Journal of Sports Sciences

ISSN: 0264-0414 (Print) 1466-447X (Online) Journal homepage: http://www.tandfonline.com/loi/rjsp20

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To cite this article: David Forrest & Ron Dorsey (2008) Effect of toss and weather on County Cricket Championship outcomes, Journal of Sports Sciences, 26:1, 3-13, DOI: 10.1080/02640410701287271

To link to this article: http://dx.doi.org/10.1080/02640410701287271

Published online: 20 May 2008.

Journal of Sports Sciences, January 1st 2008; 26(1): 3 – 13

Routledge
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Effect of toss and weather on County Cricket Championship outcomes

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(Accepted 19 February 2007)

Abstract
The principal competition in English professional cricket has become more competitive with the introduction of hierarchical divisions linked by promotion and relegation. Using regression analysis, we examine the effect on league points when teams suffer different degrees of weather disruption over the season and different amounts of luck in winning the toss for choice of first innings. The results are used to illustrate the sensitivity of championship, promotion, and relegation outcomes to such matters of chance and revised league tables are produced after applying adjustments to account for the influence of weather and toss. Policy recommendations are presented on how the influence of weather and toss might be lessened in future seasons.

Keywords: *Cricket, coin toss, sports league*

Introduction

County cricket is one of the oldest organized sports in the world, with a ''first-class County Championship'' accepted as having been in existence since 1863. Before 1999, it was unlike many European sports leagues in that there was no promotion and relegation between divisions or into or out of the league. Instead, the same counties played annually for a Championship with no penalty threatening those that finished at the bottom of the standings.

From 1999, the structure was altered. Thereafter, the 18 county teams were to play in two divisions of nine clubs, with promotion and relegation (three up and three down) between the two. Initial membership of the two divisions was determined by final league positions in 1999, with the divisional structure itself operating from 2000. Subsequently, the First Class Forum determined that only two teams instead of three would be promoted/relegated from the end of 2006.

In introducing promotion and relegation, the governing body had two overt aims. First, it was expected that interest and aggregate attendance would increase if there were more matches that ''mattered'' and fewer matches whose outcome had no implications for the teams involved. Second, it was hoped that the top division, by concentrating talent, would provider a tougher breeding ground for potential members of the ailing national team.

So far, the first goal appears to have been achieved in that the long-run decline in attendance seems to have been arrested (see figure 1 in Paton & Cooke, 2005, p. 26). This might be attributed partly to the reduction in the number of ''meaningless'' matches. In their match attendance demand study for 2000 – 2001, Paton and Cooke found that attendance was lowered in any match where the home team was no longer involved in ''issues'' – that is, the race for the Championship or promotion or relegation; by implication, promotion – relegation makes more matches significant and these attract more spectators. On the second aspiration for the structural reform, that it should feed through to a tougher and stronger national team, the mechanism might be working, since England's place in Test world rankings has improved. Whether this can be attributed to the introduction of the two-division format, or the coincident implementation of the central contract system from season 2000 – whereby elite players are effectively withdrawn from domestic cricket matches to concentrate on playing for the national team – or whether the improvement is simply a ''cyclical'' team form issue is, however, open to debate.

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ISSN 0264-0414 print/ISSN 1466-447X online © 2008 Taylor & Francis
DOI: 10.1080/02640410701287271

Having come late to the promotion–relegation format, cricket adopted what appeared to be a particularly harsh regime. One-third of the top division was to be demoted each season, compared with, for example, only 15% in Premier League soccer. This raised the possibility that a relatively good team would be relegated through ''bad luck''. This is, in contrast, unlikely to happen in soccer. Certainly, soccer teams are on occasions unlucky in finishing in the bottom three of 20 contestants; but they are likely still to be teams that are below the average standard for the division. The high proportion of teams subject, initially, to demotion in cricket meant that, given the susceptibility of outcomes to ''luck'' (discussed below), one could by no means be confident that all relegated teams were weak teams.

Although the demotion of three teams appeared harsh relative to alternative one- or two-team relegation, there was a sense in which demoting such a high proportion of teams reduced pressure on management. First, relegation became a common experience that could more easily be attributed to ''bad luck'' rather than poor management. Second, relegation was less serious because hope of an early return was more realistic given that the counterpart to three clubs being ejected by relegation was that three were admitted or re-admitted by promotion.

Although the rationale for the introduction of promotion–relegation appears to an extent to have been vindicated, it is the efficiency of the system itself that is the focus here. It is clear that the effectiveness of a promotion–relegation regime is likely to depend on the detailed specification of the scheme. Relegating a high proportion of the division perhaps boosts attendance in the short term by raising the number of ''significant'' games. But a hierarchical two-division league structure is also intended to raise the incentive for clubs to invest in team quality to the advantage of spectators (and long-run attendance) (Ross & Szymanski, 2002). If too many teams perceive a high risk of relegation, there might be insufficient incentive for players and/or management to increase effort to the extent that the prospect of relegation becomes less threatening if the route back appears relatively easy. Furthermore, if chance could dictate that even good teams could enter into the relegation zone, investment in constructing a high-quality team might be deterred by the risk that the team will not be playing in the top division the following season. Such risk has to be taken seriously. There is some evidence that memberships (season tickets) fall with relegation. For example, of the three clubs relegated in 2000, two experienced a major decline in memberships sold for the following season (Durham −36%, Derbyshire −26%; Hampshire membership was, by contrast, almost unchanged). If a high-quality team is relegated, keeping the team together could become unaffordable in the face of falling income even if prospects for speedy promotion are good.

''Luck'' in cricket

Anecdotal evidence suggests that in all sports, league rankings are sensitive to runs of ''bad luck'' for teams. Sometimes these have serious consequences for clubs and their supporters. Referee errors or player injuries can lead to teams being relegated or deprived of a championship. But cricket has two unique sources of ''luck'', which, we will demonstrate, have strong potential to influence season outcomes. These are the importance of the toss and of the weather.

The influence of the toss

Matches begin with a coin toss. Whichever captain wins may choose which side takes first innings. Championship games are spread over four days and each team has two innings. Because the game is long, the playing surface is subject to wear and tear, creating conditions that make batting and scoring runs more difficult by the final innings. Therefore, teams typically opt to bat first. But batting can also be difficult in certain weather conditions – for example, on a cloudy, humid morning, skilled ''seam'' bowlers can extract more swing from a cricket ball and, on such mornings at the start of the match, it can be rewarding to elect that the opposition should bat first.

That the advantage gained by winning the toss is deemed unusually important in cricket is underlined by the fact that broadcast commentaries almost always specify which team has won the toss and often discuss the merits of the choice made by the winning captain. In the coverage of no other team sport is the toss (to determine choice of ends or who takes first play) routinely mentioned at all. Surprisingly, previous cricket research has indicated no significant advantage to the team winning the toss, albeit in other variants of the game. In one-day international cricket, Allsopp and Clarke (2004), Clarke and Allsopp (2001), and De Silva and Swartz (1997) found no competitive advantage from winning the toss. In an analysis of all one-day internationals to date, Bhaskar (2004) reported a negative effect from winning the toss because teams chose to bat first too often. In (five-day) Test Match cricket, Allsopp and Clarke (2004) also found no advantage from winning the toss and likewise linked this to an excessive taste for batting first. More recently,

Morley and Thomas (2005) reported a significant positive effect of winning the toss in English domestic one-day matches in 1996 and 1997. However, the effect was positive and significant in only one (of three) of the model specifications presented (insignificant and negative sign in the other two models).

In contrast to findings for international and one-day cricket, the significance of the toss in County Championship cricket is evident from raw data on match outcomes. Over the period between the change from three- to four-day matches in 1993 and the end of the 2006 season, 1329 games had a definite winner (the remainder were drawn), of which 54.2% were won by the team winning the toss and 45.8% by the team losing the toss. Using a z-test, the hypothesis that the toss winner has a 0.5 chance of winning a match (that reaches a result) was rejected ($z = 3.16$, critical value of z (1% level) $= 2.57$).

We also assessed whether home teams were better able to exploit the winning of the toss because of greater familiarity with local pitch and weather conditions, but this proved not to be the case (the proportion of away winners that had won the toss was marginally greater – although not by a statistically significant amount – than the proportion of home winners that had won the toss). The toss is therefore equally important to win for both home and away teams.

The reason for the greater significance of the toss in County Championship cricket compared with one-day and test cricket is a matter for debate. One factor could be that rules in one-day competitions specify a maximum number of overs a player can bowl; if conditions favour one particular bowler, the extent to which this might be exploited is therefore limited, in contrast to timed games. Another consideration is the greater potential for the playing surface to deteriorate over four days, which makes the order in which teams bat matter potentially more in County Championship than in one-day cricket. On the other hand, more resources are available to prepare a durable pitch for showpiece (five-day) Test matches and the pitches there might, on average, deteriorate less than in a four-day county fixture, again making the toss more important in the County Championship.

The influence of weather interruptions

Part of the significance of the toss derives from the fact that the winner might be able to exploit weather conditions at the beginning of a game. However, the influence of weather is only partially captured by statistics on toss advantage. The major reason for weather being an important factor is that rain, a saturated field or poor light causes suspension of play. Unlike in other sports, lost time is not made up. In some cases, no play may be possible throughout the period set aside for the match and neither side can gain the league points for a win. Generally, the more weather disruption, the less chance that there will be time for the match to reach a conclusion and for ''win'' points be awarded. Furthermore, if a result is reached, it could be because one or both sides forfeit part of their first innings in an attempt to move the game towards a conclusion, resulting in fewer ''bonus points'' being earned: bonus points are awarded for reaching specified batting (runs scored) and bowling (opposition batsmen out) targets in the first innings. Dorsey (2002) used match data from 1996 – 2001 to reveal strong negative correlations between time lost to rain and both the probability of a match yielding a winner and the number of points awarded from a match. We extended Dorsey's analysis to cover 1993 – 2006 and found similar results. Table I illustrates that the probability of either side winning declines rapidly as the duration of weather interruptions increases. This impact from rain suggests the need to determine whether Championship rankings are related to the extent of weather disruption experienced by different teams.

Here, we attempt to estimate the impact of the number of tosses won and the amount of playing time lost to weather on the number of points scored by each county over a season. We demonstrate that in some recent seasons, ''luck'' with regard to toss and weather has had a decisive impact on championship, relegation, and promotion outcomes.

Table I. Weather interruptions and County Championship results, 1993 – 2006.

Number of sessions lost	Number of matches	Proportion of matches with an outright winner
0	1211	0.834
1	181	0.597
2	142	0.577
3	185	0.395
4	102	0.235
5	77	0.195
6	83	0.157
7	34	0.114
8	26	0.036
9	25	0
10	11	0
11	5	0
12	5	0

Note: Weather interruptions for each individual match were estimated from reports in *Wisden*, *The Times*, *The Sunday Times*, and *The Daily Telegraph* and from the cricinfo website. Minutes lost were expressed in terms of equivalent sessions (a match is divided into 12 sessions) and the data above relate to sessions lost to the nearest whole number.

Determination of end-of-season finishing positions in the County Championship

Since 1963, finishing positions in the Championship have been determined by the number of match points accumulated over the course of the season. This is of course conventional in sports leagues, although it has at times been different in cricket. For example, from 1960 to 1962, teams played different numbers of matches from each other and finishing order was on the basis of points per game.

The scoring system at the start of our sample period (1993) was as follows:

Points for a win = 16
Points for a draw = 0
Points for a tie (drawn match, scores level) = 8

In addition, batting and bowling bonus points were awarded for achievements in the first 120 overs of each team's first innings:

Batting bonus points	*Bowling bonus points*
200 – 249 runs = 1 point	3 – 4 wickets = 1 point
250 – 299 runs = 2 points	5 – 6 wickets = 2 points
300 – 349 runs = 3 points	7 – 8 wickets = 3 points
350+ runs = 4 points	9 – 10 wickets = 4 points

Detailed changes were subsequently made to points regulations in 1996, 1999, 2000, and 2003. The first of these changes introduced points for achieving a draw. The second increased further the reward for a draw (from one-fifth of win points to one-third of win points).

Empirical model

We use a regression model in which the dependent variable is the number of league points won by county i in season t. Our data cover the 14 seasons 1993 – 2006. Our hypothesis is that points won depend on the strength of the players at the club, the number of tosses won during the season, and the amount of time lost (during ''active'' playing time – i.e. rain on the fourth day of a match completed in three days is ignored) to weather. Time lost was estimated from reports and scorecards in annual editions of *Wisden Cricketers' Almanack* and match reports in *The Times*, *Sunday Times*, and *Daily Telegraph* newspapers. Estimation has become easier over time because sources produced progressively more detailed reports and we are confident in the accuracy of our estimates from 1993 on, although it is not always possible to ascertain the *exact* number of overs lost to bad weather. For convenience, time lost was converted to an estimated equivalent in ''sessions'' (on each day of the four days of a match, play is divided into three sessions to permit meal breaks).

Additional controls used in the model are categorical variables to capture the influence of variations in points regime and the number of matches. The 1993 points system was detailed in the previous section. From 1996, 3 points were awarded to each team in a drawn match. In 1999, win points were reduced from 16 to 12 and draw points increased from 3 to 4. From 2000, while the maximum possible bonus points remained at 8, the division of the available points between batting and bowling was modified and, furthermore, each club played one less fixture than before. In 2003, points per win were increased to 14 with other aspects being unchanged. (From 2000, teams played in two divisions but when a categorical variable to distinguish between the points-generating process in each division was included, it was insignificant and is omitted from the model we report.)

Changes in total points available from a match or the number of matches played are clearly likely to shift the points array in the final Championship table and this explains the need to include this series of categorical variables in the model specification.

It was necessary, of course, to control for playing strength to permit isolation of the impact of weather and toss on Championship points. In some other sporting contexts, club wage bills have been used to proxy squad strength but in cricket this would be problematic – even if complete data were available from club accounts, the wage variable would suffer from endogeneity given performance-related pay. To estimate playing strength, we instead exploit betting odds on the eve of the relevant season (as recorded in *Wisden Cricketers' Almanack*) in respect of a team winning the Championship of its division. These odds are quoted in the form a/b (for example, 9/1). An alternative way of expressing odds is in terms of ''probability odds'', which are given by $b/(a+b)$, in this example 0.10. ''Probability odds'' is the variable used in our regression analysis.

The model we estimate is, therefore:

$$\text{points}_{it} = \text{f}(\text{sessionslost}_{it},\ \text{tosseswon}_{it},\ \text{probabilityodds}_{it},\ 1996/8\text{pointsregime}_t,\ 1999\text{pointsregime}_t,\ 2000/02\text{pointsregime}_t,\ 2003/06\text{pointsregime}_t),$$

where subscripts i and t refer to clubs and seasons respectively. The model was estimated over 1993 – 2006.

Results

Table II records our results. Predictably, pre-season probability odds are very significant in accounting for team points. Changes in rules for awarding points in

Table II. Ordinary least squares regression results (dependent variable = Championship points won in a season).

	Coefficient estimate	Robust standard error	*p*-value
sessionslost	−0.792	0.268	0.003
tosseswon	3.818	1.177	0.001
probabilityodds	169.550	28.861	<0.001
1996/8pointsregime	6.955	8.662	0.423
1999pointsregime	−17.456	8.648	0.045
2000/02pointsregime	−23.939	7.526	0.002
2003/06pointsregime	18.149	5.739	0.002
Constant	165.880	14.942	<0.001
R^2	0.25		
Number of observations	252		

1999, 2000, and 2003 are shown to have had the anticipated effects. The coefficients on the focus variables, tosses won and sessions lost, are of expected sign and significant at the 1% level (with *P*-values of 0.001 and 0.003 respectively). The regression estimates suggest that each extra toss won in a season generates approximately 3.8 extra points for a team (this estimate will reflect a combination of the potential advantage to be had from choice of first innings and the extent to which captains exercise sound judgement in that decision), while each session of play lost to rain costs teams, on average, approximately 0.79 Championship points.

A potential additional effect of the bonus point changes in 1996 and 1999 is that they might have lessened the damage done to teams when they lost playing time to the weather: the problem for two teams that suffer rain interruptions is that their match is less likely to produce an outright winner but, if points for a draw are introduced/increased (as in 1996/1999), this could mitigate the impact on total points generated since both teams at least receive draw points from the fixture. However, two interaction terms, one equal to sessions lost multiplied by a categorical variable set equal to one for observations in 1996 and afterwards, and the other equal to sessions lost multiplied by a variable taking the value one from 1999, were found to be statistically insignificant and were thus omitted from the model we report. Non-significance of the interaction terms might be related either to the small number of points given for a draw or to the possibility that rewarding a draw might itself have altered strategy in the competition. In any event, testing revealed no statistically significant difference in the "cost" of rain delays between the relevant sub-periods.

We would judge our estimated effect on points of time lost to rain as likely to be biased downwards – that is, the "true" coefficient on sessions lost should be larger, because of the presence of probability odds in the regression equation. The conclusion from a large number of studies of sports betting markets surveyed by Sauer (1998) is that odds successfully capture available public information. It is well known that some counties are wetter than others according to long-term data and that wet counties suffer more disruption to their home games than others. For example, Glamorgan and Lancashire lose the greatest amount of time to rain according to Dorsey (2002). Their handicap in pursuing championships should therefore be reflected in the odds offered by bookmakers and some of the effects of weather may be already captured in the coefficient estimate on probability odds.

An alternative approach that avoids the use of betting odds is to employ the fixed effects estimator. The specification replaces probability odds by a series of club-specific constants to capture team strength and yields unbiased estimates even if there is a correlation between unobservable county effects and the independent variable (weather, as represented by sessions lost). However, estimating with fixed effects has the weakness that team relative strengths are assumed to have remained constant over the data period (Surrey was revealed as the strongest and Durham as the weakest county). This is a very strong restriction and so we choose to present results based on the earlier specification; however, we note that the impacts of both weather and toss remained statistically significant ($p < 0.001$ and $p = 0.019$ respectively) in fixed effects estimation, with estimates of the impacts of weather and toss of -0.927 (points per session lost) and $+2.877$ (points per toss won) respectively. Below we identify cases where championship, promotion, and relegation issues appear to have been changed by differential experiences across clubs with respect to weather and toss. The list of cases so identified proved to be identical when we employed impacts estimated from the fixed effects version of our model rather than from the results reported in Table II. Thus choice between using betting odds and fixed effects estimation is not crucial to anything that follows.

As just stated, we now take the estimated impacts from tosses won and sessions lost, as derived from Table II, to evaluate the impact of these factors on league positions, particularly on the identity of teams winning championships or experiencing promotion or relegation. We are not suggesting that official league tables be adjusted in the way used here, as standard errors on relevant coefficient estimates are quite high. However, it is informative to see the extent to which these factors have influenced end-of-season positions.

Effects of tosses won and sessions lost on County Championship finishing positions

Table III presents actual and ''shadow'' league tables for seasons 1999–2006, with the shadow league tables showing points totals adjusted to what each county could have been anticipated to achieve given ''average'' luck with toss and weather. The adjustment is made, using coefficient estimates from the betting odds version of our model, on the basis of 3.818 points for a toss win and −0.792 points per session lost to adverse weather. For example, Lancashire (actual points 208) has an adjusted points tally for 1999 calculated as follows:

$$\begin{aligned}&\text{Adjusted points total for Lancashire (1999)}\\&= 208 + 3.818(8.5 - 8) - 0.792(23 - 33)\\&= 217.8\end{aligned}$$

In 1999, all counties competed in a single division to determine which nine would be allocated to the new Division 1 to be introduced in 2000. On the basis of our ''shadow'' table, Warwickshire and Sussex were unfortunate to lose out on places in the top division; Durham and Derbyshire were the beneficiaries. Warwickshire, while experiencing average luck with the toss (9 tosses won from 17), suffered remarkably from the weather (41 sessions lost compared with a league average of 23 sessions lost in 1999), playing the equivalent of eight fewer days' cricket than Durham and Derbyshire (and ten days less than Essex). Our toss and weather-adjusted table would in fact have accorded them fourth position in the 18-member league but they were nevertheless relegated to the new Division 2.

In season 2000, Surrey retained the County Championship but our adjusted table would have awarded the title to second-placed Lancashire, which lost 40% more time to rain and won six fewer tosses than the champions. By contrast, weather and toss appear not to have affected the identity of the teams relegated in 2000, Derbyshire and Durham this time failing to escape the reprieve given to them by these extraneous factors in 1999. However, in Division 2, Gloucestershire were winners of our shadow championship but in reality did not even gain promotion. Against long-run expectations, Glamorgan had the least weather disruption of any of the 18 counties and played over six extra days of cricket compared with Gloucestershire. Even then, Glamorgan appear to have relied on Gloucestershire's bad luck with the toss (they won only three times in 16 games) to claim the latter's ''rightful'' promotion slot.

Seasons 2001 and 2002 were, on average, drier than 2000 and the variance in number of tosses won was noticeably less in each division. Consequently, crucial issues appear to have been little influenced by the weather and toss except that, in 2001, Warwickshire (still unlucky with both) lost out on first place prize money in Division 2; and in 2002 Nottinghamshire claimed a promotion place that belonged, according to the shadow table, to Worcestershire. The latter two counties were, however, extremely close contenders for the last promotion place (201.75 and 200 points accumulated respectively in 2002) and therefore any number of minor incidents in games, affecting bonus points, could have tipped the balance.

In 2003, Lancashire were thought by some to have been unlucky not to win the title:

> Almost eleven days were lost to the weather, badly affecting four matches they had the better of, while the sun seemed to shine constantly for the eventual winners, Sussex. Jack Simmons, the club chairman, joked grimly about relocating to the South Coast . . . (*Wisden*, 2004, p. 599)

However, on the basis of the model employed here, Sussex were worthy champions. On the other hand, Essex were ''wrongly'' relegated instead of Warwickshire (11 tosses won and relatively kind weather).

In 2004, Kent were the ''true'' champions on the basis of the adjusted table. In 2005, the only issue that would have been settled differently on the basis of the adjusted table is that Middlesex would have been relegated instead of London rivals Surrey because they enjoyed the benefit of substantially less rain interruption over the season.

Finally, in 2006, substantial variation in time lost to weather was responsible for major differences between actual and adjusted outcomes. Champions Sussex appear not to have been the worthy champions they had been in 2003. They played 30 sessions (ten full days) more cricket than Lancashire and won three more tosses. Compared with Hampshire, they played 20 more sessions and won seven more tosses. In our adjusted table, Sussex are replaced not only by Lancashire as the top county but have also been overtaken by Hampshire. And even though this was the year when two-team replaced three-team promotion and relegation, these issues were also altered by toss and weather to the benefit of Yorkshire and Worcestershire and to the disadvantage of Nottinghamshire and Essex.

In the majority of the cases where issues would have been settled differently according to our shadow league tables, it was weather and toss working in the same direction that caused the deviation from the actual outcomes. It is notable that the potential of weather disruption to distort rankings is roughly equivalent to that of variation in toss wins. Over the

Table III. Actual and "shadow" (toss- and weather-adjusted) Championship positions, 1999 – 2006.

	Actual points	Tosses won (mean = 8.5)	Sessions lost (mean = 23)	Adjusted points	"Shadow" table	
1999						
Surrey	264	6	18	269.6	Surrey	269.6
Lancashire	208	8	33	217.8	Lancashire	217.8
Leicestershire	200	9	27	201.3	Leicestershire	201.3
Somerset	194	7	15	193.4	Warwickshire	199.3
Kent	194	11	22	183.7	Hampshire	195.1
Yorkshire	193	9	18	187.1	Somerset	193.4
Hampshire	191	7	21	195.1	Yorkshire	187.1
Durham	188	10	17	177.5	Kent	183.7
Derbyshire	187	13	17	165.1	Sussex	182.9
Warwickshire	187	9	41	199.3	Glamorgan	180.3
Sussex	185	8	18	182.9	Durham	177.5
Essex	181	8	11	173.4	Northants	174.5
Northants	171	8	25	174.5	Essex	173.4
Glamorgan	163	5	28	180.3	Middlesex	168.1
Worcestershire	159	10	27	156.4	Derbyshire	165.1
Middlesex	156	7	31	168.1	Worcestershire	156.4
Notts	140	8	15	135.6	Gloucestershire	135.7
Gloucestershire	136	9	25	135.7	Nottinghamshire	135.6
	Actual points	Tosses won (mean = 8)	Sessions lost (mean = 35)	Adjusted points	"Shadow" table	
2000						
DIVISION 1						
Surrey	213	10	30	201.4	Lancashire	213.8
Lancashire	193	4	42	213.8	Surrey	201.4
Yorkshire	188	10	27	174.0	Yorkshire	174.0
Leicestershire	165	11	41	158.3	Somerset	159.8
Somerset	145	6	44	159.8	Leicestershire	158.3
Kent	140	6	35	147.6	Kent	147.6
Hampshire	112	8	27	105.7	Derbyshire	108.9
Durham	112	7	24	107.1	Durham	107.1
Derbyshire	111	10	42	108.9	Hampshire	105.7
DIVISION 2			Sessions lost (mean = 35)			
Northants	188	9	23	174.7	Gloucestershire	182.6
Essex	165	8	30	161.0	Northants	174.7
Glamorgan	160	7	23	154.3	Essex	161.0
Gloucestershire	158	3	42	182.6	Worcestershire	156.5
Worcestershire	151	8	42	156.5	Warwickshire	154.9
Warwickshire	150	9	46	154.9	Glamorgan	154.3
Notts	148	9	44	151.3	Nottinghamshire	151.3
Middlesex	138	11	29	121.8	Sussex	135.6
Sussex	134	8	37	135.6	Middlesex	121.8
	Actual points	Tosses won (mean = 8)	Sessions lost (mean = 27)	Adjusted points	"Shadow" table	
2001						
DIVISION 1						
Yorkshire	219	8	21	214.2	Yorkshire	214.2
Somerset	203	8	16	194.3	Somerset	194.3
Kent	175	8	31	178.2	Surrey	182.7
Surrey	169.5	6	34	182.7	Kent	178.2
Leicestershire	165	10	16	148.7	Lancashire	161.9
Lancashire	153	9	43	161.9	Leicestershire	148.7
Northants	148	10	18	133.2	Glamorgan	146.3
Glamorgan	133	7	39	146.3	Northants	133.2
Essex	116	4	22	127.3	Essex	127.3
DIVISION 2			Sessions lost (mean = 26)			
Sussex	208	10	6	183.7	Warwickshire	201.3
Hampshire	192	8	28	192.8	Hampshire	192.8
Warwickshire	185.75	6	37	201.3	Sussex	183.7
Gloucestershire	173	13	23	150.7	Middlesex	165.8
Middlesex	172	9	24	165.8	Nottinghamshire	154.3
Worcesters'	151.75	10	34	149.7	Gloucestershire	150.7
Notts	141.25	5	29	154.3	Worcestershire	149.7

(*continued*)

Table III. (*continued*).

Durham	140	6	22	143.7	Durham	143.7
Derbyshire	92.25	5	27	103.7	Derbyshire	103.7
	Actual points	Tosses won (mean = 8)	Sessions lost (mean = 24)	Adjusted points	"Shadow" table	
2002						
DIVISION 1						
Surrey	242.75	9	16	232.6	Surrey	232.6
Warwickshire	198	10	22	188.8	Warwickshire	188.8
Kent	195.5	9	14	183.8	Leicestershire	184.2
Lancashire	172	8	30	176.8	Kent	183.8
Leicestershire	171	6	31	184.2	Lancashire	176.8
Sussex	154	7	26	159.4	Sussex	159.4
Hampshire	131	5	34	150.4	Hampshire	150.4
Somerset	126.75	9	20	119.8	Somerset	119.8
Yorkshire	124.75	9	19	117.0	Yorkshire	117.0
DIVISION 2			Sessions lost (mean = 24)			
Essex	219	7	17	217.3	Essex	217.3
Middlesex	211.75	8	19	207.8	Middlesex	207.8
Nottinghamshire	201.75	10	26	195.7	Worcestershire	201.6
Worcestershire	200	8	26	201.6	Nottinghamshire	195.7
Glamorgan	169	6	24	176.6	Glamorgan	176.6
Derbyshire	167.75	7	22	170.0	Derbyshire	170.0
Northants	162.5	9	21	156.3	Northants	156.3
Gloucestershire	136.5	8	23	135.7	Gloucestershire	135.7
Durham	90.75	9	36	96.4	Durham	96.4

In 2001–2002, counties were fined points for bowling overs below a minimum rate per hour: this accounts for fractional terms in actual points totals.

	Actual points	Tosses won (mean = 8)	Sessions lost (mean = 24)	Adjusted points	"Shadow" table	
2003						
DIVISION 1						
Sussex	257	9	14	245.3	Sussex	245.3
Lancashire	223	10	30	220.1	Lancashire	220.1
Surrey	219	7	19	218.9	Surrey	218.9
Kent	198	9	19	190.2	Kent	190.2
Warwickshire	171.5	11	19	156.1	Middlesex	179.9
Middlesex	169	7	33	179.9	Essex	170.8
Essex	156	6	33	170.8	Warwickshire	156.1
Notts	132	7	18	131.1	Leicestershire	138.7
Leicestershire	125.5	6	31	138.7	Nottinghamshire	131.1
DIVISION 2			Sessions lost (mean = 24)			
Worcestershire	245.75	6	25	254.2	Worcestershire	254.2
Northants	237	11	18	220.8	Northants	220.8
Gloucestershire	190	8	33	197.1	Gloucestershire	197.1
Yorkshire	183.5	8	32	189.8	Yorkshire	189.8
Glamorgan	183	9	20	176.0	Glamorgan	176.0
Durham	159.25	8	22	157.7	Durham	157.7
Somerset	157	9	11	142.9	Hampshire	154.8
Hampshire	140	6	33	154.8	Somerset	142.9
Derbyshire	114	7	18	113.1	Derbyshire	113.1
	Actual points	Tosses won (mean = 8)	Sessions lost (mean = 28)	Adjusted points	"Shadow" table	
2004						
DIVISION 1						
Warwickshire	222	13	28	202.9	Kent	211.5
Kent	206	8	35	211.5	Warwickshire	202.9
Surrey	195.5	10	22	183.1	Gloucestershire	187.6
Middlesex	179	10	33	175.3	Surrey	183.1
Sussex	172	6	22	174.9	Middlesex	175.3
Gloucestershire	172	6	38	187.6	Sussex	174.9
Worcestershire	161	5	26	170.9	Worcestershire	170.9
Lancashire	154	8	23	150.0	Lancashire	150.0
Northants	134	6	24	138.5	Northants	138.5

(*continued*)

Table III. (*continued*).

DIVISION 2			Sessions lost (mean = 40)			
Nottinghamshire	252	6	35	265.2	Nottinghamshire	265.2
Hampshire	228	10	36	226.7	Hampshire	226.7
Glamorgan	196.5	9	42	203.8	Glamorgan	203.8
Somerset	175	6	39	191.3	Somerset	191.3
Essex	165	7	28	168.8	Yorkshire	176.3
Leicestershire	163.5	8	42	174.6	Leicestershire	174.6
Yorkshire	162	8	46	176.3	Essex	168.8
Derbyshire	126	9	45	135.6	Derbyshire	135.6
Durham	118.5	9	43	126.6	Durham	126.6
	Actual points	Tosses won (mean = 8)	Sessions lost (mean = 28)	Adjusted points	"Shadow" table	
2005						
DIVISION 1						
Nottinghamshire	236	5	29	254.6	Nottinghamshire	254.6
Hampshire	233.5	10	22	227.4	Hampshire	227.4
Sussex	224	8	23	226.4	Sussex	226.4
Warwickshire	209.5	6	11	210.0	Warwickshire	210.0
Kent	202.5	10	17	192.5	Kent	192.5
Middlesex	181.5	10	17	171.5	Surrey	185.4
Surrey	180.5	9	31	185.4	Middlesex	171.5
Gloucestershire	104	6	15	107.7	Gloucestershire	107.7
Glamorgan	88.5	8	17	86.1	Glamorgan	86.1
DIVISION 2			Sessions lost (mean = 28)			
Lancashire	212	5	27	229.0	Lancashire	229.0
Durham	205	11	32	203.1	Yorkshire	216.8
Yorkshire	200.5	6	31	216.8	Durham	203.1
Northants	193	9	31	197.9	Northants	197.9
Essex	185	7	24	192.0	Essex	192.0
Worcestershire	179.5	8	22	181.1	Worcestershire	181.1
Leicestershire	159.5	10	31	160.6	Leicestershire	160.6
Somerset	155	11	36	156.2	Somerset	156.2
Derbyshire	116	5	22	129.0	Derbyshire	129.0
	Actual points	Tosses won (mean = 8)	Sessions lost (mean = 28)	Adjusted points	"Shadow" table	
2006						
DIVISION 1						
Sussex	242	11	5	215.5	Lancashire	232.7
Lancashire	224	8	35	232.7	Hampshire	223.1
Hampshire	207	4	25	223.1	Sussex	215.5
Warwickshire	189	9	20	182.0	Warwickshire	182.0
Kent	175	9	24	171.2	Kent	171.2
Yorkshire	154	12	30	143.5	Nottinghamshire	168.6
Durham	153.5	7	18	152.6	Durham	152.6
Notts	153	6	34	168.6	Yorkshire	143.5
Middlesex	133.5	6	21	138.8	Middlesex	138.8
DIVISION 2			Sessions lost (mean = 16)			
Surrey	262	8	5	247.0	Surrey	247.0
Worcestershire	229	12	18	209.0	Essex	218.8
Essex	220	5	8	218.8	Worcestershire	209.0
Leicestershire	185.5	7	23	188.5	Leicestershire	188.5
Derbyshire	178.5	12	23	162.4	Derbyshire	162.4
Northants	163	8	20	159.8	Northants	159.8
Gloucesters'	155.5	7	13	150.6	Gloucestershire	150.6
Glamorgan	146.5	6	14	146.2	Glamorgan	146.2
Somerset	140	9	20	133.0	Somerset	133.0

period studied, our results imply that a county losing one standard deviation above the mean number of sessions lost to weather in a season would lose 7.8 "expected" points, whereas if the number of tosses won were one standard deviation below the mean, expected points would fall by 8.6.

Our results demonstrate that in each of the eight seasons studied, championship, relegation, and promotion outcomes were affected (sometimes radically) by toss and weather. These outcomes would have been affected similarly had there been a two-up, two-down, rather than the actual three-up,

three-down, regime in place to 2005. Indeed, despite the adoption of two-up, two-down in 2006, the identity of promotion and relegation teams was still affected. This is, of course, because the underlying sources of inequity have not been addressed. For outcomes not to be distorted by chance factors, cricket has to rely on relatively dry summers and on a relatively even distribution of toss wins across counties in any given season.

Policy implications

Important issues in County Championship cricket have been shown to have the potential to be determined somewhat arbitrarily according to luck with toss and weather. Part of sport's appeal is its ''glorious uncertainty'' and allowing a role for random factors to determine outcomes in one sense generates greater competitive balance. But credibility of competition might suffer if the uncertainty is unrelated to on-the-field play. Consequently, we would recommend that authorities seek to lessen the influence of toss and weather on season outcomes.

It is not out of the question that cricket would accept the introduction of a statistical method that would adjust league tables to take account of toss wins and weather disruption. After all, the results of international and domestic one-day matches are now routinely determined by the Duckworth-Lewis method (Duckworth & Lewis, 1998), which essentially relies on using past data to predict how a one-day match would have developed had it not been interrupted by rain. As mentioned earlier, we would not recommend that official league tables be adjusted in the way employed here, as standard errors on the coefficient estimates are quite high. However, future work based on match data could provide the basis for more reliable adjustment and this could conceivably be incorporated into the points system. But this is speculative and relies on the results of future research.

More immediate measures are feasible. First, the toss could be abolished. Counties have already rejected a proposal that would have awarded the rights of a toss winner to the away team (a similar proposal for National League one-day matches was argued against in Morley & Thomas, 2005). The motive for the unsuccessful proposal was to deter home teams from preparing poor batting pitches. We would recommend that counties reconsider the scheme in light of the quite different consideration that eliminating variance in the number of toss wins in a season should make determination of league seasonal outcomes less arbitrary. It should also make for closer matches. Examining outcomes of the 1329 matches with a definite winner over 1993–2006, we found that 56% were won by the home team. We noted above that 54.2% had been won by toss winners. Hence home advantage and toss advantage in county cricket appear to be of comparable magnitude and, if the toss were deemed always to be won by the visitors, the chances of each team winning an individual game would on average tend to be made more even (this is not to say that it would promote balance in every single match, since sometimes a game might become more interesting if a weak home team's prospects are boosted by being able to choose batting order).

Of course, traditionalists might be reluctant to forego the ritual of the toss. They will point to the interest in one captain being granted, by chance, the opportunity to use his judgement to decide which side should bat first, given pitch and weather conditions. Indeed, while our estimation method constrains the estimated value of the toss to be the same across teams, some captains could in fact gain to a greater extent than others if they are more insightful on the merits of batting or bowling first. But under our proposal, captains would still face this strategic decision, an appealing feature of the game that rewards sound judgement of current (and expected future) conditions, though on a predictable basis (when the team is playing away) rather than randomly (when it happens to win the toss).

The influence of weather cannot be eliminated. But alleviation is feasible through scheduling. For Table IV we calculated the mean numbers of sessions lost per match according to the month in which a match was played (data for all Championship matches 1993–2006). Disruption varies appreciably across the summer, with April games losing on average almost one whole day (and September games over two sessions) from the four days scheduled. July and August appear as much more auspicious months in which to play cricket. Rescheduling to use July and August more intensively for county cricket would normally make the Championship less open to weather influence. It would also raise attendances according to Paton and Cooke (2005), whose model reveals benefits to scheduling games during school holidays.

Table IV. Weather interruptions in County Championship matches, 1993–2006.

Month	Matches scheduled	Sessions lost	Sessions lost per game
April	133	381	2.87
May	355	563	1.59
June	341	473	1.39
July	308	291	0.94
August	404	475	1.18
September	246	502	2.04

Of course, the cricket schedule is tight – with one-day competitions interspersed with County Championship matches – and complicated by the overlay of international games. Allocating some matches to April and September, when rain is more likely and grounds dry more slowly, is therefore possibly unavoidable given the number of clubs in the league. However, since these months are little used for other tournaments, one solution would be to add a reserve day to matches in April and September, to be used if the amount of time lost exceeded some threshold. In April, almost a day's play is on average lost to rain anyway, so allowing five days for a four-day contest would, in a sense, merely be accepting reality. The practice could be extended to the midsummer months if a reduction in the number of counties were to be implemented; but the need is less then because of typically drier conditions. Reducing aggregate loss of hours through weather and eliminating the toss would go some way to alleviating the potential we have demonstrated for county cricket to throw up seasonal outcomes, including relegation, which could be labelled ''arbitrary''.

Conclusions

This article adds to existing literature on the potential advantage of winning the coin toss in cricket. Our study supplements the literature by analysing the effect of toss wins in the County Championship and by investigating the effect on seasonal, rather than individual match, outcomes. In addition, the effect of weather interruptions in Championship matches is analysed. This is important, since, unlike in one-day competitions, no adjustment exists to take account of time lost to weather.

County-level variations in these extraneous factors, unrelated to skill and effort, have been shown to have a significant impact in the determination of championship, promotion, and relegation outcomes in English county cricket. The significance of winning the toss in Championship matches is in marked contrast to the results from studies in other forms (mostly one-day) of cricket match and emphasizes that generalizations from such studies are inappropriate. The results on toss and weather would appear to undermine the credibility of the Championship as a ''fair'' competition for the counties involved, in the sense that random events can settle important outcomes; this aspect of cricket creates extra risk for clubs considering increased investment in player talent (and even spectator facilities). In addition, results indicate that these issues are unlikely to be resolved by the change to a two-up, two-down promotion and relegation system in 2006. In fact, the rationale for this regime change was to encourage more positive cricket (by reducing the emphasis on avoiding relegation) and to reduce ''instability'' (Kent is currently the only county not to have been relegated from Division 1). Our suggestion to the authorities would be to concentrate on the key causes, rather than the effects, of such instability.

Policy actions that could mitigate toss and weather effects include: removing the random way in which the choice to bat or bowl first is assigned, by allowing the away team captain to choose in every match; and rescheduling fixtures or allowing a fifth ''reserve day'' for potential use when weather interruptions are severe. A statistical method of adjustment to account for disparities in weather interruptions, in particular, is not ruled out, but requires further research of individual matches rather than aggregate league position.

Future research might usefully address the influence of chance – that is, factors not under the control of athletes – on the outcome of sporting contests beyond cricket. An intriguing focus for analysis would be that the role of chance could either increase interest in a sport by raising outcome uncertainty or reduce interest by undermining the credibility of the competition.

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