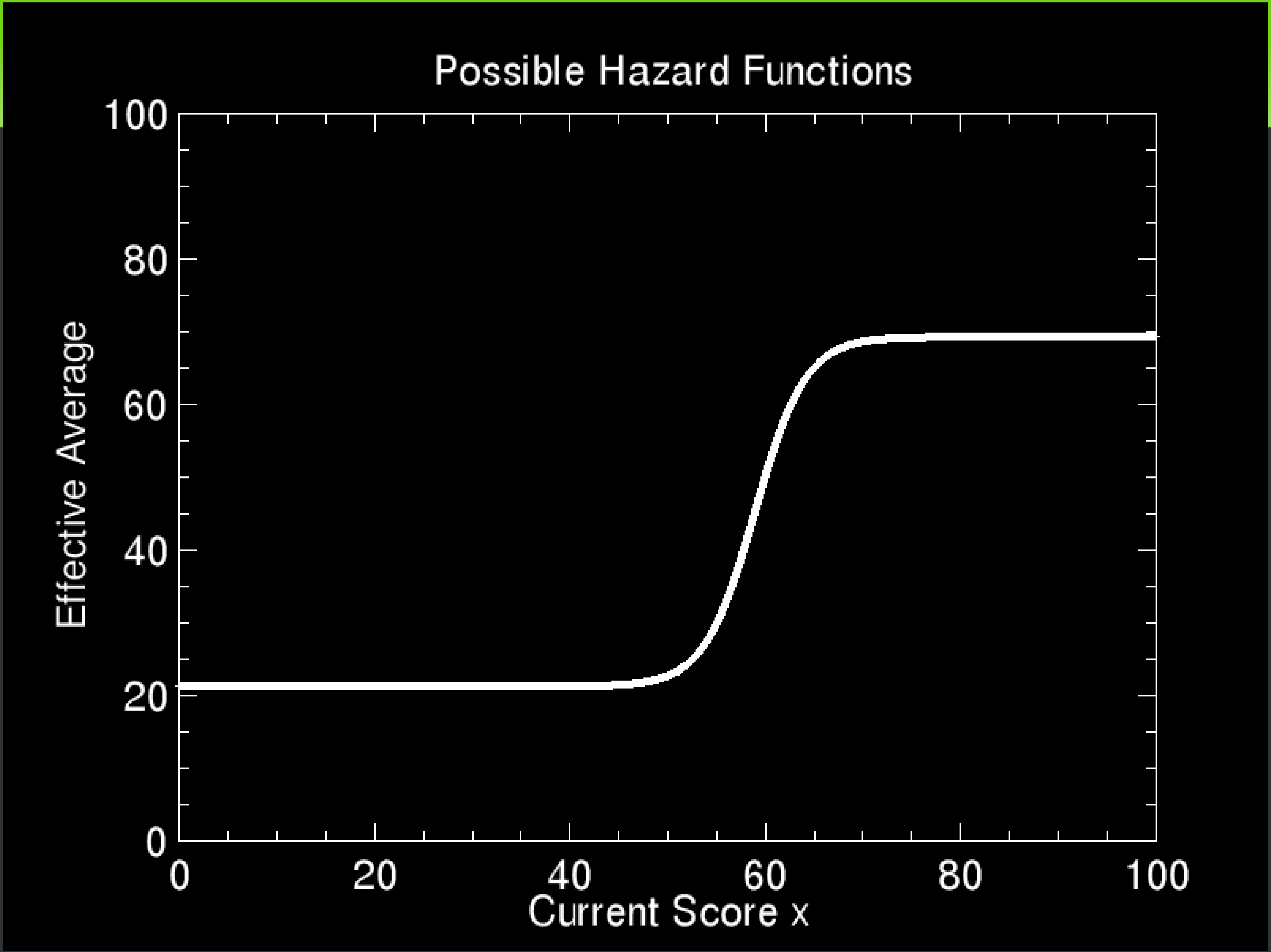




Getting Your Eye In

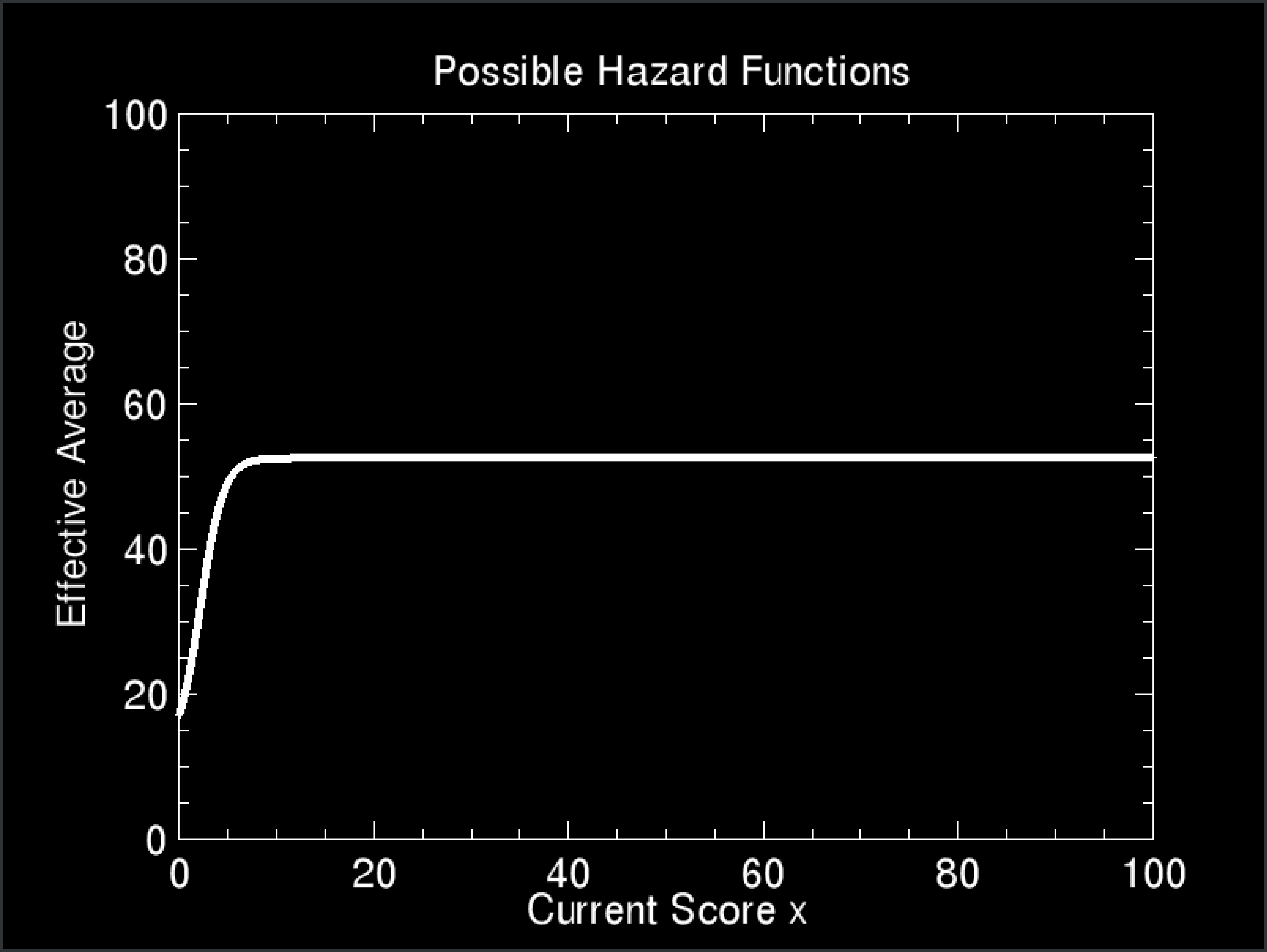
- Geometric distribution => constant probability per run of getting out
- We have more information than this
- Hazard function: $H(x) = P(X = x \mid X \geq x)$
- Infer "effective average" ≈ 1/H as a function of time.


Parameterisation
50
40
30
20
10
0
0
20
40
60
80
100
Effective Average (Ability)
Current Score
μ2
μ1
L
τ



Possible Hazard Functions
100
80
60
40
20
0
Effective Average
0
20
40
60
80
100
Current Score x

Steve Waugh


Possible Hazard Functions
Effective Average
Current Score x
0
20
40
60
80
100
0
20
40
60
80
100

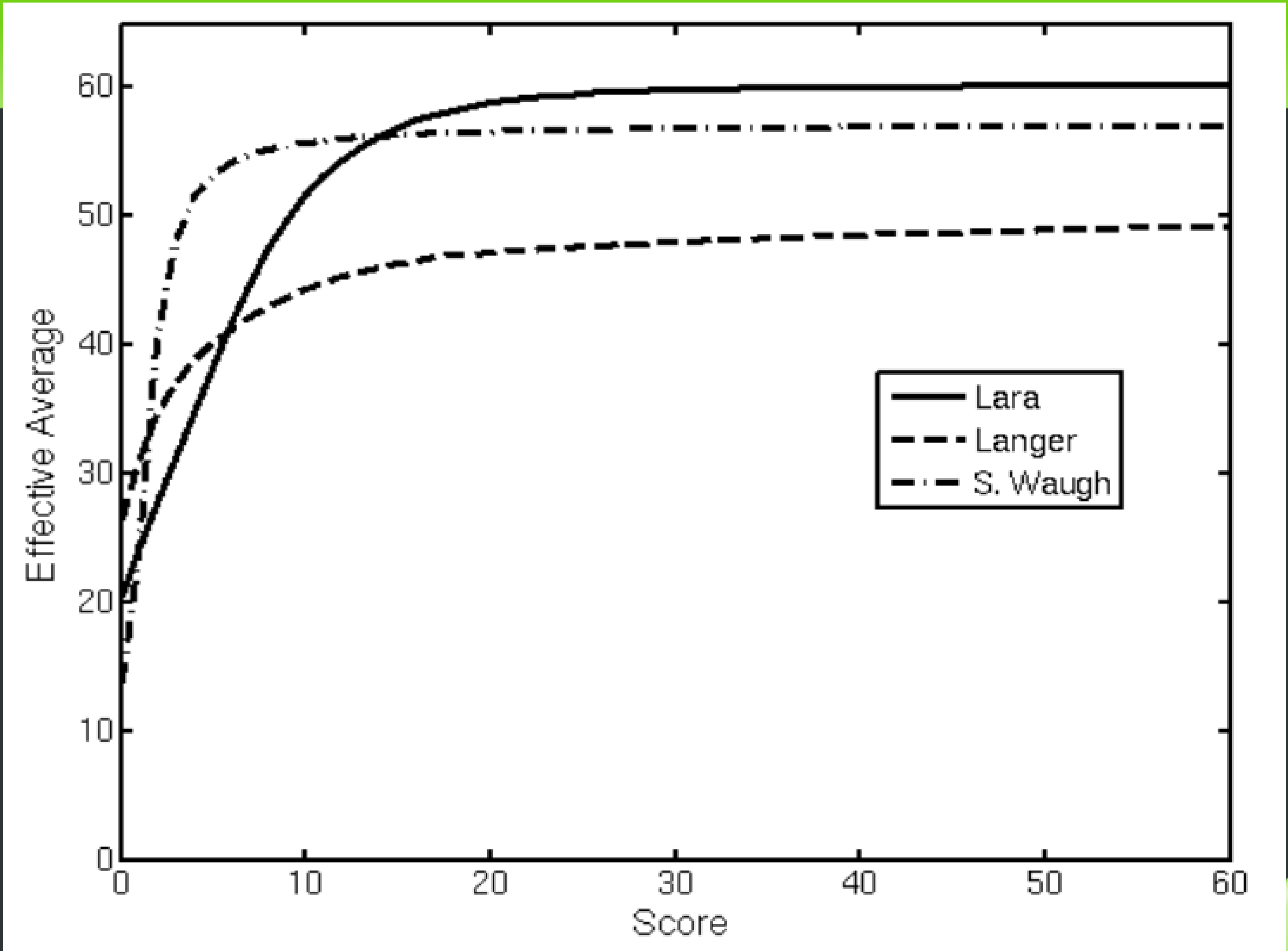
I know you're not meant to do this in talks...

Table 1: Summaries for the sample of players.

Player	μ_1	μ_2	τ	L
Cairns	26.9 ± 9.2	36.7 ± 5.5	14.5 ± 17.7	3.1 ± 3.0
Hussain	15.6 ± 9.1	42.1 ± 4.4	5.2 ± 7.1	2.2 ± 1.0
Kirsten	16.6 ± 9.3	54.1 ± 5.7	7.3 ± 5.5	2.9 ± 2.4
Lara	14.5 ± 8.3	60.2 ± 4.7	5.1 ± 2.9	2.8 ± 1.8
Langer	24.3 ± 11.5	49.6 ± 4.9	8.9 ± 14.3	2.8 ± 2.9
Pollock	22.1 ± 7.7	38.9 ± 5.4	9.7 ± 9.3	3.1 ± 2.9
Warne	3.5 ± 2.0	21.1 ± 2.0	1.1 ± 0.6	0.5 ± 0.4
Waugh	10.5 ± 5.5	57.3 ± 4.4	1.8 ± 1.6	0.8 ± 1.2
Prior	32.9 ± 17.4	32.9 ± 17.4	20.0 ± 20.0	3.0 ± 3.0

Predictive Distribution

- $p(x_{N+1} \mid \{x_1, x_2, ..., x_N\}) = \int p(\mu, x_{N+1} | \{x_1, x_2, ..., x_N\}) d\mu$
- In words: each possible value for the parameters produces a probability distribution for the next data point.
- Our knowledge about the next data point is the average of all of these distributions, averaged over the posterior distribution for the parameters.



Effective Average
Score
0
10
20
30
40
50
60
Lara
Langer
S. Waugh

A Citation :-)

- David Barry's cricket stats blog
- Used a pooled data set
- Found that most players have a large jump between 0 and 1, then a gradual rise. My parametrisation must compromise.
- Allrounders appear to be an exception – in agreement with my results
- http://pappubahry.blogspot.com/2008/04/getting-your-eye-in.html

Conclusions

- It is straightforward to put error bars on batting averages using Bayesian Inference (and avoiding conventional statistics)
- Allrounders seem to get their eye in quicker than specialist batsmen
- Questions?