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(54) Title: SYSTEM AND METHOD FOR ASSESSING OR PREDICTING A MATCH OUTCOME IN A SPORTING EVENT

(57) Abstract: The invention provides a method for determining an outcome of a sporting event. The method comprises determining, by a contextual engine, a momentum factor at any point in time of the sporting event, wherein the momentum factor is based on previous events in the sporting event; and determining, by a prediction engine, the outcome of the sporting event based on at least the momentum factor. The invention further provides a system configured to determine an outcome of a sporting event, and a method for correlating a performance of a player or team to a playing condition in a sporting event.

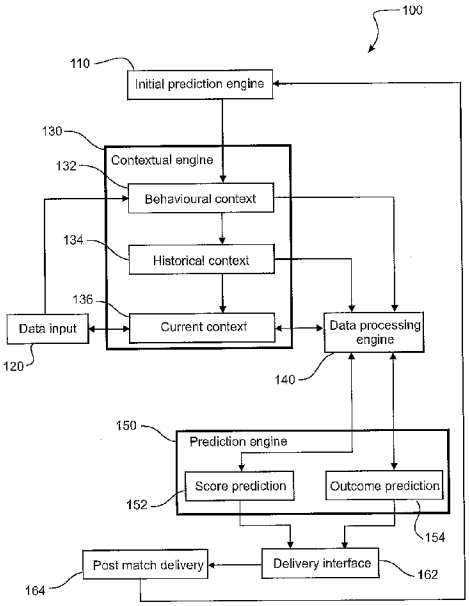

FIGURE 1

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SYSTEM AND METHOD FOR ASSESSING OR PREDICTING A MATCH OUTCOME IN A SPORTING EVENT

FIELD OF THE INVENTION

The present invention generally relates to a system and method for assessing or predicting a match outcome in a sporting event. Embodiments of the present invention relate to a contextual system for real-time prediction of match outcomes in a sporting event. Embodiments of the present invention relate to a system for determining a factor which correlates the playing conditions to the match outcome and a system for determining a measure of a player's impact on the match outcome.

BACKGROUND

Examples of existing systems for predicting an outcome in a sporting match include systems based on the Duckworth & Lewis method (D/L method). A system using this method is used in cricket to forecast scores in limited-overs cricket matches. The D/L method is a mathematical formula designed to calculate a target score for a team batting second in a limited-overs match interrupted by weather or other circumstances.

In cricket, the basic principle of the D/L method is that each team in a limited-overs match has two resources available with which to score runs: wickets remaining, and overs to play. In a sporting event, a resource can be consumed by either team to seek to score points. Teams cannot score points in the sporting event once one or more resources available in the sporting event are exhausted or depleted. This concept of resources is used to inform the context within the sporting contest. For sports like Rugby Union, Rugby League, American football, Australian Rules football, netball, soccer, hockey and ice hockey the resource available is time. For most sports, the scoring rate advances in a non-linear fashion relative to time remaining. The scoring rate relative to time is informed by the match context.

A system for predicting the outcome of a cricket match, using the D/L method, is restricted to rain affected games, second innings forecasts, and limited-overs matches. In these games where play is interrupted, the D/L method is applied to predict the score if the game was not interrupted and the play continued.

Other match prediction systems for cricket using other algorithms, such as the WASP and Crampton algorithms, have similar restrictions. For example, the WASP algorithm is

restricted to limited-overs matches and can only provide a score projection in the first innings and only a probability of winning in the second innings.

None of the prior art systems take into account a behavioural context. The behavioural context involves data representing previous events that occurred in a sporting event. Examples of previous events include points scored over an amount of resource consumed to score those points.

The absence of a behavioural context has the potential to hinder the ability to make accurate real-time (or near real-time) predictions of a match outcome within a sporting event. Prior art systems are unable to efficiently or effectively generate up to date alerts representing match outcome predictions. It is important to provide reliable estimates of these match outcome predictions.

It is an object of at least preferred embodiments of the present invention to, at least seek to, provide a system and method for assessing and/or predicting a match outcome in a sporting event that seeks to overcome the limitations and disadvantages discussed above, or to at least provide the public with a useful alternative.

SUMMARY OF THE INVENTION

In a first aspect, the present invention broadly consists in a computer-implemented method for determining an outcome of a sporting event, the method comprising:

determining, by a contextual engine, a momentum factor at any point in time of the sporting event, wherein the momentum factor is based on previous events in the sporting event; and

determining, by a prediction engine, the outcome of the sporting event based on at least the momentum factor.

In an embodiment, the contextual engine and prediction engine comprise one or more computing devices. In an embodiment, the computing device(s) of the contextual engine is/are the same as the computing device(s) of the prediction engine. In an alternative embodiment, the computing device of the contextual engine(s) is/are separate from the computing device(s) of the prediction engine.

In an embodiment, the outcome includes a result of the sporting event. In an embodiment, the result comprises a win, a loss, or a draw.

In an embodiment, the sporting event comprises team sporting events or individual sporting events. For example, the sporting event comprises cricket, Rugby Union, Rugby League, American football, Australian Rules football, netball, basketball, soccer, hockey, tennis, squash, badminton, and/or ice-hockey. In an embodiment, the method comprises determining the outcome of one or more formats of the sporting event. For example, where the sporting event is cricket, the formats may be limited-over matches where each team bats once (such as T20 cricket, 40 overs cricket, and/or 50 overs cricket for example) and/or multiple-innings matches where each team can bat multiple times per match (such as first class, test, two-day, and/or three-day matches for example).

In an embodiment, the method comprises determining the outcome at a start of the sporting event. In an embodiment, the start of the sporting event is when the first ball in an innings is bowled. In an embodiment, the start of the sporting event is a first second of the sporting event.

In an embodiment, the method comprises determining a probability of a team (or side) winning. In an embodiment, the method comprises determining the probability of the team winning before the sporting event starts. In an embodiment, the method comprises determining the probability of a first team beating a second team. In an embodiment, the method comprises determining the probability of the first team beating the second team based at least in part on a score in a previous sporting event between the first team and a third team and on a score in a previous sporting event between the second team and the third team.

In an embodiment, the method comprises determining a score prediction of the sporting event. In an embodiment, the method comprises determining the score prediction before the sporting event starts. In an embodiment, the score prediction is based on one or more contextual factors. In an embodiment, the contextual factors are quantifiable. In an embodiment, the contextual factor comprises one or more of weather conditions, pitch conditions, size-of-ground, and out-field conditions.

In an embodiment, the method comprises determining a behavioural context of the sporting event, wherein the outcome is determined based at least partly on the behavioural context. In an embodiment, the momentum factor is based at least partly on the behavioural context. In an embodiment, the behavioural context comprises information relating to previous events that occurred in the sporting event. In an embodiment, the method comprises providing the behavioural context from a data capture system. In an embodiment, the behavioural context comprises points scored

over an amount of a resource consumed to score those points, wherein a resource is consumed by a team in the sporting event to score points. In an embodiment, where the sporting event is cricket, the behavioural context comprises in-game scoring rate. In an embodiment, the in-game scoring rate comprises a run-rate or wicket-loss rate over a previous number of overs in the sporting event. In an embodiment, the method comprises determining the in-game scoring rate over two or more overs in the sporting event. In an embodiment, the method comprises determining the in-game scoring rate over five or more overs in the sporting event.

In an embodiment, the momentum factor is based on recent changes in score. In an embodiment, the momentum factor is based on changes in resources. In one embodiment, where the sporting event is cricket, the resources include batsmen and the changes in resources relate to batsmen dismissed.

In an embodiment, the method comprises determining a historical context of the sporting event, wherein the outcome is determined based at least partly on the historical context. In an embodiment, the historical context comprises information relating to previous sporting events. In an embodiment, the historical context for a team comprises a historical scoring rate of the team.

In an embodiment, the method comprises determining a current context of the sporting event, wherein the outcome is determined based at least partly on the current context. In an embodiment, the current context comprises information relating to a current state of the sporting event. In an embodiment, the method comprises providing the current context from a data capture system. In an embodiment, the current context comprises information on available resource(s) and/or a current difference between scores of teams in the sporting event. In an embodiment, where the sporting event is cricket, the information relating to available resource(s) comprises overs remaining or wickets remaining.

In an embodiment, the method comprises applying predictive algorithms to determine the outcome of the sporting event.

In a second aspect, the present invention broadly consists in a method for displaying an outcome of a sporting event, wherein the outcome is determined by the method of the first aspect described above.

In a third aspect, the present invention broadly consists in a system for determining an outcome of a sporting event, the system comprising:

a contextual engine for determining a momentum factor at any point in time of the sporting event, wherein the momentum factor is based on previous events in the sporting event; and

a prediction engine for determining the outcome of the sporting event based on at least the momentum factor.

In an embodiment, the outcome includes a result of the sporting event. In an embodiment, the result comprises a win, a loss, or a draw.

In an embodiment, the sporting event comprises team sporting events or individual sporting events. For example, the sporting event comprises cricket, Rugby Union, Rugby League, American football, Australian Rules football, netball, basketball, soccer, hockey, tennis, squash, badminton, and/or ice-hockey. In an embodiment, the method comprises determining the outcome of one or more formats of the sporting event. For example, where the sporting event is cricket, the formats may be limited-over matches where each team bats once (such as T20 cricket, 40 overs cricket, and/or 50 overs cricket for example) and/or multiple-innings matches where each team can bat multiple times per match (such as first class, test, two-day, and/or three-day matches for example).

In an embodiment, the system comprises an initial prediction engine for determining the outcome at a start of the sporting event. In an embodiment, the start of the sporting event is when the first ball in an innings is bowled. In an embodiment, the start of the sporting event is a first second of the sporting event.

In an embodiment, the initial prediction engine is configured to determine a probability of a team (or side) winning. In an embodiment, the initial prediction engine is configured to determine the probability of the team winning before the sporting event starts. In an embodiment, the initial prediction engine is configured to determine the probability of a first team beating a second team. In an embodiment, the initial prediction engine is configured to determine the probability of the first team beating the second team based at least in part on a score in a previous sporting event between the first team and a third team and on a score in a previous sporting event between the second team and the third team.

In an embodiment, the initial prediction engine is configured to determine a score prediction of the sporting event. In an embodiment, the initial prediction engine is configured to determine the score prediction before the sporting event starts. In an embodiment, the score prediction is based on one or more contextual factors. In an

embodiment, the contextual factors are quantifiable. In an embodiment, the contextual factor comprises one or more of weather conditions, pitch conditions, size-of-ground, and out-field conditions.

In an embodiment, the system comprises a contextual engine for determining a behavioural context of the sporting event, wherein the outcome is determined based at least partly on the behavioural context. In an embodiment, the momentum factor is based at least partly on the behavioural context. In an embodiment, the behavioural context comprises information relating to previous events that occurred in the sporting event. In an embodiment, the behavioural context comprises points scored over an amount of a resource consumed to score those points, wherein a resource is consumed by a team in the sporting event to score points. In an embodiment, where the sporting event is cricket, the behavioural context comprises in-game scoring rate. In an embodiment, the in-game scoring rate comprises a run-rate or wicket-loss rate over a previous number of overs in the sporting event. In an embodiment, the method comprises determining the in-game scoring rate over two or more overs in the sporting event. In an embodiment, the method comprises determining the in-game scoring rate over five or more overs in the sporting event.

In an embodiment, the momentum factor is based on recent changes in score. In an embodiment, the momentum factor is based on changes in resources. In one embodiment, where the sporting event is cricket, the resources include batsmen and the changes in resources relates to batsmen dismissed.

In an embodiment, the system is configured to determine a historical context of the sporting event, wherein the outcome is determined based at least partly on the historical context. In an embodiment, the historical context comprises information relating to previous sporting events. In an embodiment, the historical context for a team comprises a historical scoring rate of the team.

In an embodiment, the system is configured to determine a current context of the sporting event, wherein the outcome is determined based at least partly on the current context. In an embodiment, the current context comprises information relating to a current state of the sporting event. In an embodiment, the current context comprises information on available resource(s) and/or a current difference between scores of teams in the sporting event. In an embodiment, where the sporting event is cricket, the information relating to available resource(s) comprises overs remaining or wickets remaining.

In an embodiment, the system comprises a data capture system. In an embodiment, the data capture system is configured to provide the behavioural context to the contextual engine. In an embodiment, the data capture system is configured to provide the current context to the contextual engine.

In an embodiment, the system comprises a data processing engine for receiving data from the contextual engine. In an embodiment, the data processing engine is configured to collate, combine, manipulate and transform data. The data processing engine is configured to convert data to a flat file structure.

In an embodiment, the system comprises a prediction engine for applying predictive algorithms to determine the outcome of the sporting event.

In an embodiment, the system comprises a delivery interface for transmitting match outcome to relevant parties. The delivery interface is further configured to feedback the match outcome to the initial prediction engine.

In a fourth aspect, the present invention broadly consists in a computer-implemented method for correlating a performance of a player or team to a playing condition in a sporting event, the method comprising:

determining, by a computing device, an actual match outcome of a player or team in a sporting event under a first playing condition at any point in time during the sporting event; and

comparing, by a computing device, the actual match outcome to a predicted match outcome to determine a correlation factor, wherein the correlation factor can be applied to other players or teams in further sporting events to determine a match outcome of the player or team under the first playing condition.

In an embodiment, the computing device for determining the actual match outcome is the same as the computing device for comparing the actual match outcome of the predicted match outcome. In an alternative embodiment, the computing device for determining the actual match outcome is separate from the computing device for comparing the actual match outcome of the predicted match outcome.

In an embodiment, the method comprises determining a match outcome in a sporting event based at least in part on the correlation factor.

In an embodiment, the predicted scoring rate is determined according to the method of the first aspect or system of the third aspect, and respective embodiments of the method and system, described above.

In an embodiment, the first playing condition comprises the pitch conditions, environment conditions (temperature or humidity), outfield conditions, condition of the ball, lighting conditions, and/or whether the team is playing on home ground or away.

In an embodiment, the correlation factor is a pitch correlation factor, wherein the pitch correlation factor puts the score of a player or team on a particular pitch into context and can be used to indicate a player or team's ratings.

In an embodiment, the method comprises determining the correlation factor based on the scoring rate of both sides, and the peak, relative and contextual run rates over specified periods of time.

In an embodiment, the method comprises determining an overall weighting to estimate resources used and resources remaining. In an embodiment, the resources comprise time, overs and/or balls.

In an embodiment, the method comprises determining the correlation factor based on minimum information required to record the result of a game. In an embodiment, the method comprises determining a pitch correlation factor for cricket, wherein pitch correlation factor is based on one or more of the attributes listed below:

- current runs per ball: current runs scored from current balls faced
- recent runs per ball: runs scored recently
- comparative runs per ball: recent runs per ball divided by current runs per ball
- required runs per ball (for chasing teams): number of runs scored by the team batting first divided by the total number of balls permissible
- chasing runs per ball (for chasing teams): current runs per ball divided by required runs per ball
- remaining runs per ball (for chasing teams): number of runs remaining from number of balls left.

In a fifth aspect, the present invention broadly consists in a computing device configured to perform the method of the fourth aspect, and any respective embodiment of the fourth aspect, described above.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to

which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

In addition, where features or aspects of the invention are described in terms of Markush groups, those persons skilled in the art will appreciate that the invention is also thereby described in terms of any individual member or subgroup of members of the Markush group.

As used herein, '(s)' following a noun means the plural and/or singular forms of the noun.

As used herein, the term 'and/or' means 'and' or 'or' or both.

The term 'comprising' as used in this specification means 'consisting at least in part of'. When interpreting each statement in this specification that includes the term 'comprising', features other than that or those prefaced by the term may also be present. Related terms such as 'comprise' and 'comprises' are to be interpreted in the same manner.

It is intended that reference to a range of numbers disclosed herein (for example, 1 to 10) also incorporates reference to all rational numbers within that range (for example, 1, 1.1, 2, 3, 3.9, 4, 5, 6, 6.5, 7, 8, 9, and 10) and also any range of rational numbers within that range (for example, 2 to 8, 1.5 to 5.5, and 3.1 to 4.7) and, therefore, all sub-ranges of all ranges expressly disclosed herein are hereby expressly disclosed. These are only examples of what is specifically intended and all possible combinations of numerical values between the lowest value and the highest value enumerated are to be considered to be expressly stated in this application in a similar manner.

In this specification where reference has been made to patent specifications, other external documents, or other sources of information, this is generally for the purpose of providing a context for discussing the features of the invention. Unless specifically stated otherwise, reference to such external documents or such sources of information is not to be construed as an admission that such documents or such sources of information, in any jurisdiction, are prior art or form part of the common general knowledge in the art.

Although the present invention is broadly as defined above, those persons skilled in the art will appreciate that the invention is not limited thereto and that the invention also includes embodiments of which the following description gives examples.

BRIEF DESCRIPTION OF THE FIGURES

Embodiments of the invention will now be described, by way of non-limiting example, with reference to the accompanying figures in which:

Figure 1 shows an overview of the contextual system according to an embodiment of the present invention for real-time prediction of match outcomes in sport;

Figures 2 and 2A show a sample output from a data input of Figure 1;

Figures 3 and 3A show a sample output from a data processing engine of Figure 1;

Figure 4 shows application of the system according to an embodiment of the present invention to Rugby Union;

Figure 5 shows another application of the system according to an embodiment of the present invention to Rugby Union;

Figure 6 shows application of the system according to an embodiment of the present invention to Short Form Cricket;

Figure 7 shows another application of the system according to an embodiment of the present invention to Short Form Cricket;

Figure 8 shows an application of the system according to an embodiment of the present invention to Multiple Innings Cricket;

Figure 9 shows an application of the system according to an embodiment of the present invention to Multiple Innings Cricket; and

Figure 10 shows a flow chart for determining a correlation/correction factor between a match outcome and a playing condition according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION

A system of an embodiment of the present invention relates to a data-driven contextual system that determines real-time (or near real-time) predictions of a match outcome within a sporting event, that can be either delivered during or after that sporting event. In the context of the specification, a 'match outcome' includes one or more of the result (win, loss, or draw for example), the score (points or runs for example), and the margin of victory (the score difference between the teams) of the match.

This system is applicable to a variety of team and/or individual sporting events. The system of the present invention may be used for, but not restricted to, cricket, Rugby Union, Rugby League, American football, Australian Rules football, netball, basketball, soccer, hockey, tennis, squash, badminton, and/or ice-hockey for example.

The system is also applicable to all, or at least a variety of, formats of these types of organised sporting events. For example, this system can be configured to predict a match outcome which includes projected runs scored, margin of victory and probability of winning for all forms of cricket such as limited over matches (for example, T20 cricket, 40 overs, and 50 overs, where each team bats only once per match) as well as two innings matches (such as first class, test, two-day, and three-day matches, where each team can bat up to twice per match). Additionally, both projected scores and probability of winning estimates are generated from the very start of the match through until completion (first ball of first innings, or first second of time bound event).

The system according to an embodiment of the present invention is based on a contextual system for real-time prediction of match outcomes in a sporting event, and delivery of the predictions to interested parties (such as media, coaches, players, administrators, advertisers and spectators) that are meaningful and quantitative indications to the progress of a sporting context. The system is further configured to indicate the probability of each team (or side) in the sporting event winning at any point in time during the match, and also what the likely score for each team is likely to be. In particular, at any point in time during the match, the system can calculate the probability of each team winning and the predicted margin of victory (ie. wickets remaining, balls to spare, or runs margin where the sporting event is cricket).

Using contextual information, the system can make predictions during the first and second innings. Further, based on the progression of a team's score in the current sporting event (ie. the run rate or the wicket loss rate for cricket), the system is configured to calculate a 'momentum' factor (or behavioural context or game pace) for that team (for example, relative recent scoring rate in rugby or when the net difference between scores is less than one scoring play). The system can take this 'momentum' factor into account when making predictions.

According to an embodiment of the present invention, the method, and system implementing the method, for determining an outcome of a sporting event comprises determining the momentum factor at any point in time of the sporting event and determining the outcome of the sporting event based on at least the momentum factor.

The momentum factor is based on the behavioural context (or previous events) in the sporting event. The behavioural context comprises information relating to previous events that occurred in the sporting event (such as points scored over an amount of a resource consumed to score those points, wherein a resource is consumed by a team in the sporting event to score points). Where the sporting event is cricket, the behavioural

context comprises in-game scoring rate, such as a run-rate or wicket-loss rate over a previous number of overs in the sporting event (for example, two or more overs).

Referring to Figure 1, the contextual system 100 according to an embodiment of the present invention for real-time (or near real-time) prediction of a match outcome in a sporting event (which can be delivered during or post event) has six components, which are identified below:

1. Initial Context/Prediction Engine 110
2. Data capture/Real-time (or near real-time) data input system 120
3. Behavioural Context/Contextual Engine 130
4. Data Processing Engine 140
5. Score Prediction Engine 150
6. Delivery Interface 160

Figure 1 shows how the six components 110-160 of the system 100 interact together. These components will be explained in further detail below.

Initial Prediction Engine 110

This initial prediction engine 110 is configured to determine the probability of winning. For example, in an embodiment this initial prediction engine 110 is configured to estimate the likelihood of Team A beating Team B. This estimation may be based on work similar to that described by, and referenced in, Bracewell, P.J., *et al. 'Determining the Evenness of Domestic Sporting Competition Using a Generic Rating Engine'*, Journal of Quantitative Analysis in Sports (2009), Vol. 5, No. 1, pp 1-25.

The initial prediction engine 110 may also be configured to make a score prediction. The prediction may be based on quantifiable contextual factors that influence scoring rate (e.g. weather, pitch, size of ground).

In an embodiment, the initial prediction engine 110 is configured to make predictions prior to the start of the sporting event.

The initial prediction engine 110 is static during an event and is updated at the conclusion of an event. The initial prediction system 110 determines the probability of Team A beating Team C at the start of the game based on historical results, such as the outcome of events between Team A and Team B, and between Team B and Team C for example.

Data input system 120

The data capture or data input system 120 is an electronic or digital system for capturing data regarding the event. The data is then automatically passed into the Contextual Engine via digital/electronic means. The input system is configured for real-time (or near real-time) data input. The result is that data is sent to the contextual engine in real time (or near real-time).

The data input system 120 comprises intelligent data processing to minimise data capture to enable access to all levels of a sport without bespoke data entry.

For instance, for rugby and other ball-orientated sports (such as netball, Australian Rules, American Football), the system comprises a timer to track the resource use/consumption (time) within the game and a mechanism for entering the number of points awarded to each team at any point in time (ie. 5 points for a try in rugby union).

For cricket, a system such as CricHQ (www.CricHQ.com) is suitable for capturing the minimum data elements relative to the resource use/consumption. In both instances, the data input system transfers the information to a database in real-time (or near real time, or in batch mode for simulation purposes). The database can be accessed by the relevant scoring and contextual engines in (or near real time, or in batch mode for simulation purposes).

In the case of cricket, the cricket scorer enters data into the CricHQ Scoring Application via an internet connected device. Examples of internet connected devices include tablets, laptops and smart phones. Scoring of cricket is mandated by the laws of the game. Preferably the CricHQ system is configured to score virtually any level of cricket, from international though to children's cricket.

The data is preferably extracted and uploaded in a batch mode. In this case score projections and the probability of winning is only relevant for post-match analysis.

Figures 2 and 2A show a sample output from the data input system 120.

Contextual engine 130

The contextual engine 130 comprises:

a. Behavioural context sub-model 132 – considers what has happened in the current sporting event prior to current action or time.

b. Historical context sub-model 134 – considers what has happened in sporting events completed prior to this sporting event.
c. Current context sub-model 136 – considers the current state of the current sporting event.

The data capture system 120 provides data to the behavioural context and current context sub-models 132, 136. The current context sub-model 136 considers the current state of the sporting event at the present play/action or time.

The information from the historical context sub-model 134 relates to previous momentum states observed in historical matches. The historical context sub-model 134 is different from the initial prediction engine 110. The initial prediction engine 110 is configured to predict the match outcome prior to the sporting event. In contrast, the historical context sub-model considers how events and strings of events within previous games have impacted on historical games in progress to then reweight these attributes to recalculate the forecasted outcome.

For example, in cricket, the behavioural context may include in-game scoring rate (run rate or wicket-loss rate over the previous number of overs in the current sporting event), the historical context may include historical scoring rate of the team, and the current context may include the remaining resources available (overs and/or time and wickets remaining) and the required run rate to reach the opposition total. As used herein, a points/score rate (such as a 'run rate') is the points scored over the amount of resources consumed to score those points. For example, a 'run rate' is the number of runs over the number of balls/overs to achieve those runs.

Similarly, the behavioural context in rugby may include in-game scoring rate (points scoring rate or try scoring rate over the number of minutes lapsed in the current sporting event), the historical context may include historical scoring rate of the team, and the current context may include the remaining resources available (time remaining) and the required scoring rate to reach the opposition total (that is a rugby team may need to outscore the opposition by a factor of 2-to-1 to take the lead immediately prior to the completion of the win.

The behavioural context is dynamic and depends on the current context of the sporting event. The value of the behavioural context factor may change throughout the sporting event. Alternatively, the value of the behavioural context factor may be constant through the sporting event, or throughout at least a portion of the event. The

behavioural context reflects the impact of recent events in this sporting event on the prediction at the current action or time.

The contextual engine 130 encompasses all match formats, all innings, and is not restricted to rain affected matches. The contextual engine 130 incorporates match context into the estimates, which can be obtained from all sports types. Examples of match context include:

- scoring system used (for example, the scoring system used in Rugby Union awards 5 points for a try, 2 points for a conversion, and 3 points for a penalty)
- historical scoring rate
- in-game scoring rate
- minimum number of successful scoring opportunities to take the lead.

Additional match context unique to a particular sport may be used. For example, cricket may alternatively or additionally incorporate the following types of contextual information (which can be derived from a minimal data capture system in-game):

- Likely maximum overs used in first innings (for two-innings games)
- Current run rate
- Recent run rate (for example, in the last two, three, four or five overs)
- Required run rate to reach opposition total
- Recent number of wickets lost (for example, in the last two, three, four or five overs)
- Resources available
    - Overs and/or time
    - Wickets (10 for limited overs; or 20 for two innings matches).

The end result is a robust prediction system that adjusts to match circumstances as the match unfolds. The underlying model architecture which enables these accurate and robust predictions is outlined in the following section.

Data Processing Engine 140

The data processing engine 140 collates, combines, manipulates and transforms data so that the data can be presented to the prediction engine 150.

The data processing engine 140 converts data from a transaction (or long-thin) file format to a flat file (or short-fat) structure to enable the calculations to be performed for the relevant time period (or event of interest). Processing of previous events and/or strings or previous events is also processed in this step (for example, time lag or series

of time lagged data). Any necessary processing to ensure assumptions of modelling techniques are also performed (for example, square root transformation of count data to stabilise variance and/or induce an approximately normal distribution). Where data is obtained from multiple data sets, these are combined into a single data set (for example, historical individual strike rate combined with strike observed in current match).

The first component modelled by the data processing engine 140, and applied in the contextual system is the predicted score. The output from the data processing engine 140 is used in the prediction engine 150. As outlined above, the forecasted score utilises the concept of resources. Simply, resources translate to the scoring or points system of the sporting event. The relationship used to create the model structure is defined below:

$$P(S_{c,i}) = S_{c,i}/R_{c,i} \quad (1)$$

where :

- $P(S_c)$ is the predicted final score for the i^{th} team observed at point c in the sporting event, where c either represents time or some other measure of match progress (such as overs or balls bowled).
- The i^{th} team represents either one of the two teams competing in the sporting event.
- $S_{c,i}$ is the current score for the i^{th} team observed at point c in the sporting event, where c is defined above.
- $R_{c,i}$ is the estimated resources currently consumed by the i^{th} team observed at point c in the sporting event, where c is defined above. The estimate for $R_{c,i}$ is modelled based on historical behaviour:

$$R_{c,i} = S_{c,i}/T_i \quad (2)$$

where:

- T_i is the final score achieved by the i^{th} team. The proportion, $S_{c,i}/T_i$, is then used as the dependent variable in a statistical model F[.] where the relevant contextual inputs, $Context_{c,i}$, based on the type of sporting event are used as independent variables.

$$S_{c,i}/T_i = F[Context_{c,i}] \quad (3)$$

To illustrate this structure, consider:

- a game of rugby, with 50% of resources used (based on time and context). Team A has scored 23 points at this stage. Consequently, they are forecast to score 46 points in total. (46 = 23/0.5)

- a game of cricket, with 25% of resources used (based on time or overs, wickets and context). Team A has scored 83. Consequently, they are forecast to score 332 (332=83/0.25).

The second component modelled is the match result (win, loss, or draw). The outcome is simplified to binary (win, loss) with the draw (specifically for cricket in two innings matches) absorbed into the match prediction via the context engine (in which case the probabilities of winning for each of the team batting first and the team batting second will sum to less than or equal to 1). The structure of this attribute is shown below:

$$P_{c,i} = G[Context_{c,i}] \quad (4)$$

where:

- $P_{c,i}$ is the probability of winning for the i^{th} team observed at point c in the sporting event, with c defined previously in this section. In defining the model, this outcome is the dependent variable and is either 1 (Team A wins) or 0 (Team B wins).
- A statistical model G[.] is applied to the relevant contextual inputs, $Context_{c,i}$, based on the type of sporting event. These contextual inputs are used as independent variables in the model construction.

Figures 3 and 3A show a sample output produced by the data processing engine.

An example of one metric derived from the current context:

Game_id	Baseline
NE090213	1.9630062237

Table 3 shows an example of the historical context for a batting team.

Balls left	Total wickets lost	Recent wickets lost	Current run rate	Recent run rate	Baseline run rate	Required run rate
99	0.090528	0.453527	-0.00689	0.39283	0.004756	-0.01215
98	0.091240	0.450880	-0.00720	0.38782	0.004949	-0.01279
97	0.091961	0.448166	-0.00751	0.38287	0.005150	-0.01346

Table 3: Example of historical context for a batting team

Prediction Engine 150

The prediction engine 150 applies a suite of predictive algorithms (derived using statistical/mathematical/econometric modelling applied to historical sporting event data) to estimate:

i. Score
ii. Margin of Victory
iii. Probability of Winning

The estimated margin of victory can be determined from the estimated score.

The prediction engine 150 feeds predicted outcomes back to the data processing engine 140.

The prediction engine 150 comprises a score prediction sub-model 152 for predicting a score and margin of victory, and an outcome prediction sub-model 154 for predicting the probability of winning.

The prediction engine 150 considers the impact of events that occurs in-game. For example, the prediction engine 150 considers recent changes in score, or recent, dramatic changes in resources (batsmen dismissed where the sporting event is cricket). This is where the concept of current match context comes into play, referred to as 'momentum'. The system takes into account the culmination of recent events and the localised impact that the culmination of events has on an outcome.

The prediction engine 150 learns from the data that is provided in an automated scoring system, which is built for the purpose of capturing the minimum required data to determine an outcome in the event and competition (for example, runs and wickets in cricket; points scored and type of points scored in rugby; and goals in soccer). Adjustments are made for environmental factors without having to specify these as input variables. Momentum is detected by the context system during the game, which makes it applicable to all levels of a sport - social, junior, club through to representative, semi-professional, and professional.

The prediction engine 130 looks at the impact of events that occurs in-game and, in particular, how the rate of change of the events (or game state or resource consumption) impacts the prediction of the match outcome.

There are insufficient historical instances of every plausible event and string of events, referred to as context or momentum. Statistical modelling is used to infer what may have happened in a particular scenario. The massive variation in scoring systems due to environmental conditions and the inability to harvest reliable, objective data requires the deployment of data driven methods to address the context of an event to provide reliable estimates (especially relevant in cricket, but also in rugby, league etc.).

The system of the present invention addresses this problem by modelling resources consumed using techniques that impose situational context onto the estimates which is then reflected in the resultant scoring projections (ie. on a low scoring pitch in cricket, the system scales the estimates effectively). Further, strings of recent events also have a statistically significant impact. Accordingly, the dynamic context of a match (recent scoring rate, recent resource change, relative scoring rates) is applied to refine resource estimates.

These resource estimates, embracing context (and including concepts such as momentum, game pace and/or balance), provide automated projections that are applicable to all levels of sport and do not require any specialist data capture mechanisms beyond the minimal data capture system for keeping score.

The resources are modelled to account automatically for environmental factors.

The prediction engine 150 also defines a margin of victory. The challenge in coming up with a margin of victory is that in some sports (such as cricket), events are loosely time bound. For example, in a 2 innings game - a team could bat as long as they want and are able. Additionally, the margin of victory must also consider the match contest. Accordingly, the estimate of the margin of victory is completely dependent on the adjustment for the match conditions.

The prediction engine 150 looks at consecutive strings of recent events or states to overcome the challenge of access to data and designed to create a truly universal system that can be applied to different formats of multiple sporting events. Game information is updated. Game information includes score, calculations performed for the projected score, and calculations performed for the probability of winning.

Delivery Interface 160

The delivery interface 160 comprises a delivery sub-model 162 for delivering data to interested parties or other devices, and a post-match delivery sub-model for delivering data back to the initial prediction engine 110.

Information in the form of data is preferably available for viewing by all interested parties with an internet connected device. An internet connected device includes a tablet, laptop and smart phone. This information is preferably available to parties in a form that does not require them to capture any data not mandated by the laws of cricket for scoring.

The delivery sub-model 162 of the delivery interface 160 transfers the data to interested parties and connected digital/electronic systems automatically. Figures 2 to 7 show examples of the information from the system 100 displayed on user devices.

Figure 4 shows application of the system to Rugby Union. This figure shows the probability of winning projection (New Zealand {Team A} vs France {Team B}, Pool Play, Rugby World Cup 2011).

Figure 5 shows another application of the system to Rugby Union. This figure shows the score projections (New Zealand vs South Africa, 12 September 2009).

Figure 6 shows application of the system to Short Form Cricket (e.g. T20 or 50 Overs). This figure shows the probability of winning projection (New Zealand {Chasing Team} vs England {Setting Team}, T20, 9 February 2013).

Figure 7 shows another application of the system to Short Form Cricket (e.g. T20 or 50 Overs). This figure shows the score projections (New Zealand {Chasing Team} vs England {Setting Team}, T20, 9 February 2013).

Figure 8 shows an application to Multiple Innings Cricket (e.g. First Class, Test or Club Two-day). This figure shows the probability of winning projection (with projected scores overlaid).

Figure 9 shows an application to Multiple Innings Cricket (e.g. First Class, Test or Club Two-day). This figure shows the score projections (Sri Lanka vs Pakistan, 1st Test, 4-7 July 2009).

The post-match delivery sub-model 164 delivers final outcomes to the initial prediction engine 110 to update the relevant estimates.

In order to define the initial probability of winning in cricket, an appropriate scoring system is required. Traditionally, if the team batting second wins, the margin of victory is reported as the number of wickets that remained.

As an example, consider the T20 cricket match between Wellington and Auckland, 16 November 2012. An indicative example of margin of victory for cricket matches where the team batting second wins is shown below.

Wellington Firebirds: *116 from 20*; Auckland Aces: *117/5 from 17.1*;
Win to: Auckland Aces by 5 wickets (*27 runs*); Performer of Match: *CJ Borgas (Firebirds)*

Auckland, batting second, overtook Wellington's total of 116 with 17 balls remaining to win. The traditional margin of victory is 5 wickets. However, with the resources available (17 balls, 5 wickets), Auckland were forecast to score an additional 27 runs. Thus, the margin of victory for the contextual system is 27. This enables a work similar to that described by, and referenced in, Bracewell *et al.*, (2009)) to be used to create ratings for cricket teams based on interactive performances.

Contextual information about the playing conditions is fed into this system in the form of a correlation/correction factor which scales the scores based on the playing/environmental conditions to enable suitable comparisons to be generated. The correlation/correction factor will be described in further detail below.

Correlating playing conditions to the performance of a player or team

This aspect of the system generates a correlation (or correction) factor that correlates the performance of a player or team to the playing conditions. Examples of playing conditions include the pitch conditions, environment conditions (temperature or humidity), outfield conditions, condition of the ball, lighting conditions, and whether the team is playing on home ground or away, for example.

The correlation factor may be used as a contextual input for the contextual engine 130 of the system 100.

Figure 10 shows a flow chart 1000 which indicates at a high level the flow to derive a context, which may be used in the contextual engine 130. The shaded boxes indicate

where data is entered into the system. Shaded boxes with the prefix "model" refers to historical context. The unshaded boxes refer to the creation of current and behavioural contextual attributes which are derived in game.

Basic scorecard information is extracted 1002 from the input system, describing the events. The export_ball_by_ball_data.txt file is imported 1004 into the system. The system prepares 1006 the ball by ball data so it can be merged with information about the individuals involved.

Basic scorecard information is extracted 1008 from the input system, describing who was involved in the events and a summary of their skill sets. The system imports 1010 the export_team_list.txt file into the system. Data relating to the individuals involved in the event is the processed 1012.

The system combines 1014 ball by ball information with details of the individuals involved in each interaction. The ball by ball information is consolidated 1016 and candidates identified for post-match processing.

Time dependent variables are calculated 1018 based on the state of the match, including the identification of consecutive events. The system quantifies 1020 the outcome of the event for post match processing.

The system prepares 1022 the data set which contains all input variables necessary to calculate probability of winning and projected total for an innings. This includes the calculation of variables that consider relative run rates. These run rates include past run rates, current run rates and required run rates. The system derives 1024 contextual weightings for variables based on the current state of the match.

The system accepts 1026 as input a data set which contains the weights necessary to perform the calculations on the input variables derived in the first innings. The system prepares a data set 1028 which contains both the input variables and corresponding weights to enable calculations to be performed on first innings data.

The system prepares 1030 a data set which contains both the input variables and corresponding weights to enable calculations to be performed on second innings data.

The data set is ordered 1032 to created sorted data sets.

The system extracts 1034 the last probability of winning from the completion of the 1st innings to adjust the early estimates of winning in the 2nd innings. Projections are collated 1036 from first and second innings, depending on the current state of progress of the game being processed. Calculations to ensure continuity in the probability of winning between the end of the first innings and start of second innings are performed in this stage.

The system takes as input a data set 1038 that contains the weights necessary to perform the calculations on the input variables derived in the second innings.

A data set is prepared 1040 that has the ball-by-ball projected totals for the game in progress. The system prepares 1042 a data set which has the ball-by-ball projected probability of winning for the game in progress.

A final data set is prepared 1044 that contains all scored information per ball. Accepted as input is 1046 a data set to ensure data is appropriately formatted. An example of formatting comprises one observation per legal delivery, up the maximum number of legal deliveries to ensure consistency in graphical displays of the preditictions.

The correlation factor can be determined based on the scoring rate of both sides, and the peak, relative and contextual run rates over specified periods of time (depending if the batting team is setting a total or chasing a total). This is also countered by reasonability limits of the scoring mechanism (for example, it is highly unlikely that in a rugby match that 160 points would be scored by a single team within the permissible 80 minutes. Thus a sustained scoring limit exceeding 160/80minutes is unlikely and therefore this forms an upper reasonability threshold). The overall weighting can then be determined that is given to time (overs and/or balls in cricket) in the estimates of resourcing used and therefore remaining.

A pitch correlation factor puts the score of a player or team on a particular pitch into context and can be used to indicate a player's ratings. For example, a player's rating based on a score obtained from a bowler-friendly pitch may be worth more compared to the same score obtained from a batsmen-friendly pitch.

The correlation factor makes use of the bare minimum required to record the result of a game in the context of a match and/or competition. For example, in determining a pitch correlation factor for cricket, the following attributes are derived and used to create the pitch correlation metric (note, these metrics are examples only):

- Current runs per ball: current runs scored from current balls faced.

- Recent runs per ball: runs scored recently (e.g. 12 balls).
- Comparative runs per ball: recent runs per ball divided by current runs per ball.
- Required runs per ball (for chasing teams): number of runs scored by the team batting first divided by the total number of balls permissible (i.e. for T20 this is 120 balls).
- Chasing runs per ball (for chasing teams): current runs per ball divided by required runs per ball.
- Remaining runs per ball (for chasing teams): number of runs remaining from number of balls left.

These scoring rates (or variation thereof) can be derived for any team sport and the above list serves as an indication only.

The correlation factor is used to scale scores based on playing conditions to allow for comparisons of teams' performances across different playing conditions. The system infers this from the match data, which allows the system to be used at all levels. Specifically, the interaction between teams - observed purely through the relative scoring rates and very recent events within the game (again, observed purely on the scoreboard) - are used to infer conditions. This objective, intelligent, contextual processing is data driven from the simplest of inputs. The system makes use of the readily available information for the correlation factor calculation.

The match outcome from other players or teams in a sporting event under a particular playing condition defines a correlation factor (or base condition), that can be used as a measure to determine the match outcome of other players or teams in future sporting events under the same or similar playing conditions.

The system uses the minimum statistics collected for all forms of the game, which makes it a universal system applicable to all levels of a sport. With respect to cricket, these conditions have a massive impact upon a potential score, which may be in the order of hundreds. Using historical data and additional variables, hones in on the average case, which omits the nuances of the game, which the simple, contextual system of the present invention captures to give more precise, natural, intelligent estimates.

Measure of player impact

The system also provides a measure of predicted impact of a player to the overall performance of the team. In deriving the measure, the system takes into account the

change in outcome of the sporting event before and after the player comes onto the pitch or court.

To determine the impact of an individual, which is scaled and relevant to the context of the match, the observed outcome on the probability of winning before and directly after a specific event (for example a delivery in cricket) is captured. For all events in which an individual was involved, the changes in probability are added together to give an overall indication of match impact. For example, consider an arbitrary example where a batsmen faces four balls . Ball 1, no run is scored resulting in the probability of winning dropping from 0.4305 to 0.4295, meaning a -0.001 impact on winning. Ball 2 results in 3 three runs and a 0.002 increase in the probability of winning. Ball 3 is hit for a boundary (4 runs), increasing the probability of winning by 0.005. On the fourth ball, the batsman is dismissed, meaning the probability of winning drops by 0.05. Thus, the overall batting match impact of this individual is:

$$-0.001 + 0.002 + 0.005 - 0.050 = -0.044$$

which corresponds to the probability by which the individual impacted the result. The overall batting impact can then be multiplied by 100 to convert it to a percentage. This overall batting impact as a percentage is shown as "batting impact" in Table 4.

Table 4 shows an example of match impacts (from a T20 International Cricket match between England and New Zealand, 25 June 2013):

innings	name	batting impact	runs scored	balls faced
1	BB McCullum	23	83	51
1	HD Rutherford	20	64	37
1	LRPL Taylor	9	33	20
1	TWM Latham	-6	23	18
1	JEC Franklin	12	0	1
2	L Wright	23	55	37
2	JC Buttler	7	19	10
2	AD Hales	4	42	29
2	MJ Lumb	1	30	15
2	RS Bopara	-6	32	19
2	EIG Morgan	-16	8	10
2	BA Stokes	-23	9	5

Table 4: Example of match impacts

A player has a positive impact if the outcome of the sporting event after the player comes onto the pitch or court improves.

The outcome of each interaction (i.e. a delivery) between a batter and bowler sums to zero. In particular, the sign of the impact measure for the batsmen would be opposite to the sign of the impact measure for the bowler and fieldsman in a play. For example, if a batsmen in a play brings a -0.001 probability of winning for Team A, then the bowler in the same play brings a +0.001 probability of winning for Team B.

Sets of computer executable instructions are executed within one or more engines or sub-models to perform the methods described above. The engines and sub-models comprise computing devices, or combinations of computing devices, configured to execute specific sets of computer executable instructions. Preferably, the computing device is connected to other devices. Where the device is networked to other devices, the device is configured to operate in the capacity of a server or a client machine in a server-client network environment. Alternatively, the device can operate as a peer-to-peer or distributed network environment. The device may also include any other machine capable of executing a set of instructions that specify actions to be taken by that machine. These instructions can be sequential or otherwise.

The term 'computing device' includes any collection of machines that individually or jointly execute a set or multiple sets of instructions to perform any one or more of the methods describes above.

The computing device includes a processor. An example of a processer is a central processing unit. The device further includes main system memory and static memory. The processor, main memory, and static memory communicate with each other via a data bus.

Computing device may also include a reader unit, network interface device, display device, optical media drive, cursor control device, and signal generation device.

The reader unit is able to receive a machine readable medium on which is stored one or more sets of instructions and data structures, for example computer software. The software uses one or more of the methods described above. Reader unit includes a disc drive and/or a USB port. In these cases, the machine readable medium includes a floppy disc and a static storage device such as a thumb drive. Where the optical media drive is used, the machine readable medium includes a CD-ROM.

Software may also reside completely or at least partially within the main system memory and/or within the processor during execution by the computing device. In this case, the main memory and processor constitute machine-readable tangible storage media.

Software may further be transmitted or received over the network via a network interface device. The data transfer uses any one of a number of well known transfer protocols. One example is the hypertext transfer protocol.

The machine-readable medium may be a single medium or multiple media. Examples of multiple media include a centralised or distributed database and/or associated caches. These multiple media each store one or more sets of computer executable instructions. The term 'machine-readable medium' includes any medium that is capable of storing, encoding or carrying a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methods described above. The machine-readable medium is also capable of storing, encoding or carrying data structures used by or associated with these sets of instructions. The term 'machine readable medium' includes solid-state memories, non-transitory media, optical media, magnetic media, and carrier wave signals.

It is not the intention to limit the scope of the invention to the abovementioned examples only. As would be appreciated by a skilled person in the art, many variations are possible without departing from the scope of the invention, as defined by the accompanying claims.

CLAIMS

1. A method for determining an outcome of a sporting event, the method comprising:

determining, by a contextual engine, a momentum factor at any point in time of the sporting event, wherein the momentum factor is based on previous events in the sporting event; and

determining, by a prediction engine, the outcome of the sporting event based on at least the momentum factor.

2. The method of claim 1 wherein the outcome includes a result of the sporting event.

3. The method of claim 2 wherein the result comprises a win, a loss, or a draw.

4. The method of any one of the preceding claims wherein the sporting event comprises team sporting events or individual sporting events.

5. The method of claim 4 wherein the sporting event is selected from cricket, Rugby Union, Rugby League, American football, Australian Rules football, netball, basketball, soccer, hockey, tennis, squash, badminton, and/or ice-hockey.

6. The method of any one of the preceding claims further comprising determining the outcome of one or more formats of the sporting event.

7. The method of claim 6 wherein the sporting event comprises cricket, the one or more formats comprising limited-over matches where each team bats once and/or multiple-innings matches where each team can bat multiple times per match.

8. The method of claim 6 or claim 7 wherein the outcome is determined at a start of the sporting event.

9. The method of claim 8 wherein the start of the sporting event is when the first ball in an innings is bowled.

10. The method of claim 8 wherein the start of the sporting event is a first second of the sporting event.

11. The method of any one of the preceding claims further comprising determining a probability of a team or side beating a second team or side.

12. The method of claim 11 comprising determining the probability of the team winning before the sporting event starts.

13. The method of claim 11 or claim 12 comprising determining the probability of the first team beating the second team based at least in part on a score in a previous sporting event between the first team and a third team and on a score in a previous sporting event between the second team and the third team.

14. The method of any one of the preceding claims further comprising determining a score prediction of the sporting event.

15. The method of claim 14 comprising determining the score prediction before the sporting event starts.

16. The method of claim 14 or claim 15 wherein the score prediction is based on one or more contextual factors.

17. The method of claim 16 wherein the contextual factor(s) is/are quantifiable.

18. The method of claim 16 or claim 17 wherein the contextual factor(s) comprise(s) one or more of weather conditions, pitch conditions, size-of-ground, and out-field conditions.

19. The method of any one of the preceding claims comprising determining a behavioural context of the sporting event, wherein the outcome is determined based at least partly on the behavioural context.

20. The method of any one of the preceding claims wherein the momentum factor is based at least partly on the behavioural context.

21. The method of claim 20 wherein the behavioural context comprises information relating to previous events that occurred in the sporting event.

22. The method of any one of claims 19 to 21 comprising providing the behavioural context from a data capture system.

23. The method of any one of claims 19 to 22 wherein the behavioural context comprises points scored over an amount of a resource consumed to score those points, wherein a resource is consumed by a team in the sporting event to score points.

24. The method of any one of claims 19 to 23 wherein the sporting event is cricket, the behavioural context comprising in-game scoring rate.

25. The method of claim 24 wherein the in-game scoring rate comprises a run-rate or wicket-loss rate over a previous number of overs in the sporting event.

26. The method of claim 24 or claim 25 comprising determining the in-game scoring rate over two or more overs in the sporting event.

27. The method of any one of claims 24 to 26 comprising determining the in-game scoring rate over five or more overs in the sporting event.

28. The method of any one of the preceding claims wherein the momentum factor is based on recent changes in score.

29. The method of any one of claims 1 to 27 wherein the momentum factor is based on changes in resources.

30. The method of claim 29 wherein the sporting event is cricket, the resources including batsmen and the changes in resources relate to batsmen dismissed.

31. The method of any one of the preceding claims further comprising determining a historical context of the sporting event, wherein the outcome is determined based at least partly on the historical context.

32. The method of claim 31 wherein the historical context comprises information relating to previous sporting events.

33. The method of claim 31 wherein the historical context for a team comprises a historical scoring rate of the team.

34. The method of any one of the preceding claims further comprising determining a current context of the sporting event, wherein the outcome is determined based at least partly on the current context.

35. The method of claim 24 wherein the current context comprises information relating to a current state of the sporting event.

36. The method of claim 34 or claim 35 further comprising providing the current context from a data capture system.

37. The method of any one of claims 34 to 36 wherein the current context comprises information on available resource(s) and/or a current difference between scores of teams in the sporting event.

38. The method of claim 37 wherein the sporting event is cricket, the information relating to available resource(s) comprises overs remaining or wickets remaining.

39. The method of any one of the preceding claims further comprising applying at least one predictive algorithm to determine the outcome of the sporting event.

40. The method of any one of the preceding claims wherein the contextual engine and prediction engine comprise one or more computing devices.

41. The method of claim 40 wherein the computing device(s) of the contextual engine is/are the same as the computing device(s) of the prediction engine.

42. The method of claim 40 wherein the computing device of the contextual engine(s) is/are separate from the computing device(s) of the prediction engine.

43. A method for displaying an outcome of a sporting event, the outcome of the sporting event determined by the method of any one of the preceding claims.

44. A system configured to determine an outcome of a sporting event, the system comprising:

a contextual engine for determining a momentum factor at any point in time of the sporting event, wherein the momentum factor is based on previous events in the sporting event; and

a prediction engine for determining the outcome of the sporting event based on at least the momentum factor.

45. The system of claim 44 wherein the outcome includes a result of the sporting event.

46. The system of claim 45 wherein the result comprises a win, a loss, or a draw.

47. The system of any one of claims 44 to 46 wherein the sporting event comprises team sporting events or individual sporting events.

48. The system of claim 47 wherein the sporting event is selected from cricket, Rugby Union, Rugby League, American football, Australian Rules football, netball, basketball, soccer, hockey, tennis, squash, badminton, and/or ice-hockey.

49. The system of any one of claims 44 to 48 wherein the system is configured to determine the outcome of one or more formats of the sporting event.

50. The system of claim 49 wherein the sporting event comprises cricket, the one or more formats comprising limited-over matches where each team bats once and/or multiple-innings matches where each team can bat multiple times per match.

51. The system of any one of claims 44 to 50 further comprising an initial prediction engine for determining the outcome at a start of the sporting event.

52. The system of claim 51 wherein the start of the sporting event is when the first ball in an innings is bowled.

53. The system of claim 51 wherein the start of the sporting event is a first second of the sporting event.

54. The system of any one of claims 51 to 53 wherein the initial prediction engine is configured to determine a probability of a team or side beating a second team or side.

55. The system of claim 54 wherein the initial prediction engine is configured to determine the probability of the team winning before the sporting event starts.

56. The system of claim 54 or claim 55 wherein the initial prediction engine is configured to determine the probability of the first team beating the second team based at least in part on a score in a previous sporting event between the first team and a third team and on a score in a previous sporting event between the second team and the third team.

57. The system of any one of claims 51 to 56 wherein the initial prediction engine is configured to determine a score prediction of the sporting event.

58. The system of claim 57 wherein the initial prediction engine is configured to determine the score prediction before the sporting event starts.

59. The system of claim 57 or claim 58 wherein the score prediction is based on one or more contextual factors.

60. The system of claim 59 wherein the contextual factor(s) is/are quantifiable.

61. The system of claim 59 or claim 60 wherein the contextual factor(s) is/are selected from weather conditions, pitch conditions, size-of-ground, and out-field conditions.

62. The system of any one of claims 44 to 61 further comprising a contextual engine for determining a behavioural context of the sporting event, wherein the outcome is determined based at least partly on the behavioural context.

63. The system of claim 62 wherein the momentum factor is based at least partly on the behavioural context.

64. The system of claim 62 or claim 63 wherein the behavioural context comprises information relating to previous events that occurred in the sporting event.

65. The system of any one of claims 62 to 64 wherein the system is connected to a data capture system from which the behavioural context is obtained.

66. The system of any one of claims 62 to 65 wherein the behavioural context comprises points scored over an amount of a resource consumed to score those points, wherein a resource is consumed by a team in the sporting event to score points.

67. The system of any one of claims 62 to 66 wherein the sporting event is cricket, the behavioural context comprising in-game scoring rate.

68. The system of claim 67 wherein the in-game scoring rate comprises a run-rate or wicket-loss rate over a previous number of overs in the sporting event.

69. The system of claim 67 or claim 68 wherein the system is configured to determine the in-game scoring rate over two or more overs in the sporting event.

70. The system of any one of claims 67 to 69 wherein the system is configured to determine the in-game scoring rate over five or more overs in the sporting event.

71. The system of any one of claims 44 to 70 wherein the momentum factor is based on recent changes in score.

72. The system of any one of claims 44 to 70 wherein the momentum factor is based on changes in resources.

73. The system of claim 72 wherein the sporting event is cricket, the resources including batsmen and the changes in resources relates to batsmen dismissed.

74. The system of any one of claims 44 to 73 further configured to determine a historical context of the sporting event, wherein the outcome is determined based at least partly on the historical context.

75. The system of claim 74 wherein the historical context comprises information relating to previous sporting events.

76. The system of claim 74 or claim 75 wherein the historical context for a team comprises a historical scoring rate of the team.

77. The system of any one of claims 44 to 76 further configured to determine a current context of the sporting event, wherein the outcome is determined based at least partly on the current context.

78. The system of claim 77 wherein the current context comprises information relating to a current state of the sporting event.

79. The system of claim 77 or claim 78 wherein the system is connected to a data capture system from which the current context is obtained.

80. The system of any one of claims 77 to 79 wherein the current context comprises information on available resource(s) and/or a current difference between scores of teams in the sporting event.

81. The system of claim 80 wherein the sporting event is cricket, the information relating to available resource(s) comprises overs remaining or wickets remaining.

82. The system of any one of claims 44 to 81 further comprising a data capture system.

83. The system of claim 82 wherein the data capture system is configured to provide the behavioural context to the contextual engine.

84. The system of claim 82 wherein the data capture system is configured to provide the current context to the contextual engine.

85. The system of any one of claims 44 to 84 further comprising a data processing engine for receiving data from the contextual engine.

86. The system of claim 85 wherein the data processing engine is configured to collate, combine, manipulate and transform data.

87. The system of claim 85 or claim 86 wherein the data processing engine is configured to convert data to a flat file structure.

88. The system of any one of claims 44 to 87 further comprising a prediction engine configured to apply at least one predictive algorithm to determine the outcome of the sporting event.

89. The system of any one of claims 44 to 88 further comprising a delivery interface for transmitting match outcome to relevant parties.

90. The system of claim 89 wherein the delivery interface is further configured to feedback the match outcome to the initial prediction engine.

91. A method for correlating a performance of a player or team to a playing condition in a sporting event, the method comprising:

determining, by a computing device, an actual match outcome of a player or team in a sporting event under a first playing condition at any point in time during the sporting event; and

comparing, by a computing device, the actual match outcome to a predicted match outcome to determine a correlation factor, wherein the correlation factor can be

applied to other players or teams in further sporting events to determine a match outcome of the player or team under the first playing condition.

92. The method of claim 91 comprising determining a match outcome in a sporting event based at least in part on the correlation factor.

93. The method of claim 91 or claim 92 comprising determining the predicted scoring rate according to the method of any one of claims 1 to 44.

94. The method of any one of claims 91 to 93 wherein the first playing condition is selected from pitch conditions, environment conditions, outfield conditions, condition of the ball, lighting conditions, and/or whether the team is playing on home ground or away.

95. The method of any one of claims 91 to 94 wherein the correlation factor is a pitch correlation factor, wherein the pitch correlation factor puts the score of a player or team on a particular pitch into context and can be used to indicate a player or team's ratings.

96. The method of any one of claims 91 to 95 comprising determining the correlation factor based on the scoring rate of both sides, and the peak, relative and contextual run rates over specified periods of time.

97. The method of any one of claims 91 to 96 comprising determining an overall weighting to estimate resources used and resources remaining.

98. The method of claim 97 wherein the resources comprise time, overs and/or balls.

99. The method of any one of claims 91 to 98 comprising determining the correlation factor based on minimum information required to record the result of a game.

100. The method of any one of claims 91 to 99 comprising determining a pitch correlation factor for cricket, wherein pitch correlation factor is based on one or more of current runs per ball, recent runs per ball, comparative runs per ball, required runs per ball, chasing runs per ball, and remaining runs per ball.

101. The method of any one of claims 91 to 100 wherein the computing device for determining the actual match outcome is the same as the computing device for comparing the actual match outcome of the predicted match outcome.

102. The method of any one of claims 91 to 100 wherein the computing device for determining the actual match outcome is separate from the computing device for comparing the actual match outcome of the predicted match outcome.

103. A system configured to determine an outcome of a sporting event, the system comprising:

a processor; and

a computer readable medium having stored thereon computer-executable instructions that, when executed by the processor, cause the processor to perform the method of any one of claims 1 to 43.

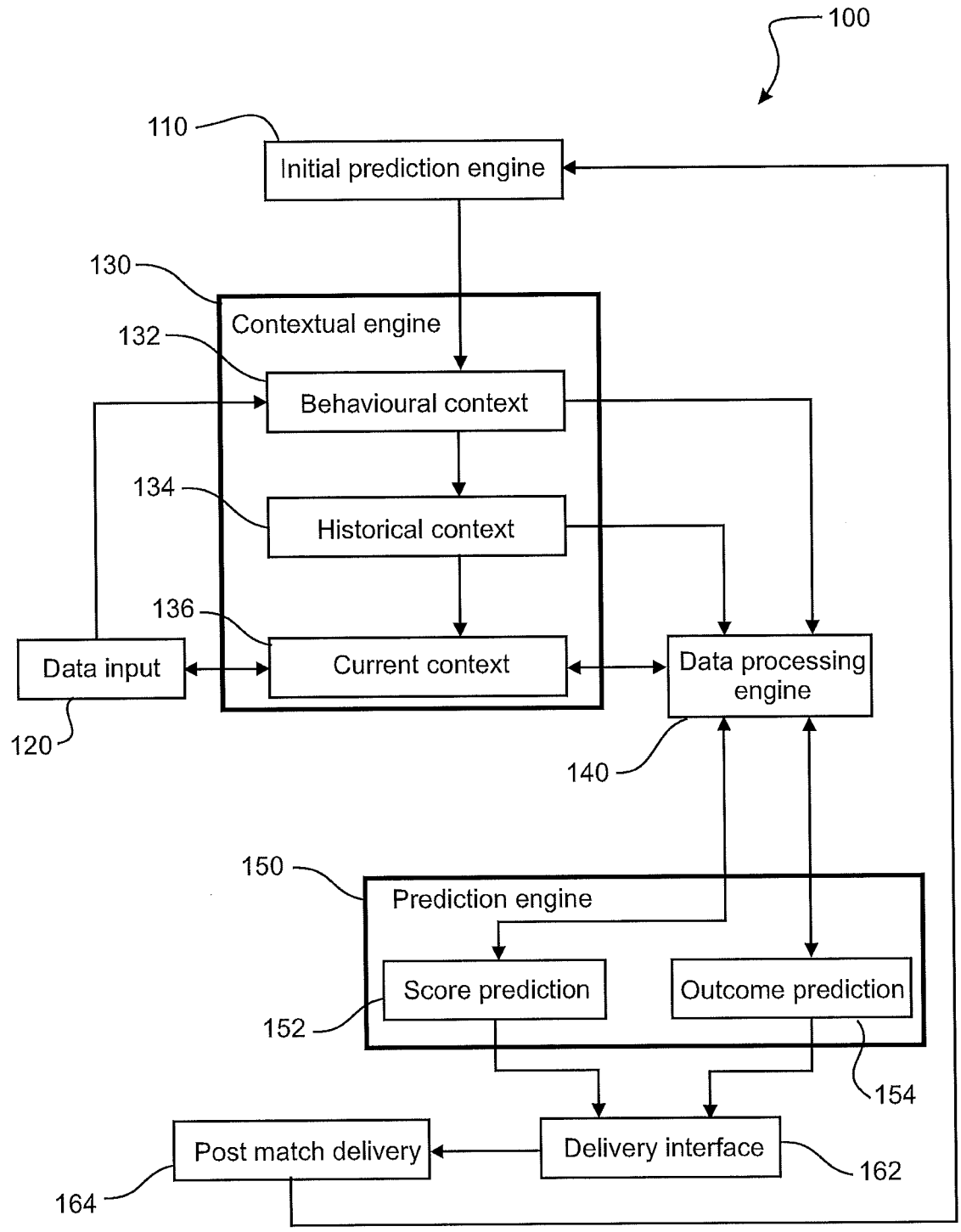
100
110
Initial prediction engine
130
Contextual engine
132
Behavioural context
134
Historical context
136
Current context
Data input
120
Data processing engine
140
150
Prediction engine
Score prediction
152
Outcome prediction
154
Post match delivery
164
Delivery interface
162

FIGURE 1

Game ID	Home	Away	Venue	Innings	Over	Ball	Description	...
NE090213	NZ	England	41314	1	0	1		
NE090213	NZ	England	41314	1	0	2		
NE090213	NZ	England	41314	1	0	3		

FIGURE 2

Game ID	...	Out	Runs Scored	Sundry Type	Batting name	Bowling name	Team batting	Team bowling	Match date
NE090213		0	1		MJ Lumb	MJ McClenaghan	England	NZ	2/09/2013
NE090213		0	3		AD Hales	MJ McClenaghan	England	NZ	2/09/2013
NE090213		0	1		MJ Lumb	MJ McClenaghan	England	NZ	2/09/2013

FIGURE 2A

Batting name	Bowling name	Game ID	Innings	Over	Ball	Sundry Type	Bat Type	Bwl Type	...
MJ Guptill	ST Finn	NE090213	2	8	3		Right hand	RFM	
MJ Guptill	ST Finn	NE090213	2	8	4		Right hand	RFM	
LRP Taylor	ST Finn	NE090213	2	8	5		Right hand	RFM	
LRP Taylor	ST Finn	NE090213	2	8	6		Right hand	RFM	
C Munro	SR Patel	NE090213	2	9	1		Right hand	SLA	
MJ Guptill	SR Patel	NE090213	2	9	2		Right hand	SLA	
MJ Guptill	SR Patel	NE090213	2	9	3		Left hand	SLA	

FIGURE 3

...	Wickets lost	Total runs	Balls left	Current rpb	Recent wkts	Recent rpb	Required rpb	Chasing rpb	Remaining rpb
	2	76	69	1.4902	0	1.2	1.7833	0.8356	2.0000
	2	77	68	1.4808	0	1.3	1.7833	0.8303	2.0147
	2	77	67	1.4528	0	1.2	1.7833	0.8147	2.0447
	3	77	66	1.4259	1	1.0	1.7833	0.7996	2.0757
	3	78	65	1.4181	1	1.0	1.7833	0.7952	2.0923
	3	84	64	1.5000	1	1.2	1.7833	0.8411	2.0312
	3	85	63	1.4912	1	1.3	1.7833	0.8362	2.0476

FIGURE 3A

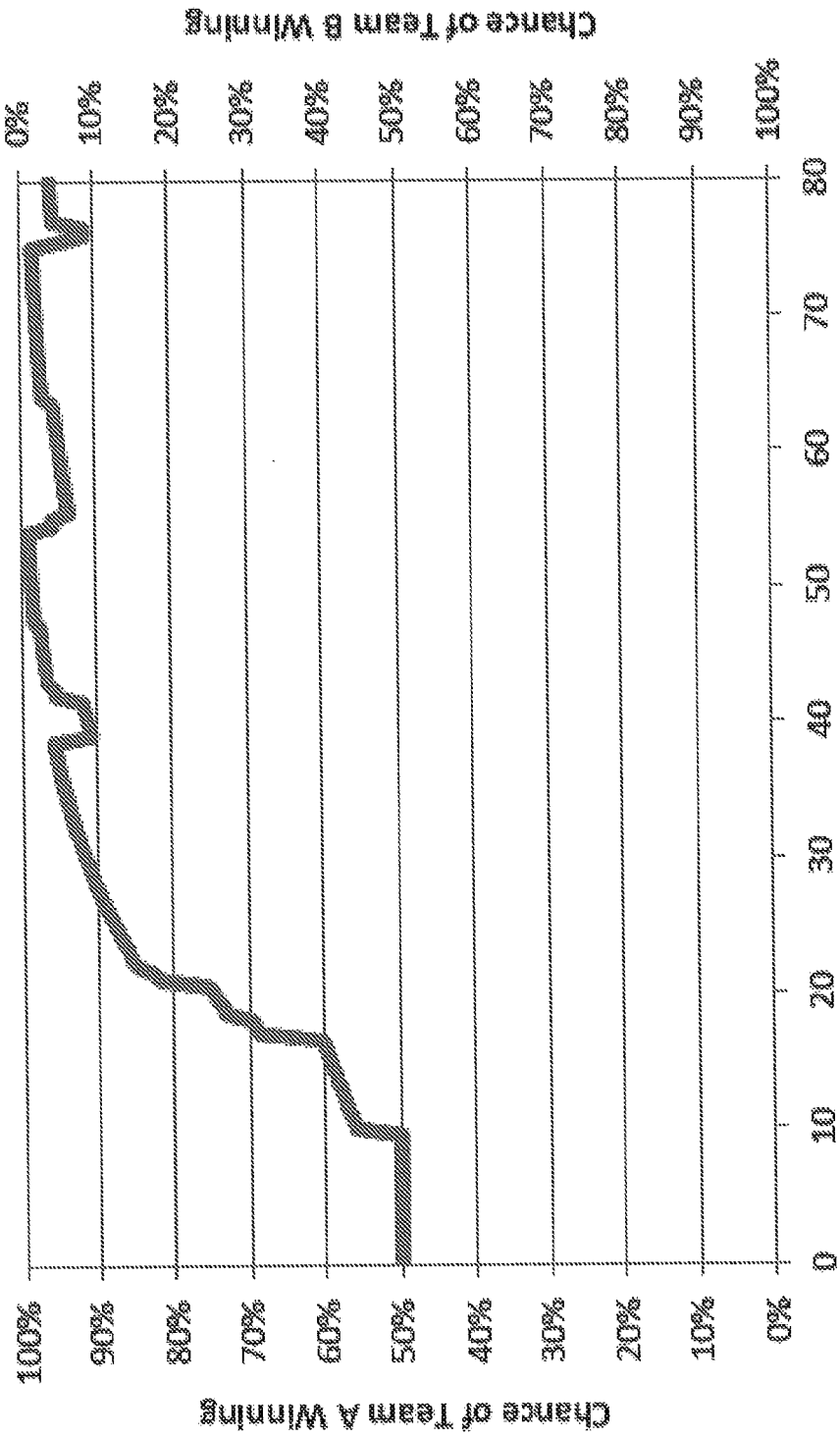
Chance of Team A Winning
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
20
30
40
50
60
70
80
Minutes
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Chance of Team B Winning

FIGURE 4

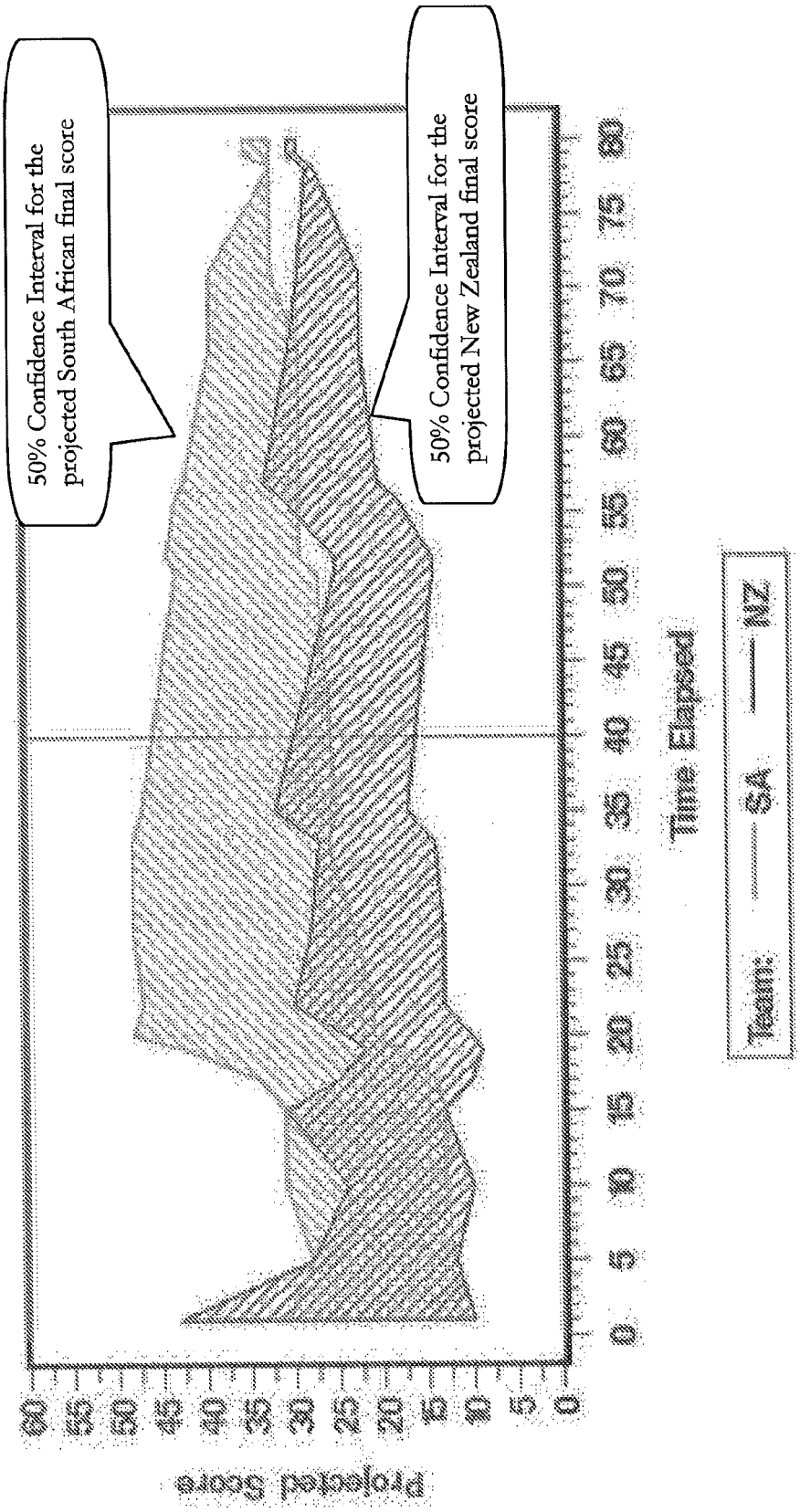
50% Confidence Interval for the projected South African final score
50% Confidence Interval for the projected New Zealand final score
Projected Score
Time Elapsed
Team: SA NZ

FIGURE 5

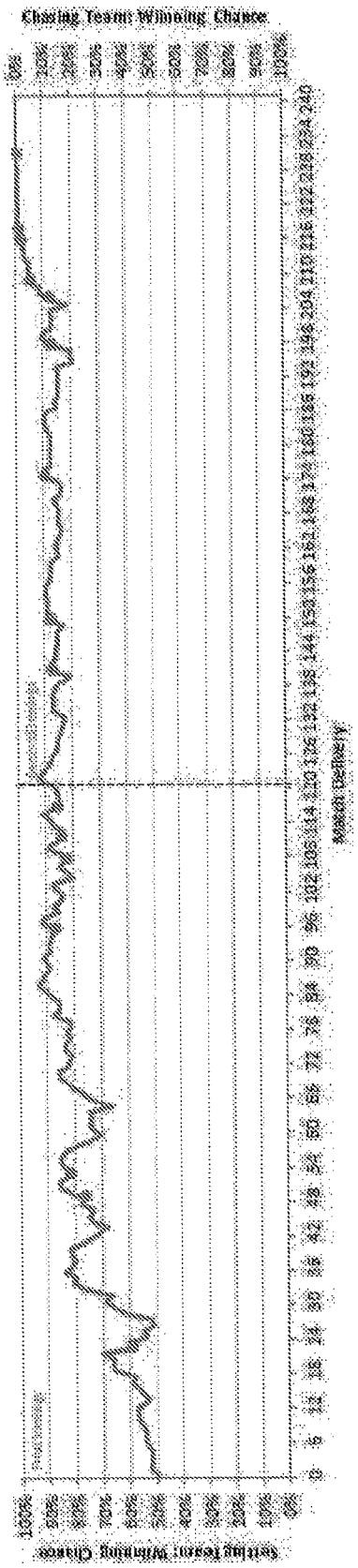

FIGURE 6

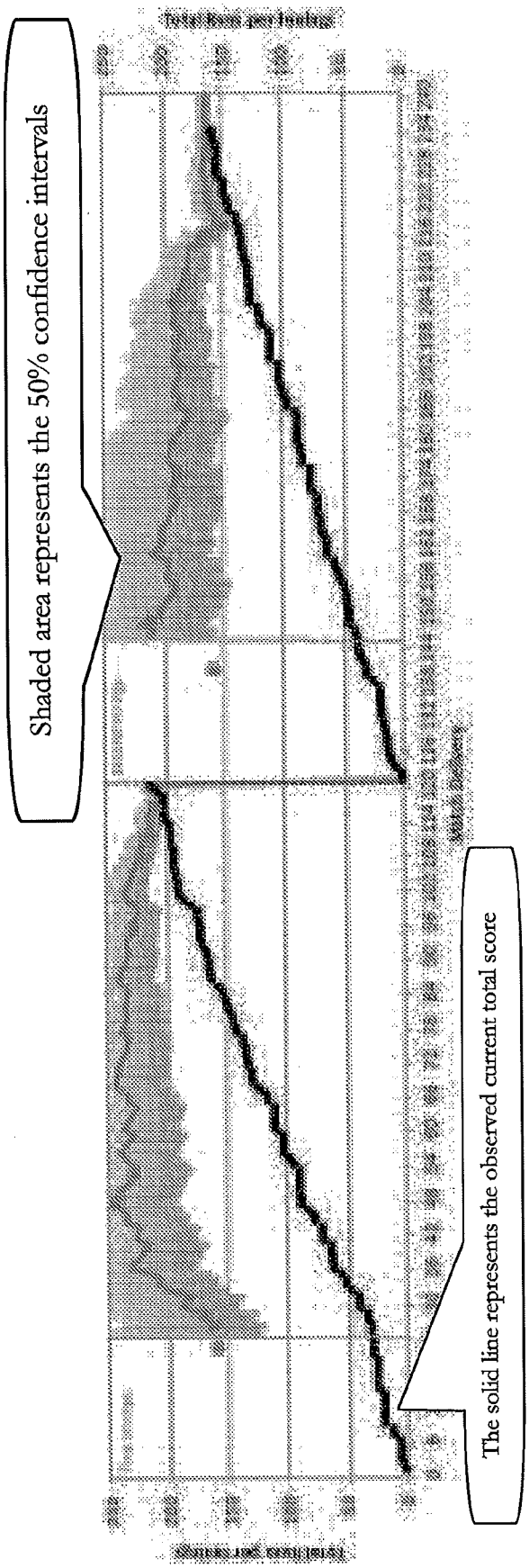
Shaded area represents the 50% confidence intervals
The solid line represents the observed current total score

FIGURE 7

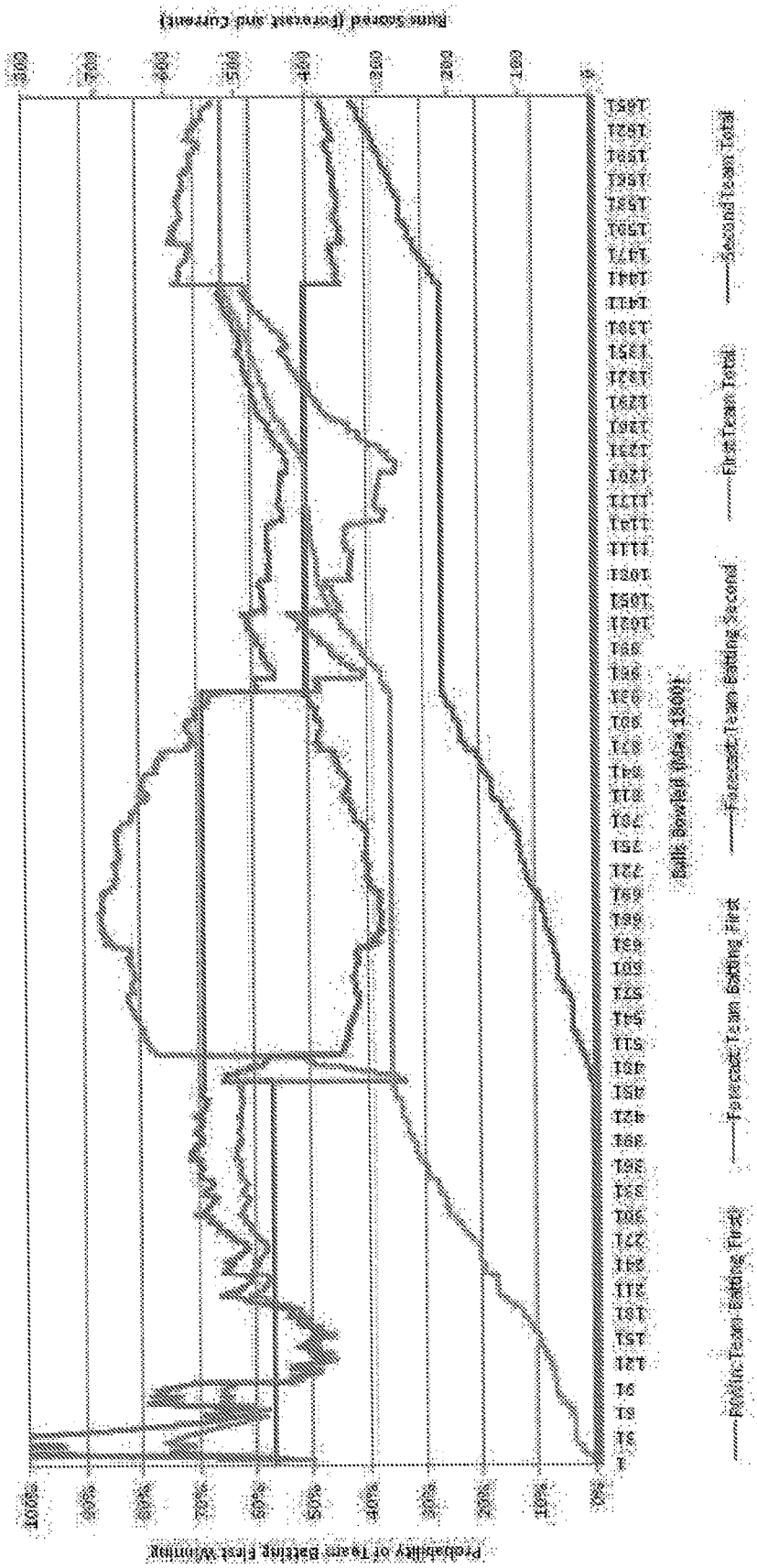
Runs Scored (Forecast and Current)
Probability of Team Batting First Winning
Balls Bowled (Max 1800)
Probable Team Batting First
Forecast Team Batting First
Forecast Team Batting Second
First Team Total
Second Team Total

FIGURE 8

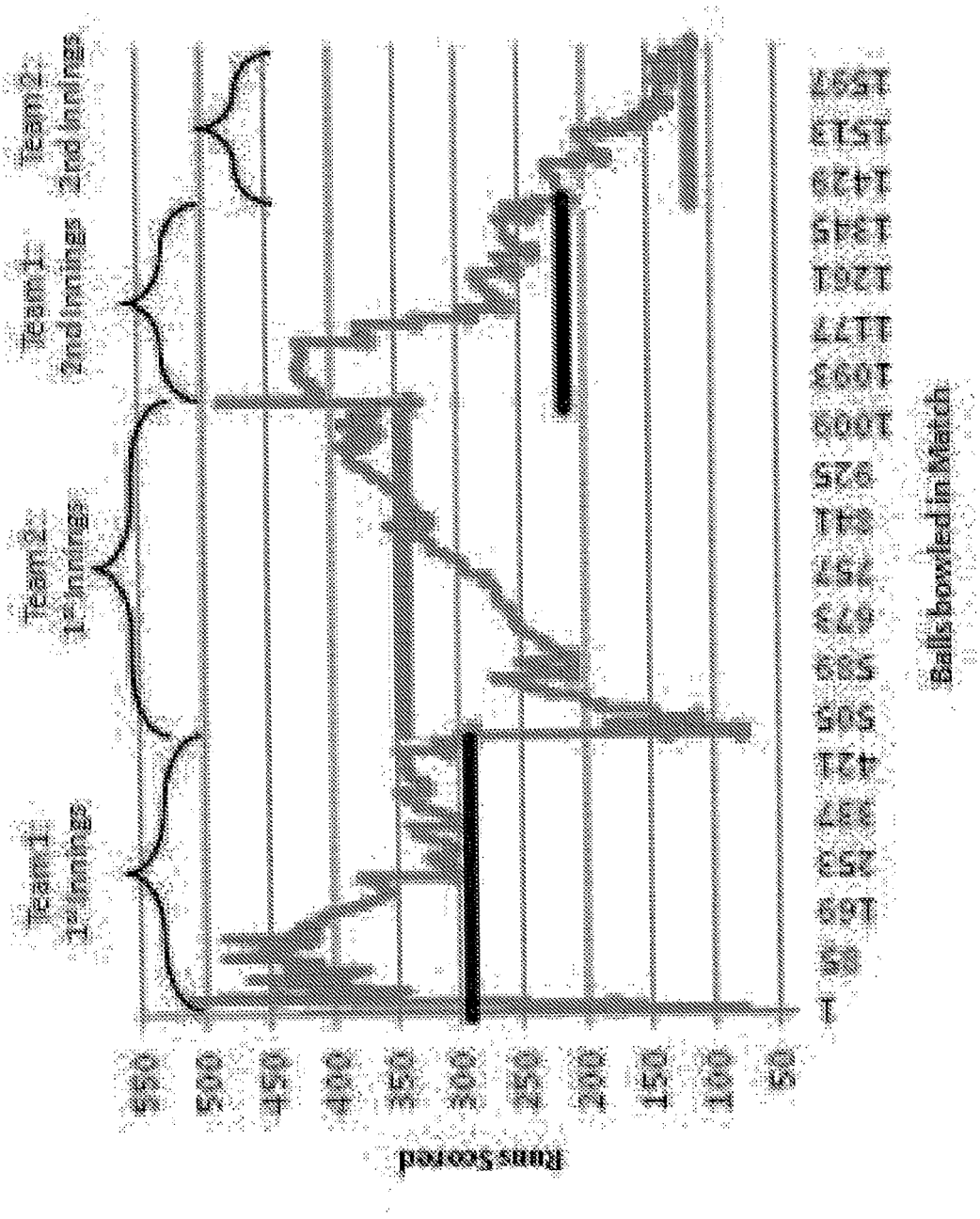
Team 1: 1st innings
Team 2: 1st innings
Team 1: 2nd innings
Team 2: 2nd innings
Runs Scored
550
500
450
400
350
300
250
200
150
100
50
Balls bowled in Match
1
85
169
253
337
421
505
589
673
757
841
925
1009
1093
1177
1261
1345
1429
1513
1597

FIGURE 9

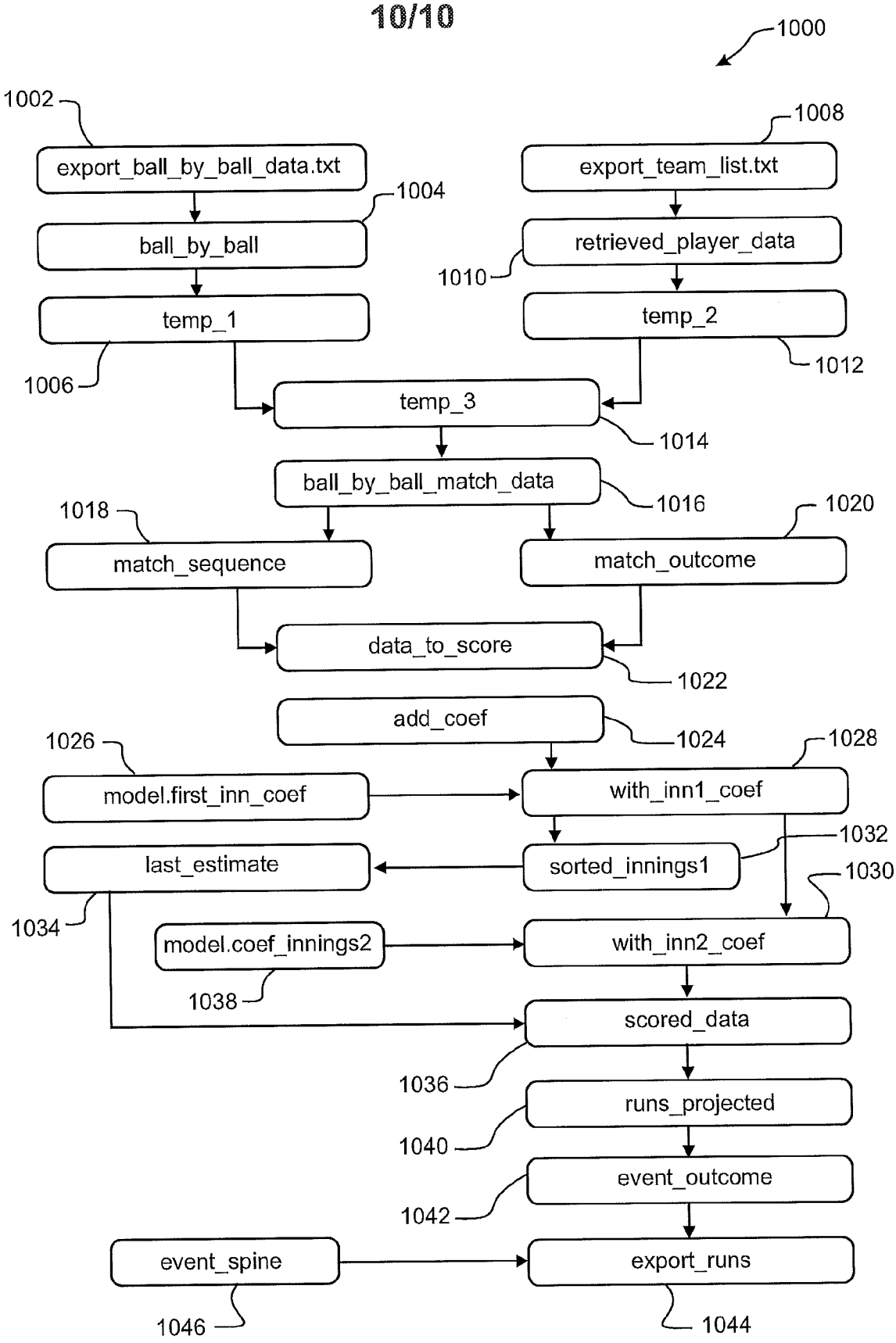
1000
1002
export_ball_by_ball_data.txt
1004
ball_by_ball
temp_1
1006
1008
export_team_list.txt
retrieved_player_data
1010
temp_2
1012
temp_3
1014
ball_by_ball_match_data
1016
1018
match_sequence
1020
match_outcome
data_to_score
1022
add_coef
1024
1026
model.first_inn_coef
1028
with_inn1_coef
1032
last_estimate
sorted_innings1
1030
1034
model.coef_innings2
with_inn2_coef
1038
scored_data
1036
runs_projected
1040
event_outcome
1042
event_spine
export_runs
1046
1044

FIGURE 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2014/050012

A. CLASSIFICATION OF SUBJECT MATTER

G06Q 10/04 (2012.01) G06Q 90/00 (2006.01) G06Q 99/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

TXTE, EPDOC, FREE PATENTS ONLINE, GOOGLE SCHOLAR and GOOGLE:

sporting, cricket, outcome, event, match, contest, game, result, predict, forecast, extrapolate, calculate, context, behaviour, history, record, previous, past, weather, condition, location, venue, score, points, runs, momentum, impetus, present, status, situation, state, current, real time with other similar terms and synonyms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 April 2015	10 April 2015

Name and mailing address of the ISA/AU

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Authorised officer

Boris Cetinich
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No. 0399359619

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2014/050012

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:

because they relate to subject matter not required to be searched by this Authority, namely:

the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. ☐ Claims Nos.:

because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:

because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-90

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/NZ2014/050012**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AKHTAR S. et al. - "Forecasting Test Cricket Match Outcomes In Play", International Journal of Forecasting 28 (2012) 632–643 abstract and pages 632-641	1-13, 19-56 and 62-90
X	BAILEY M. et al. - "Predicting The Match Outcome In One Day International Cricket Matches, While The Games Is In Progress", Journal of Sports Science and Medicine (2006) 5, 480-487 abstract and pages 480-484	1-90
X	SCARF P. et al. - "Modelling Match Outcomes And Decision Support For Setting A Final Innings Target In Test Cricket", IMA Journal of Management Mathematics (2005) 16, 161−178 abstract and pages 162-173	1-13, 19-56 and 62-90
A	BOULIER B.L. et al. - "Predicting The Outcomes Of National Football League Games", International Journal of Forecasting 19 (2003) 257–270 whole document	1-90
A	US 8,532,798 B2 (FERRARO, III et al.) 10 September 2013 whole document	1-90

INTERNATIONAL SEARCH REPORT	International application No. PCT/NZ2014/050012

Supplemental Box

Continuation of: **Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-90 are directed to towards a method of determining an outcome of a sporting event. The feature of determining the "momentum factor at any point in time of the sporting event, wherein the momentum factor is based on previous events in the sporting event" is specific to this group of claims.

- Claims 91-103 are directed towards a method of determining an outcome of a sporting event. The feature of comparing "the actual match outcome to a predicted match outcome to determine a correlation factor" is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions and which provides a technical relationship among them is *"predicting an outcome of a sporting event"*

However this feature does not make a contribution over the prior art because it is disclosed in:

D1: AKHTAR S. et al. - "Forecasting Test Cricket Match Outcomes in Play", International Journal of Forecasting 28 (2012) 632–643 [abstract]

Therefore in the light of this document this common feature cannot be a special technical feature. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a posteriori*.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/NZ2014/050012**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
US 8,532,798 B2	10 September 2013	US 8532798 B2	10 Sep 2013

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.