Original Article

Searching for the Power Law in a historical analysis of Test cricket

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ABSTRACT

Govindarajan, V. (2014). Searching for the Power Law in a historical analysis of Test cricket. *J. Hum. Sport Exerc., 9*(2), pp.629-644. Active research has been going on to observe and validate the Power Law in physics, computer science, economics, linguistics, sociology, geophysics etc. Newton's Law of Gravitation, the Coulomb force equation, Gutenberg-Richter Law for earthquake sizes, Pareto's Law of income distribution (the famed '80-20 Law'), inter alia, are all classic examples of the Power Law. This paper starts off with the hypothesis that the Power Law is applicable to several aspects of the 'system' of Test cricket – distribution of runs scored, matches played, wickets taken, half-centuries and centuries scored, catches pouched, etc., and investigates data accumulated and organised from a single statistical source on the Internet – www.howstat.com – in order to test this hypothesis. It was found out that there is a healthy conformity to the Power Law for almost all the aspects of the game of cricket. The inferences are dependent on the timing of the study. What is inferred in this analysis is not necessarily what has been applicable to the 'system' of Test cricket all along, or what can be assumed to always apply to it in the future. The hypothesis has to be tested dynamically, at regular intervals of time. It can also be extended to several other aspects not considered in this paper, to other versions of this sport – One-day cricket and the Twenty20 matches – as well as to other sports. **Key words**: TEST CRICKET, POWER LAW, RUNS, WICKETS, CATCHES

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INTRODUCTION

Power Law

Active research has been going on to observe and validate the Power Law in physics, computer science, economics, linguistics, sociology, geophysics etc. Newton's Law of Gravitation, the Coulomb force equation, Gutenberg-Richter Law for earthquake sizes, Pareto's Law of income distribution (the famed '80-20 Law'), Horton's Law of river systems, Richardson's Law of severity of violent conflicts, and even Bradford's Law of citations of journal papers, are all classic examples of the Power Law, which can be expressed generally by the following equation:

$$Y = a^* (x^\wedge k) \qquad \text{(Equation 1)}$$

Here 'y' and 'x' are the variables related by the Power Law, 'a', and 'k' are constants.

Research has validated the Power Law type of distribution in the frequency of words in a text, population of cities, the GDP per capita of countries (Guilimi et al., 2003), the hyperlinks from/to websites on the World-wide Web (Shiode & Batty, 2010), *inter alia.* Philip Ball (2004), in his award-winning best-seller Critical Mass, has dwelt on the relevance of the Power Law to manmade and natural systems. There is the phenomenon of isomorphism in General Systems Theory which states that there are common features or properties in systems even if the systems are of rather different natures. The Power Law is one such common feature.

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Philip Ball, in his award-winning best-seller Critical Mass (published in 2004 in the UK), has dwelt on the relevance of the Power Law to manmade and natural systems. Aidt, et al. (2006) detected the Power Law even in the tenure lengths of English football managers for the period 1874-2005. Kühnert, et al. (2006) studied the correlation of electric energy, electric energy delivered to households and length of low-voltage electric cables to population size, in cities in France, UK, Spain, Italy, Germany and the Netherlands, using the logarithmic binning method, and established the prevalence of the power law. The exponents k for the three relationships were respectively 1.1, 1 and 0.9. The paper goes on to state further that such power law distributions can be found for several other quantities like hospitals, car dealers, hospital beds, petrol stations, post offices, restaurants and pharmacies. Lämmer, et al. (2006), which has also been referred to by Kühnert, et al. (2006), in an analysis of urban road networks in 20 cities in Germany, showed that the distribution of vehicular flows over the roads obeys the Power Law, indicating thereby a clear hierarchical order of the roads.

Test cricket

Cricket is not as popular (or as international) a game as soccer (football) is. The author would recommend readers unfamiliar with this sport to refer to *http://en.wikipedia.org/wiki/Cricket* for a good description of the game. While readers from all Commonwealth countries, it can safely be generalised, know the sport well, those outside the Commonwealth and aware of the intricacies and nuances of baseball, will find it easy to understand cricket by referring to the Wikipedia page referred to. As far as international cricketing contests are concerned, one can identify three distinct versions of the game in the order of inception – Test cricket (every contest lasts for 5 days, @ 7 hours everyday), One-day cricket (every contest lasts for about 7 hours and is completed in a single day) and Twenty20 cricket, the latest addition to international cricket, in which a contest lasts for a little under 3 hours. The focus of this paper however, is only on Test cricket, the oldest and longest version of the game.

Test cricket since its inception in the 19th century – 15th March 1877 – at the Melbourne Cricket Ground, when Australia took on England on home soil, has come a long way. At the time of submission of this paper, it is over 130 years old. According to Howstat Computing Services, about 2550 players have represented their respective countries in Test Cricket thus far. Over 1950 Test matches have been played (1957 to be precise as at the end of the Test series between New Zealand and England in New Zealand in the 2009-2010 season). At the time of writing, the Test cricket teams in the fray are Australia, Bangladesh, England, India, Pakistan, Sri Lanka, South Africa, Zimbabwe, West Indies, and New Zealand. Table 1 summarises the entries of the aforesaid national Test cricket teams into the world scene – in other words, recognition by the International Cricket Council as Test-cricket teams (derived from Howstat Computing Services).

Table 1. *Initiations of the national Test cricket teams, and details of their respective first Test matches*

Country/Team	Date	At
Australia	15th March, 1877	Melbourne/Home
England	15th March, 1877	Melbourne/Away
South Africa	12th March, 1889	Port Elizabeth/Home
West Indies	23rd June 1928	London/Away
New Zealand	10th January, 1930	Christchurch/Home
India	25th June 1932	London/Away
Pakistan	16th October 1952	New Delhi/Away
Sri Lanka	17th February 1982	Colombo/Home
Zimbabwe	18th October 1992	Harare/Home
Bangladesh	10th November 2000	Dhaka/Home

This paper starts off with the hypothesis that the Power Law is applicable to several aspects of the 'system' of Test cricket – distribution of runs scored, matches played, wickets taken, half-centuries and centuries scored, catches pouched, etc. Multiple regression is performed in order to verify whether the Power Law relationship is the best way to describe the distributions. A comparison is done with quadratic polynomial and logarithmic relationships.

The author claims that this study is the first of its kind and hence, specific literature references are distinctly lacking. This analysis could possibly show the way for similar analyses in cricket as well as other sports. In the sections that follow, the methodology is explained, the regressions performed and the results reported thereafter. The paper ends with the final inferences, identification of the limitations and recommendations for further analysis.

MATERIAL AND METHODS

The methodology, essentially can be split up into five parts:

1. Data gathering (from Howstat Computing Services)
2. Data organisation into the fields needed for the study (using MS Excel)
3. Data grouping and sorting as required (using MS Excel)
4. Single update (of the records of currently-active Test cricketers) a week before subjecting the data to the tests.
5. Multiple regression of the data fields to test the Power Law and the possibility that the distribution could be better described by other relationships (using MS Excel and the Sigma Plot software).

The data gathering is time-consuming as it basically involves reading and copying record by record from the database - *www.howstat.com*, in alphabetical order. If done at a stretch, this exercise can be completed within a week, and the regression can be done during the next one, thus resulting in a completed analysis within a fortnight or 20 days. However, this was not the case, as far as this paper is concerned. The data compilation was started in mid-2009 and spanned more than a year. Unlike the records of cricketers who have retired from the game at the time of the data compilation exercise, which need not be updated when the data processing is done, the records of current Test cricketers need to be handled with greater care. As the database is revisited just before the regression analyses are carried out, only to update the records of the current players whose names were entered during the initial compilation exercise, there is a distinct risk and possibility that the records of some new players who may have made their debuts in 2009-2010 may have been left out. However, these are relatively fewer in number as compared to the size of the database (in terms of the number of records) and the inevitable omissions can be assumed to have negligible effect on the final inferences. The last updation of the records of the current players was done on the 22nd of May 2010.

The data fields which are identified and considered for this study (in addition of course to the names of the players, which do not play a significant role in the analyses however), are listed in *Table 2.*, along with the class widths considered, and the respective numbers of classes (data-points in the graphs in other words). The class widths are selected randomly. The class width is not equal to the difference between the minima and maxima of the class, but greater than it by one – in other words, the extremities are also included in the class. The final inferences are sensitive to the selection of the class widths which influence the number of data points and thereby the outcome of the regression. A point worth mentioning at this juncture is that even if a cricketer has been active for only a few months in a year, one whole year is added to 'Years Played'. For instance, if a cricketer A starts playing in October 1995 and ends his Test career in March 2007, he is considered to have played for 13 years. Having said that it must also be mentioned that the 'Years played' for currently active players, denotes the number of years they have been active in Test cricket at the time of writing. Some of them may not be playing Test cricket for their respective national teams, but may also not have formally announced their retirement from this version of the game. The value of this field for these cricketers is thus sensitive to the timing of the analysis. Thus, the points for the currently-active Test cricketers who may play more Tests in the future, score more runs, (and 50s and 100s thereby), bowl more deliveries, bag more wickets and take more catches, can be considered as floating points which are bound to move towards the right of the corresponding graphs, over time.

Table 2. *Data fields selected for the regression analyses*

Data field	Number of Tests			Years played	Runs scored			50s scored	100s scored	Wickets taken		Deliveries bowled		Catches pouched	
Class width/s	5	10	20	1	250	500	1000	5	5	50	100	1000	5000	5	10
Number of classes, resp.	34	17	9	32	54	27	14	13	10	16	8	45	9	95	48

Harking back to *Equation 1* introduced in the previous section, for every point on the graph, the 'y', in the context of the aspects of the system of Test cricket, stands for the population of the class, while 'x' , in general, stands for the midpoint value of the class. In the best-fit line equation, for instance, for the number of Tests played, 'y' Test cricketers play 'x' Test matches each. Empty classes – those for which 'y' equals zero – are excluded from the regression. The data in each case (each class-width selection for each field) are regressed for three different trends – power law, quadratic polynomial and logarithmic – and these three are compared with each other on the basis of the R^2 value, which is the chief determinant of the goodness of fit. The equations and the goodness-of-fit (R^2) values are reported and discussed.

RESULTS AND DISCUSSIONS

The equations of the best-fit lines and the corresponding R^2 values are tabulated in Table 3. The discussions appear in the following sub-sections, which have been named after the variables being analysed for conformity (or otherwise) to the Power Law equation. Towards the end, the author has defined 'run-equivalents' of catches and wickets and arrives at one single number for each cricketer which incorporates the aggregate runs scored, the wickets taken and the catches pouched, and tested the Power Law for the same.

Number of Test cricketers

As on the 22nd of May 2010, 2550 individuals have played Test cricket for 10 countries – making that an average of 255 cricketers per Test-playing nation, at a standard deviation of 173. Three of these have represented two countries during their respective careers. The Englishmen who pioneered the game dominate the pack with nearly 25% of these. The Aussies, South Africans and West Indians follow at the second, third and fourth positions respectively, as shown in Figure 1. The Bangladeshis, the most-recent inductees (see Table 1), for obvious reasons, are the last in the list. Of the 2550, between 6-7% are still active – currently members of national Test teams or players who have not yet announced their retirement from the game and are available for selection. If the Test-playing countries are ranked in the decreasing order of the number of Test cricketers who have represented them, and if 'x' corresponds to the rank, and 'y' to the number of Test cricketers, a regression of this x-y plot yields a best-fit logarithmic relationship with an R^2 value of 0.96 (Figure 1). In comparison, the conformity to the Power Law is poorer – an R^2 value of 0.81.

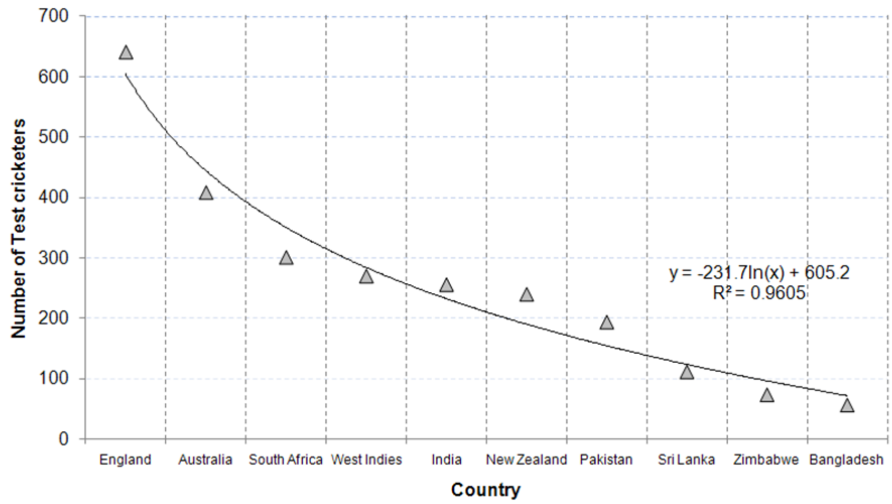

Figure 1. *Best-fit line – Number of Test cricketers who have represented each of the 10 Test-cricket* playing *countries (as on 22nd May 2010)*

Years played

Figure 2 plots the best-fit line for the distribution of Test cricketers according to the number of years each one of them has been active on the international Test cricket scene. It is seen that the best-fit line is of an exponential nature, with an R^2 value of 0.941. The conformity to the Power Law equation in this case is poorer, with the corresponding R^2 value being 0.81.Of the 2550 cricketers, 721 have had careers spanning over only one year, 526 have played Test cricket for 10 or more years, and 32 for two decades or more. On average, a Test cricketer has represented his country for about 5 to 6 years (5.53 is the exact number).

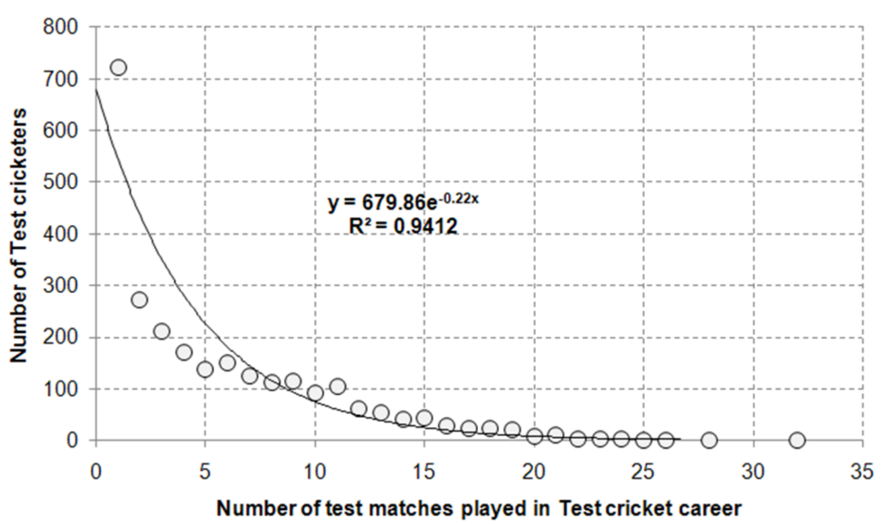

Figure 2. *Best-fit line – Distribution of Test cricketers according to years of Test cricket played (for current cricketers, as in 2010)*

Test matches played

If the cricketers are distributed on the basis of the number of Tests each one has played during his career, an exponential relationship emerges, as indicated in Figure 3 and Figure 4. In Figure 3, the class-width chosen is narrower than that in Figure 4 – 5 Test matches vis-a-vis 10 Test matches. The R^2 values are respectively 0.934 and 0.949. Nearly 57% of the 2550 Test cricketers have played 9 Test matches or less in their careers, while a little less than 2% of them have played 100 or more. On an average, a Test cricketer has played about 17 Tests in his career (16.73 is the exact number). While the best-fit line equations are certainly just close approximations (for the chosen class-widths), by substituting any value for 'x', it is possible to obtain an approximate value for the corresponding number of Test cricketers for the cohort defined by the midpoint value 'x'. For instance, in the equation obtained in Figure 3, if 'x' would be assigned a value 40.5 (defining the class - 38 to 43 Tests), the corresponding value of y is 69.82 (rounded off to 70 cricketers). Verifying back to the database, the correct value is found to be 68. Performing a sample trial with the equation in Figure 4, with 'x' equal to 95.5 (defining the class – 91 to 100 Tests), the corresponding 'y' is 17, while the real value from the database is 13.

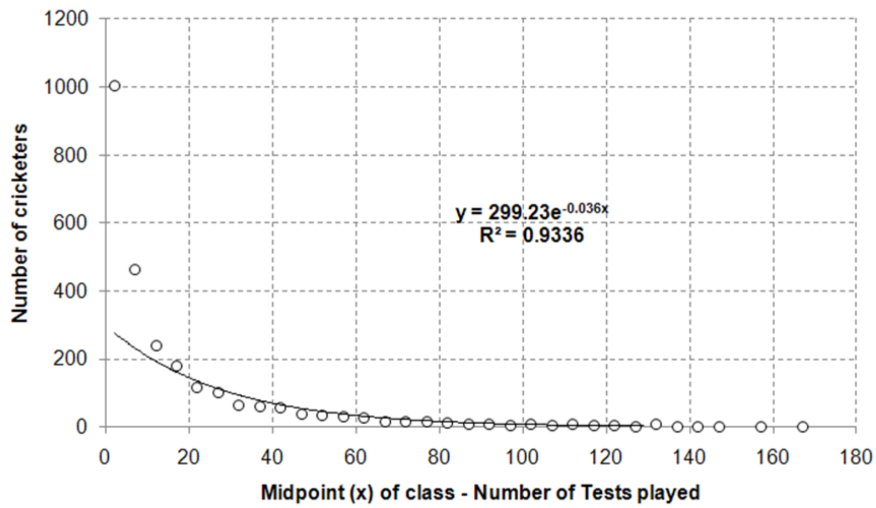

Figure 3. *Best-fit line – Number of Tests played; class-width of 5 Test matches*

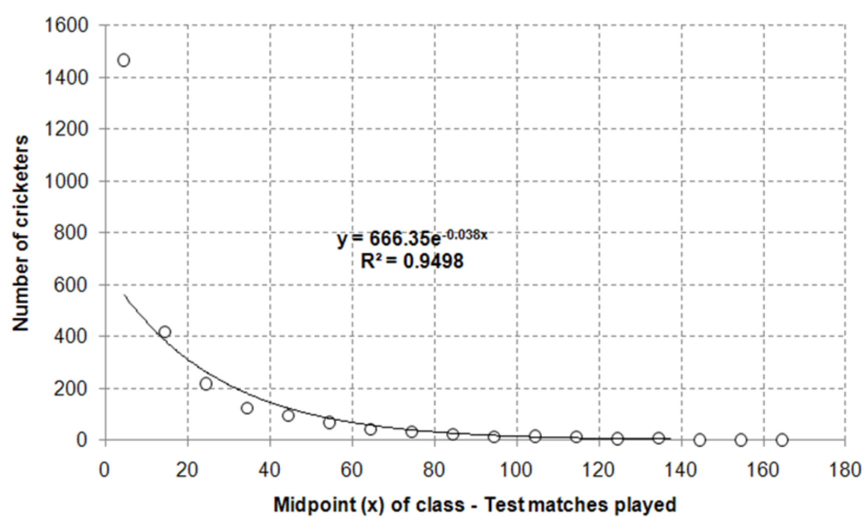

Figure 4. *Best-fit line – Number of Tests played; class-width of 10 Test matches*

Aggregate runs scored

As far as the aggregate runs scored are concerned, as seen in Figures 5, 6 and 7 – tested for class-widths of 250, 500 and 1000 runs respectively, there is a very decent conformity to the Power Law with the R^2 values for all the three tests being greater than 0.91. The 2550 cricketers have scored 1,783,580 runs at an average of 700 runs per head, as things stand on the 22nd of May 2010. The standard deviation of the distribution is about 1446 runs. Also striking in this distribution is the applicability of Pareto's 80-20 principle. If arranged in increasing order of aggregate runs scored, the first 80% (2040 cricketers) together account for 20.3% of the sum total of all aggregates.

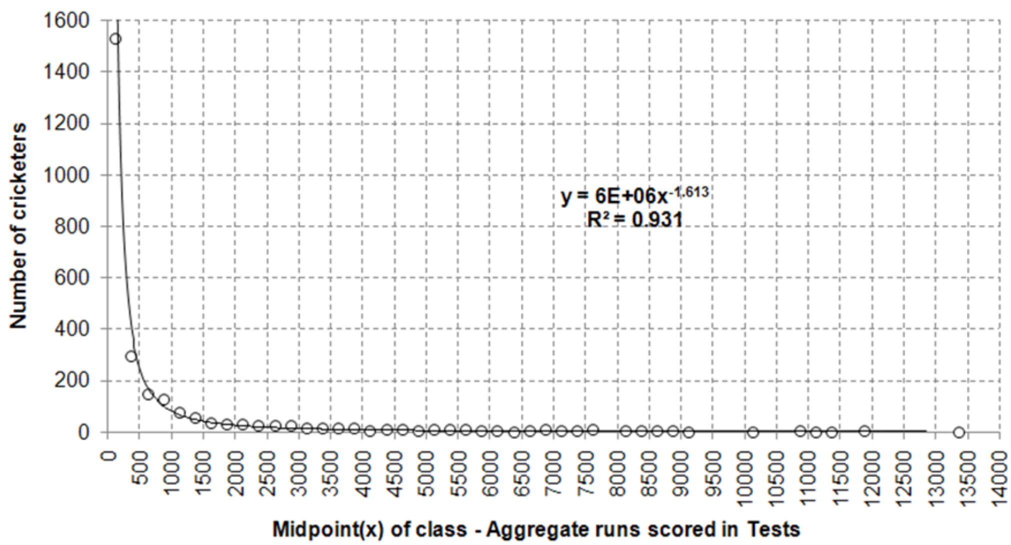

Figure 5. *Best-fit line – Aggregate runs scored; class-width of 250 runs*

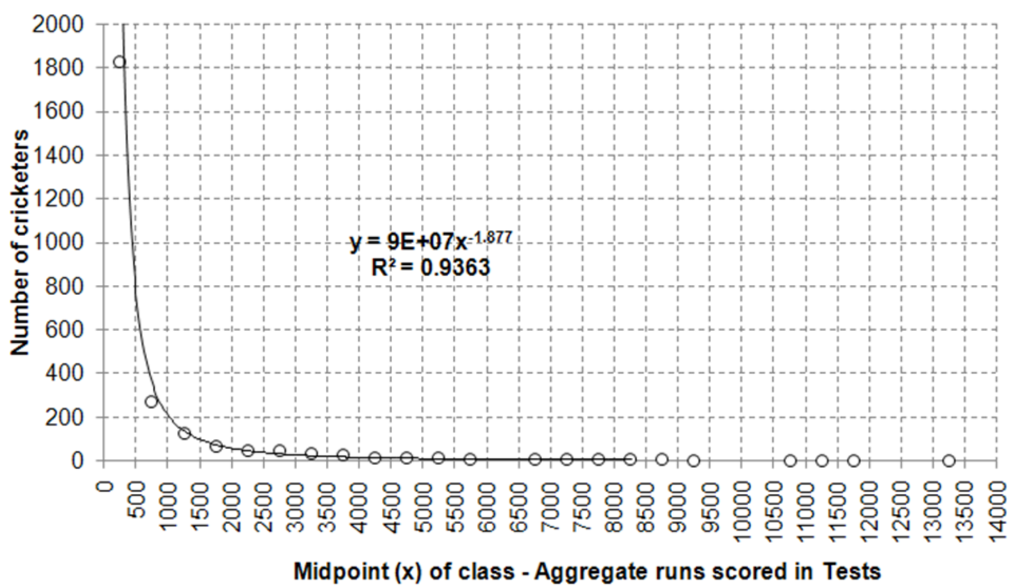

Figure 6. *Best-fit line – Aggregate runs scored; class width of 500 runs*

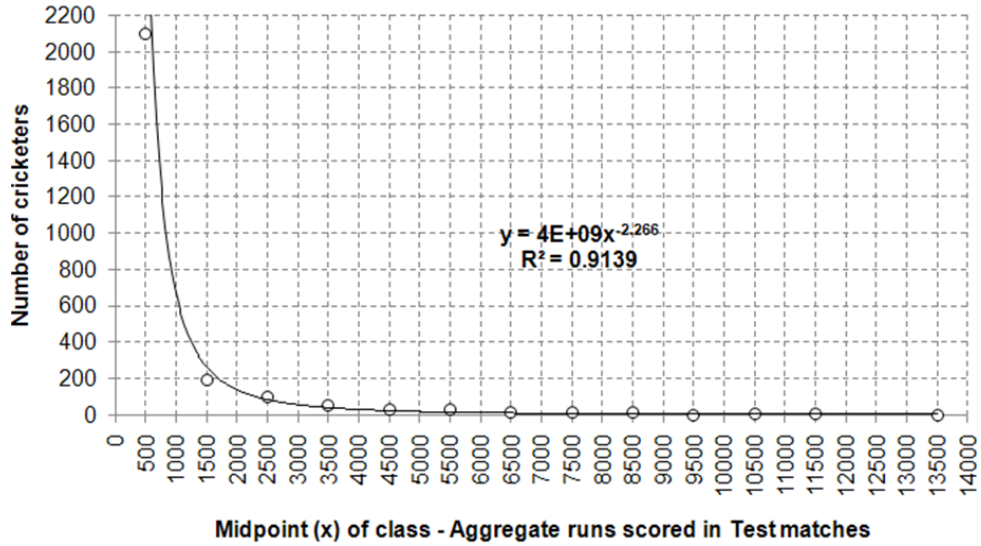

Figure 7. *Best-fit line – Aggregate runs scored; class width of 1000 runs*

Centuries scored

A century, in cricketing parlance, is a score of 100 runs or more scored in a single innings by a cricketer. Overall, 3339 centuries have been scored by Test cricketers, in the 1957 Tests played thus far – at an average of 1.71 per Test. Nearly 75% of the cricketers have not scored a century in their careers. Thirty-one of them have scored 20 or more centuries, and account for 24% of all the centuries scored, and 109 of them (4.2% of the total number) have scored 10 or more centuries, accounting for 56% of the total. The regression was carried out with just one class-width – 5 centuries – and the best-fit line, as seen in Figure 8, conforms to the Power Law, with an R^2 value of 0.954.

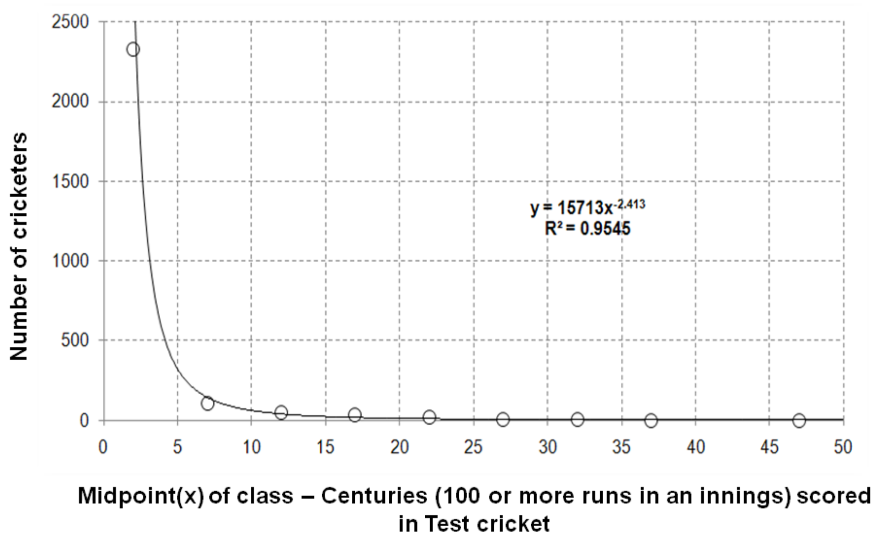

Figure 8. *Best-fit line – Centuries scored in Tests; class width of 5 centuries*

Half-centuries scored

A half-century in cricketing parlance, is a score greater than or equal to 50 and less than 100, scored by a cricketer in a single innings. In all, 8167 half-centuries (a little over 3 half-centuries per head) were scored in 1957 Tests, at an average of slightly over 4 per Test match. Over 55% of cricketers (unlike the 75% in the previous instance), have not scored a half century in their careers. While 258 cricketers have scored 10 or more half-centuries in their careers (accounting for 66% of all the half-centuries scored), 110 have scored 20 or more (41% of all the half-centuries scored).

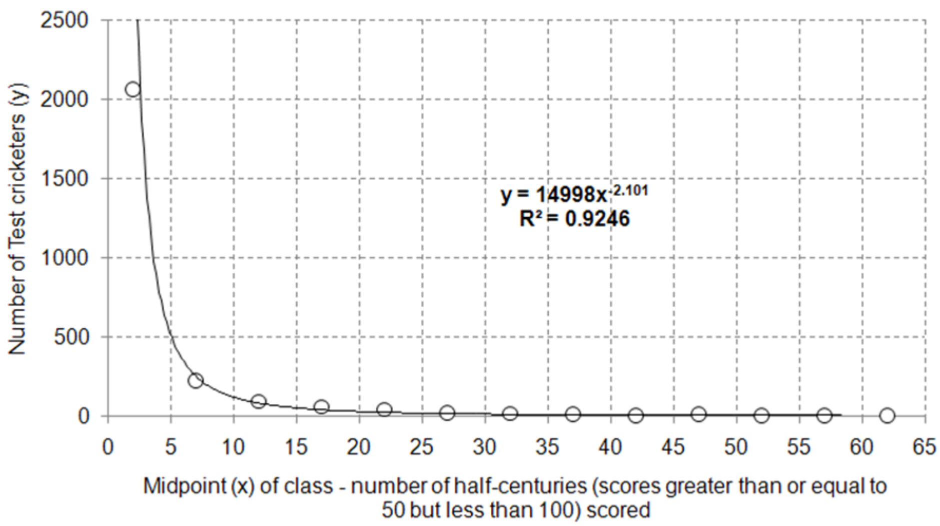

Figure 9. *Best-fit line - Half-centuries scored in Tests; class-width of 5 half-centuries*

Deliveries bowled

Over 4,041,570 (fair) deliveries were bowled in the 1957 Test matches played thus far. This equates to an average of 2065 deliveries per Test match. Of the 2550 cricketers, 681 (26.7% of the total) never bowled at all. Over 37% of all the deliveries bowled were accounted for, by 93 of the 2550 cricketers – 3.6% of the total. Over 60% were accounted for by 227 cricketers (8.9% of the total). Approximately 17% of the total account for 80% of the total deliveries bowled – not totally out of conformity with Pareto's 80:20 principle.

Both equations – in Figure 10 and Figure 11 – are Power Law equations, with a high-enough R^2 value indicating appreciable conformity. When the class-width is narrowed from 5000 deliveries to 1000 deliveries, the conformity tends to decrease slightly, if one would go by the R^2 values. Substituting, for instance, the value 7000.5 for 'x' (depicting the range 4501 to 9500 deliveries) in the equation $y = 6E + 12 * x^{-2.74}$ yields a value of 168 for 'y'. The actual value verified from the database is 158.

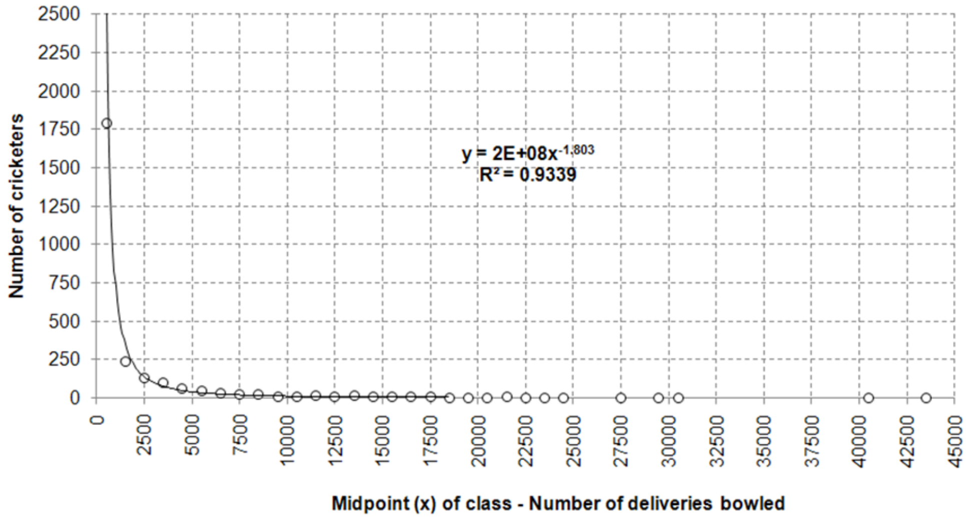

Figure 10. *Best-fit line – Deliveries bowled; class-width of 1000 deliveries*

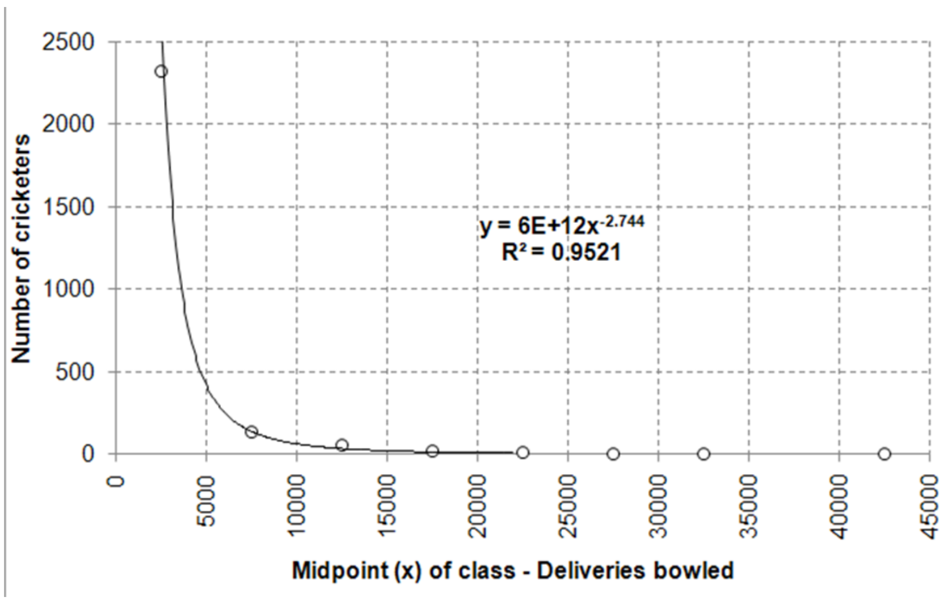

Figure 11. *Best-fit line – Deliveries bowled; class-width of 5000 deliveries*

Wickets bagged

If 681 of the 2550 cricketers never bowled at all, of the 1869 who bowled, 1048 did not bag any wickets. In other words, 821 cricketers (32% of the total) were successful at taking at least one wicket. In all, 57,165 wickets were taken by bowlers in the 1957 Tests – at an average of 29 wickets per Test, and 31 wickets per cricketer who bowled. Over 54% of the wickets which were bagged, fell to just 6% of the total number of cricketers. Eighty per cent of the total was accounted for less than 16% of the cricketers – a higher concentration as compared to the Pareto 80-20 principle. As with the case of the deliveries bowled, widening the class-width from 50 wickets to 100 wickets, results in increased conformity – with the R^2 value rising from 0.977 to 0.981.

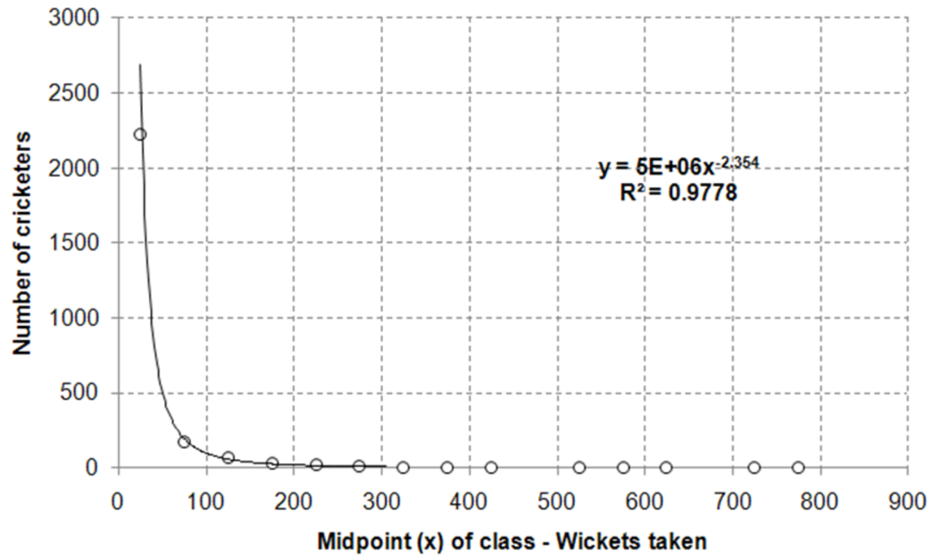

Figure 12. *Best-fit line – Wickets taken; class width of 50 wickets*

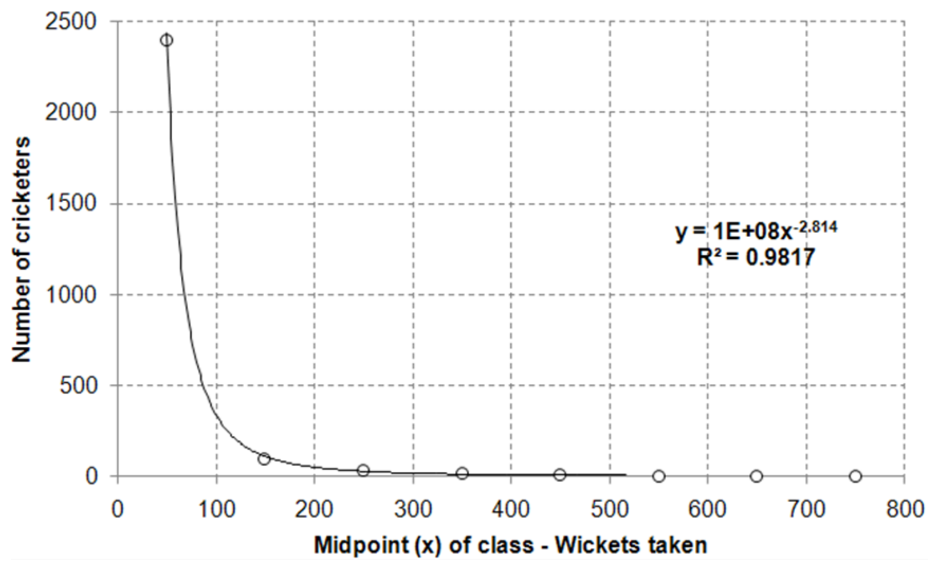

Figure 13. *Best-fit line – Wickets taken; class-width of 100 wickets*

Catches pouched

Of the 57,165 wickets bagged by bowlers, 33129 were by means of catches pouched by fielders in the outfield and wicket-keepers behind the stumps. That makes for 58% of the total wickets. Every Test cricketer on average pouched 13 catches – the range extending from no catches at all (525 of the 2550 cricketers or 20.5%) to 472 wickets by a wicket-keeper (who is still playing for his national side). The distribution is more even in this case, as compared to the previous cases, with 36% of the total number of Test cricketers accounting for 80% of the catches taken. Again, the conformity to the Power Law is satisfactory, with a widening of the class-width resulting in a rise in the R^2 value. Table 3 sums up the results of the regressions, and presents information regarding the nature of the best-fit lines, their equations and R^2 values.

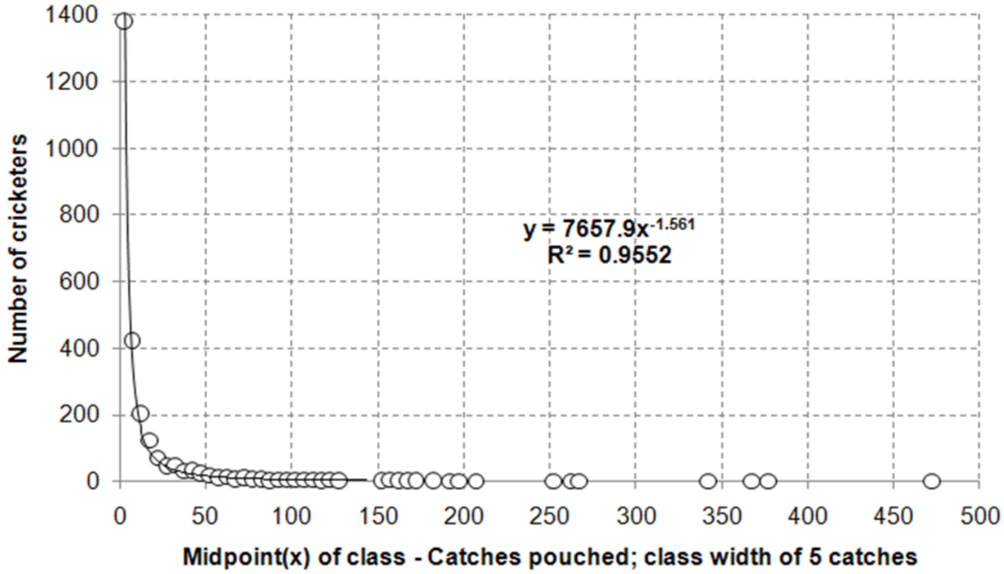

Figure 14. *Best-fit line – Catches pouched; class width of 5 catches*

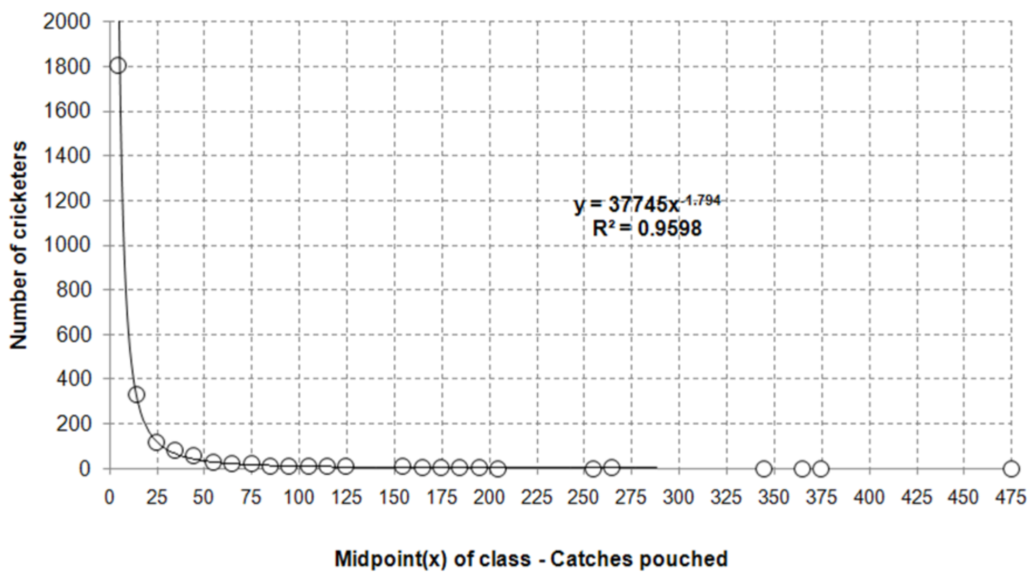

Figure 15. *Best-fit line – Catches pouched; class width of 10 catches*

Run-equivalents

The sum total of aggregate runs scored by all the cricketers is divided by the total number of catches taken in order to obtain the run-equivalent of a catch. This comes to around 53 runs. Likewise, the denominator is changed to the total number of wickets bagged in order to get the run-equivalent of a wicket bagged by a bowler. For each cricketer, the aggregate runs scored by him are added on to the product of the run-equivalent of a wicket and the total wickets taken by him, and the run-equivalent of a catch and the total number of catches pouched by him, to obtain one single number representative, if one may say, of a cricketer's overall performance in terms of run-equivalents. It follows here that we assign 53 times more value to a catch and 31 times more value to a wicket, than a run scored. The class-width here is chosen to be 1000 runs, and the logarithm of the midpoint of every class is plotted against the logarithm of the fraction of the total number of cricketers accounted for by the class (Figure 16). The Power Law is obeyed again, with an R^2 value of 0.93.

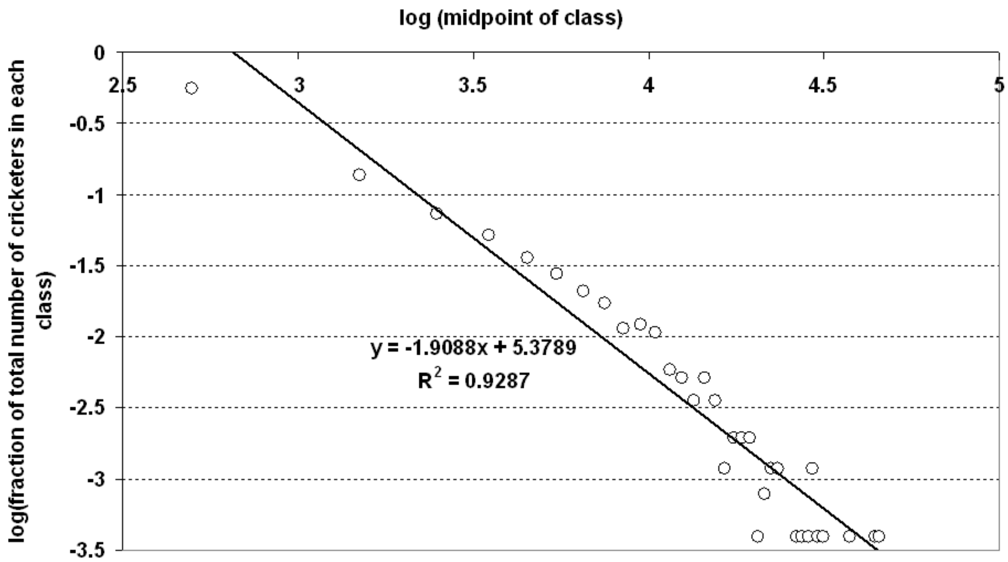

Figure 16. *Power Law conformity when run-equivalents of wickets and catches are considered*

Table 3. *Summing up the results*

Data field/aspect	Class-width	Nature of best-fit relation	Equation of best-fit line (x= midpoint of class-interval unless otherwise mentioned)	R^2 value
Number of Tests (x)	5 10	Exponential Exponential	$299.2e^{-0.036x}$ $666.3e^{-0.038x}$	0.934 0.95
Years played (x)	1	Exponential	$680e^{-0.22*x}$ (x= number of test matches played)	0.941
Runs scored (x)	250 500 1000	Power Power Power	$6E+06x^{-1.61}$ $9E+07x^{-1.88}$ $4E+09x^{-2.26}$	0.93 0.94 0.913
50s scored (x)	5	Power	$14998x^{-2.1}$	0.925
100s scored (x)	5	Power	$15713x^{-2.4}$	0.954
Wickets taken (x)	50 100	Power Power	$5E+06x^{-2.35}$ $1E+08x^{-2.81}$	0.977 0.982
Deliveries bowled (x)	1000 5000	Power Power	$2E+08x^{-1.78}$ $6E+12x^{-2.74}$	0.933 0.952
Catches pouched (x)	5	Power	$7658x^{-1.56}$	0.955

CONCLUSIONS AND FURTHER WORK

The paper started off with the hypothesis that the Power Law may very well apply to several facets of Test cricket. The authors investigated this possibility for number of Tests played by cricketers in their careers, years played, half centuries and centuries scored, aggregate runs amassed, deliveries bowled, wickets bagged and catches pouched, thus encompassing all the departments of the game – batting, bowling and fielding. Except for the number of years of played and the number of Test matches played, all the other distributions conform excellently to the Power Law, with the R^2 values being in general, greater than 0.91 throughout. Changing the class-widths to represent the distribution changes the constants in the equation as well as the R^2 values. In some cases, a widening of the class-width makes the R^2 value rise, while in other cases, the result is a drop in the R^2 value.

The limitation associated with updating has been discussed earlier, and its effect has been considered quite rightly, to be negligible on the final inferences. The class widths could be changed to study the effect on the outcome of the regressions. In other words, the scope of the sensitivity analysis can be widened.

While this analysis is performed with the accumulated data as in year-2010, it is possible to go back into the past, and perform a so-called time-series – decadal, for instance - investigation, to find out how the results vary over time. The coefficients and exponents in the best-fit equations may or may not converge to (or oscillate around) constant values. As long as the system of Test Cricket is dynamic and evolving (Test cricket does not come to an end, in other words), the 'confirmatory tests' would constitute an ongoing exercise – a relentless, non-ending pursuit, with the mission never getting accomplished, but merely being passed on from one analyst to another. The author, in sequels to this paper, intends to perform similar analyses on a country-wise basis for Test cricket, and thereafter also for the 'systems' of 'One-Day cricket' and 'Twenty20 cricket.'

Science and sports, in the past, may have been looked upon as areas of expertise as different as chalk is from cheese. Over time, the understanding of sports has been enhanced manifold, by the application of scientific and mathematical tools, methods and principles. The methodology adopted in this paper, is simple. Further, access to and availability of data, in sports of all genres, is generally very good. The analysis can be extended to aspects of several others sports forms – soccer, rugby, tennis, badminton, golf, winter sports, chess, etc.

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REFERENCES

1. Aidt, T., Leong, B, Saslaw, W & Sgroi, D (2006). A power law distribution for the tenure lengths of sports managers. *Physica A, 370,* pp. 697-703.
2. Ball P. (2004). *Critical Mass – how one thing leads to another,* Random House, UK
3. Guilimi, C., Galleati, M., & Gaffeo, E. (2003). Power law scaling in the world income distribution, *Economics Bulletin*, *15*(6), pp.1-7.

4. Howstat Computing Services. www.howstat.com. Accessed between 2009 and 2010.
5. Kühnert, C., Helbing, D & West, G. (2006). Scaling laws in urban supply networks. *Physica A, 363*, pp.96-103.
6. Lämmer, S., Gehlsen, B. & Helbing, D. (2006). Scaling laws in the spatial structure of urban road networks. *Physica A, 363*, pp.89-95.
7. Levy, M., & Solomon, S. (1997). New evidence for the Power Law distribution of wealth. *Physica A, 242 (1-2)*, pp 90-94.
8. Shiode, N., & Batty, M. (2000). Power law distribution in real and virtual worlds. *UCL Discovery, paper 19.* www.isoc.org. Accessed in February 2010.
9. Solomon, S. & Richmond, P. (2001). Power laws of wealth, market order volumes and market returns. *Physica A, 299*, pp.188-197.

