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Implementing Statistics in a Diagnostic Coaching Structure for Rugby

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Abstract

Statistics are having an increased influence in the rugby-coaching environment. Many of the statistics used are exposed to changeable match constraints and conditions, reducing the practical significance of these data.

Multivariate statistical techniques allow meaningful statistics to be created that can summarise individual performance and negate the variability in match involvement. This increases the power of the statistical tool to coaches by enabling deficient or superior performances to be identified and put into context.

The steps required to create a stable measure of overall performance are outlined, before it is shown how this same process can be used to identify inferior/superior performance on single physical tasks. The same simple process of constructing an overall rating and then deconstructing the rating to diagnose the causes of abnormal performance is applicable to other sports, but provides the coach with an easier to use data set that can be explored using graphical techniques.

Introduction

Statistics are a natural by-product of competitive sport, for in many instances this information is used to determine match result (runs, goals, points, time). Encapsulated within the resultant match data are gems relating to match performance. Extracting this information can lead to valuable insight into the performance of individuals and their relative capacity or ability. This paper will explore the use of statistics relating to individual performance from a statistical perspective, relating sound theory and methodology to enhance the information obtained, enabling 'real' problem areas to be identified. The basic approach applied is applicable to many sports; however, in this instance rugby will be used as an example, with reference to the commercially developed Eagle Rating (www.eaglesports.co.nz).

Basic Philosophy

The philosophy adopted is simple. Instead of monitoring univariate, or single task orientated variables such as tackle counts, a measure of overall performance - in this case the Eagle Rating - is calculated and monitored. The measure is comprised of Key Performance Indicators (KPI's) which are effectively a summary of the single task variables for each match. The match performance measure is monitored, over a player's career, and this provides insight regarding the potential of the player. Given that a problem is identified, the cause is found by establishing the abnormal KPI and from this the deficient skill is detected. Further, the actual event can be established from the skill grouping in many cases. It is then up to the coach to decide whether or not the problem requires remedial intervention. The basic structure required to implement statistics in a diagnostic coaching structure, as described, is outlined in Figure 1.

Due to match volatility, issues associated with non-performance and fluctuating individual involvement, stable statistics must be obtained, before any useful trend analysis or diagnostic interpretation can occur. Statistically sound data is achieved through considering holistic performance over a series of matches; that is the overall involvement an individual has had in a match provides the starting point for analyses.

For each match a stable indicator of performance is created from the separate task variables with minimal information loss. This forms the calculation stage, shown in Figure 1. From a coaching perspective it is the performance monitoring stages and beyond that are of interest in Figure 1.

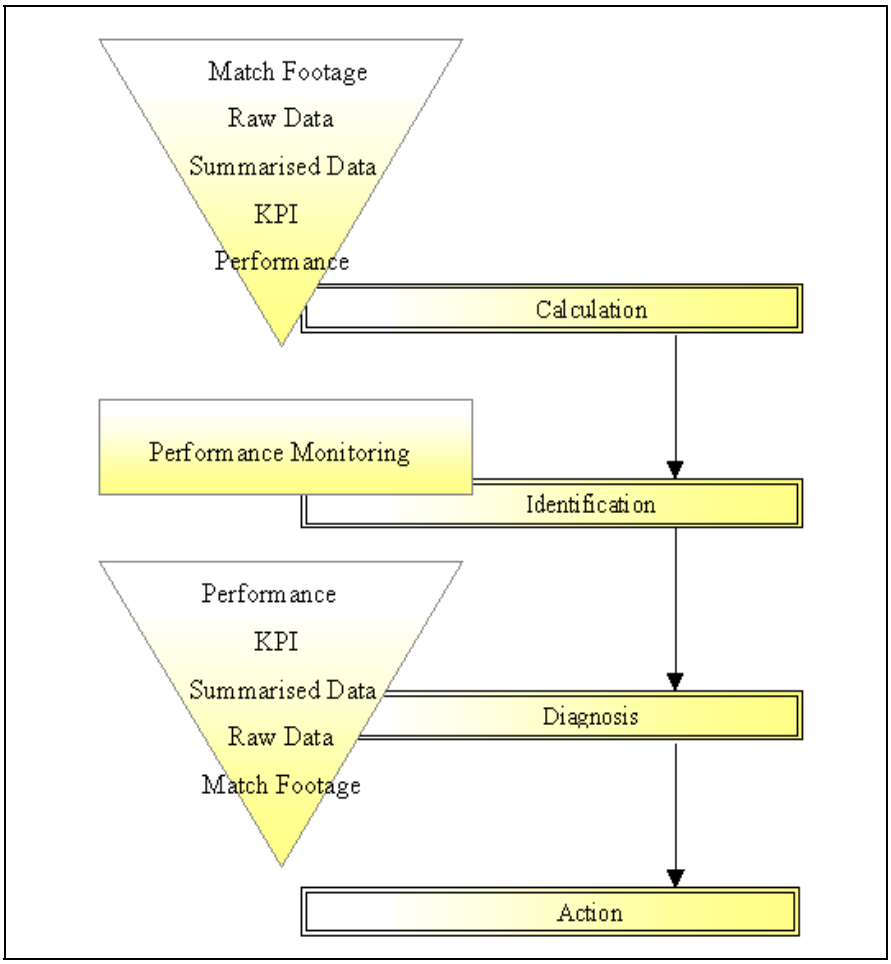

Figure 1. Flow Chart Displaying the Four Steps in Applying an Individualistic Rating System as a Diagnostic Tool

In order to implement statistics in a coaching diagnostic structure four steps must be satisfied prior to the calculation of statistics that provide the basis for any reliable inference:

Define Performance
Operationalise Performance Definitions
Quantify Match Involvement via Operationalised Measures
Calculate Performance Measures - a) KPI's,
b) Overall Performance

These steps are necessary to provide a stable foundation from which performance can be assessed and monitored. Because of the differing circumstances confronting an individual in a sporting contest, there will obviously be differences in performance. The previous four steps allow performance to be quantified. This information, coupled with information obtained from prior performances allows the match behaviour of an individual to be monitored using statistical techniques such as control charting procedures. These procedures are designed to detect real (significant) changes in performance over time.

Given an overall measure of performance on a match-by-match basis, sequential points can be plotted graphically using control charts such as an EWMA or Shewhart charts [5]. The expected capability of an athlete, defined from prior performance, is used to set process limits for these charts. From this graphical display of performance, changes are evident if the process limits (expected capability of an athlete) are exceeded or additionally in the case of the Shewhart chart one or more of the run rules are violated. If no significant changes in performances are identified this indicates that an individual is playing to his/her expected performance level. Given this performance level is acceptable, action required is minimal. However, if a change of performance is evident, this can be due to one of three scenarios: player's

performance has improved, player's performance has worsened, performance is stable and unstable match conditions have caused a false alarm. Given the available chain of evidence (Performance Measure, KPI's, Task Data, Specific Event) it is then up to the coach to decide on the appropriate course of action.

A hypothetical example is used to illustrate this point. A deficient performance measure is detected, and investigation reveals that this is due to an inferior defensive performance. The defensive attributes are examined, and it is clear that tackling was the problem, specifically too many tackles were missed. Assessing the missed tackles it is found that the missed tackles occurred when the player was attempting to use the left shoulder to drive in and make the tackle. The coach's task is to decide whether or not the individual needs remedial coaching to correct this deficiency, or if extenuating circumstances caused the lapse, and act accordingly.

This essentially summarises the processes involved with incorporating statistics into a diagnostic coaching structure. The reasoning behind the adoption of such methodology is expanded upon later. Having outlined briefly the basic philosophy and goals of performance monitoring, it is important to establish the applicability of statistics in a coaching environment.

Performance Applicability

Statistics are applicable in the rugby environment, as outlined by the New Zealand Rugby Football Union in the Coaching Accreditation Manual: Level 3 [7]. The second module of this publication, *Teaching Skills and Skills Analyses: Analysis of Performance* (pp. 9-15), discusses the benefits of statistics in a rugby coaching environment which are summarised in the following two paragraphs.

Assessment based upon only qualitative analysis can be distorted by specific events such as: injuries, current score, player's decisions, referee rulings and the most recent "calamity" or accomplishment, based upon real time and live input collection. In addition, recall of events is impaired by a number of factors, described briefly as follows. Firstly, it is impossible for coaches to absorb all the events of a game. Further individuals have limited recall of what has occurred and may struggle to put events into context, and rare events may not be recalled at all. Finally tension, emotion and personal bias significantly affect the retention of relevant data [7].

The need for use of more reliable quantitative analysis is highlighted by the fact that "improvements in performance are related to the quality of feedback given to players after a game; This is most effective if given as soon as possible". Consequently, "performance may not be improved if there are flaws in this feedback. This is particularly applicable to peripheral play away from the ball, which involves most of the players most of the time. Any feedback the coach gives to players is based on partial information because it is impossible to see all players at once and not be distracted by play with the ball ([7], p. 10)." Further, social phenomenon such as social loafing can probably only be rectified through the use of statistics that identify and attribute performance to individual players [4].

The improved development and subsequent reliance upon video analyses (incorporating digital footage and software enabling instant recall of events) to recall events can remedy a number of these problem areas in post match analysis, and statistical analyses can help coaches to pinpoint these portions of game play that need consideration.

Assessing the capabilities of an individual with respect to prior performance identifies the aberrant behaviour. Statistical techniques define performance parameters, based on prior performance of many similar individuals (defined by positional responsibilities). Match performance is then monitored with respect to these parameters, allowing trends in performance to be identified. The keys steps in creating such a process are crucial in developing a structurally sound platform on which to base inferences regarding player performance.

Creation of Stable Statistics

Statistically, an individual's ability cannot be inferred from a single match. The performance of an individual must be monitored over several matches, depending on the level of significance required. From a series of performances, trends in player performance can be established as well as the associated strengths and weaknesses. More importantly, given a series of matches ability can be inferred. Individual "ability is inferred from performance, which is inferred from the combination of the successful and unsuccessful completion of physical tasks ([2], p. 19)". In order to complete a successful physical action in a game situation, the associated mental tasks must also be completed successfully. This is an important assumption associated with applying statistics to rate individual performance. Bracewell [2]

explores the definition of performance and ability and the subsequent quantification in greater depth than is necessary here.

Sports performance is multifaceted. That is performance on many relevant, and often related, tasks is required to compete effectively. Consequently, relative performance on each attribute must be considered. However, in a team situation, or even in a direct contest with opposition, certain tasks are performed rarely due to match constraints. Match conditions, constraints and the subsequent impact on individual involvement are crucial in statistical analyses. In every match, individuals are exposed to volatile match conditions [2]. Given the rugby example, an individual may not make many tackles because his/her team has dominated possession. Consequently it is inappropriate to determine level of performance through univariate statistics such as tackle counts because tackle counts may not give a full impression of defensive performance or overall performance, given the match structure.

In order to combat match volatility, multivariate statistical techniques provide the ideal tool in summarising performance. Given that performance on separate related tasks is due to some core ability (attack, defence, kicking and so forth) inferences regarding performance relating to that core ability can be extracted using multivariate statistical techniques. The most suitable statistical techniques involve dimension reduction, where multiple variables are reduced to a smaller number of variables based on the overlap of information between variables. The vulnerability of solitary variables to match volatility is reduced by the combination of several related variables. Dimension reduction techniques such as factor analysis, neural networks and self-organising maps can be used to extract statistically sound KPI's, based upon the inherent structure of individual performance created from many individuals in similar positions over many games at a relative level [3]. There is the potential for each level of rugby (international, provincial, club, school-boy) to have a different set of KPI's, due to the structure of the game and skill level at each level.

Finally, the separate core skill components or key performance indicators for a single player in one match can be combined to produce a solitary measure of performance using multivariate process control procedures, and averaging over several matches provides a measure of player performance.

Incorporating 'Quality Control' Into a Diagnostic Structure

At this stage it must be stressed that observance of individual performance through purely objective statistical measures is just a tool for identifying level of performance. Utilisation of such a technique needs to be balanced with qualitative measures and subjective assessment performed by the coaching staff. The label, 'performance monitoring', implies a less regimented approach than 'quality control'. This phrasing has important implications on how a resultant statistics package is perceived and therefore implemented. Naming of the procedure aside, quality control is the ideal tool for assessing individual sporting performance.

The theory of quality control is almost parallel to sport statistics [6] in that the nature of a process is quantified, such that any deviation from 'expected' is quickly identified. Sport statistics seeks to specify sporting ability, the 'process' in this case. Control charting procedures provide the ideal medium to allow coaches, selectors and other interested parties to quickly evaluate the form of a given individual. However, in the sporting situation it is more desirable to be 'out-of-control' on the upper side than being average. Consequently, a shift in thinking is required to accommodate the change from the attainment of mediocrity to brilliance. In fact, the interest is with the deviation from what an individual is expected and capable of accomplishing, given parameters attained from past performance. In order to achieve this, comparison is made with perfection.

The control charts associated with quality control provide an excellent medium for displaying performance, and changes in performance visually. Not only can performance monitoring be used to indicate potential changes and causes in individual performance, control charts also enable an athlete's response to changes in training structure, coaching style and so forth to be monitored. Assessing the team as a collective using the average performance rating enables coaches to be made more accountable, as changes in the collective unit can be attributed to the involvement of the coaching staff and related programmes.

However, over dependency on statistics can promote coaching in hindsight whereby awareness of potential problems is identified after the event [1]. Thus it is important to keep the use of statistics in perspective. Through the summary of match footage, information is lost, regarding certain technical, biomechanical and decision making aspects (human elements). Consequently, statistics can never be

more than just a tool in the sporting environment. The strength of this tool can often be the weakness due to the objectively defined nature, and are thus devoid of emotion. Rugby is chaotic given that actions are defined by some initial conditions, match context must be taken into account when assessing performance.

Intuitive coaches are able to define performance, however due to human limitations recall of all events is impossible. Correctly defined and implemented statistical process provides the necessary "notes" to assist coaches in the recall of events and diagnosing of faults. Incorporating performance monitoring into a coaching structure allows certain aspects of play to be highlighted.

Importantly, sport statistics can be used to reinforce the beliefs of an intuitive coach or augment deficient areas of awareness. Implemented in the correct manner, statistics can suggest where a coach should look, to remedy certain weaknesses or provide ideas on how to maximise strengths.

Application of Control Charting Procedures

As an illustration of the control charting procedure, a Shewhart control chart illustrating the form of Otago Highlander halfback Byron Kelleher from the Super 12 Tournament, 2000 is provided in Figure 2.

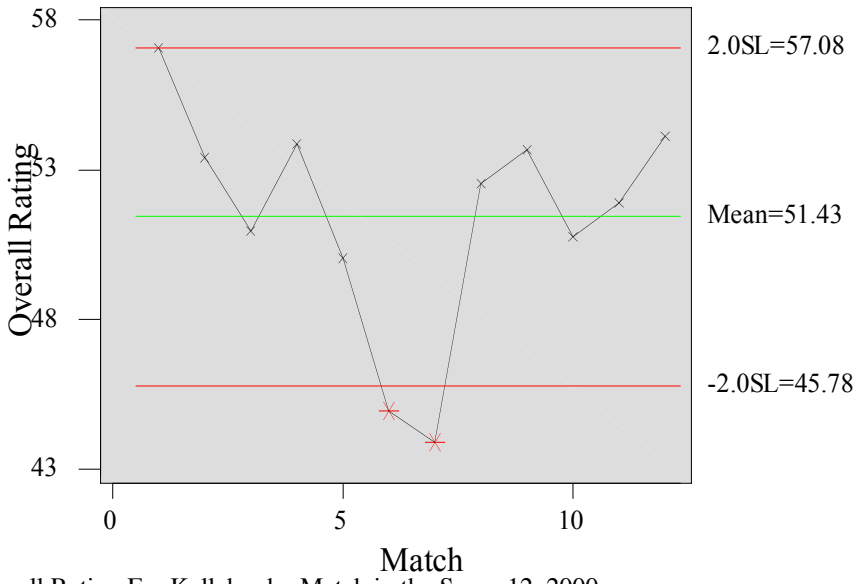

Figure 2. Overall Rating For Kelleher by Match in the Super 12, 2000

For this tournament, Kelleher provided two performances that are statistically abnormal. Firstly, a well below expected rating in match 6 is obtained from the 34-15 loss to the ACT Brumbies; and secondly another less than expected performance is produced in match 7 where the Highlanders were beaten by the Auckland Blues 26-16. Assessing the underlying KPI's indicates that the problem in both these matches is due to less than expected performances associated with a measure of handling. Further investigation reveals that this deficiency was directly associated with the number of successful passes delivered. Evidence suggests that this is not a technical problem, but is related to the relative involvement of Kelleher. In both matches, the Otago Highlanders were dominated by the Brumbies and the Blues. As a consequence Otago received very little possession, leaving Kelleher with little ball to deliver to his backs. Because the overall rating considers overall performance and Otago lacked possession, this causes reason to question current All Black Kelleher's defensive involvement. It is reasonable to expect that if the attacking opportunities are reduced then the defensive opportunities are increased. However, considering team statistics and it is found that a team-mate is responsible for Kelleher's reduced ranking. Former All Black and openside flanker Josh Kronfeld carried Otago's defensive effort in these games. Consequently, there is just cause underlying the abnormal performances presented by Byron Kelleher that is not related to technical deficiencies or reduced work-rate.

Conclusion

Sport presents many variable conditions, which will affect match statistics. Therefore the techniques employed to analyse match statistics must take into consideration the natural variability presented by different matches. Consequently, the Eagle Rating was developed as a relatively stable measure of match performance. The underlying philosophy is taken from statistical process control, which is more akin to ensuring manufactured goods meet specifications. However, with slight modifications, the control charts and techniques for ensuring processes are under control can be applied to monitor match performance and subsequently identify any changes in form, and associated strengths and weaknesses. Because athletes strive for perfection, not the average, standard process control techniques must be adjusted to compare performance to perfection, rather than the average. We do not expect athletes to perform 'in-control'. However, we are interested in changes in performance. Realistically, performances are going to differ from match to match due to different match constraints and conditions. Consequently, our interest is in identifying statistically significant changes in performance and identifying the associated causes. The changes may be either extrinsic or intrinsic. The coach can readily identify this by isolating the component (KPI) that caused the change in the overall measure of performance and identifying the cause of that change in the actual match footage. Whilst statistics have an important part to play in sport, their use must be contextual, and methodologies employed must be statistically sound and firmly supported by qualitative analysis. Given correct usage statistics can provide valuable insight into individual performance enabling strengths and weaknesses to be diagnosed.

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