Beyond Easy Averages:
Improved Performance Metrics in Limited Overs Cricket

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The Ubiquitous Statistic

Averages are:

- Simple and easy to calculate
- Familiar and (generally) interpretable

But, they rely heavily on:

- Comparability and
- “Equi-relevance” of each component

In Limited Overs Cricket

Batsmen assessed via:

- Batting average (runs per dismissal)
- Strike rate (runs per delivery)

Bowlers assessed via:

- Bowling average (runs per dismissal)
- Economy rate (runs per over)

In Limited Overs Cricket

Batsmen assessed via:

- Batting average (runs per dismissal)
- Strike rate (runs per delivery)

Bowlers assessed via:

- Bowling average (runs per dismissal)
- Economy rate (runs per over)

No ***CONTEXT*** to components of averages!

i.e., not equi-relevant

“Resource”-based Approach

- “Under what circumstances” as important as “How many”
- Measure output against available resources
  - Utilisation = runs scored per resources consumed
- How to measure resources?
  - The D/L/S Formula

ASIDE: The D/L/S Formula

- *Duckworth-Lewis-Stern Method*

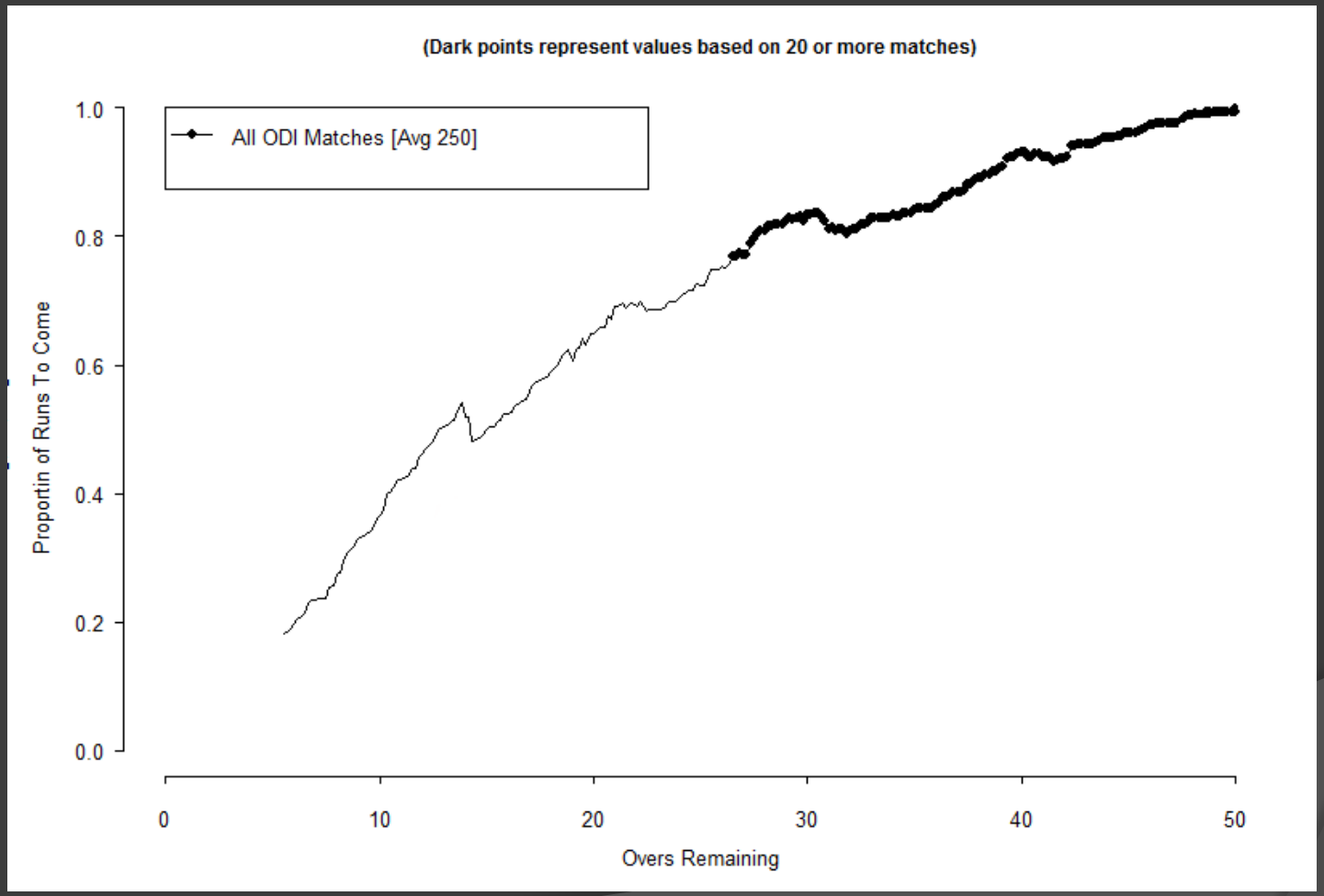
  Resources available with u overs remaining and w wickets down:

$$R(u, w, \lambda) = F_w \lambda^{n_w - n_0} \frac{\left(1 - e^{-bug(u,\lambda)/F_w \lambda^{n_w}}\right)}{\left(1 - e^{-50b/\lambda^{n_0}}\right)}$$

  - F_w's and n_w's estimated (proprietary) parameters
  - λ = "match factor" [$\lambda^{n_0}\left(1 - e^{-50b/\lambda^{n_0}}\right)$ = first innings total score]
  - $g(u,\lambda)$ is DLS "differential straightening" adjustment.

ASIDE: The D/L/S Formula

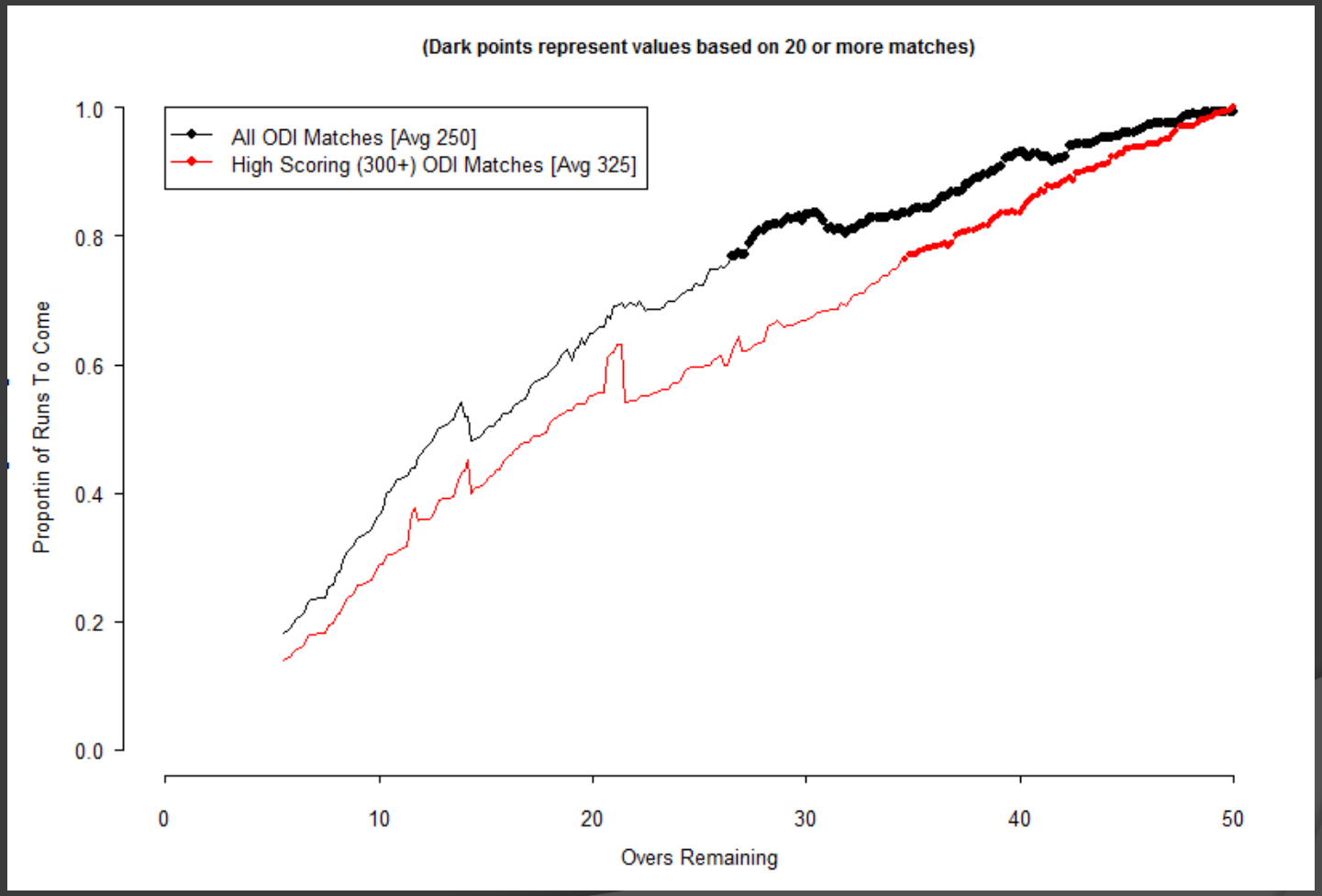
The “D/L” methodology models “standard” accelerations



[NOTE: Focus on 0 wickets down, for clarity]

ASIDE: The D/L/S Formula

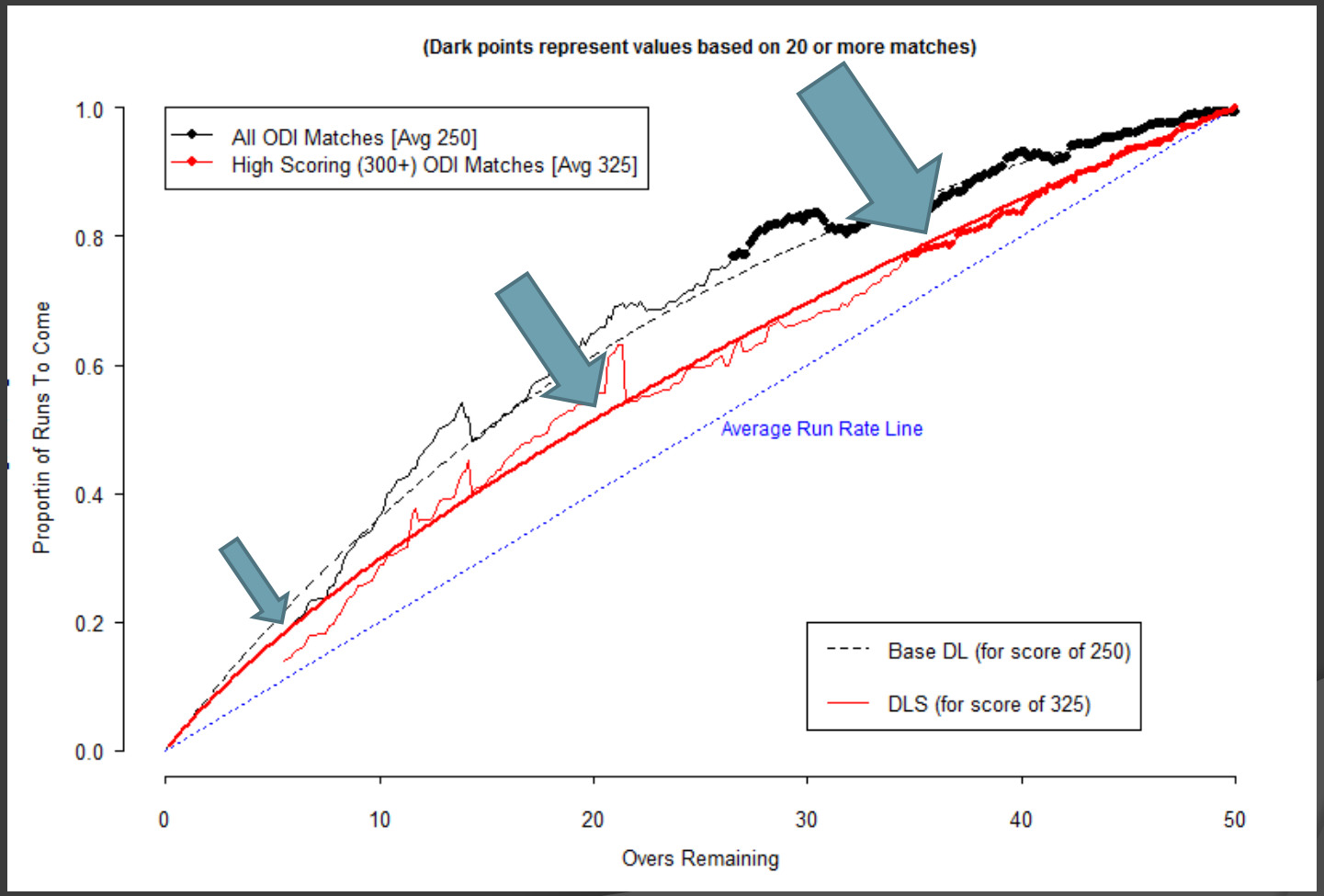
The “/S” component models “straightening” in high scores



[NOTE: Focus on 0 wickets down, for clarity]

ASIDE: The D/L/S Formula

NOTE: “Straightening” in high scores is “differential”



[NOTE: Focus on 0 wickets down, for clarity]

Individual Performances

- Assess individual's utilisation rate relative to other players in the match:
  - Net Runs Attributable:
    - Batsman i:

$$NRA_i = \sum_{k \in K_i} (\sigma_k - U_i \rho_k)$$

      - K_i = set of indices of balls faced by batsman i
      - σ_k = score (off the bat) on ball k
      - ρ_k = D/L/S resources associated with ball k
      - U_i = utilisation rate of all other batsmen $= \frac{S_1 + S_2 - s_i}{R_1 + R_2 - r_i}$

Individual Performances

- Assess individual's utilisation rate relative to other players in the match:
  - Net Runs Attributable:
    - Bowler j:

$$NRA_j = \sum_{k \in L_j} \left(V_j \rho_k - \sigma_k \right) + X_j r_j - w_j$$

      - L_j = set of indices of balls delivered by bowler j
      - X_j = extras rate for all other bowlers $= \frac{W_1 + W_2 - w_j}{R_1 + R_2 - r_j}$
      - V_j = utilisation rate of all other bowlers $= \frac{S_1 + S_2 - s_j}{R_1 + R_2 - r_j}$

Individual Performances

- Individual NRA's now “equi-relevant”.

Almost!

Individual Performances

- $aNRA$ – Adjust for performance levels of opponents faced
  - For Batsmen:

$$aNRA_i = NRA_i + \alpha \sum_{j \in J_i} \sum_{k \in K_i \cap L_j} NRA_j (\rho_k / r_j)$$

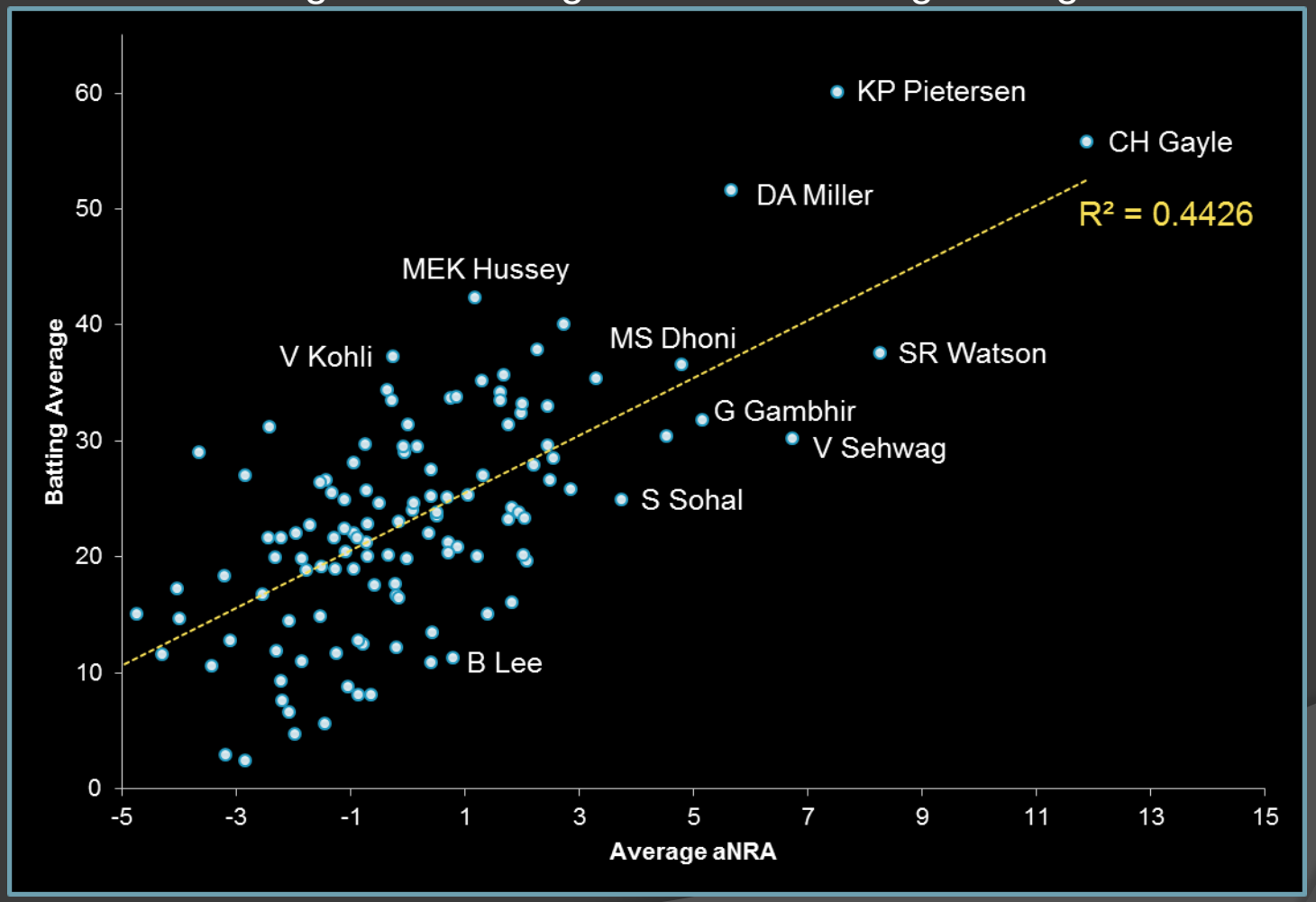
    - α = "tuning" factor (currently set at 0.1)
    - J_i = set of indices of bowlers faced by batsman i
  - Similarly for Bowlers

Indian Premier League (IPL)

- During 2010 to 2013 seasons:
  - 286 Matches scheduled (282 completed)
  - 328 Players participated
  - 125 Batsmen with at least 10 contributions
  - 106 Bowlers with at least 10 contributions
- Player salaries set periodically at auction
  - Are 2014 salaries commensurate with past performance? With 2014 performance?

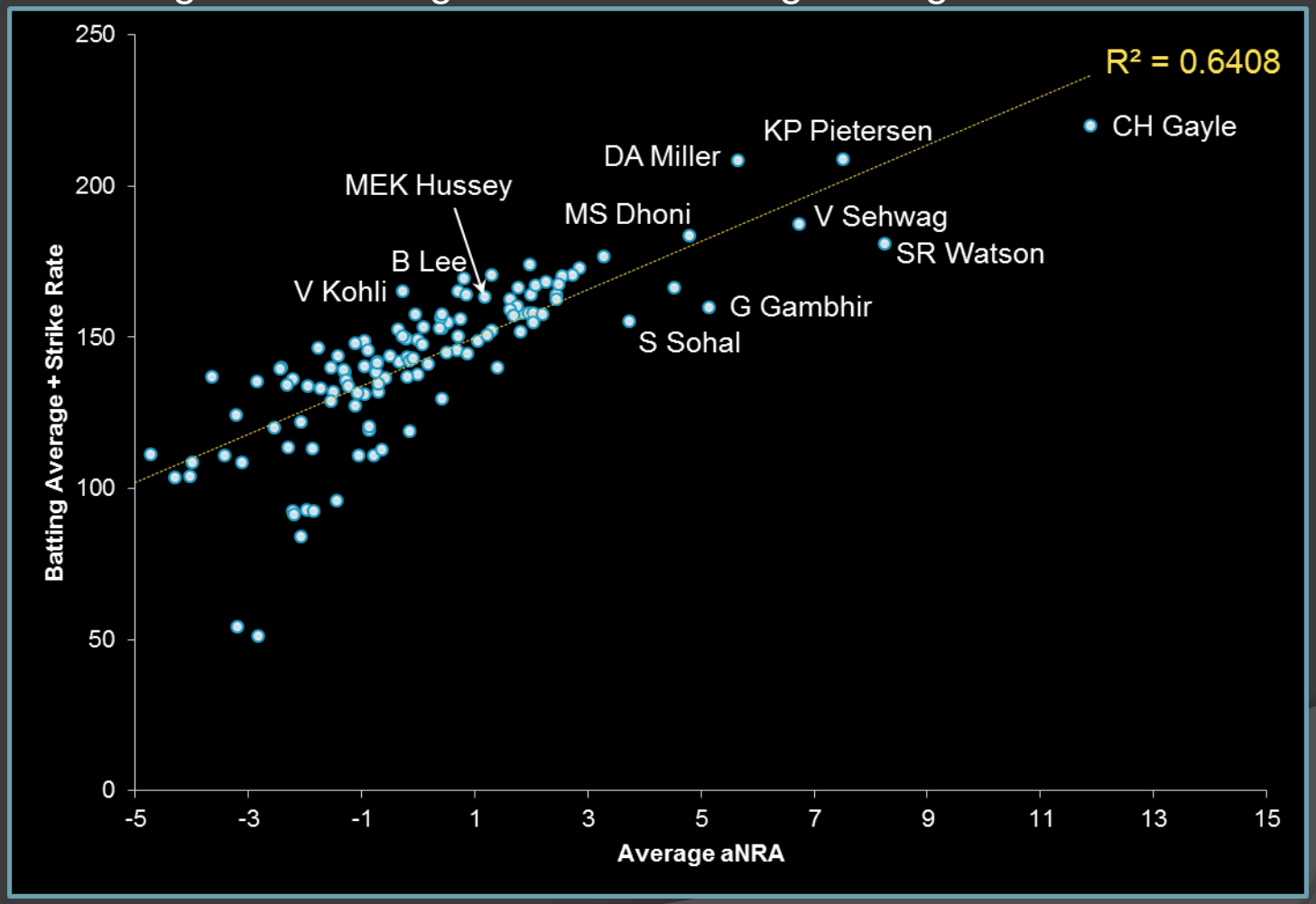
Rating Batsmen: IPL 2010–3

Figure 1: Average $aNRA$ vs Batting Average



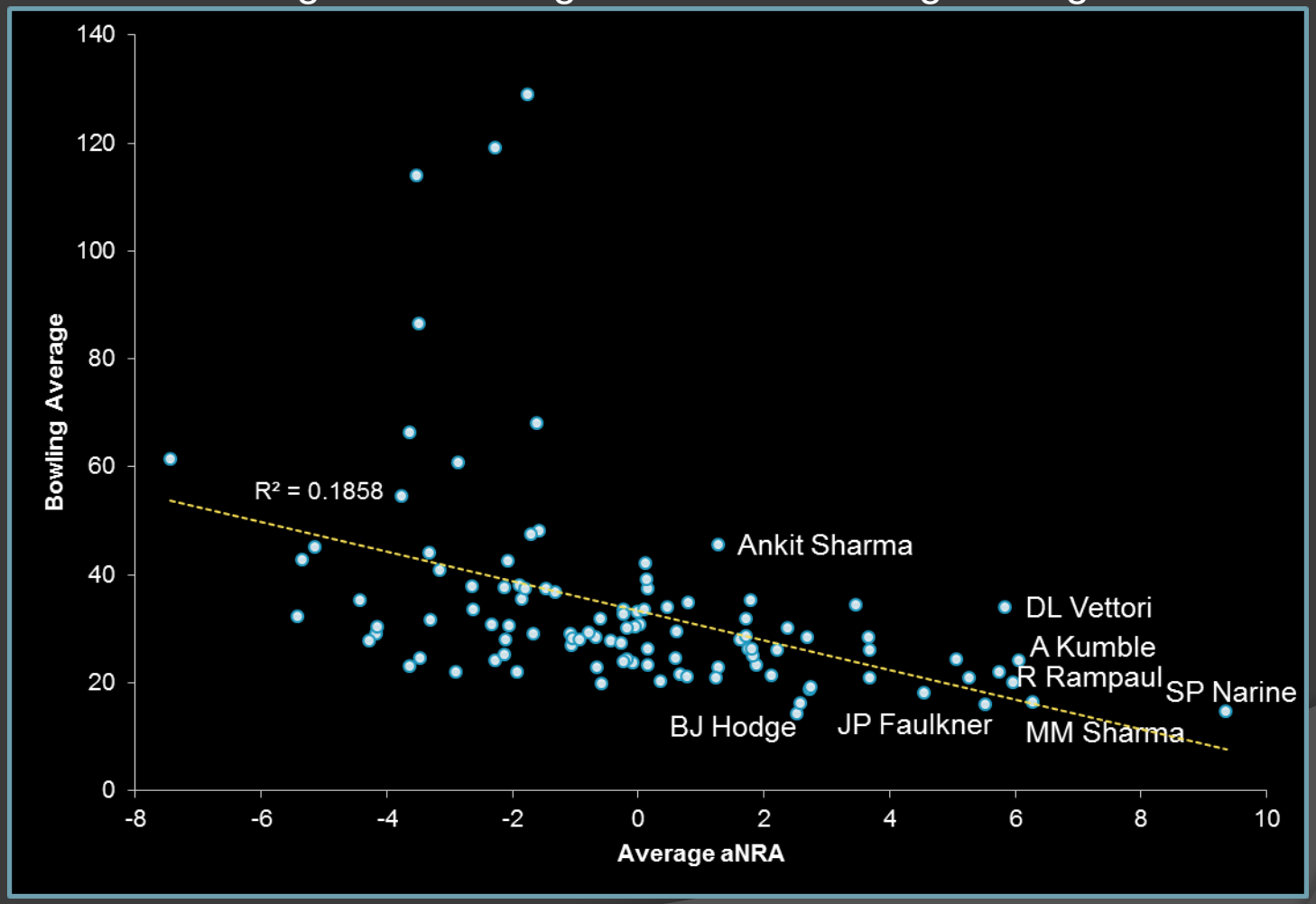
Rating Batsmen: IPL 2010–3

Figure 2: Average $aNRA$ vs Batting Average + Strike Rate



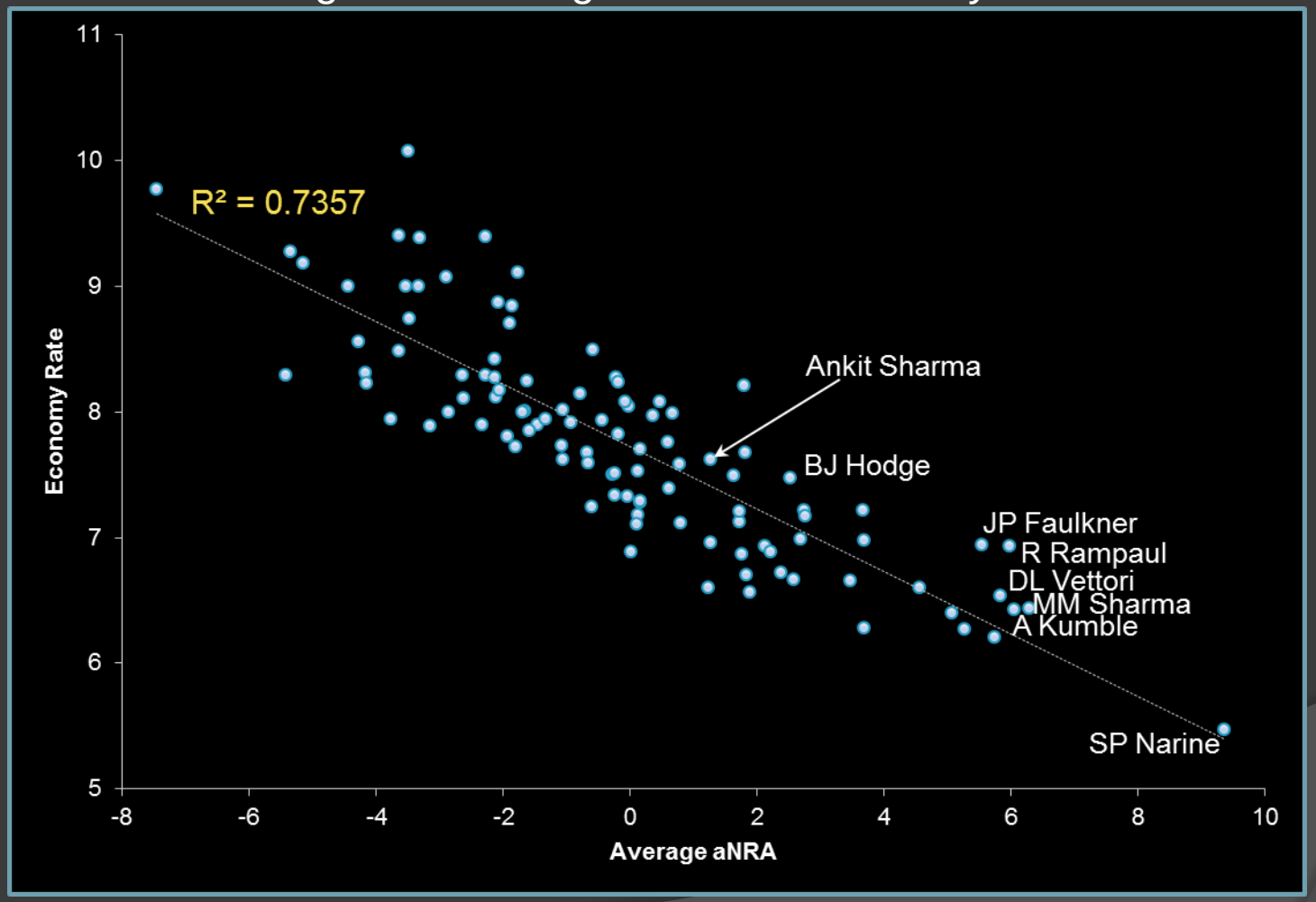
Rating Bowlers: IPL 2010–3

Figure 3: Average $aNRA$ vs Bowling Average



Rating Bowlers: IPL 2010–3

Figure 4: Average $aNRA$ vs Economy Rate



“Expert” Evaluation

- Overall value in single match for individual player:

$$cNRA = aNRA(\text{batting}) + aNRA(\text{bowling})$$

- Breakdown of 282 Man of the Match Awards:
  - 147 (52%) MotM’s = highest $cNRA$
  - 160 (57%) MotM’s = highest $cNRA$ on winning side
  - 227 (80%) MotM’s = $cNRA$ among top 3 in match

“Expert” Evaluation

Case Study #1

Kolkata Knight Riders: 4/180 (20)			Sunrisers Hyderabad: 7/132 (20)		
MS Bisla	28(24) [116.7]		PA Patel	27(31) [87.1]	
G Gambhir	**53(45) [117.8]**		CL White	34(31) [109.7]	
EJG Morgan	47(21) [223.8]		KC Sangakkara	2(3) [66.7]	
JH Kallis	41(27) [151.9]		DB Ravi Teja	10(13) [76.9]	
YK Pathan	3*(3) [100.0]		A Ashish Reddy	4(5) [80.0]	
			NLTC Perera	36(25) [144.0]	
Bowling			GH Vihari	1(2) [50.0]	
KV Sharma	1/13(2) [6.50]		KV Sharma	5*(9) [55.6]	
DW Steyn	0/29(4) [7.25]		A Mishra	1*(1) [100.0]	
A Ashish Reddy	1/15(2) [7.50]				
I Sharma	0/33(4) [8.25]		*Bowling*		
A Mishra	0/28(3) [9.33]		JH Kallis	3/13(4) [3.25]	
NLTC Perera	0/44(4) [11.0]		SMSM Senanayake	1/18(4) [4.50]	
GH Vihari	0/14(1) [14.0]		L Balaji	0/30(4) [7.50]	
			SP Narine	1/31(4) [7.75]	
			R Bhatia	2/33(4) [8.25]	

“Expert” Evaluation

Case Study #1

Kolkata Knight Riders: 4/180 (20)			Sunrisers Hyderabad: 7/132 (20)		
MS Bisla	28(24) [116.7]	0.207	PA Patel	27(31) [87.1]	–9.868
G Gambhir	**53(45) [117.8]**	**1.315**	CL White	34(31) [109.7]	–2.139
EJG Morgan	47(21) [223.8]	21.469	KC Sangakkara	2(3) [66.7]	–3.531
JH Kallis	***41(27) [151.9]***	***7.130***	DB Ravi Teja	10(13) [76.9]	–6.049
YK Pathan	3*(3) [100.0]	–1.262	A Ashish Reddy	4(5) [80.0]	–2.824
			NLTC Perera	36(25) [144.0]	6.531
Bowling			GH Vihari	1(2) [50.0]	–1.747
KV Sharma	1/13(2) [6.50]	3.514	KV Sharma	5*(9) [55.6]	–7.276
DW Steyn	0/29(4) [7.25]	0.256	A Mishra	1*(1) [100.0]	–0.407
A Ashish Reddy	1/15(2) [7.50]	1.075			
I Sharma	0/33(4) [8.25]	–2.683	*Bowling*		
A Mishra	0/28(3) [9.33]	–6.472	***JH Kallis***	***3/13(4) [3.25]***	***22.664***
NLTC Perera	0/44(4) [11.0]	–15.382	SMSM Senanayake	1/18(4) [4.50]	11.205
GH Vihari	0/14(1) [14.0]	–7.772	L Balaji	0/30(4) [7.50]	–3.107
			SP Narine	1/31(4) [7.75]	–1.038
			R Bhatia	2/33(4) [8.25]	–1.458

“Expert” Evaluation

Case Study #2

Mumbai Indians: 2/182 (20)			Kochi Tuskers Kerala: 2/184 (19)		
DJ Jacobs	12(21) [57.1]		DPMD Jayawardene	56(36) [155.6]	
AT Rayudu	53(33) [160.6]		***BB McCullum***	***81(60) [135.0]***	
SR Tendulkar	100*(66) [151.5]		RA Jadeja	25*(11) [227.3]	
			BJ Hodge	11*(7) [157.1]	
Bowling					
RP Singh	0/15(4) [3.75]		*Bowling*		
RA Jadeja	0/29(4) [7.25]		MM Patel	0/15(3) [5.00]	
NLTC Perera	0/38(4) [9.50]		Harbhajan Singh	0/33(4) [8.25]	
RV Gomez	1/29(3) [9.66]		AG Murtaza	0/37(4) [9.25]	
R Vinay Kumar	0/48(4) [12.0]		SL Malinga	2/42(4) [10.5]	
RR Powar	0/12(1) [12.0]		R Sathish	0/11(1) [11.0]	
			KA Pollard	0/43(3) [14.3]	

“Expert” Evaluation

Case Study #2

Mumbai Indians: 2/182 (20)			Kochi Tuskers Kerala: 2/184 (19)		
DJ Jacobs	12(21) [57.1]	–18.675	DPMD Jayawardene	56(36) [155.6]	5.272
AT Rayudu	53(33) [160.6]	3.622	***BB McCullum***	***81(60) [135.0]***	***–2.568***
SR Tendulkar	100*(66) [151.5]	6.756	RA Jadeja	25*(11) [227.3]	7.620
			BJ Hodge	11*(7) [157.1]	–0.635
Bowling					
RP Singh	***0/15(4) [3.75]***	***20.536***	*Bowling*		
RA Jadeja	0/29(4) [7.25]	9.152	MM Patel	0/15(3) [5.00]	11.234
NLTC Perera	0/38(4) [9.50]	–1.511	Harbhajan Singh	0/33(4) [8.25]	3.864
RV Gomez	1/29(3) [9.66]	–1.101	AG Murtaza	0/37(4) [9.25]	–0.531
R Vinay Kumar	0/48(4) [12.0]	–13.062	SL Malinga	2/42(4) [10.5]	–6.661
RR Powar	0/12(1) [12.0]	–2.392	R Sathish	0/11(1) [11.0]	–1.945
			KA Pollard	0/43(3) [14.3]	–17.204

- McCullum’s score high, but (relatively speaking) slow (Tendulkar’s century better except in losing effort)
- Singh’s economy lowest by some way (and his team won narrowly), just took no wickets!

“Expert” Evaluation

Case Study #3

Chennai Super Kings: 8/173 (20)			Mumbai Indians: 8/174 (20)		
F du Plessis	9(11) [81.8]		JEC Franklin	1(9) [11.1]	
M Vijay	41(29) [141.4]		SR Tendulkar	74(44) [168.2]	
SK Raina	36(21) [171.4]		KD Karthik	11(5) [220.0]	
DJ Bravo	40(33) [121.2]		AT Rayudu	0(2) [0.0]	
MS Dhoni	25(15) [166.7]		RG Sharma	60(46) [130.4]	
JA Morkel	3(3) [100.0]		RJ Peterson	0(2) [0.0]	
RA Jadeja	9(6) [150.0]		Harbhajan Singh	0(1) [0.0]	
R Ashwin	0(1) [0.0]		SL Malinga	0(1) [0.0]	
S Badrinath	1*(1) [100.0]		***DR Smith***	***24*(16) [266.7]***	
Bowling			RP Singh	1*(1) [100.0]	
Harbhajan Singh	0/14(3) [4.67]		*Bowling*		
SL Malinga	3/25(4) [6.25]		RA Jadeja	2/12(2) [6.00]	
RP Singh	3/28(4) [7.00]		R Ashwin	1/28(4) [7.00]	
JEC Franklin	1/8(1) [8.00]		BW Hilfenhaus	2/34(4) [8.50]	
RJ Peterson	0/22(2) [11.0]		SB Jakati	0/27(3) [9.00]	
MM Patel	0/46(4) [11.5]		DJ Bravo	2/39(4) [9.75]	
DR Smith	***0/26(2) [13.0]***		JA Morkel	0/34(3) [11.3]	

“Expert” Evaluation

Case Study #3

Chennai Super Kings: 8/173 (20)			Mumbai Indians: 8/174 (20)		
F du Plessis	9(11) [81.8]	–6.173	JEC Franklin	1(9) [11.1]	–14.861
M Vijay	41(29) [141.4]	1.099	***SR Tendulkar***	***74(44) [168.2]***	***19.942***
SK Raina	36(21) [171.4]	8.273	KD Karthik	11(5) [220.0]	3.041
DJ Bravo	40(33) [121.2]	–4.777	AT Rayudu	0(2) [0.0]	–3.454
MS Dhoni	25(15) [166.7]	2.965	RG Sharma	60(46) [130.4]	–1.350
JA Morkel	3(3) [100.0]	–1.873	RJ Peterson	0(2) [0.0]	–3.260
RA Jadeja	9(6) [150.0]	–0.596	Harbhajan Singh	0(1) [0.0]	–1.823
R Ashwin	0(1) [0.0]	–1.697	SL Malinga	0(1) [0.0]	–1.816
S Badrinath	1*(1) [100.0]	–0.646	***DR Smith***	***24*(16) [266.7]***	***10.420***
Bowling			RP Singh	1*(1) [100.0]	–0.453
Harbhajan Singh	0/14(3) [4.67]	9.569	*Bowling*		
SL Malinga	3/25(4) [6.25]	10.719	RA Jadeja	2/12(2) [6.00]	7.497
RP Singh	3/28(4) [7.00]	8.667	R Ashwin	1/28(4) [7.00]	5.905
JEC Franklin	1/8(1) [8.00]	1.860	BW Hilfenhaus	2/34(4) [8.50]	1.860
RJ Peterson	0/22(2) [11.0]	–6.473	SB Jakati	0/27(3) [9.00]	–1.102
MM Patel	0/46(4) [11.5]	–14.759	DJ Bravo	2/39(4) [9.75]	–4.663
DR Smith	***0/26(2) [13.0]***	***–10.223***	JA Morkel	0/34(3) [11.3]	–12.440

- Smith scored 6, 4, 4 from last 3 balls to grab victory!

“Expert” Evaluation

Case Study #4

Mumbai Indians: 5/139 (20)			Chennai Super Kings: 10/79 (15.2)		
SR Tendulkar	15(18) [83.3]		M Vijay	2(4) [50.0]	
DR Smith	22(24) [91.7]		SK Raina	0(1) [0.0]	
KA Pollard	1(3) [33.3]		S Badrinath	0(3) [0.0]	
KD Karthik	23(23) [100.0]		DJ Bravo	9(7) [128.6]	
AT Rayudu	10(11) [90.9]		R Ashwin	2(8) [25.0]	
RG Sharma	39*(30) [130.0]		MEK Hussey	22(26) [84.6]	
Harbhajan Singh	25*(11) [227.3]		MS Dhoni	10(12) [83.3]	
			CH Morris	1(4) [25.0]	
Bowling			MM Sharma	0(3) [0.0]	
CH Morris	0/14(3) [4.67]		RA Jadeja	20(16) [125.0]	
MM Sharma	0/20(4) [5.00]		B Laughlin	4(8) [50.0]	
R Ashwin	1/11(2) [5.50]		*Bowling*		
DJ Bravo	1/19(3) [6.33]		SL Malinga	2/6(3) [2.00]	
RA Jadeja	3/29(4) [7.25]		Harbhajan Singh	1/13(4) [3.25]	
B Laughlin	0/46(4) [11.5]		PP Ojha	3/11(2.2) [4.71]	
			P Suyal	1/21(3) [7.00]	
			MG Johnson	***3/27(3) [9.00]***	

“Expert” Evaluation

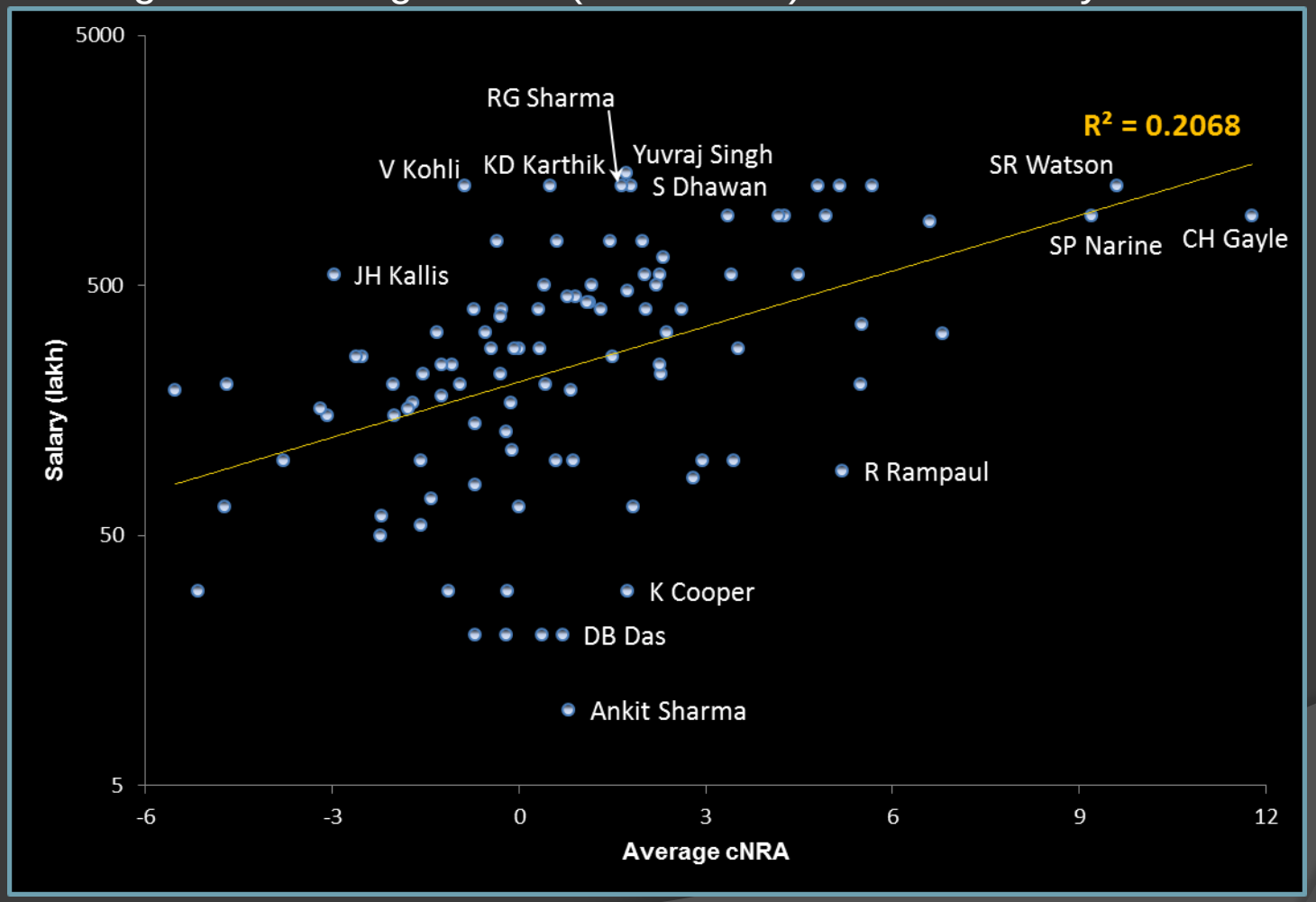
Case Study #4

Mumbai Indians: 5/139 (20)			Chennai Super Kings: 10/79 (15.2)		
SR Tendulkar	15(18) [83.3]	0.721	M Vijay	2(4) [50.0]	-4.291
DR Smith	22(24) [91.7]	3.622	SK Raina	0(1) [0.0]	-5.236
KA Pollard	1(3) [33.3]	-3.919	S Badrinath	0(3) [0.0]	-7.457
KD Karthik	23(23) [100.0]	4.912	DJ Bravo	9(7) [128.6]	-0.949
AT Rayudu	10(11) [90.9]	0.375	R Ashwin	2(8) [25.0]	-8.661
RG Sharma	39*(30) [130.0]	14.396	MEK Hussey	22(26) [84.6]	2.602
Harbhajan Singh	25*(11) [227.3]	15.434	MS Dhoni	10(12) [83.3]	-2.098
			CH Morris	1(4) [25.0]	-10.215
Bowling			MM Sharma	0(3) [0.0]	-11.556
CH Morris	0/14(3) [4.67]	-1.085	RA Jadeja	20(16) [125.0]	10.252
MM Sharma	0/20(4) [5.00]	-2.203	B Laughlin	4(8) [50.0]	3.942
R Ashwin	1/11(2) [5.50]	0.395	*Bowling*		
DJ Bravo	1/19(3) [6.33]	0.265	***SL Malinga***	***2/6(3) [2.00]***	***21.061***
RA Jadeja	3/29(4) [7.25]	-4.424	Harbhajan Singh	1/13(4) [3.25]	4.765
B Laughlin	0/46(4) [11.5]	-26.528	PP Ojha	3/11(2.2) [4.71]	19.104
			P Suyal	1/21(3) [7.00]	-4.656
			MG Johnson	***3/27(3) [9.00]***	***-5.805***

- Johnson’s 3rd cost 20 (game essentially over) and 3 catches dropped!

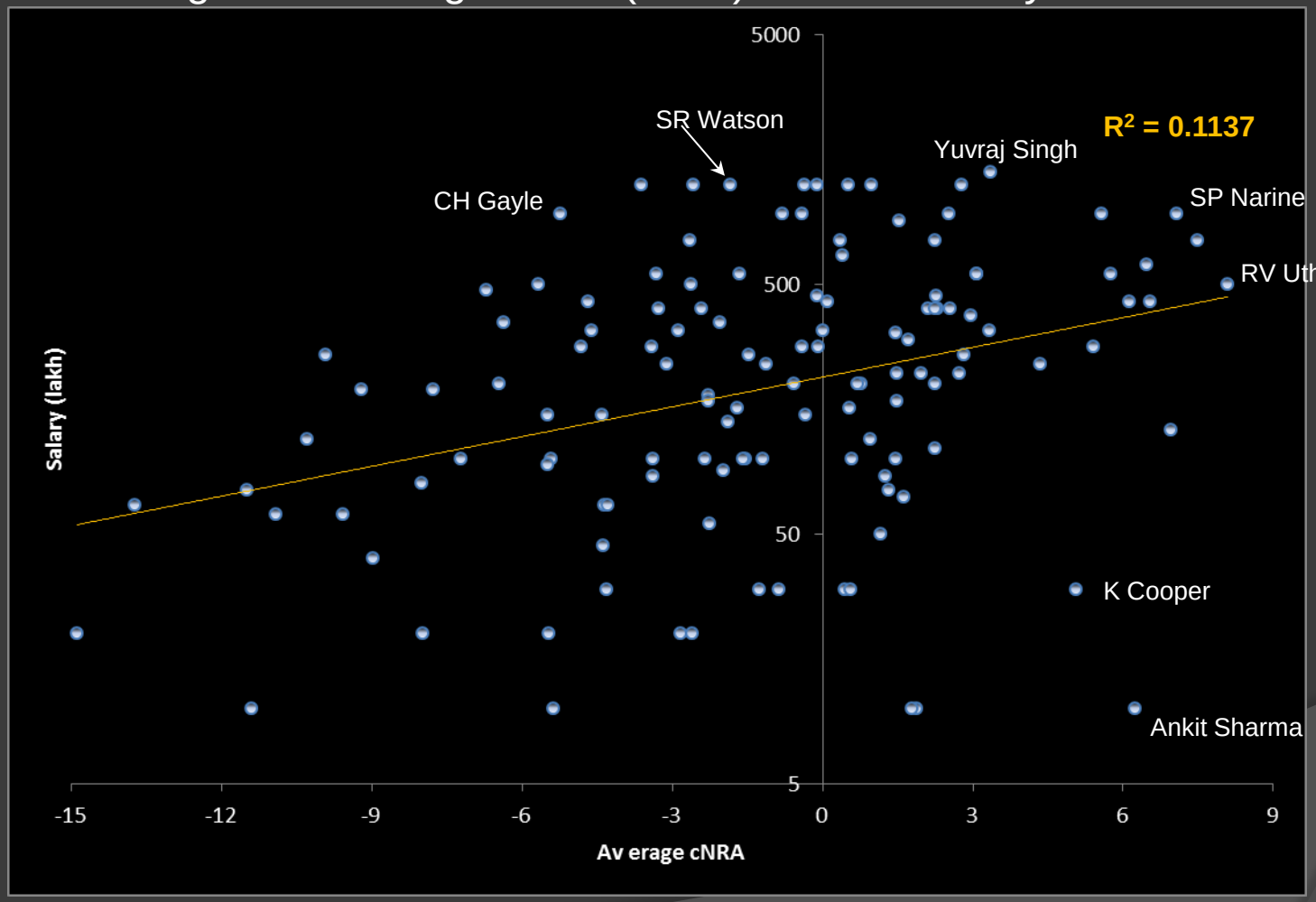
The “Market”

Figure 5: Average $cNRA$ (2010-2013) vs 2014 Salary



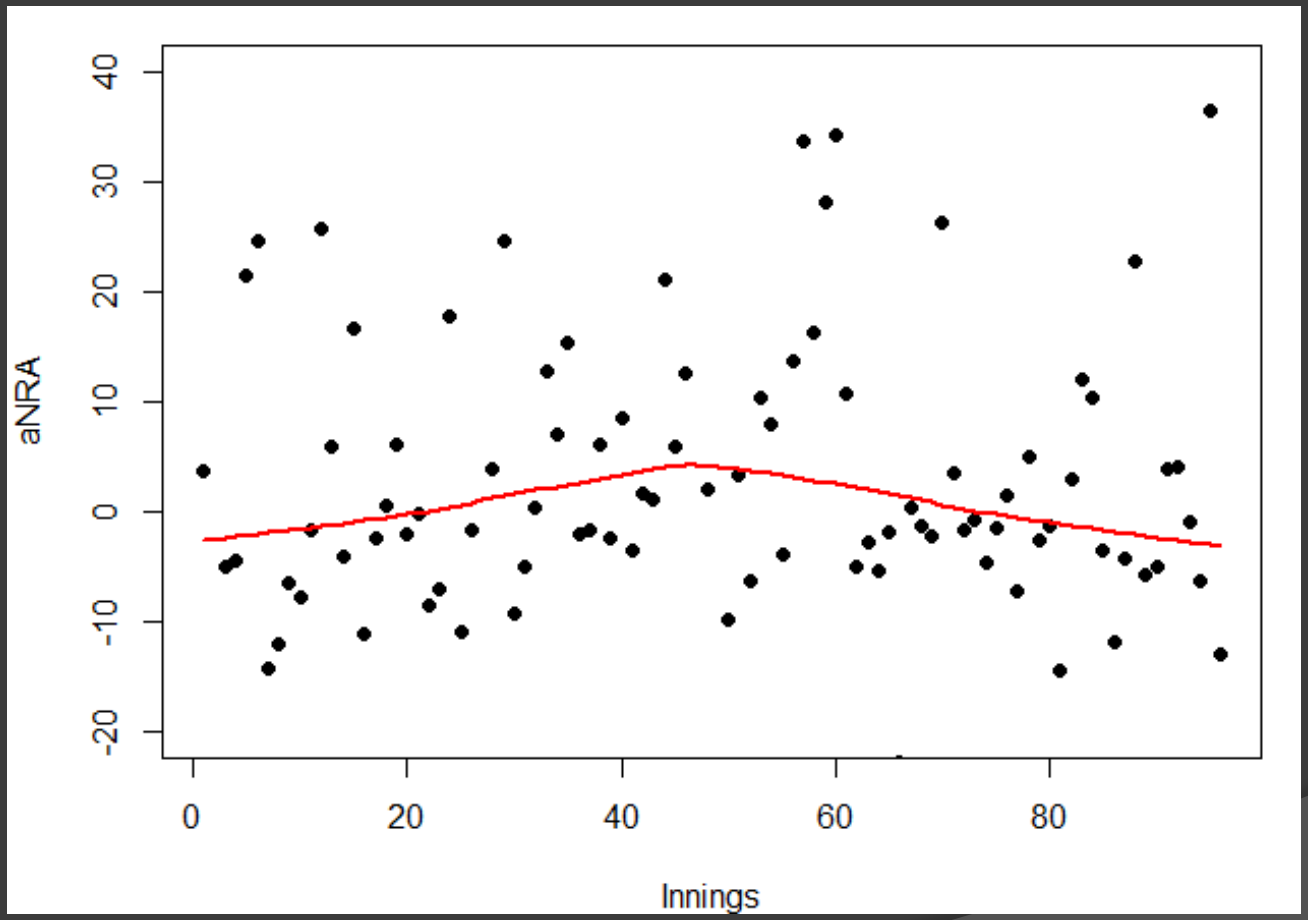
The “Market”

Figure 6: Average $cNRA$ (2014) vs 2014 Salary



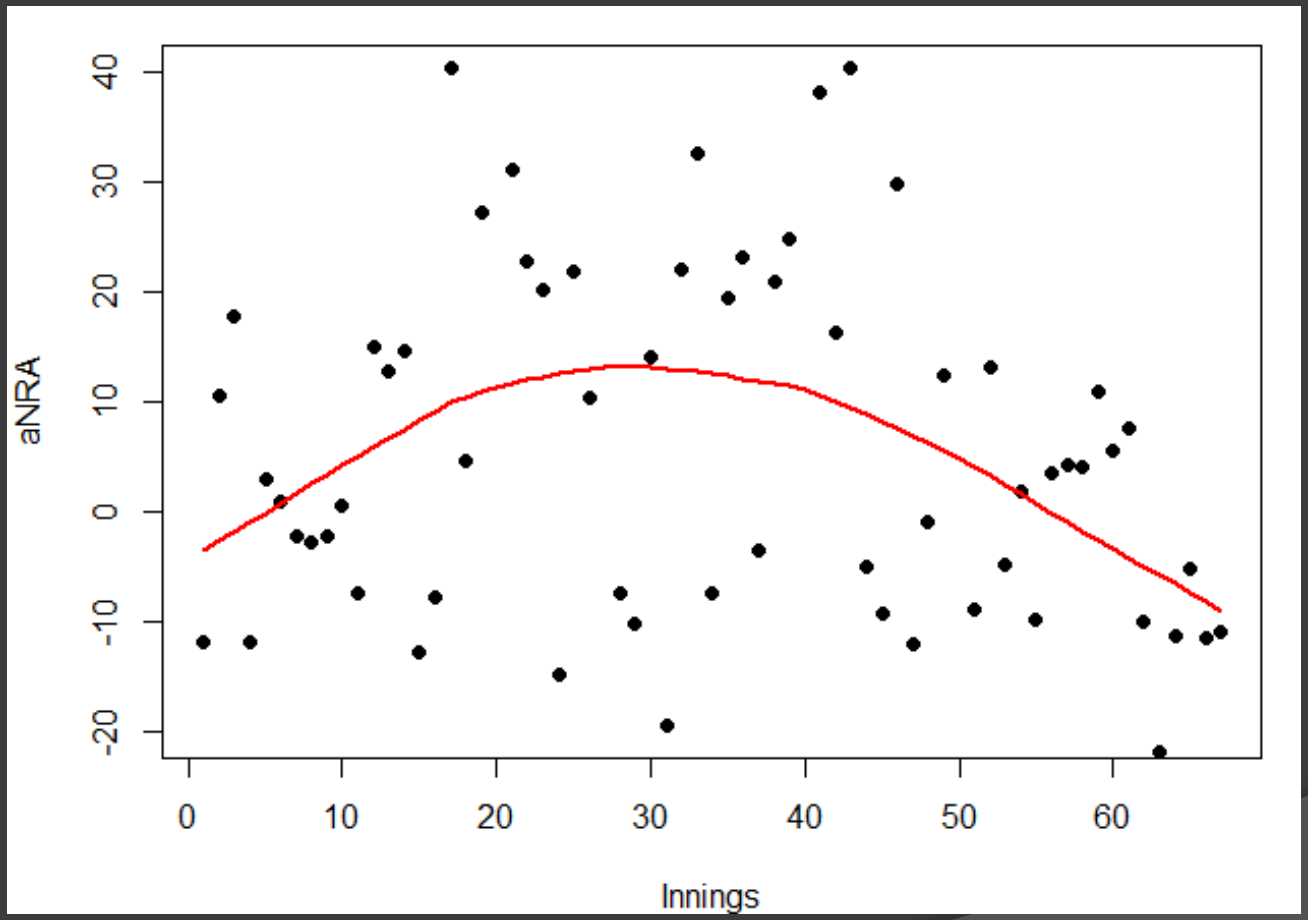
Career Arcs

Figure 7: V Sehwag (2008-2014)



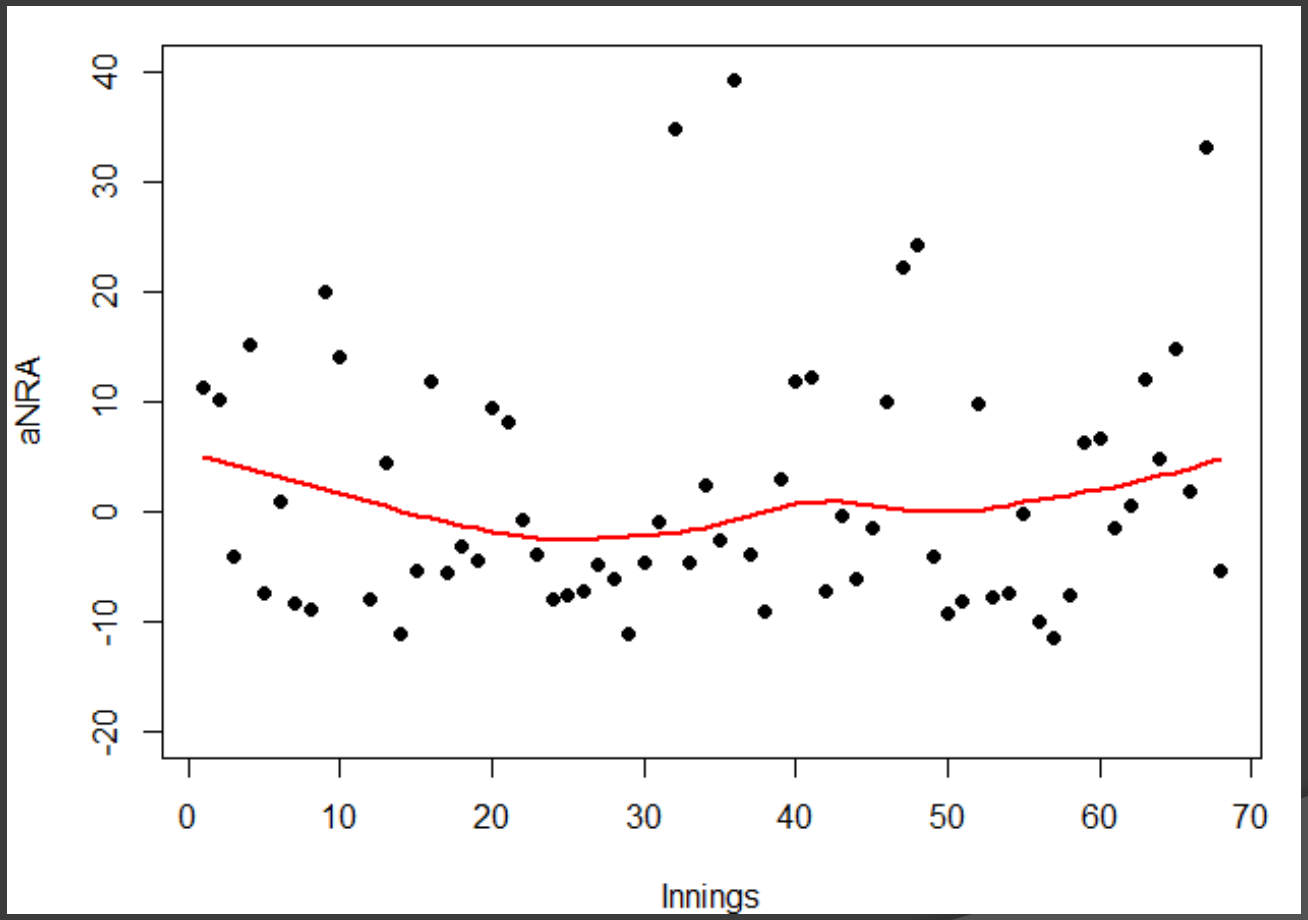
Career Arcs

Figure 8: CH Gayle (2009-2014)



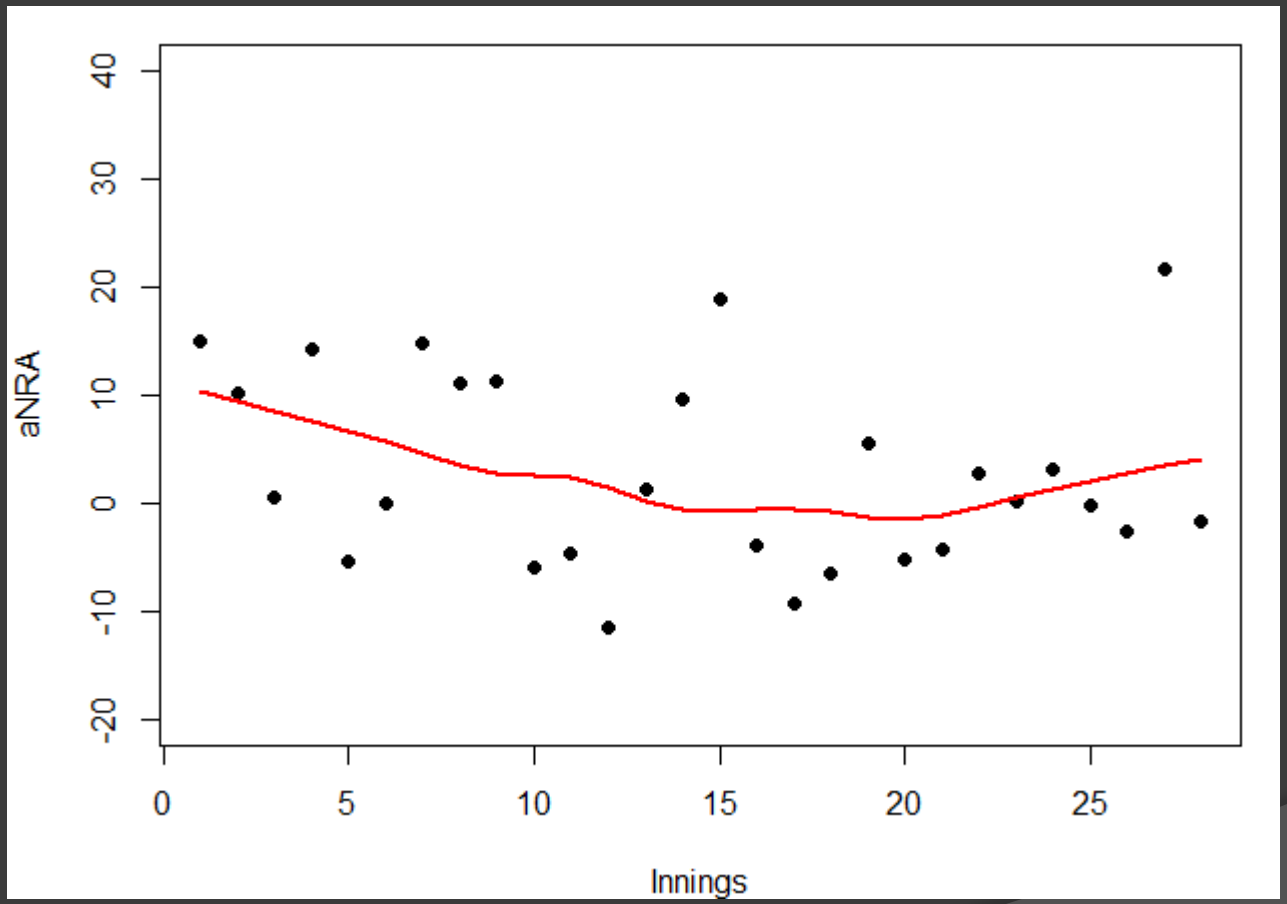
Career Arcs

Figure 10: DA Warner (2009-2014)



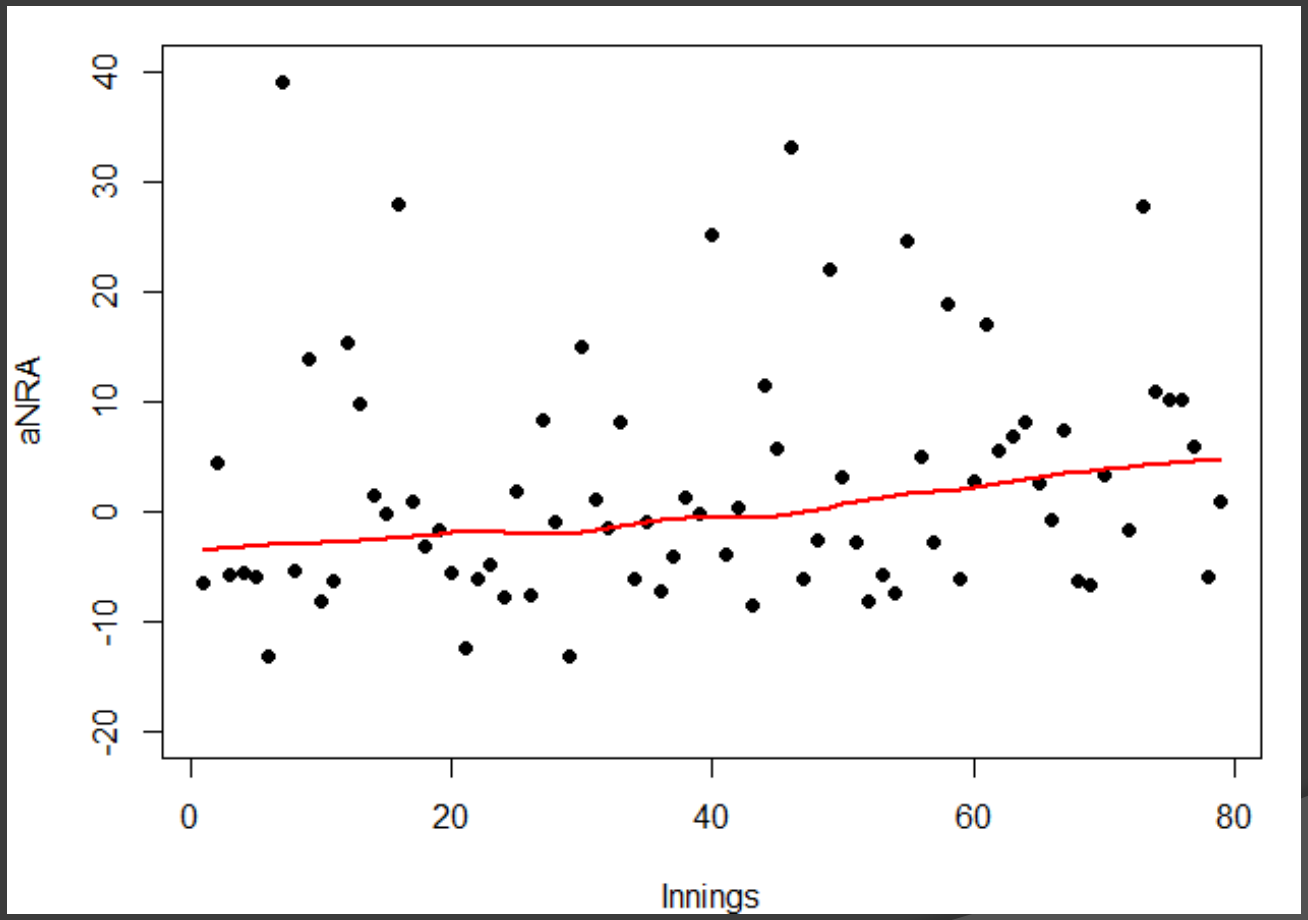
Career Arcs

Figure 11: Steve Smith (2012-2014)



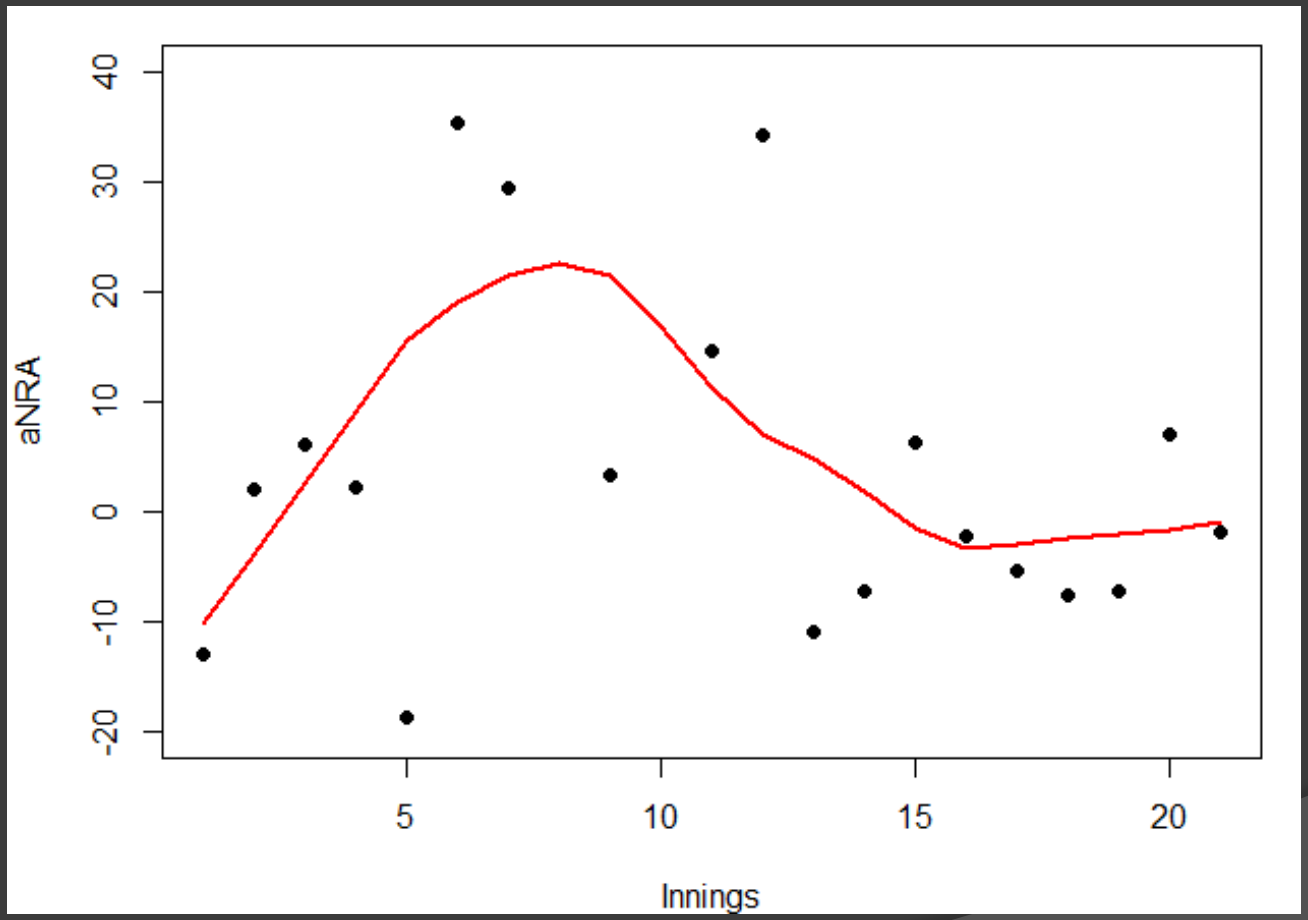
Career Arcs

Figure 12: AB de Villiers (2008-2014)



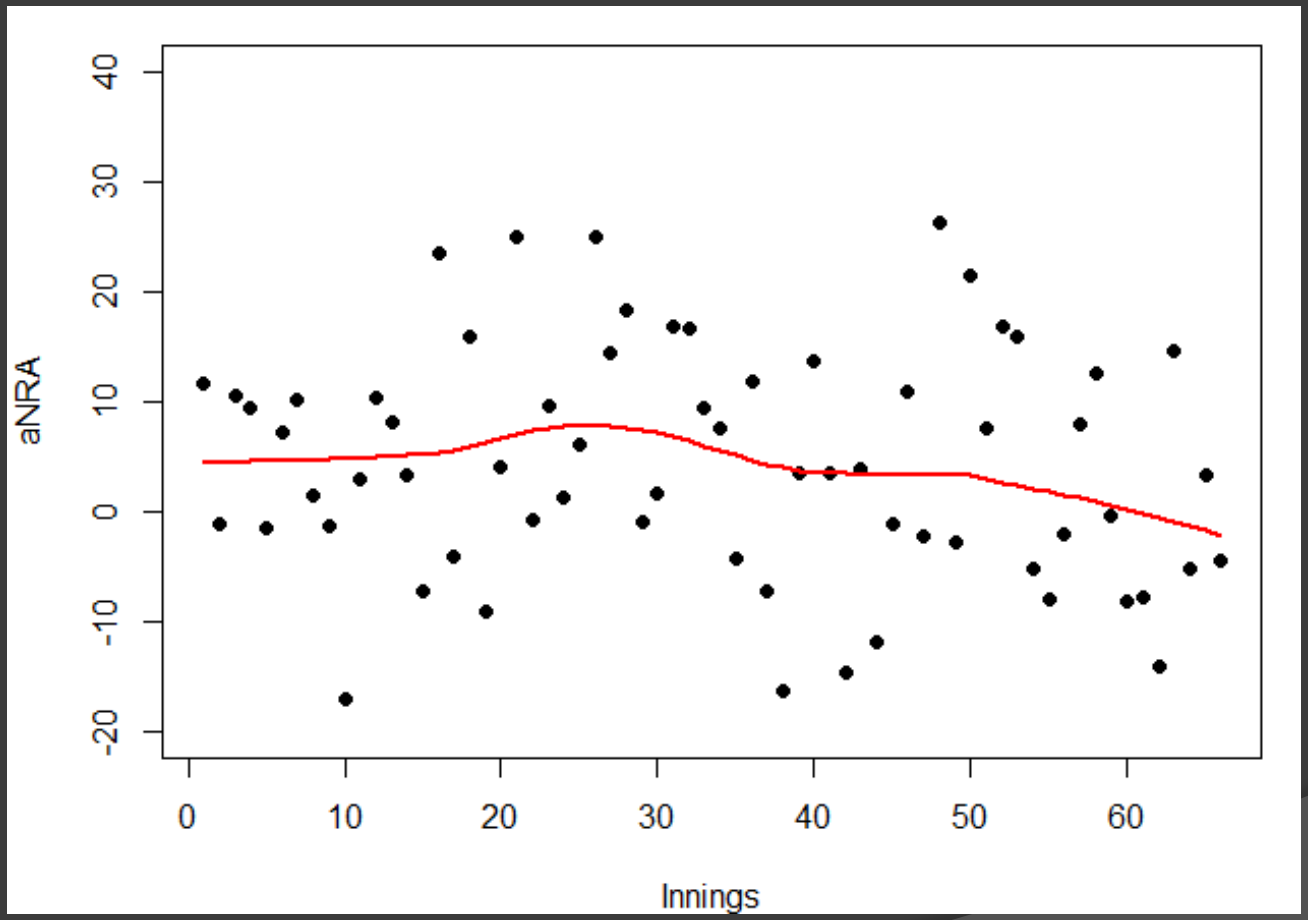
Career Arcs

Figure 13: Glen Maxwell (2012-2014)



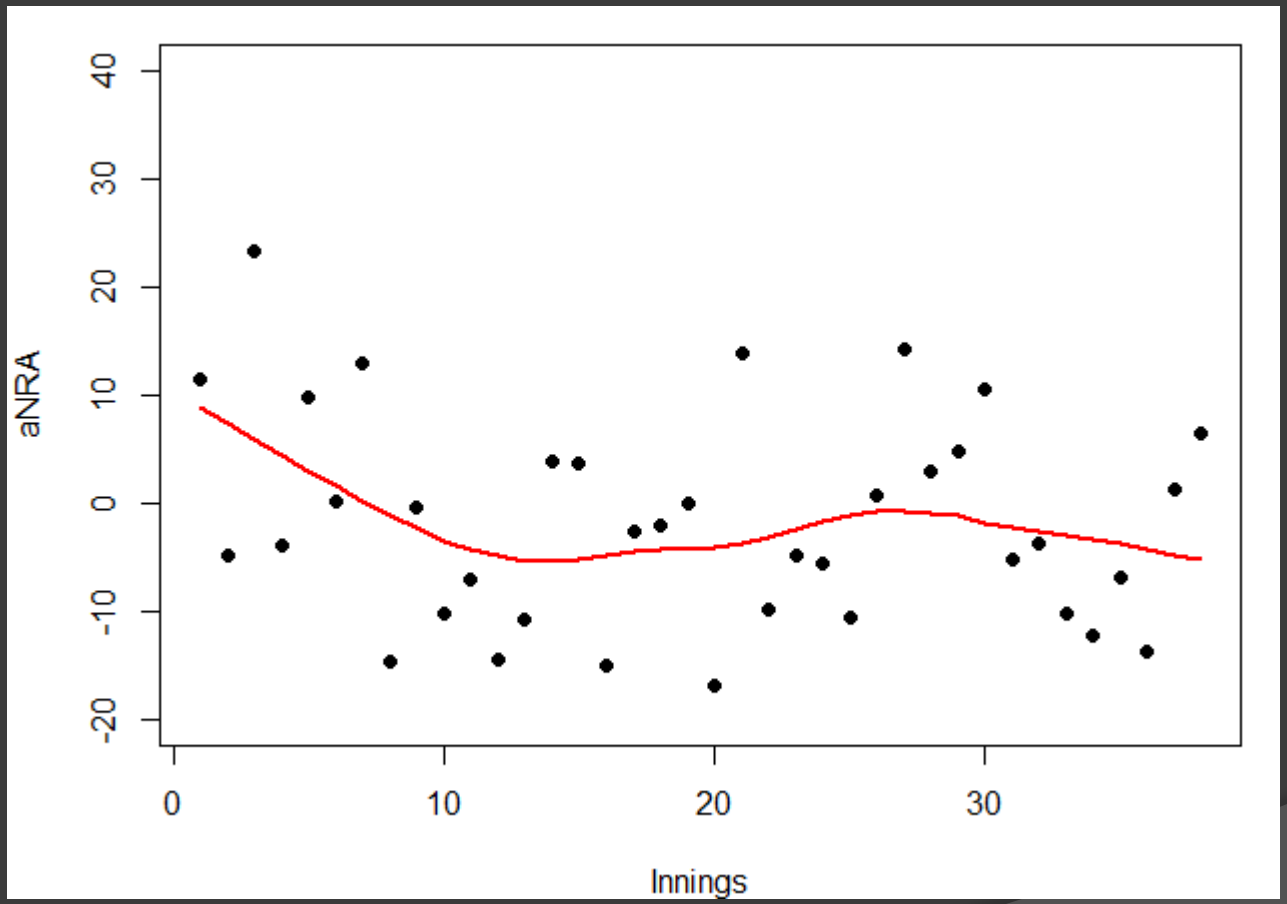
Career Arcs

Figure 14: Murali (2008-2014)



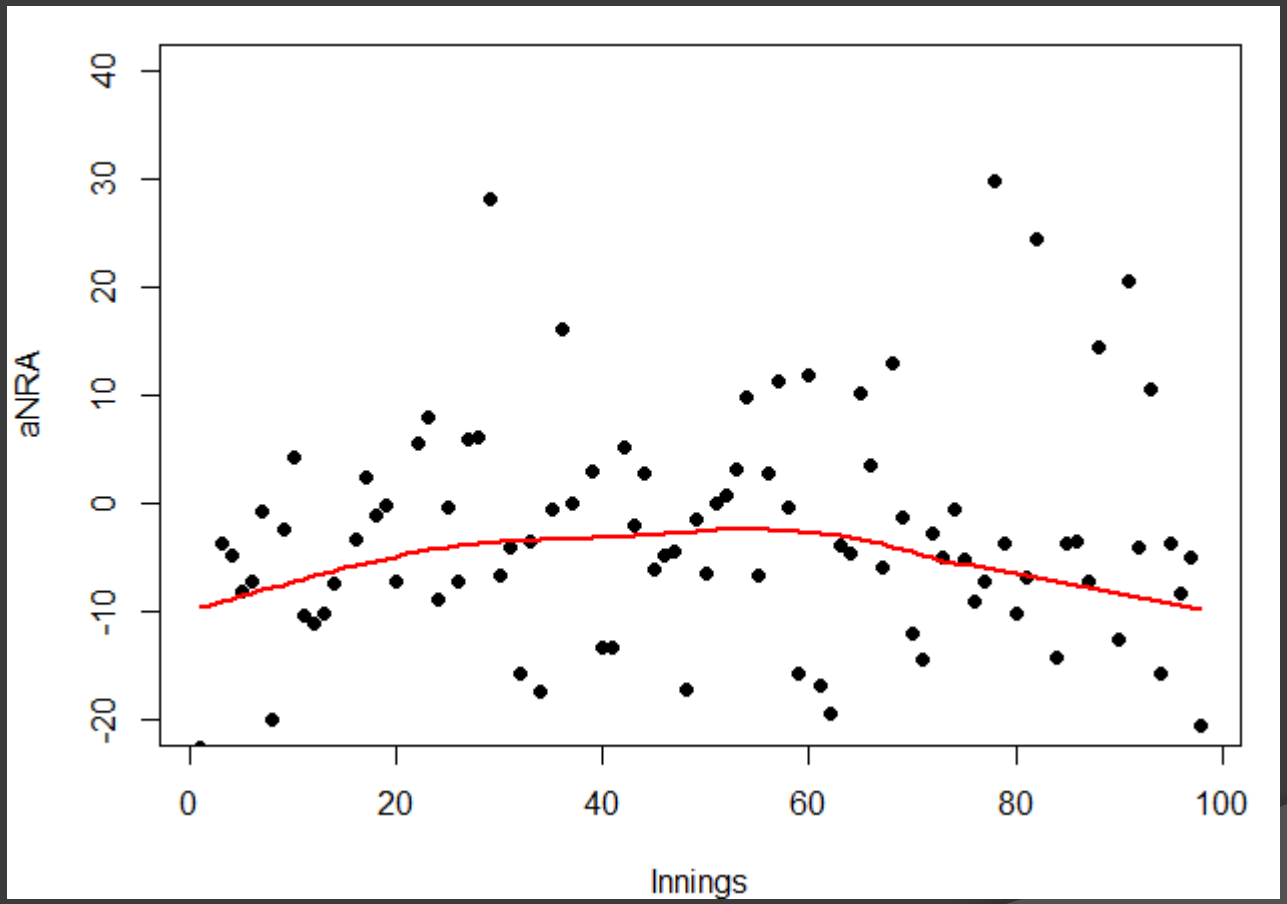
Career Arcs

Figure 15: Brett Lee (2008-2013)



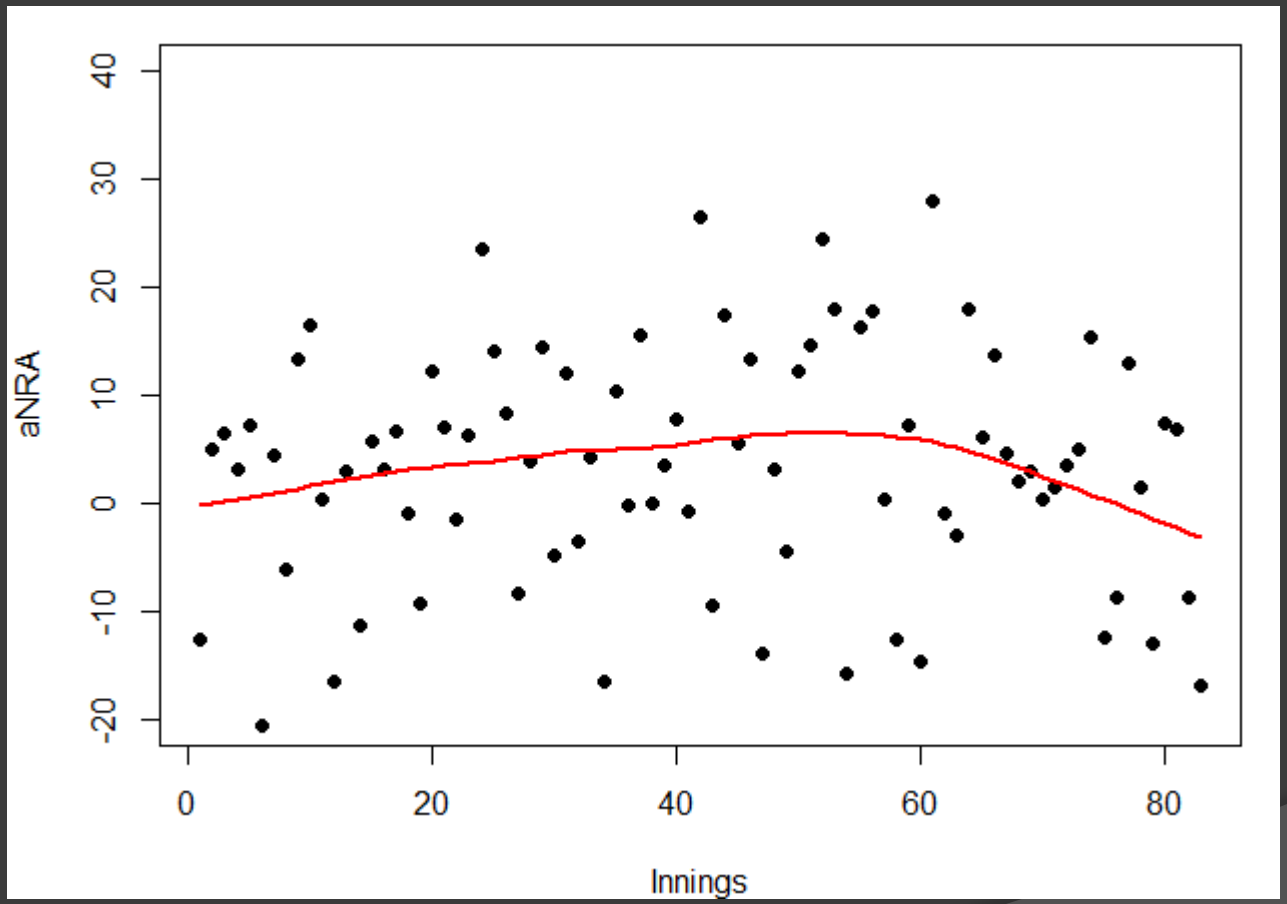
Career Arcs

Figure 16: Jacques Kallis (2008-2014)



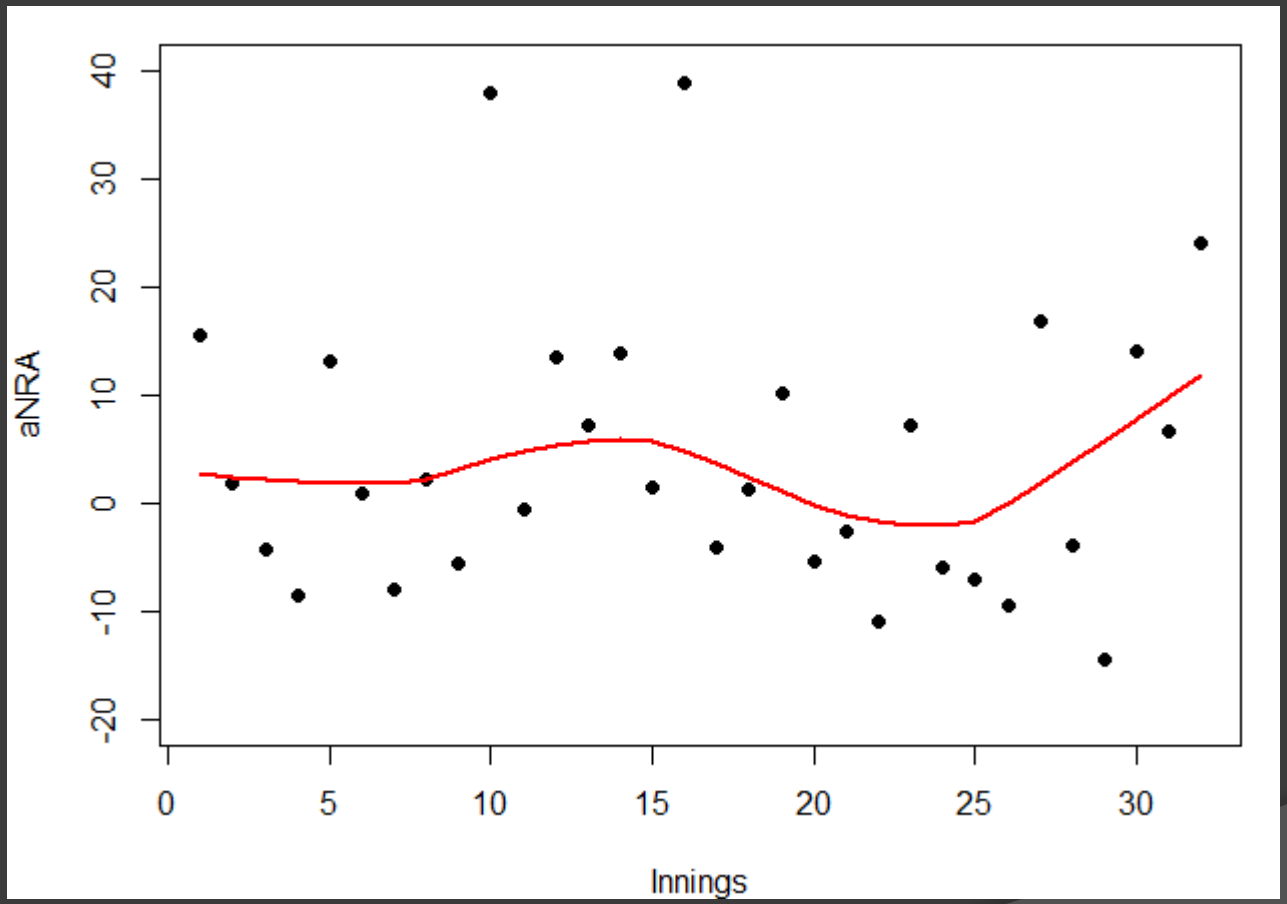
Career Arcs

Figure 17: Dale Steyn (2009-2014)



Career Arcs

Figure 18: Kevin Pietersen (2009-2014)



Conclusions:

- $aNRA$ avoids inflated averages of runs scored in “low pressure” situations (and also the issue of multiple “not out” innings)
- $aNRA$ gives reasonable trade-off between quantity and “quality” of runs (i.e., runs at good utilisation rate)
- $aNRA$ misses “symbiotic” relationships (e.g., “sheet anchor” role and the importance of partnerships) and fielding

Conclusions:

- $aNRA$ may be useful in assessing player "value", but other factors are also relevant
- $aNRA$ may be useful in tracking "career arcs" to project future performance

Extensions:

- BBL Ratings
  - Average vs Aggregate?
    - CHOICE: Aggregate but with downweighting
  - All-rounder Ratings, total vs “balance”
    - CHOICE: Balance – Use harmonic mean of batting and bowling aggregates

Extensions:

- BBL Ratings
  - End of 2014/2015 Season:

Batsmen			Bowlers			All-Rounders		
Rank	Player	Rating	Rank	Player	Rating	Rank	Player	Rating
1	Nic Maddinson	52.71	1	Brad Hogg	56.62	1	John Hastings	21.37
2	Ben Stokes	49.67	2	Brett Lee	52.40	2	Cameron Boyce	15.37
3	Chris Lynn	48.60	3	Jason Behrendorff	45.85	3	Ashton Turner	9.29
4	Tim Ludeman	45.60	4	Gurinder Sandu	42.89	4	Jacques Kallis	8.81
5	Michael Carberry	42.70	5	John Hastings	42.22	5	Ben Laughlin	8.79
6	Ben Cutting	42.64	6	Michael Beer	41.60	6	Xavier Doherty	5.18
7	Jordan Silk	41.59	7	Lasith Malinga	32.42	7	Andre Russell	4.82
8	Aiden Blizzard	41.07	8	Muttiah Muralitharan	32.36	8	Darren Sammy	4.48
9	Shaun Marsh	39.64	9	Shakib Al Hasan	31.83	9	Yasir Arafat	4.14
10	Travis Head	37.06	10	James Hopes	31.51	10	Adam Voges	3.23

Thank You