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Evaluation of Basketball Player Combinations by Use of the Offensive and Defensive Efficiency Rating System

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EVALUATION OF BASKETBALL PLAYER COMBINATIONS BY USE OF THE OFFENSIVE AND DEFENSIVE EFFICIENCY RATING SYSTEM

BY

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EVALUATION OF BASKETBALL PLAYER COMBINATIONS

BY USE OF THE OFFENSIVE AND DEFENSIVE

EFFICIENCY RATING SYSTEM

This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Advisor Date

Head, Physical Education Department Date

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CHAPTER I

INTRODUCTION

Significance of the Study

One of the most difficult tasks in coaching basketball is the selection of five players to comprise the most efficient and effective playing combination. The selection of the proper combination of five players involves more than merely choosing the five best individuals.

> It has quite often happened that the five best players have not made the best team simply because they did not bring together the right assortment of human elements and characteristics to give a smooth, effective, balanced combination.[1]

Various methods and techniques have been utilized by coaches in their selection of team players. The more common methods used have been a subjective player evaluation by the coach, skill test results, and game performance statistics. Personality and attitudes have also been an intricate part of the evaluation process. However, if a coach were to use subjective evaluation as his only method in team selection, decisions would vary in direct proportion to the coach's evaluative ability and many errors might result.

It is recognized that valuable insight can be obtained into the current abilities of a player through skill test results. This

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[1]John W. Bunn, Basketball Methods, (New York: Macmillan Co., 1939, p. 33.

information without regard to game situation tension, attitudes, or latent potentials has, however, been misleading and inadequate.

Game statistics have generally contained information on points scored, rebounds, assists, turnovers and defensive proficiency. In correlating these factors players have often been pitted against each other. Equally important has been the void of information left by game statistics in many areas of play. Eibel and Allen, in discussing the use of the box score, state:

> There is quite general agreement that the box score does not give a very complete statistical picture of the game and is consequently of little value to coach or player from the standpoint of game analysis.[2]

Possession statistics or possession evaluation is based on the number of points scored per possession for both teams. A perfect game, or one in which a team averages two points on every possession while allowing the opponent to score zero points per possession, is unattainable. However, the closer a team is able to come to the 2.00 offensive and .00 defensive goals the better its performance. In using possession statistics the coach benefits by getting a view of the total aspect of all phases of the game of basketball. Each factor of performance can be evaluated in relation to game segments as well as to total performance. Strengths and/or deficiencies of play can be evaluated.[3]

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[2]E.R. Eibel and Dr. Forrest C. Allen, "Evaluating Team and Individual Performance in Basketball," Research Quarterly, 12:541, October, 1941.

[3]Frank McGuire, Defensive Basketball, (New Jersey, Prentice-Hall, 1959), pp. 11-15.

Few, if any, of the above evaluating techniques have been sufficiently reliable to be used independently as a basis of selecting key players. If an objective measure were established to ascertain the degree of efficiency for the performance of five players, a concrete basis of team evaluation could be devised. Instead of employing the five "best" individuals, a coach could discover and capitalize upon the five players who would render the smoothest, most efficient game as a unit.

Statement of the Problem

The purpose of this study was to determine if the most efficient and effective varsity basketball playing combinations were used at South Dakota State University as determined by the Offensive Efficiency Rating and Defensive Efficiency Rating statistics compiled.

The Offensive Efficiency Rating System (O.E.R.) has been employed to discover how many points per possession a combination of players scored and how many points were conceded defensively (Defensive Efficiency Rating or D.E.R.) by the same combination.[4]

Hypothesis

1. There will be no significant difference in the efficiency of performance among the combinations of players using the Offensive Efficiency Rating in basketball game situations.

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[4]Paul R. Keller, "Some Values of Paul Keller's OER System," (Unpublished research, Delaware, Ohio), pp. 1-2 (Mimeographed.)

2. There will be no significant difference in the efficiency of performance among the combinations of players using the Defensive Efficiency Rating in basketball game situations.

Limitations and Delimitations of the Study

1. The subjects used in this investigation were eight 1970-71 varsity basketball players at South Dakota State University.

2. Subjects were arranged into combinations of five players as such combinations originated in game situations. Those combinations which had very few possessions and had little significant meaning to the head coach for the season were not considered.

3. Only varsity basketball games as scheduled for the 1970-71 season were charted for data.

4. The only data recorded were those specified by the O.E.R. system.

Definition of Terms

1. Offensive Efficiency Rating (O.E.R.). The O.E.R. is concerned with points scored per possession on offense. This system was developed by Paul R. Keller.[5] The intent of the system is to obtain an accurate charting of the game so that various factors, elements, and phases of the game can be evaluated in regard to the total game picture.

2. Defensive Efficiency Rating (D.E.R.). The D. E. R. has reference to the number of points scored per possession by the

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[5]Paul R. Keller, loc. cit.

opponent (their O.E.R.). It is used to appraise defensive play.

3. Possession. Any time a team has complete control of the basketball with the potential for a scoring opportunity it is termed a possession. The termination of a possession comes about by awarding the ball out-of-bounds to the opposing team because of a scored field goal or free throw or the gaining of complete control of the basketball by the opposing team.[6]

4. Turnover. A turnover occurs any time a scoring opportunity has been lost without a shot having been attempted from either the field or the free throw line. Such situations have included traveling, palming the ball, double and broken dribble, lane violations and all player-controlled fouls. Also included are "jumping-the-ball," over-and-back, stolen balls, time violations, and a fumbled or bad pass out-of-bounds or to the opponent.[7]

5. Field goal. A field goal refers to the opportunity for a basketball player to score two points in a game situation by legally throwing the ball through the basket.[8]

6. Free throw. A free throw is the opportunity for a player to score one point in a game situation by legally throwing the ball

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[6]McGuire, op. cit., p. 12.

[7]Paul R. Keller, op. cit., p. 10.

[8]The National Federation of State High School Athletic Association, Basketball Rules Book, (Chicago, Illinois: 1969), p. 18

toward the basket from an unobstructed position behind the free throw line. A free throw begins when the ball is given to the player at the line and terminates when the attempt is successful or unsuccessful.[9]

7. Plus situation. A plus situation is used in charting O.E.R. and transpires when a foul is called before the team fouled has crossed the center line. The team fouled is awarded a free throw.[10]

8. Potential Offensive Efficiency Rating (OER-P). The average number of points per possession that are scored when possession of the ball is kept is called OER-P. Since turnovers are inevitable the OER-P will be higher than the O.E.R. The smaller the difference between the two, the more efficient is the offensive play.[11]

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[9]Ibid., p. 15.

[10]Paul R. Keller, op. cit., p. 3.

[11]Ibid., p. 1.

CHAPTER II

REVIEW OF RELATED LITERATURE

The review of related literature indicated that the importance of an objective measure of basketball ability was voiced by many. According to Bunn, few people realize the time and effort spent by a coach in trying to compare player abilities in the selection of a team. Bunn further states: "This also means putting the best players in the right places and getting the right combinations of players together."[1]

Everett states that in all sports this selection problem involves, "distinguishing accurately the players from the reserves."[2] He continues by stating that consideration must be given to various factors, one of which is the player with latent potential. If selection is based entirely upon judgement of the coach, however, outcomes vary according to his ability to make subjective choices and a great margin of error results. Likewise, if a purely objective method of selection is to be used, intangible factors go unnoticed.

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[1]John W. Bunn, Basketball Methods, (New York: The Macmillan Co., 1939), p. 22.

[2]Peter W. Everett, "The Prediction of Baseball Ability," Research Quarterly, 23:15, March, 1952.

Therefore, an objective way of selecting players is sought to reinforce judgement or subjective ratings by a coach.[3]

Three basic areas of related research were examined in this chapter. They were as follows:

1. Skill tests used as a prediction and evaluation of basketball ability.

2. Game performance used in prediction and evaluation of individual basketball ability.

3. Research on predictive devices in other sports.

Skill Tests Used as a Prediction and Evaluation of Ability

One approach to an objective method of measuring team and individual performance involves skill testing. This is a measurement of isolated skills correlated with total performance of the team or individual. The purpose of such testing is to set up some standard with which to measure abilities in a more objective way. This standard may be used by the coach in obtaining more knowledge about his playing material.[4]

Edgren correlated general athletic ability and basketball ability tests to predict basketball playing performance. He tested for the special basketball abilities of ball handling and shooting with two groups of thirty players. He found that progress in

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[3]Ibid., p.16.

[4]Leo James Hill, "Determining Basketball Ability Through the Use of a Basketball Skill Test," (unpublished Master's thesis, State College of Washington, 1956), p. 1-3.

fundamental drills was measurable and, moreover, that there was a high correlation between the basketball skill battery and general athletic ability in individual game performance. Therefore, he concluded that skill tests were useable as a predictive device.[5]

The Knox Basketball Skill Test was devised as a screening device to evaluate team candidates. The procedures involved four test items:[6]

1. Speed-dribble test. Four chairs were put in a straight line, the first one 20 feet from the starting line and the next chairs 15 feet apart. The player had to dribble a basketball in and out of the chairs and was scored on the speed of his performance.

2. Wall-bounce test. The player was placed with toes behind a line 5 feet from the wall. He was scored on how many seconds it took to bounce and catch the ball 15 times.

3. Dribble-shoot test. Three chairs were used to divide a 65' area. The player was to dribble in and out of the chairs, make a lay-in and then dribble back. He was scored for time.

4. Penny-cup test. Figure 1 shows the plan used for this test. The subject started with his toes on the line at A, his back facing the apparatus. Three tin cups were designated by the

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[5]H.D. Edgren, "An Experiment in the Testing of Ability and Progress in Basketball," Research Quarterly, 3:165, March, 1932.

[6]Robert D. Knox, "Basketball Ability Tests," Scholastic Coach, 17:3, November, 1947, p. 45.

numerals 1, 2, and 3. Each cup was 25' from A. Tin cup number 1 was blue, number 2 was red, and number 3 was white. At the signal he turned and ran toward the cups and when he was 8' from the starting line a color was called out at which time he dropped the penny in the designated cup. Fifteen trials were given and the colors were always called in the same order which was as follows: B R W R B W W R B R W B R W B.

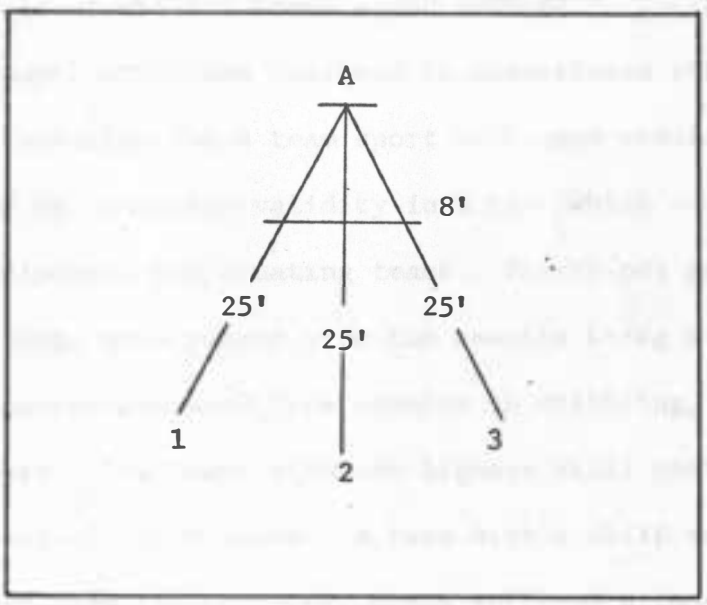

Figure 1

Plan for Penny-cup Reaction Test

The reliability found in correlating all the test items was .88 showing an over-all high correlation. The Speed-dribble test had a reliability factor of .71, the Wall-bounce test .78, indicating high correlation for both tests. The Dribble-shoot test

had a moderate correlation of .58. The Penny-cup test showed a very high correlation with .90 reliability.[7]

Boyd, McCachren and Waglow used the Knox Basketball Skill Test with the criteria for playing ability being total points and average minutes played. The battery distinguished between the 18 chosen squad members and the 24 players dropped, with a very high correlation of .96. However, the test was unable to distinguish between levels of ability among squad members.[8]

Stroup's study was designed to demonstrate the use of a validation technique for a team sport with game results as the criteria and to establish validity in a test which could be economically administered for equating teams. Thirty-one games, each 10 minutes long, were played with the results being compared with team skill scores computed from results on dribbling, passing, and shooting tests. The teams with the highest skill test scores won 83.87 per cent of their games. A team with a skill score of 6.6 points higher than the opponent, never suffered a loss.[9]

In investigating the validity of the Knox Basketball Skill Test, Loose correlated the Knox test and team success as measured by

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[7]Ibid.

[8]Clifford A. Boyd, James R. McCachren and I.F. Waglow, "Predictive Ability of a Selected Basketball Test," Research Quarterly, 26:364, October, 1955.

[9]Francis Stroup, "Game Results as a Criterion for Validating Basketball Skill Test," Research Quarterly, 26:353-357, October, 1955.

the final league standings of teams. He determined that there were no predictive qualities in this correlation, nor was it an accurate predictive device in team selection when correlating the Knox test with the coach's rank of individual players.[10]

Hill also investigated the possibility of using the Knox Basketball test as a predictive measure in selecting members of a team. Validity was judged by criteria of game performance and subjective ratings by the coach. No significant correlation was found.[11]

Bunn included the Penny-cup test as one of three procedures he used for choosing team members. He says:

> Ability to start quickly, stop instantly and change direction suddenly are indispensable characteristics of a good basketball player.[12]

Athletic success with regard to body reaction time was investigated by L.P. Keller. Upon visual stimulus the subject was to make physical contact with targets as a reaction. Time was recorded from stimulus to reaction. Scores were correlated with subjective ratings of the coach. A significant difference was found between athletes and non-athletes but no significance could be found among squad members.[13]

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[10]W.A. Loose, "A Study to Determine Validity of the Knox Basketball Test," (unpublished Master's thesis, Washington State University, Pullman, 1961), p. 33.

[11]Hill, op. cit., p. 3. [12]Bunn, op. cit., p. 39.

[13]L.P. Keller, "The Relation of 'Quickness' of Body Movement' to Success in Athletics," Research Quarterly, 13:145-155, May, 1942.

In comparing selected and rejected college freshman basketball candidates, Patty found that the selected candidates excelled over the rejected candidates in body reaction time. No significance was found among the chosen or selected candidates.[14]

Game Performance Used in Prediction and Evaluation of Basketball Ability

Bunn, realizing the importance of individual performance in game situations, attempted to estimate performance ability. He used the game of "hunch" early in the season as one of his three procedures of rating the abilities of players. In this game there were three on a side and all played for the same basket. The players were paired and statistics were kept for each individual. Each game was ten minutes in length and players were rotated so that a different opponent was drawn each time. All scrimmages were officiated. The rating involved the net results of the points scored by a player against the points scored by his opponent. The writer felt the contest increased motivation and it enabled a very good estimate of abilities to be made. Bunn also kept a personal rating chart of individuals for assessing abilities which included both positive and negative characteristics. Charts were kept during scrimmage and early season games.[15]

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[14]Elbert K. Patty, "The Relationship of Selected Measurable Traits to Success in Basketball," (unpublished P.E.D. thesis, Indiana University, Bloomington, 1953), pp. 83-85.

[15]Bunn, op. cit., pp. 34-36, 82, 83.

Peterson sought to meet three primary needs through investigation of game performance:

1. To place high school basketball on a more scientific basis.
2. To aid coaches in learning of objective factors.
3. To establish a scientific basis for rule changes.

His study involved an examination of certain objective factors in high school basketball and a determination of their relationship to team success as measured in terms of winning. Each team was classified as successful (winning 50 per cent of games) or unsuccessful. This status was then compared with several objective factors tested. Team factors included:

1. Shooting (short, medium, long, free throw)
2. Rebounding (offensive and defensive)
3. Ball handling errors
4. Jump balls
5. Passing
6. Dribbling
7. Time of possession
8. Substitution
9. Total players used
10. Personal fouls
11. Player's characteristics (age, height, weight)

Peterson concluded that in relation to winning, the most important factor in shooting involved those who used the short shot most frequently and with accuracy. These teams were successful. Successful teams were more accurate from the free throw line.

Defensive rebounding was significant as was control of jump balls. Height and weight were very important.[16]

McGuire found fault with putting faith in average defensive and offensive scores because it did not show a true picture of the game action. He listed the benefits derived from possession statistics to be threefold. (1) Possession statistics were helpful in working on one particular phase of the game because weaknesses were pointed out. (2) During the game it was possible to view performance at a quick glance and to make changes in strategy. (3) An indication of whether team performance was steady or erratic was evident.[17]

Eibel and Allen developed a list of offensive basketball factors to be investigated. These factors were then grouped as being either positive or negative items in relation to team success. During the 1939-40 University of Kansas season they developed a player offensive playing efficiency and a player defensive efficiency. This efficiency was computed by using sums of positive characteristics and then subtracting the negative characteristics. The results of their study determined the game point production factor to be the most important attribute to individual success. Secondary observations

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[16]Herbert Donald Peterson, "A Study of Certain Objective Factors in High School Basketball and Their Relationship to Team Success," (unpublished Doctoral dissertation, Indiana University, 1952).

[17]Frank McGuire, Defensive Basketball, (New Jersey: Prentice-Hall, Inc., 1959), p. 12-15.

showed the lack, to date, of information on total game performance available to the coach and also showed a marked interest in improving performance by the players (motivation).[18]

Strain explored the possibility of developing a predictive device to aid in team selection. Comparisons were made of individual sophomore game statistics and varsity point production. The five variables of successful field goal average per game, attempted free throw average per game, successful free throw average per game, field goal percentage and rebound percentage were correlated with varsity point production. Strain found that a relatively high relationship existed between predictor variable and success criteria and, therefore, concluded that a computer orientated study could lead to a predictive device in playing success.[19]

Research in Predictive Devices in Other Sports

In a complex investigation of reaction times as related to success in sports, Steitz determined the only significant correlation to be between the reaction time of the right hand moving to the right,

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[18]E. R. Eibel and Dr. Forrest C. Allen, "Evaluating Team and Individual Performance in Basketball," Research Quarterly, 12:538-555, October, 1941.

[19]David Ford Strain, "Predicting Future High School Basketball Player Success as Measured by Estimated Varsity Game Point Production From Individual Sophomore Game Statistics," (unpublished Master's thesis, South Dakota State University, 1969.

and ability. In all sports investigated the coach's rank of members validated the high correlation.[20]

Brace administered eight test items to 65 University of Texas varsity football players during the 1940 spring practice. Total scores of test items were compared to the average of the coach's ratings of abilities. Since judgement ratings were involved the correlation was not high. However, 77.7 per cent of the players making the first two teams in the fall were in the top 24 player achievement score list. From the results obtained, Brace felt this would be a measure of great assistance to the coach, especially where he has little previous knowledge of the player's ability. He also indicates:

> A battery of achievement tests could very profitably be used in measuring the amount of learning, i.e., general ability, in football skills possessed by players.[21]

Lee's methods of analytical and evaluative research on a battery of tests to predict football potential, investigated the specific areas in running, speed, strength and agility. He found three specific exercises to be significant. They were the bench

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[20]Edward S. Steitz, "The Relationship of Reaction Time, Speed, Sargent Jump, Physical Fitness, and Other Variables to Success in Specific Sports," (unpublished D.P.E. thesis, Springfield College, Springfield, 1963), p. 138.

[21]D.K. Brace, "Validity of Football Achievement Tests as Measures of Motor Learning and as a Partial Basis for the Selection of Players," Research Quarterly, 14:372-377, December, 1943.

press, pull-ups, and bar dips. The evaluation results of the three coaches showed a high reliability of .96, .96, .99 to success.[22]

A predictive device was investigated by Solberg in an effort to aid high school coaches in finding best offensive and defensive linemen. A challenge drill was developed and progress in points scored and points allowed was kept. Rankings were taken at the end of the season by other coaches. There was a .88 offensive and a .91 defensive reliability between the drill and the rankings. He concluded that performance can be successfully predicted through the use of this drill, especially for defensive linemen.[23]

Everett used the University of Iowa baseball players as subjects in trying to predict baseball achievement. In listing qualities for testing through correlation analysis it was found that the Sargent Jump test was the best single measure for selecting baseball talent.[24]

Summary

Related investigations of prediction and evaluation of individual and team success in basketball were basically classified as skill test research. Ball handling, shooting ability and reaction time were the three skills most often investigated. Tests were

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[22]Robert Charles Lee, "A Battery of Tests to Predict Football Potential" (unpublished Master's thesis, University of Utah, 1966).

[23]Charles M. Solberg, "The Development of a Challenge Drill to Determine Abilities of Football Linemen," (unpublished Master's thesis, Washington State University, 1966).

[24]Everett, op. cit., p. 16-19.

validated by coach rating and game performance. Significant correlation was found in the choosing of squad members from interested candidates but not in determining the ability levels among the chosen squad members. Total agreement was not found in evaluating the worth of skill test performance as a single predicting device.

Game performance was compared with individual and team success in an effort to include game situation stresses and reactions. Performance was correlated with skill tests to form a complete picture of abilities. Investigation of possession statistics and their worth was initiated along with the concept of efficiency in play. A predicting device using early basketball playing performance was developed. The value of game performance was recognized but was not considered solely adequate in predicting ability.

Investigations of predictive devices in other sport areas were made with comparable results. An objective method of evaluation could not be used reliably without inclusion of subjective rank of ability and skill test performance. It was generally felt that it could, however, be a valuable aid to the coach.

CHAPTER III

METHOD AND PROCEDURE

Organization of the Study

The purpose of this study was to ascertain which of the forty combinations of the top eight varsity basketball players at South Dakota State University were the most efficient and effective as determined by the O.E.R. and D.E.R. statistics computed according to Keller's Offensive Efficiency Rating System.[1]

The study was conducted during the 1970-71 varsity basketball season at South Dakota State University in Brookings, South Dakota. Data were collected during the playing of 23 varsity games which included tournament play. The first basketball game was played on December 1, 1970, and the last game was played on February 25, 1971.

The Keller O.E.R. System, which also included the D.E.R. (opponent's O.E.R.) was employed to gather data for this study. Permission to use the Keller system was purchased by the investigator.[2] For predictive implications both the O.E.R. and the D.E.R.

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[1]Paul R. Keller, "Some Values in Paul Keller's OER System," (unpublished research, Delaware, Ohio), p. 3 (Mimeographed.)

[2]Statement by Paul R. Keller, Telephone conversation, May 24, 1971.

were employed for charting purposes in order that the data obtained and analyzed would be meaningful to coaches of basketball.

Source of Data

The subjects used in this study consisted of eight 1970-71 South Dakota State University varsity basketball players chosen by the head basketball coach. Practice, scrimmages and intersquad games prior to the first game aided in the selection of the eight players. The eight players were selected because of their predicted contribution to the team and the amount of playing time they would probably see. Offensive Efficiency Rating performance data were recorded for all five-player combinations as they occurred in game situations that included any of the eight players selected. The intent of the study was to find the best combination of players, choosing from those with the better abilities and experience; and therefore, the consideration of all combinations was not imperative. Combinations not including the eight chosen players were grouped together and labeled "others". Table I shows the eight individuals along with their age, height, weight, and identified position.

Of the eight players studied, forty combinations were possible. These combinations are listed in Appendix A. The O.E.R. and D.E.R. were charted for all forty combinations for the entire season. When the season was completed, the head coach along with the investigator chose only nine combinations to be statistically

analyzed. This was due to the number of possessions acquired during the season and because of their importance to the head coach.

TABLE I

PLAYERS USED

Subject	Age	HT.	WT.	Position
LC	20	6'5"	195	G-F
RG	18	6'1"	170	G
JM	21	6'4"	170	G
DT	20	6'5½"	195	F
RH	21	6'5"	185	F-C
DH	21	6'4"	200	F
JJ	21	6'7"	220	C
JH	20	6'3"	180	G

Collection of the Data

Each game was charted by the investigator for data collection purposes on O.E.R. and D.E.R. according to the method as recommended by Keller.[3] The O.E.R. record sheet which is located in Appendix B was used in tabulating each scheduled basketball game. In explaining the charting process the procedures have been incorporated into a game situation account to aid the reader. The writer also recommends

[3]Paul R. Keller, op. cit., p. 5.

that the reader purchase information regarding the Keller system for detailed description and other benefits which the author offers.

The game situation charting for data collections was as follows:

As the game begins the number 1 is placed in the possession column (P) of the team that gained control of the opening tip, making some notation of which team got the tip. Referring to Figure 2, South Dakota State University (SDSU) controlled the tip as indicated by the asterisk (*). The ensuing action dictates what should be placed in the point column (Pt) to the right of the possession column. In this case SDSU failed to score from their shooting attempts. The opponent gained possession of the ball and a zero was then placed in SDSU's point column. Immediately the number 1 was placed in opponent A's possession column. The same procedure was followed for charting the action of both teams. Only the action of SDSU is illustrated from this point on.

SDSU failed to score from the floor in possession number 2 and the opponent gained possession of the ball. In possession number 3 a field goal was scored by number 21 of SDSU and a 2 was placed in the point column indicating points scored after the 3 in the possession column. The number 21 was placed in the comment column (Com) to indicate the player that had scored.

In the next possession player number 21 was fouled and received one free throw. When a free throw attempt was shot a 0 was

placed in the comment column. If the free throw attempt was successful as in possession number 7, an x was recorded in the 0 (@). In the ninth possession a 0 was placed in the point column. The TO in the comment column indicates there was a turnover when number 41 traveled with the ball. This then indicated that SDSU did not get a shot at the basket. A number 1 was placed in the turnover column (TO) for SDSU to show that it was the first turnover. Since the opponent did not score on their next possession a 0 was then placed in the column reserved for points scored.opposite the turnover 1. When looking at possession 12 for SDSU there was a turnover charged to player 51 for a 3-second violation and a 2 was placed in the turnover column. This time opponent A scored 1 point in their next possession so a 1 was placed in the column next to the turnover number indicated.

Possession number 10 has a 3 in the point column. This resulted when player number 43 was fouled while shooting, and made the basket. The @ indicates that the free throw was also successful making it a 3-point play. Possession number 11 showed that player 51 made two free throws. Between possession 12 and 13 there was a plus (+) in the possession column. This indicates that there was a plus situation. Player 41 was fouled before SDSU brought the ball past the center court line. In possession 13 there was another 3-point play, but this one occurred differently. Player 45 was awarded two free throws. He made the first one and missed the second. Player 43 rebounded the missed shot and scored, giving SDSU a

3-point play. In possession 15 the same thing happened. Because of a substitution, the combination number was different and the 2 points from the rebound were awarded to another combination. Therefore, this had to be put on a different line. The plus situation immediately after possession 15 was a result of a technical foul against the opponent. Number 41 missed the free throw, SDSU retained possession by grabbing the rebound and number 43 converted for 2 points.

Once the mechanics of Keller's methods for charting a ball game had been mastered, a system of recording the performance of each combination was established. This was done so that correct tabulation of O.E.R. and D.E.R. could be accomplished for each separate combination. Upon entry into the game of each substitute for SDSU a line was drawn through each column to indicate the starting of a new combination. In referring to Figure 2, note that after SDSU's ninth possession a substitute came in. Also note that the jersey number of each individual is placed in the left-hand margin to denote which combination is in the basketball game. If a player entered the game during a free throw situation the points were awarded to the combination with the play leaving the game. Supposing that the free throw was missed and the team shooting controlled the ball, the possession would then be given to the combination involving the substitute. The same possession was used for this new combination. However, only one possession was used to compute the team Offensive Efficiency Rating. Figure 2, possession 15, shows that the possession was recorded for both combinations.

It is important that a specific record be kept of the number of offensive and defensive possessions along with the offensive and defensive turnovers for each combination of five players.

A running tabulation of performance was kept for each combination of players. This performance was recorded in Appendix C. Included was the number of offensive possessions with points scored, turnovers and OER-Potential, and defensive turnovers.

The Offensive Efficiency Rating system indicated how many points were scored per possession. To arrive at the O.E.R. figure, the number of possessions must be divided into the number of points scored to the nearest hundredth. This number can then be evaluated and compared. The unattainable perfect game situation would result in an O.E.R. of 2.00. The following interpretation of scores on the college level will help in evaluating success.[4]

OER	RATING
.90- .99	Good
1.00-1.09	Excellent
1.10-1.19	Very Superior
1.20-	Fantastic

The defensive efficiency rating of a team is actually the opponent's O.E.R., D.E.R. can be computed by dividing the opponents' total possessions into their total points. This can be used as a great motivation tool for individual and team performance in

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[4]Paul R. Keller, op. cit., p. 2.

striving to maintain a low D.E.R. average. An excellent D.E.R. score would be .80 with the unrealistic perfect D.E.R. being .00.[5]

Offensive Efficiency Rating Potential (OER-P) shows the number of points scored per possession when the ball is kept. A comparison of OER-P and O.E.R. should be made to formulate a total picture of game performance, although in this study OER-P is not directly related to combination distinction. To find a team's OER-P, subtract the number of turnovers from the total possessions and divide that number into the total number of points. A difference of no more than .30 points per possession indicates efficient playing in most cases.[6]

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[5]Ibid., p. 3.

[6]Ibid., p. 2.

SDSU vs. Opponent A Date: ____________

#	Pos	Pt	Com
23 *	1	0	
21	2	0	
41	3	2	21
43	4	0	0 - 21
45	5	2	41
	6	2	43
	7	1	⊗ - 41
	8	0	
	9	0	TO 41 Tr
43	10	3	43 ⊗ -43
51	11	2	⊗ ⊗ - 51
41	12	0	TO 51 3s
45	+	1	⊗ -41
21	13	3	⊗045 R43
	14	0	
	15	1	⊗0-43
41	15	2	R41
43	+	2	0-41T 43
51			
45			
25			

TO	
1	0
2	1

TO	
1	2
2	0

Pos	Pt	Com
1	0	
2	2	40
3	0	
+	1	⊗ - 32
4	0	TO
5	2	20
6	0	
7	2	32
8	0	
9	2	40
10	1	⊗ - 20
11	1	0⊗ - 40
12	0	
13	0	TO
14	0	
15	0	

Total ____ half: ____ + ____ = ☐ ____ + ____ = ☐

Game total ____ + ____ = ☐ ____ + ____ = ☐

* Denotes team controlling opening tip.

Figure 2

O.E.R. Record Sheet

CHAPTER IV

ANALYSIS AND DISCUSSION OF RESULTS

Organization of the Data for Analysis

The data were organized in a manner which would be used to formulate an objective method of analysis and evaluation of differences observed among various game combinations of basketball players. The analysis of variance statistical procedure was applied to the data to determine if game player-combinations significantly differed from each other in their Offensive Efficiency Rating and Defensive Efficiency Rating.[1] The .05 level of confidence was accepted as the minimum level needed in order for an F-ratio to be considered significant. If an F-ratio was found to be significant, the Duncan Multiple Range Test was used to discover where the specific differences between the player combinations existed.[2] The Multiple Range Test was conducted by assigning a value of .14 for the number of replications in each totalment. For the purposes of the present work this approximate procedure for analysing data with unequal number of replications was considered satisfactory.

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[1]Jerome C. Weber and David R. Lamb, Statistics and Research in Physical Education, (St. Louis, Illinois: The C.V. Mosby Co., 1970), pp. 103-109.

[2]James L. Bruning and B.L. Kintz, Computational Handbook of Statistics, (Glenview, Illinois: Scott, Foresman and Co., 1968), pp. 115-117.

A coefficient of variability was computed to assist in evaluating the variability within combinations from basketball game to basketball game.[3]

Raw data are found in Appendix D. These include means, standard deviations, and coefficients of variability of the O.E.R. and D.E.R. for each of the game player combinations, nine in number, which were analyzed in this study.

Analysis of the Data

Data were collected for all forty player-combinations throughout the entire basketball season, but observations for only nine combinations were used to compute the combination means. The number of season possessions, means, standard deviations, and coefficient of variability of combinations are shown in Table II.

The results of the analysis of variance for the O.E.R. and D.E.R. are shown in Table III. The F-ratio of 2.28 obtained for the O.E.R. from this portion of the data indicated a significiant difference among the combinations at the .05 level of confidence. There was no significant difference found in the D.E.R. of the player combinations.

The results of the Duncan Multiple Range Test which analyzed the combination mean differences are illustrated in Table IV. Combinations XXXVII, X, XXII, and V were found to have a

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[3]Robert G.D. Steel and James H. Torrie, Principles and Procedures of Statistics, (New York: McGraw-Hill Book Co., Inc., 1960), p. 20.

TABLE II

RESULTS OF COMBINATION PERFORMANCE

Combination	I	II	V	X	XII	XIX	XXII	XXXIII	XXXVII
Possessions*	246	84	39	719	39	44	110	127	62
O.E.R. Mean	.77	.83	1.09	1.01	.51	.59	1.06	.84	.98
SD	.37	.25	.18	.12	.30	.45	.55	.52	.33
V	48.23	29.74	16.92	12.10	58.93	75.79	52.10	61.65	33.52
Possessions*	249	85	38	732	35	46	111	122	58
D.E.R. Mean	1.03	1.23	.83	.78	.86	.93	1.25	.90	.85
SD	.30	.13	.27	.21	.58	.65	.86	.35	.47
V	28.67	10.21	32.43	26.18	67.52	70.17	68.68	38.42	55.16

* Any time a team has complete control of the basketball with the potential for a scoring opportunity, it is termed a possession.

TABLE III

ANALYSIS OF VARIANCE FOR THE COMBINATIONS ON THE O.E.R. AND D.E.R.

	Source of Variance	SS	df	ms	F*
O.E.R.	Treatment	2.7464	8	.3433	2.2795
	Error	12.9588	86	.1506	
	Total	15.7052	94	--	--
D.E.R.	Treatment	3.0238	8	.3779	1.4779
	Error	21.9409	86	.2551	
	Total	24.9647	94	--	--

F.05 (8/86) = 2.07

TABLE IV

RESULTS OF THE DUNCAN MULTIPLE RANGE TEST
WITH ANALYSIS OF COMBINATION
MEAN DIFFERENCES FOR O.E.R.

Combination		XII	XIX	I	II	XXXIII	XXXVII	X	XXII	V
	Mean	.52	.59	.77	.83	.84	.99	1.01	1.06	1.09
XII	.52	--	.07	.25	.31	.32	.47*	.49*	.54*	.57*
XIX	.59		--	.18	.24	.25	.40	.42	.47*	.50*
I	.77			--	.06	.07	.22	.24	.29	.32
II	.83				--	.01	.16	.18	.23	.26
XXXIII	.84					--	.15	.17	.22	.25
XXXVII	.99						--	.02	.07	.10
X	1.01							---	.05	.08
XXII	1.06								--	.03
V	1.09									--

* Indicates significance beyond the .05 level of confidence.

R_2: .39 R_5: .43 R_8: .45

R_3: .40 R_6: .44 R_9: .45

R_4: .42 R_7: .44

significantly better O.E.R. than combination XII. Combinations XXII and V were also found to be significantly better in their season's O.E.R. than combination XIX. All other combinations showed no significant differences in the O.E.R. system of rating combinations, as checked against results of the Multiple Range Test.

Discussion of the Results

The F-ratio indicated that there was a significant difference between the game combinations. No statistically significant differences, at the .05 level of confidence, were found for the D.E.R.

The results of the study revealed that player combinations V and XXII, with mean O.E.R.'s of 1.09 and 1.06, respectively, were the best offensive combinations. By Keller's standards, an O.E.R. of from 1.00 to 1.09 is considered excellent.[4] Only one other combination was in the "excellent" category, that being combination X with an O.E.R. of 1.01.

Although the analysis of the D.E.R.'s revealed no significant differences, it is interesting to compare the means of selected combinations. The highest O.E.R. combination (V=1.09) also had a good D.E.R. of .83. The O.E.R. for combination X was 1.01 with an excellent D.E.R. of .78, which was the lowest of all combinations. On the other hand, combination XXII, which had the

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[4]Paul R. Keller, "Some Values of Paul Keller's OER System," (Unpublished research, Delaware, Ohio), p. 2, (Mimeographed.)

second highest O.E.R. of 1.06, had the poorest D.E.R. of all combinations, with a value of 1.25. According to Keller's standards of D.E.R. performance, an excellent D.E.R. would be .80 or below.[5]

Additional interpretive data were obtained by the analysis of the coefficient of variations. In both the O.E.R. and D.E.R. results, groups V and X were much less variable than group XXII. Therefore, it would appear to the investigator that the two best combinations were V and X with combination X being the less variable of the two.

It is also interesting to note the number of possessions for the various combinations. Group V had the highest O.E.R. of 1.09 but had only 39 possessions. On the other hand, combination X had 719 possessions and still maintained an O.E.R. of 1.01 with the lowest D.E.R. of .78.

Previous research indicates that there has been little success in correlating future basketball game performance, especially within squads, from various types of physical and basketball skill tests or from investigations of game performance. Numerous studies reported on predictive devices were either based upon, or made reference to, the Knox Basketball Skill Test. The Knox Skill Test was designed as a screening and evaluative device, and it

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[5]Ibid.

involved four skill tests. Results showed a composite reliability of .88, which indicated a high correlation of success to the skill test results.[6]

Strain found, in a comparison of sophomore game statistics with later performance, that a prediction can be made with a relatively high relationship to success. A Junior-Senior multiple correlation of .79 was found to be the best predictor. He, however, expressed some doubt as to the degree of effectiveness of the process as an independent predictor.[7]

The above studies indicate to the writer that objective predictive devices, whether in the areas of skill testing such as the Knox Basketball Skill Test, game-performance statistics, or in possession statistics as found in the results of this study, should not be used as the only method or methods for determining either the basketball player's ability or squad selection. It is the writer's opinion, however, that these devices can be used to aid the basketball coach in making squad selections as effective supplements to subjective judgment.

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[6]Robert D. Knox, "Basketball Ability Tests," Scholastic Coach, 17:3, November, 1947, p. 45.

[7]David Ford Strain, "Predicting Future High School Basketball Player Success as Measured by Estimated Varsity Game Point Production From Individual Sophomore Game Statistics," (unpublished Master's Thesis, South Dakota State University, 1969).

On the basis of the results found in this study, the following conclusions in regard to the hypothesis were made:

1. The null hypothesis, which stated there would be no significant difference in combinations with the use of the O.E.R. system, was rejected, since there were combinations which were significantly different.

2. The null hypothesis, which stated there would be no significant difference in combinations with the use of the D.E.R. system, was retained.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to determine which were the most efficient and effective varsity basketball playing combinations used at South Dakota State University during the 1970-71 season as determined by the Offensive Efficiency Rating and Defensive Efficiency Rating statistics compiled.

Eight basketball players which were of the most interest to the head basketball coach were used in the gathering of the data. Any combination of five players which played in a basketball game was charted by use of Keller's Offensive Efficiency Rating System.[1]

The study involved the collection of data from all of South Dakota State University's twenty-three basketball games for the 1970-71 season. The method used for collection was Keller's Offensive Efficiency Rating and Defensive Efficiency Rating Systems. This procedure keeps track of possessions and points scored on the possessions for each combination of players. Also charted were

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[1]Paul R. Keller, "Some Values of Paul Keller's OER System," (Unpublished research, Delaware, Ohio), p. 2, (Mimeographed.)

the opponent's possessions and subsequent points scored, which is the Defensive Efficiency Rating for the combinations. There was a total of forty combinations. Of these forty, only nine combinations were of importance to the head basketball coach or involved enough possessions to be of meaning in an analysis.

An F-ratio was computed to determine the significance between combinations for the O.E.R. and D.E.R. The .05 level of confidence was accepted as the minimum level of confidence needed in order to have a significant difference. The standard deviation and coefficient of variability were computed to find the variability within combinations for both the O.E.R. and D.E.R.

At the .05 level of confidence an F-ratio of 2.07 was needed. The F-ratio for the O.E.R. was 2.28, making it significant, while the D.E.R. was 1.48 and was, therefore, not found to be significant. By using Duncan's Multiple Range Test it was found that combinations XXXVII, X, XXII, and V were significantly different from combination XII. Also, combinations XXII and V were significantly different from combination XIX. Combinations X and V were found to be the least variable of all combinations.

Conclusions

Within the limitations of this study, the following conclusions were made:

1. Through the use of the Offensive Efficiency Rating and Defensive Efficiency Rating Systems the basketball coach can find the combination of basketball players which are significantly more efficient that other combinations.

2. South Dakota State University was using the best combination with regard to the Offensive Efficiency Rating, Defensive Efficiency Rating, and variability for the greater share of possessions.

3. A basketball coach looking for the best player combination should take both the Offensive Efficiency Rating and Defensive Efficiency Rating into consideration in the selection.

Recommendations for Further Study

The following recommendations are proposed for further study:

1. That a similar study be undertaken with a team which will have fewer combination possibilities.

2. That a similar study be undertaken using a skill test before the season starts, to rank players according to their ability and to see if the best five players are the best combination as determined by the Offensive Efficiency Rating and the Defensive Efficiency Rating.

3. That a similar study be undertaken to include the use of Keller's Offensive Efficiency Rating Potential system.

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APPENDIX A

TABLE V

RECORDED COMBINATIONS

I	II	III	IV	V
LC	LC	JM	LC	LC
JH	JH	JH	JH	RG
JM	JM	DH	JM	JM
DT	DH	DT	DH	DH
RH	RH	RH	DT	RH

VI	VII	VIII	IX	X
RG	LC	LC	LC	LC
JM	RG	RG	RG	RG
RH	JH	JM	JH	DT
DH	RH	DH	JM	JM
JJ	JJ	DT	RH	RH

XI	XII	XIII	XIV	XV
LC	LC	JM	LC	LC
RG	JH	JH	JM	RG
JH	JM	DH	DH	JH
DT	RH	RH	RH	DH
RH	JJ	JJ	JJ	JJ

XVI	XVII	XVIII	XIX	XX
RG	LC	LC	RG	LC
JH	JH	RG	JM	RG
RH	JM	JM	DH	JH
DH	DT	DH	DT	DH
JJ	JJ	RH	RH	DT

APPENDIX A

TABLE V (Continued)

RECORDED COMBINATIONS

XXI	XXII	XXIII	XXIV	XXV
RG	LC	LC	LC	LC
JH	RG	RG	JH	RG
JM	JM	JH	JM	JM
DH	DT	DT	DH	DH
RH	JJ	JJ	JJ	JJ

XXVI	XXVII	XXVIII	XXIX	XXX
JH	LC	RG	RG	RG
RG	RG	JH	JH	JM
JM	DT	JM	JM	DT
DT	DH	DH	DT	DH
RH	RH	JJ	JJ	JJ

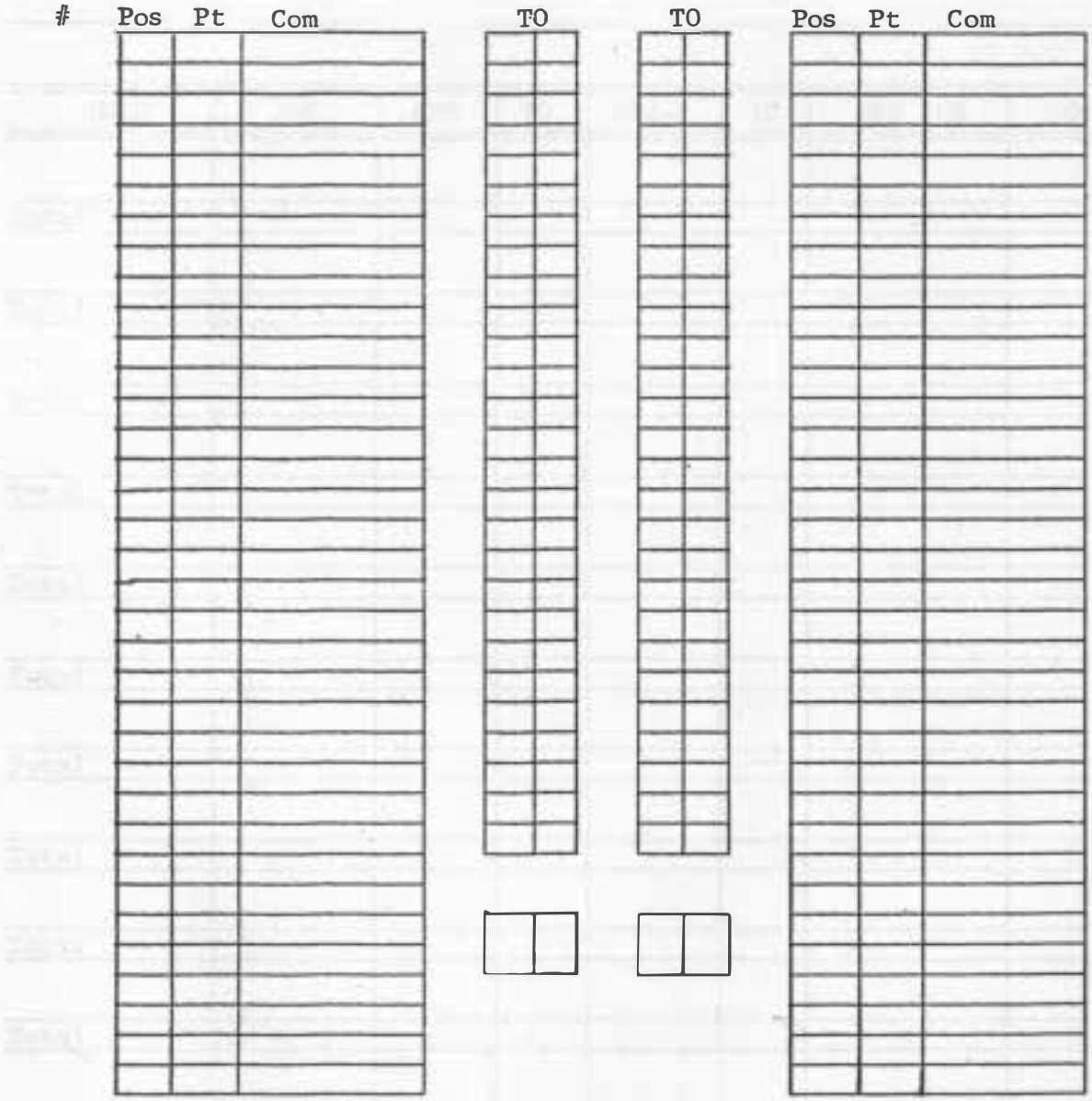
XXXI	XXXII	XXXIII	XXXIV	XXXV
LC	JM	RG	JH	JH
RG	JH	JM	JM	RG
JH	DT	RH	RH	RH
DH	DH	DT	DT	DT
RH	JJ	JJ	JJ	JJ

XXXVI	XXXVII	XXXVIII	XXXIX	XL
RG	RG	LC	JH	RG
JM	LC	JH	JM	JH
LC	JM	JM	RH	JM
RH	RH	DT	DT	RH
JJ	JJ	JJ	JJ	JJ

APPENDIX B

O.E.R. RECORD SHEET

SDSU vs. _____ Date: _____



Total ____ half: ____ + ____ = ☐ ____ + ____ = ☐

Game total: ____ + ____ = ☐ ____ + ____ = ☐

APPENDIX C

COMBINATION RECORD SHEET

COMBINATION _____

_____ _____ _____ _____ _____

GAME	POS	OER	TO	OER-P	TO	OPP POS	DER
Total							
Total							
Total							
Total							
Total							
Total							
Total							
Total							
Total							
Total							
Total							
Total							
Total							

APPENDIX D

TABLE VIII

RAW DATA FOR O.E.R. COMBINATIONS

	I	II	V	X	XII	XIX	XXII	XXXIII	XXXVII
	1.10	1.12	1.00	1.00	.90	.85	.33	1.14	1.20
	.76	.93	1.00	.96	.50	1.33	1.50	.86	1.33
	.12	.66	1.00	.72	.00	.12	1.75	.16	.22
	.90	.94	1.37	1.12	.40	.61	.00	.80	1.00
	1.07	.50		.96	.66	.50	.00	.87	1.00
	.82			.90	.63	.75	1.11	1.18	1.07
	.68			1.05		.00	1.37	.00	1.00
	.70			.91			.76	.28	1.06
	.33			1.28			1.66	.86	
	1.33			.97			1.00	1.66	
	.66			.93			1.19	1.38	
	.00			.93			1.00		
	1.11			1.07			1.50		
	1.21			1.09			1.00		
	.75			1.08			1.00		
	.80			.91			.85		
				1.05			2.00		
				1.20			1.00		
				1.08					
				.95					
M	.77	.83	1.09	1.01	.51	.59	1.06	.84	.98
SD	.37	.25	.18	.12	.30	.45	.55	.52	.33
V	48.23	29.74	16.92	12.10	58.93	75.79	52.10	61.65	33.52

APPENDIX D

TABLE IX

RAW DATA FOR D.E.R. COMBINATIONS

	I	II	V	X	XII	XIX	XXII	XXXIII	XXXVII
	.73	1.17	1.20	.66	1.44	1.00	2.50	.75	1.00
	1.16	1.29	.71	.57	1.40	.80	1.50	1.14	.00
	1.00	1.43	.57	.85	.00	1.33	.67	1.20	1.00
	.83	1.12	.85	.33	.60	.35	4.00	.33	1.00
	1.00	1.16		1.00	1.20	1.00	1.40	.80	.87
	1.00			.81	.50	2.00	1.44	1.00	.61
	.94			.89		.00	.89	.42	.66
	1.20			.93			.73	.71	1.66
	1.60			.50			1.00	1.37	
	1.33			.93			.89	1.33	
	1.20			1.10			1.05	.83	
	1.50			.97			1.00		
	.80			.57			.80		
	.84			1.00			.75		
	.70			1.00			1.00		
	1.60			.62			.43		
				.57			2.00		
				.85			.50		
				.76					
				.78					
M	1.03	1.23	.83	.78	.86	.93	1.25	.90	.85
SD	.30	.13	.27	.21	.58	.65	.86	.35	.47
V	28.67	10.21	32.43	26.18	67.52	70.17	68.68	38.42	55.16