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**DEVELOPMENT OF A MULTIPLE REGRESSION EQUATION
FOR SELECTING COLLEGE BASEBALL PLAYERS
THROUGH AN ANALYSIS OF MEASURES OF
SELECTED BEHAVIORAL SKILLS**

Linn Michael Stranak

**A dissertation presented to the
Graduate Faculty of Middle Tennessee State University
in partial fulfillment of the requirements
for the degree Doctor of Arts**

August, 1977

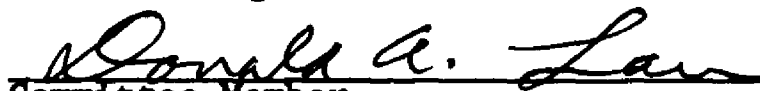
DEVELOPMENT OF A MULTIPLE REGRESSION EQUATION
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ABSTRACT

DEVELOPMENT OF A MULTIPLE REGRESSION EQUATION FOR SELECTING COLLEGE BASEBALL PLAYERS THROUGH AN ANALYSIS OF MEASURES OF SELECTED BEHAVIORAL SKILLS

by Linn Michael Stranak

The development of a prediction equation for selecting college baseball players by way of multiple linear regression techniques was the purpose of this investigative study. Subjects for the study were seventy-one male, volunteer college baseball players from three institutions of higher education in North Carolina.

Authorities and the researcher collected data during the spring semester, 1977, on seven independent variables. The seven variables were the performance variables hitting, running, fielding, and throwing plus behavioral characteristics associated with each and the concomitant variables including personality, baseball knowledge, and fitness. Subjective rating of overall baseball ability was evaluated and served as the criterion measure.

A personality profile was completed by each subject's coach and a teacher-made baseball knowledge examination was administered to the subjects. In addition, fitness of the

subjects was evaluated before data were collected on the performance variables. The performance variables were measured during an actual game situation involving the varsity baseball teams at the North Carolina institutions. The total period of collecting the data was ten weeks.

By analysis of covariance, there was found to be regression in the sample of subjects and by multiple step-wise linear regression a prediction equation for overall baseball ability was developed. The equation was Overall Baseball Ability = .015 (personality) + .009 (baseball knowledge) + .120 (hitting) + .403 (fielding) - .982, thus revealing significant partial regression coefficients. Intercorrelation coefficients, multiple correlation coefficients, and coefficients of multiple determination supported the inclusion of the variables listed in the prediction equation.

DEDICATED TO MIKE WALTER STRANAK
AND ALL THAT HE MEANT TO ME

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In conclusion, the author must not neglect the most important contributors: his family, especially his wife, Judy, whose patience and abilities made this whole program worthwhile, and his mother who has sacrificed many years for his betterment.

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Chapter 1

INTRODUCTION

An interest in the area of measurement and evaluation of specific sport skills led to the present investigative study. More specifically, the investigator was concerned with attempting to lend a degree of quantification to skills pertinent to playing college baseball. Constructing a baseball skills test was an equal concern.

Specific sport skills have been and are recognized as an integral part of the activity domain of physical education. Many of these skills are considered lifetime sports such as golf and tennis. One usually selects a sport for lifetime use based on enjoyment and success, with the latter being determined to a great extent by skill proficiency or skill level attained.

Whether one learns an activity through private means such as country clubs or through an educational institution, assessment of progress takes place either objectively or subjectively. A basic principle of measurement and evaluation states that the more objective the measurement,

the more reliable the assessment.¹ Gruber² took this principle one step further when he claimed to the extent that goals of physical education are intangible they are practically worthless. It would seem that this is the philosophy of "education of the physical" supported by such early leaders in physical education as Dudley Sargent, Edward Hitchcock, and C. H. McCloy.³ This philosophy deals with measurement and its tools as evidenced by those particular individuals and their work.

An emphasis on measurement and evaluation in physical education occurred during the years 1915-1930.⁴ The major thrust was the appointment of James H. McCurdy as chairman of a committee to develop means of measuring motor ability.⁵ From this emphasis point, numerous measuring

¹Harold M. Barrow and Rosemary McGee, A Practical Approach to Measurement in Physical Education (Philadelphia: Lea and Febiger Publishing Co., 1967), p. 26.

²Joseph J. Gruber, Ph.D., Health, Physical Education, Recreation 545, Class Notes, University of Kentucky, Lexington, Fall, 1971.

³Daryl Siedentop, Physical Education-Introductory Analysis (Dubuque, Iowa: Wm. C. Brown Co., Publishers, 1976), pp. 88-90. See, also, Kenneth D. Miller, "Edward Hitchcock--Biographical Sketches of Early Leaders," Journal of Health, Physical Education and Recreation, XXI (April, 1960), 35.

⁴Mabel Lee and Bruce Bennett, "This is an Heritage--Part III: A Time of Teacher Training and Testing," Journal of Health, Physical Education, and Recreation, XXXI (April, 1960), 52-58.

⁵Lee and Bennett, p. 54.

devices have been developed that purport to measure specific motor abilities.

As evidenced by the publications of Barrow and McGee⁶ and Johnson and Nelson,⁷ tests exist for measuring the skill level in specific sports or activities. As one can readily observe from these sources and others,⁸ they are practically void of tests that measure or predict levels of ability in baseball. The aforementioned facts, plus an incessant love for the game of baseball, stimulated the investigator to seek a way to alter in a small, but hopefully significant, manner this situation. Twenty-one consecutive years in organized baseball would seem to qualify the author as an expert in the area. These years were spent as a player and coach at many various levels of the sport.

⁶Barrow and McGee, pp. 269-287.

⁷Barry L. Johnson and Jack K. Nelson, Practical Measurements for Evaluation in Physical Education (Minneapolis: Burgess Publishing Co., 1974), pp. 230-297.

⁸Margaret J. Safrit, Evaluation in Physical Education--Assessing Motor Behavior (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1973), pp. 272-285. Also, see, Francis Stroup, Measurement in Physical Education (New York: The Ronald Press Co., 1957), p. 133.

Predictive equations have been developed for physical fitness,⁹ basketball,¹⁰ baseball,¹¹ and other physical or movement-oriented attributes. It is a useful statistical technique for attempting to quantify certain phenomena; however, in baseball the equations involved nonspecific skill variables to a great degree. By stepwise multiple linear regression and by the use of specific variables in baseball, the researcher desired to derive a useful equation.

STATEMENT OF THE PROBLEM

The problem of this study was to develop a regression equation to predict baseball ability of college-aged students from an analysis of measures of selected baseball behavioral skills. The study attempted to determine which, if any, of the variables were predictors of baseball ability.

⁹Penti Teraslinna, Ph.D., Health, Physical Education, Recreation 770-2, Class Notes, University of Kentucky, Lexington, Fall, 1971.

¹⁰Ira Mitchell, "Two Selected Methods of Judging Varsity Basketball Players Ability" (Unpublished Master's thesis, North Carolina Central University, 1974).

¹¹Peter Everett, "Prediction of Baseball Ability," Research Quarterly, XXIII (March, 1952), 15-19.

PURPOSE OF THE STUDY

The purpose of this study was to derive through statistical techniques a predictive equation that would allow the physical educator and/or coach to evaluate more objectively students' present level of performance in baseball skills. In addition, the investigator will present this method of evaluation of an activity as a skills test in the area of baseball. To accomplish this purpose, ways of developing norms will be presented in order to provide the professional physical educator with a discriminating means of evaluating students' performance.

NEED FOR THE STUDY

Physical educators and coaches are constantly searching for new and better ways to justify discriminating between levels of ability, particularly where physical skills are involved. It is well acknowledged that the more objective or reliable the measurement, the better the assessment.¹²

While implications for the physical educator are mainly concerned with differentiation for the purpose of assigning grades, they are vitally important for the coach because, more often than not, a coach selects his squad from

¹²Gruber, 1971.

completely subjective assessment. He is left open to criticism by many who may question his judgment. Legal ramifications exist today concerning the expert judgment of a coach in a specific sport.¹³ The coach must prove expertise through knowledge of the sport and skill ability as well. Only then may he be considered to possess the necessary skills to be accepted as a qualified coach.

A review of the literature revealed a limited number of studies that were conducted to predict baseball ability. Everett¹⁴ made this point explicitly clear in his study.

Reif¹⁵ dealt aptly with the situation and put it in proper perspective when he said that the physical education profession would welcome objective tests which could "truly" measure baseball ability. He observed with caution the conclusion that the Sargent Jump was the best measure of baseball ability as athletes in general perform well on this item.

As one can readily see, skills pertinent to various positions yet relative to general baseball ability have not

¹³Peter L. Obremsky, "Courts Set Legal Guidelines for Coaches, P. E. Instructors," The First Aider, Cramer Products, Inc., Gardner, Kansas, XLVI (December, 1976), 8-9.

¹⁴Everett, pp. 15-19.

¹⁵Guy Reif, What Research Tells the Coach About Baseball (Washington, D.C.: The Division of Men's Athletics of AAHPER, 1971), p. 34.

been measured. Stroup¹⁶ claimed that uniqueness of skills by position was the very reason baseball skills tests were lacking. Thus, the need was evident for a test to be devised that measured skills by position in addition to general skills.

DELIMITATIONS OF THE STUDY

The subjects for this study consisted of seventy-one baseball players from Warren Wilson, Montreat-Anderson, and Mars Hill Colleges. Due to the statistical design, at least seventy subjects were desired to provide reliability.

Variables selected for the study pertained to performance skills of baseball and were hitting, running, fielding, and throwing, plus the concomitant variables of personality, fitness, and baseball knowledge. The author and other authorities, who were Dr. C. Larry Wilson, Dr. Hugh Hinman, Al Ferguson, and Donald C. McKenzie, collected data on these variables. The experts were college coaches other than the author and persons associated with baseball for at least ten years.

The data were collected in Black Mountain, Swannanoa, Montreat, and Mars Hill, North Carolina, and were collected during the spring semester of the 1976-77 academic year. The period of collection was ten weeks and took place

¹⁶Stroup, p. 133.

during February, March, and April, 1977. Any subject who missed any phase of the testing was eliminated from the study.

LIMITATIONS OF THE STUDY

Several limitations occurred as the result of the nature, scope, and design of the study. The affective personal factors of the subjects could not be controlled.

The environmental conditions of extreme cold and rain delayed the collection of data. Particularly, the skill variables that were measured out of doors were delayed.

DEFINITIONS OF TERMS

Associated with this study are certain terms that may be applicable to this study alone. In order to enable the reader to more fully comprehend the contents within this paper, the following terms are defined.

Objective. For the purpose of this study, objective has a twofold meaning: (1) the specific end of a planned action which should be measurable and achievable¹⁷ and (2) as pertinent to measurement, objective refers to testing

¹⁷Reuben B. Frost, Physical Education Foundations-Practices-Principles (Reading, Mass.: Addison-Wesley Publishing Co., 1975), p. 39.

where there is no difference of opinion among scorers as to whether responses are to be scored right or wrong.¹⁸

Subjective. Resulting from feelings or temperament of the subject rather than the attributes of the object in question.¹⁹

Behavioral skills. A term meaning specific descriptions of actions which are thought to be desirable by the end of the learning experience.²⁰ These skills are the offensive skills of hitting and running. Hitting is a performance variable referring to the ability to swing a bat and strike a baseball and composed of behavioral characteristics. Running refers to the ability to move efficiently from one point to another on a baseball field and composed of behavioral characteristics. Fielding and throwing are defensive skills with fielding referring to the ability to catch or receive a thrown or batted ball and composed of behavioral characteristics. Throwing refers to the ability of a player to impart impetus to a baseball with the hand and composed of behavioral characteristics.

Concomitants. Existing or occurring together.²¹
In this study this term refers to variables added that

¹⁸Barrow and McGee, p. 549.

¹⁹Barrow and McGee, p. 552.

²⁰John E. Nixon and Ann E. Jewett, An Introduction to Physical Education (Philadelphia: W. B. Saunders Publishing Co., 1974), pp. 98-99.

²¹Funk and Wagnals, Standard College Dictionary (New York: Harcourt, Brace, and World, Inc., 1966), p. 280.

were thought to yield possible significance. The following two terms represent the concomitant variables in addition to fitness. Baseball knowledge represents acquired knowledge of the fundamentals, rules, strategies, and techniques of baseball. Personality is how one reacts to his environment.²² Specifically, it refers to the sum total of a person's responses as a player in a baseball setting. This includes player-coach and player-player relationships.

Specific sport skill. Those physical activities constituting each sport which are distinctive to that sport.²³

Multiple linear regression. The process of finding a line or curve that represents the functional relationship between two variables X and Y where more than one X variable exists.²⁴ In relation to this study the Y variable is a criterion measure which was the subjective rating by experts of the baseball playing ability of the subjects. The X variables were the behavioral skills of hitting,

²²Kenneth L. Jones, Louis W. Shainberg, and Curtis O. Byer, Health Science (New York: Harper and Row, Publishers, 1971), p. 6.

²³Barrow and McGee, p. 126.

²⁴Charles O. Dotson and Don R. Kirkendall, Statistics for Physical Education, Health and Recreation (New York: Harper and Row, Publishers, 1974), p. 204.

running, fielding, throwing, plus the concomitants baseball knowledge, personality, and fitness.

BASIC ASSUMPTIONS

Assumptions associated with this study were experimental and statistical and were as follow:

1. It was assumed the subjects participating in this study were beyond the beginner stages of learning baseball. This statement does not imply ability level is being equated with beginning stages.

2. It was assumed that strength, structure, and non-specific baseball variables listed by Everett,²⁵ Hooks,²⁶ and Nelson²⁷ that purport to measure baseball ability are necessarily inherent in the success of hitting, running, fielding, and throwing.

3. The relationships of the variables are linear.²⁸

²⁵Everett, pp. 15-19.

²⁶Eugene Hooks, Prediction of Baseball Ability Through an Analysis of Measures of Strength and Structure," Research Quarterly, XXX (March, 1959), 38-48.

²⁷Robert E. Kelson, "Baseball Classification Plan for Boys," Research Quarterly, XXIV (October, 1953), 304-307.

²⁸Taro Yamane, Statistics--An Introductory Analysis (New York: Harper and Row, Publishers, 1967), p. 429.

4. The X values are fixed and do not have a distribution.²⁹

5. The error term is independent and normally distributed with a mean of 0 and variance = σ_{γ}^2 .³⁰

HYPOTHESES

In order to accomplish the purposes of this study, the following null hypotheses were tested:

1. The overall test of the regression line was not significantly different from zero. In this hypothesis, it was the purpose to determine the closeness of fit of the regression plane to the actual points. Again, statistically, this is shown as

$$H_0: B_1 = B_2 = \dots B_k \text{ where } K = 7 = 0.$$

$$H_a: B_1 \neq B_2 \neq \dots B_k \text{ where } K = 7 = 0.³¹$$

2. The partial regression coefficients (B's) were not significantly different from zero. In other words, the weights or importance of the variables in predicting baseball ability were not significantly different from zero. Statistically, this is represented by:

²⁹Yamane, p. 429.

³⁰Yamane, p. 429.

³¹Yamane, p. 792.

$$H_0: B_i = 0 \quad i = 1, 2, 3, 4, 5, 6, 7.$$

$$H_a: B_i \neq 0 \quad i = 1, 2, 3, 4, 5, 6, 7.^{32}$$

B_i for $i = 1 - 4$ represents hitting, running, fielding, and throwing--behavioral skills.

B_i for $i = 5 - 7$ represents baseball knowledge, personality, and fitness--concomitants.

³²Yamane, p. 789.

Chapter 2

REVIEW OF RELATED LITERATURE

The literature review proceeds from the general to the specific in relation to the present investigation. The studies reviewed were categorized into three areas. These areas involved attempts at predicting baseball ability, research on the performance variables of hitting, running, fielding, throwing, and their behavioral characteristics, and the concomitant areas of personality, fitness, and knowledge as they relate to physical performance.

Although numerous research studies have been done on baseball, there has been little research concerning overall baseball ability. The research is limited to individual baseball skills and aspects of the skills. Most specific sports skills have had tests developed to measure a student's level of ability in that sport; however, baseball and its skills seem to be the least researched.

Providing a basis for the selection and justification of variables for this study was the review of articles that are not specifically research oriented. They have merit for inclusion in that they are written by experts in the field and pertain directly to baseball.

Specifically, the initial group of studies reviewed pertained to the prediction of baseball ability. The next studies categorized dealt with performance variables and were subcategorized into the offensive variables of hitting and running and the defensive variables of fielding and throwing. Last, research studies pertaining to the concomitant variables personality, baseball knowledge, and fitness were reviewed.

RELATED RESEARCH STUDIES PERTAINING TO PREDICTING BASEBALL ABILITY

The plethora of research that exists for baseball skills does not exist when it comes to predicting baseball ability. Everett¹ tested thirty University of Iowa varsity players on ten variables. The variables were: (1) throw for distance, (2) running speed and agility, (3) eye-hand coordination, (4) fast reaction time, (5) ability to judge distance, (6) ability to visualize spacial relationships, (7) ability to make quick decisions, (8) ability to throw accurately, (9) ability to relax properly, and (10) motor capacity. The criterion measure was subjective rating of the varsity coach. He concluded that the Sargent Jump is the best measure of baseball ability. His prediction

¹Peter Everett, "Prediction of Baseball Ability," Research Quarterly, XXIII (March, 1952), 15-19.

equation was T score - 0.92 Sargent Jump (cm) - 0.08 S test - 0.23 Blocks test + 16.19.

Strength and structure variables were used as predictors by Hooks.² He wished to determine the relation of nineteen strength and structure variables to success in the skills of hitting, throwing, running, fielding, and overall ability. Left shoulder flexion was the best predictor found in this study with right shoulder flexion the second best. Strength measures were better predictors on the whole than structural measures. For this study the prediction equation was ability = .50 (ht.) + .28 (left shoulder flexion) - 15.15.

Nelson³ developed a classification plan for boys. Utilizing sixty-four Little League boys as subjects, he concluded that the baseball throw for distance was the best classification based on correlations obtained. The children were subjectively rated on batting, throwing, and catching by health, physical education, and recreation majors. In addition, he gave some merit to behavior, coordination, and ability to handle oneself while performing skills.

²Eugene Hooks, "Prediction of Baseball Ability Through an Analysis of Measures of Strength and Structure," Research Quarterly, XXX (March, 1959), 38-48.

³Robert E. Kelson, "Baseball Classification Plan for Boys," Research Quarterly, XXIV (October, 1953), 304-307.

Checklists have been important for total subjective evaluation of performance. Reeves⁴ compiled one such list on important points for offensive and defensive performance in baseball. Michael⁵ went one step further than a checklist when he recommended working players on drills at specific positions for the purpose of evaluation.

RELATED RESEARCH STUDIES ON PERFORMANCE VARIABLES-BEHAVIORAL SKILLS

An abundance of research exists on the specific variables of hitting, throwing, fielding, and running as they pertain to baseball. Hitting and running are offensive variables and fielding and throwing are classified as defensive variables. These studies serve to reinforce the importance of the variables as necessary performance skills in determining baseball ability. It is noteworthy to add that, in addition to research, many qualified experts on baseball have written numerous articles stressing the particular variables mentioned.

⁴Fred Reeves, "Quick Checklist for Baseball Coaches," Scholastic Coach, VIII (April, 1969), 32-34.

⁵Les Michael, "Individual Position Drills are the Key to Winning Baseball," Athletic Journal, L (January, 1970), 32.

Hitting

Twenty varsity baseball players at the University of Iowa were subjects in a study by Watkins.⁶ The purpose of this study was to determine if motion picture analysis aided in the correction of batting faults. The subjects were divided into two groups. Both were filmed but only one group was then given instructions and shown faults. Watkins concluded that those who viewed pictures and received instructions reduced the number of batting faults.

Hubbard⁷ utilized electromyography, observation, analysis of photographs, and cinematography to determine the best way for the head and eyes to track a baseball. He used 101 subjects and found that batters made use of pursuit movement of the eyes with the head fixed and that the eyes never followed the ball to the point of contact.

Lande⁸ has identified forty-four specific objectives for the analysis of hitting. They are categorized into the areas of action prior to swing, action during swing, general physical and mental factors, and selection of the bat.

⁶David L. Watkins, "Motion Pictures as an Aid in Correcting Batting Faults," Research Quarterly, XXXIV (May, 1963), 228-233.

⁷Alfred Hubbard and Charles Seng, "Visual Movements of Batters," Research Quarterly, XXVI (December, 1955), 365-369.

⁸Leon Lande, "Analysis Chart for Hitters," Athletic Journal, XLVII (February, 1967), 26.

This work was a climax to one he wrote concerning natural hitters in baseball.⁹

Electromyographic study of muscle groups pertinent to batting swing has been conducted. Muscle action potential during phases of the swing was recorded for two skilled and two unskilled subjects by Kitzman.¹⁰ He found right-handed batters could increase force transferred to a bat by strengthening the left triceps brachii.

The effects of eye dominance on hitting has been the concern of more than one writer. Adams¹¹ divided twenty-eight college baseball players into two groups based on laterality. It was determined in this study that unilaterals scored better in most batting categories. A similar research project was conducted by Lakatos¹² on the 1967 University of Arizona baseball team.

More research has been conducted on the mechanical analysis of hitting than any other aspect of this skill.

⁹Leon Lande, "What is Natural in Hitting?", Athletic Journal, XLVI (January, 1966), 26.

¹⁰Eric Kitzman, "Baseball: Electromyographic Study of Batting Swing," Research Quarterly, XXXV (May, 1964), 166-178.

¹¹Gary Adams, "Effects of Eye Dominance on Baseball Batting," Research Quarterly, XXXVI (March, 1965), 3-9.

¹²John Lakatos, "Eye Dominance in Batting Performance," Athletic Journal, XLIX (November, 1968), 76.

McCord¹³ claimed grip, stance, stride, and swing were of utmost consideration in hitting. Utilizing seventeen professional ballplayers, Race¹⁴ said that hip rotation and powerful uncocking of the wrists were important. In addition, he listed body balance, position of the head, stance, and arm movement through the follow-through as vital characteristics.

Shapiro¹⁵ applied the kinesiological principle of summation of forces to the analysis of hitting. This principle suggests that the second movement should be a result of and faster than the first movement for best results. He concluded that stance--hips, wrists, and arms--should follow this principle and the head should remain stationary.

Breem¹⁶ provided a checklist of batting characteristics necessary for successful batting. He claimed the center of gravity, head position, speed of bat,

¹³Bubba McCord, "The Physics in Hitting," Athletic Journal, L (December, 1969), 42, 44-48.

¹⁴D. E. Race, "Cinematographic and Mechanical Analysis of the External Movements Involved in Hitting a Baseball Effectively," Research Quarterly, XXXII (October, 1961), 394-403.

¹⁵Harvey Shapiro, "Mechanical Analysis of Hitting," Proceedings, American Association of College Baseball Coaches, Chicago, 1976.

¹⁶James L. Breem, "What Makes a Good Hitter?," Journal of Health, Physical Education and Recreation, XXXVIII (April, 1967), 36-39.

length of stride, and support of weight were important and used cinematography of professional players to disclose the above techniques. McKinney¹⁷ et al. reinforced Breem's findings by concluding that form or technique were so essential to good hitting.

Running

Much research has been conducted on baseball at Springfield College. This is further strengthened and evidenced by a study conducted by Seymour.¹⁸ Each of fifteen varsity baseball players had fifteen trials on two methods of running to first base. The methods were the normal stride to and beyond the base and leap to the base. Eleven reached first base faster by the first method.

Keilitz¹⁹ claimed base running starts when opponents take the field. He gave an excellent pictorial account of hitting the bag in stride, the lead and break off the base, drive back to first base, tagging up, and head-first slide.

¹⁷Wayne C. McKinney, Tom Hodge, and Gene A. Logan, "The Use of Specifics by Baseball Hitters," Athletic Journal, L (January, 1970), 76, 96-97.

¹⁸Emery W. Seymour, "Comparison of Baserunning Methods," Research Quarterly, XXX (October, 1959), 321-325.

¹⁹Dave Keilitz, "Base-Running," Athletic Journal, LV (February, 1975), 28-40, 91-92.

A renowned college baseball coach, Jack Stallings,²⁰ discussed and gave a pictorial account of rounding a base in which he listed three points as vital. They were swinging out properly, tagging inside corner, and pushing off hard. Furthermore, to emphasize Stallings' comments on running, Hecker²¹ stated that running speed and technique were vital to properly running the bases. Horizontal arm swing, high step, and relaxed muscles in the neck, face, and shoulders were characteristics of successful base runners.

Methods of rounding bases and taking leads have led to research in baseball. Woodward²² compared twenty-two baseball players at Florida State University on methods of rounding first base. The round out, narrow angle and wide angle methods were compared using a clock to record times. The wide angle method was the best for rounding first base, as concluded by Woodward.

Similarly, Mehn²³ compared three methods of running to first base. Sixty-six Adams State College players were

²⁰Jack Stallings, "Techniques of Baserunning," Athletic Journal, LI (February, 1971), 26.

²¹Barry Hecker, "Teaching Baseball Players to Run," Athletic Journal, LIV (February, 1974), 18, 83.

²²William Woodward, "A Comparison of Baserunning Methods in Baseball" (unpublished Master's thesis, Florida State University, 1970).

²³Duane Mehn, "An Experimental Analysis of Base-Running Techniques" (unpublished Doctoral dissertation, Colorado State College, 1963).

tested nine days by the Standard Electric Chronoscope on the direct pivot, half-moon traditional, and the ninety degree turn methods of running to and rounding first base. The half-moon traditional method proved to be the fastest.

Israel²⁴ tested methods of rounding first base utilizing thirty college baseball players at Appalachian State University as subjects. He found the cross-over and jab-step starts were the best for base stealing over the sprinter's start methods.

Fielding

Michael²⁵ wrote an extensive and complete article dealing with fielding by position. He presented and discussed lists of positive contributions that the pitcher, catcher, infielders, and outfielders must be able to do in order to be successful at those positions. No significant difference was reported. Also, concerning outfield play, Correy²⁶ felt fundamental skills were important to successful play. These were catching, charging, and judging the ball properly.

²⁴Richard G. Israel, "Time Comparisons Among the Cross-Over Step, Jab-Step, and Two Types of Sprinter's Starts in Base Stealing," Research Quarterly, XLVII (May, 1976), 196-202.

²⁵Les Michael, "Check List for Defensive Baseball," Athletic Journal, XL (February, 1960), 14-15, 71-72.

²⁶Tony Correy, "Playing the Outfield," Athletic Journal, LIV (February, 1974), 70-71, 77.

Ranta²⁷ dealt with infield play as far as fielding is concerned. He listed proper fielding techniques for a shortstop. These techniques were centering the body over the ball, fielding the ball out in front of the body, looking the ball into the glove, flexing the wrist, and stepping toward the target before throwing.

In addition to the article by Ranta, Wren²⁸ commented on the infield play of the shortstop and second baseman. He gave a pictorial account of not only positioning, but movements of these players as fielders.

Discussion on outfield play was adequately handled by Weiskopf²⁹. He also gave a pictorial account of how to field in the outfield. He made use of big leaguers to explain how to go to the left, right, back, in, and fielding ground balls. In the same vein, Russo³⁰ discussed the mechanics of catching fly balls and ground balls.

One of the supreme articles on the catcher as a fielder was written by McCabe.³¹ He diagrammed the position

²⁷Bill Ranta, "Fielding Keys for the Shortstop," Athletic Journal, LV (March, 1975), 40-45, 96.

²⁸Robert Wren, "The Shortstop and Second Baseman as Fielders," Athletic Journal, XLVII (February, 1968), 26-31.

²⁹Don Weiskopf, "Outfield Play," Athletic Journal, XLVIII (December, 1968), 10-14, 64-65.

³⁰Joe Russo, "Outfield Play," Proceedings, American Association of College Baseball Coaches, Chicago, 1976.

³¹Bill McCabe, "Basic Footwork for the Catcher," Athletic Journal, XLIII (March, 1963), 44, 84.

of the feet for various situations that involve the catcher shifting as a fielder.

Throwing

Van Huss³² et al. concluded that overload warmup significantly improved the velocity of a thrown baseball. Equally important to research done on the effects of training methods on throwing is that done on the methods of throwing. Wescott³³ compared the overhand throw with resistance and combination throwing methods on seventy-three male college students and found no difference in terms of speed and accuracy of throwing.

A well known baseball personality, Lee Eilbract,³⁴ discussed and gave a pictorial account of the correct points or objectives in throwing a baseball. He analyzed the overhand, underhand, and sidearm techniques of throwing pertinent to the position where they are most commonly used.

With the exception of an unassisted put out or lack of ensuing play, any time a ball is fielded it must be

³²W. D. Van Huss, L. Albrecht, R. Nelson, and R. Hagerina, "Effect of Overload Warmup on the Velocity and Accuracy of Throwing," Research Quarterly, XXXIII (October, 1962), 472-475.

³³Richard Wescott, "The Effect of an Imitative Type of Resistance Exercise on Throwing Skill" (unpublished Doctoral dissertation, Indiana University, 1965).

³⁴Lee Eilbract, "Throwing the Baseball," Athletic Journal, XL (May, 1960), 34-35.

thrown, no matter who the fielder is or what position he plays. Groch³⁵ gave a pictorial account of the preliminary position, uncoiling, and follow-through of a baseball pitcher. Dedin³⁶ carried this one step further when he discussed the mechanics of pitching. This included the stride, push-off, follow-through, and proper positioning to field.

Logan³⁷ et al. divided thirty-nine subjects into three groups at Southwest Missouri State College. They were pre-tested to determine velocity of throw. One group was given isotonic resistance. Another group practiced throwing while the third group served as controls. The velocity increased greater through the overhand range of motion with light resistance.

³⁵Dick Groch, "Analyzing the Pitcher," Athletic Journal, L (March, 1970), 8, 113-114.

³⁶Tom Dedin, "Teaching Control to Young Pitchers," Proceedings, American Association of College Baseball Coaches, Chicago, 1976.

³⁷Gene Logan, Wayne McKinney, and William Rowe, "Effect of Resistance Through a Throwing Range-of-Motion on the Velocity of a Baseball," Perceptual and Motor Skills, XXIII (August, 1966), 55-58.

RELATED RESEARCH STUDIES ON
CONCOMITANT VARIABLES

Personality

Booth³⁸ compared personality ratings of several groups of college students by the Minnesota Multiphasic Personality Inventory. Athletes were compared with non-athletes and the former were further divided into sport of participation. He concluded that a difference existed in the personality of athletes and non-athletes and between participants in different sports.

The purpose of a study by LaPlace³⁹ was to determine whether specific personality traits are associated with success in professional baseball. He compared forty-nine major leaguers with sixty-four minor league ballplayers. The instruments utilized were the Minnesota Multiphasic Personality Inventory and a biographical sketch. The major leaguers were better able to be aggressive, have self-discipline to a greater degree, adjust more readily to different situations and exhibit greater initiative.

³⁸E. G. Booth, Jr., "Personality Traits of Athletes as Measured by the MMPI," Research Quarterly, XXIX (March, 1958), 127-137.

³⁹John P. LaPlace, "Personality and Its Relationship to Success in Professional Baseball," Research Quarterly, XXV (October, 1954), 313-319.

Kroll⁴⁰ gave ninety-six subjects the Sixteen Personality Factor Questionnaire. These subjects were wrestlers at three levels of amateur competition. He found collegiate wrestlers to be tough-minded, self-reliant, and masculine.

Research that has identified personality traits which characterize athletes shows no cause-effect relationship between the two.⁴¹ Frost went on to list several personality traits of good athletes that the great coach should be concerned with when selecting a team. These traits were self-confidence, dominance, surgence, need to achieve, and extroversion.

Werner⁴² compared 340 athletes with 116 non-athletes. The Cattell Inventory was the instrument used for testing purposes. None of the findings indicated that college athletics influenced personality formation. The Cattell Inventory was given to 334 subjects by Schnedel.⁴³ They

⁴⁰Walter Kroll, "Sixteen Personality Factor Profiles of Collegiate Wrestlers," Research Quarterly, XXXVIII (March, 1967), 49-57.

⁴¹Reuben B. Frost, Physical Education Foundations-Practices-Principles (Reading, Mass.: Addison-Wesley, 1975), pp. 207-214.

⁴²Alfred Werner and Edward Gotheil, "Personality Development and Participation in College Athletics," Research Quarterly, XXXVIII (March, 1966), 126.

⁴³Jack Schendel, "Psychological Differences Between Athletes and Nonparticipants in Athletics at Three Educational Levels," Research Quarterly, XXXVI (March, 1965), 52-67.

ranged from ninth graders to college age individuals. He found a difference in personality between athletes and non-participants, particularly at the college level. The nonparticipants had had higher means on eight items of the Cattell Personality Inventory.

Two notable research projects dealing with personality and athletics were completed by Slusher⁴⁴ and Singer.⁴⁵ The former study determined that femininity and intelligence were lower for baseball, basketball, football players, swimmers, and wrestlers than nonathletes. Hypochondriasis was greater in athletes and, in general, the wrestlers were more neurotic as measured by the Minnesota Multiphasic Personality Inventory. Singer found baseball players to be significantly different from tennis players on the personality items of achievement, intraception, dominance, and abasement. This study by Singer used the Edwards Personal Preference Scale as the measuring device.

⁴⁴Howard Slusher, "Personality and Intelligent Characteristics of Selected High School Athletes and Non-athletes," Research Quarterly, XXXV (December, 1964), 539-545.

⁴⁵Robert N. Singer, "Personality Difference Between and Within Baseball and Tennis Players," Research Quarterly, XL (October, 1969), 582-588.

Johnson⁴⁶ et al. agreed with Slusher in that athletes, particularly baseball players, were higher in hypochondriasis. This study and others reinforce a statement by Dr. C. Larry Wilson⁴⁷ "that at the high level of performance such as college athletics personality plays an important role."

Fitness

It has been shown that pre-season conditioning could play an important role to the participants in baseball.⁴⁸ DeBriyn and Brown at the University of Arkansas claimed that sixteen varsity baseball players increased strength, endurance capacity, and maximum oxygen uptake as a result of pre-season conditioning. In addition, cholesterol level, resting heart rate, and systolic blood pressure decreased.

Rothermal⁴⁹ compared differences in physical fitness characteristics of professional baseball players and

⁴⁶Perry Johnson, Wynn Updyke, Mary Ellen Schaefer, and Donald Stolberg, Sport, Exercise and You (New York: Holt, Rinehart and Winston Publishing Co., 1975, pp. 323-325).

⁴⁷Dr. C. Larry Wilson, personal interview, April 22, 1977, Montreat, North Carolina.

⁴⁸Norm DeBriyn and Barry S. Brown, "Is Pre-Season Baseball Conditioning Necessary?", Athletic Journal, LIV (January, 1974), 60-63.

⁴⁹Bradley Rothermal, "Selected Physical Fitness Characteristics of Professional Baseball Players" (unpublished Doctoral dissertation, University of Illinois, 1965).

college-aged males by non-parametric statistics. Thirty-five professional players were tested on ninety-three physical fitness items. The professionals were significantly better on twenty-six of thirty-two anthropometric measures, seven of forty-two cardiovascular measures, and twelve of nineteen motor performance measures. Similarly, Popescue⁵⁰ tested throwing speed after an eight-week training period. By analysis of covariance, it was determined the group using weights improved significantly better on throwing speed as measured by a strobe light.

Jensen⁵¹ postulated that strength produces by-products that aid athletic ability. These by-products are endurance, power, ability, and running speed. More specific rationalizations for conditioning programs in baseball were given by Weiskopf⁵² and Frederick.⁵³ Weiskopf credited Dr. Bauman's fitness and stretching program for the success of the St. Louis Cardinal baseball players.

⁵⁰Michael Popescue, "Weight Training and the Velocity of a Baseball," Athletic Journal, LV (May, 1975), 74, 105-106.

⁵¹Clayne R. Jensen, "Essentials for Strength Building for Athletics," Athletic Journal, LIV (February, 1974), 68-70.

⁵²Don Weiskopf, "St. Louis Cardinals Conditioning Program," Athletic Journal, XLIX (December, 1968), 10-12.

⁵³Gary Frederick, "Baseball Circuit Training," Athletic Journal, L (December, 1969), 34.

Likewise, Frederick emphasized conditioning activities as improvement factors in ability.

Two well known physical educators have discussed the relationship of conditioning to athletic performance. Siedentop⁵⁴ claimed there was a direct relationship of physical fitness to performance and specific fitness was necessary for each sport. Fox and Matthews⁵⁵ determined that the maximal effort for baseball players at one time is 10-20 seconds. They suggested conditioning for anaerobic power for baseball players.

Knowledge and Athletic Ability

Research has been somewhat equivocal as to the effects of knowledge on performance. Works by DiGiovanni⁵⁶ and Hackensmith and Miller⁵⁷ seem to bear this out. The former study compared intelligence and athletic ability of college men. The results indicated no significant

⁵⁴Daryl Siedentop, Physical Education-Introductory Analysis (Dubuque, Iowa: Wm. C. Brown Co., Publishers, 1976), pp. 95-107.

⁵⁵Edward L. Fox and Donald Matthews, Interval Training (Philadelphia: W. B. Saunders Publishing Co., 1974), p. 198.

⁵⁶V. G. DiGiovanni, "A Comparison of the Intelligence and Athletic Ability of College Men," Research Quarterly, VIII (October, 1937), 96-106.

⁵⁷C. W. Hackensmith and L. Miller, "A Comparison of Academic Grades and Intelligence Scores of Participants and Non-Participants in Intramural Athletics at the University of Kentucky," Research Quarterly, IX (March, 1938), 94-99.

correlation between athletic or motor ability and intelligence. To the contrary, Hackensmith and Miller's study revealed men involved in intramural athletics at the University of Kentucky had a higher GPA and intelligence quotient than those not involved.

Byrley and Anderson⁵⁸ tested 1,013 secondary school boys, athletic vs. nonathletic, using the Hanmon Nelson Test of Mental Ability. The authors found significance between the jump test for power and athletic ability but not with intelligence.

Thorpe⁵⁹ found by analysis of variance that skill and not intelligence was highly significant in relation to success in badminton and tennis. Three hundred seventy-five college women served as subjects. They played a round robin singles tournament and took the Otis Intelligence Test.

In conclusion two articles were located that utilized regression analysis in relation to baseball. Featherstone and Studenmund⁶⁰ predicted games won with

⁵⁸Lloyd R. Byrley and Roy Leonard Anderson, Jr., "Relation of Jump and Reach Measures of Power to Intelligence Scores and Athletic Performance," Research Quarterly, XXVI (March, 1955), 28-35.

⁵⁹JoAnn Thorpe, "Intelligence and Skill in Relation to Success in Singles Competition in Badminton and Tennis," Research Quarterly, XXXVIII (March, 1967), 119-125.

⁶⁰Dennis Featherstone and A. H. Studenmund, "A Statistical Model for Baseball Standings," Research Quarterly, XLV (March, 1974), 80-85.

multiple linear regression. His regression equation was $Win = A + b_1 ERA + b_2 BA + b_3 HR + b_4 FLD + E$. He concluded that ERA was the most important with a beta weight of 50 percent.

Similarly, McCarthy⁶¹ correlated measures of success with offensive and defensive categories. He correlated championships, winning percentage, his run production and opponents run production with hits, runs, doubles, triples, home runs, walks, stolen bases, runs batted in, on base percentage, and batting average. It was concluded that no offensive factors were related to championships but most were related to his winning percentage and run production.

As evidenced by the literature reviewed, more research in prediction of baseball ability deserves merit. Although specific sport skill tests exist for many areas, they are lacking in the area of baseball. Thus, it is appropriate that this study be concerned with predicting baseball ability of college men based on behavioral skills pertinent to baseball.

⁶¹Jean McCarthy, "Winning Baseball: Offense or Defense," Proceedings, American Association of College Baseball Coaches, Chicago, 1976.

Chapter 3

METHODS AND PROCEDURES

In order to accomplish the purposes of this study certain methods and procedures were utilized. These involved the selection of subjects, variables related to the study, collection of data by way of testing procedures, and statistical procedures for analyzing the data.

The subjects for this study were students enrolled in three North Carolina colleges. The variables utilized in this study were chosen based on personal experience, professional scouts, tryout books, and gleaning of the literature.

It was desired that the variables relate directly to performance and behavioral skills of baseball. Thus, four performance variables and corresponding behavioral skills were selected in addition to concomitant variables. Again, these variables were the performance variables of hitting, running, fielding, and throwing along with behavioral skills associated with each. Specific behavioral skills or characteristics will appear in the variable section of this chapter and will be broken down by position--infield, outfield, catcher, and pitcher--for each defensive

performance variable and by technique for the offensive performance variables. The concomitant variables were personality, fitness, and baseball knowledge.

Testing procedures to collect data were applied to the subjects during the spring of 1977. The authorities already mentioned administered the tests to the subjects. The administration included subjective rating of overall baseball ability plus collection of data on the variables. Statistically, multiple linear regression was the technique selected to analyze the data. A prediction equation can be obtained by using this method of analysis.

SELECTION OF SUBJECTS

The subjects for this study were seventy-one male, volunteer college students from three institutions of higher education in North Carolina. The colleges were Montreat-Anderson College of Montreat, North Carolina; Warren Wilson College of Swannanoa, North Carolina; and Mars Hill College of Mars Hill, North Carolina. At least seventy subjects were desired by the investigator to participate in the study and seventy-one actually completed all testing phases.

The population from which the subjects were available included the student populations of Montreat-Anderson College, Warren Wilson College, and Mars Hill College. More specifically, the sample of subjects available for this study consisted of all students who tried

out for and participated in varsity baseball at the colleges listed during the spring semester, 1977. They were told that they were participating in a research study to stress the importance of cooperation and reliability for attendance on their part.

ESTABLISHING RELIABILITY AND VALIDITY OF INDEPENDENT VARIABLES

Experience as a college baseball coach has led this writer to conclude that many skills inherent in baseball ability are necessary to consider in an assessment of such. Working with professional scouts in conducting tryout camps substantiate this feeling. As mentioned previously, authorities such as Ranta¹ and Stallings² have alluded through the literature to behavioral skills as important characteristics of baseball performance.

Four baseball performance variables were chosen by the fact that authorities purport they are necessary skills

¹Bill Ranta, "Fielding Keys for the Shortstop," Athletic Journal, LV (March, 1975), 40-45.

²Jack Stallings, "Techniques of Baserunning," Athletic Journal, LI (February, 1971), 26.

to overall successful baseball play.³ These authorities just cited consisted of a jury of experts and established face or content validity for their inclusion. In addition, validity was reported to be .918 and was established by obtaining the subjective rating of overall baseball ability and correlating these with scores obtained on the skills examination. Reliability for these four items was established by the split halves method and equaled .847. Three other variables were chosen as concomitants. These variables were added as they were thought to provide possible information in the prediction of baseball ability.

These latter three variables must possess validity and reliability as well. Personality and fitness were measured using instruments which have met certain criterion for their establishment. Permission was granted for their

³Walter Shannon and Thomas Sommers, "The Making of a Professional Ball Player," Proceedings, American Association of College Baseball Coaches, Chicago, 1976; Gene Casey, "Coach of Baseball," Southern Connecticut State College Health, Physical Education, Recreation Department, Proceedings, American Association of College Baseball Coaches, Chicago, 1974; Jean McCarthy, "Winning Baseball: Offense or Defense?," Proceedings, American Association of College Baseball Coaches, Chicago, 1976; Dick Siebert, "University of Minnesota Baseball Clinic," Proceedings, American Association of College Baseball Coaches, Chicago, 1976; Jim Casalino, "Philosophy in Development," Proceedings, American Association of College Baseball Coaches, Chicago, 1976; and Don Weiskopf, How to Play Baseball (St. Louis: The Sporting News, 1973), pp. 8-21, 35-49, 157-189.

inclusion in this study as shown in Appendix A. The baseball knowledge variable was validated by Donald C. McKenzie and the investigator subjectively assessing the test. This method is acceptable as it is a teacher-made examination. Reliability was established by the test-retest method and equaled .893. Specifically, the variables selected were the offensive performance variables of hitting and running, the defensive performance variables of fielding and throwing, and the concomitant variables of personality, fitness, and baseball knowledge.

TESTING PROCEDURES

Rater reliability was calculated to establish the validity of the scores and how well each authority understood the purpose of the rating device and how to perform the rating itself. To be included as an authority, certain criteria had to be met by the individuals under consideration. The criteria were having coached baseball at the college level and having been associated with organized baseball for at least ten years. The authorities were Dr. C. Larry Wilson and Donald C. McKenzie in addition to the author.

By taking 20 percent of the sample and correlating the scores, rater reliability was .931. This was accomplished by a random selection of 20 percent of the subjects.

A training of the raters was conducted to determine the feasibility of the investigation in addition to acquainting the raters with the details of their duties. As an instrument for the collection of data, the rater must be trained to observe accurately what he is supposed to observe. This was accomplished according to the method described by Rummel.⁴ In particular, the training involved the performance variables only.

The duties of Dr. C. Larry Wilson, Don McKenzie, and the researcher were to subjectively rate the baseball playing ability of the subjects. A copy of the rating device was distributed to the raters before the testing period. They studied the rating sheet, met with the investigator to discuss the sheet, and completed a trial run at one of the Montreat-Anderson College practice sessions.

The duties of Don McKenzie and the researcher were to evaluate the subjects objectively utilizing the behavioral skills examination sheet. McKenzie served as a check for reliability on this phase of testing. This instrument was distributed to the testers before actual testing occurred. They studied the battery of test items and had the opportunity to administer the test during a

⁴J. Francis Rummel, An Introduction to Research Procedures in Education (New York: Harper and Row, Publishers, 1964), pp. 95-96.

trial run at a practice session in order to familiarize themselves with the device.

During January, 1977, this writer met with Dr. C. Larry Wilson, Don McKenzie, and the baseball coaches of Warren Wilson and Mars Hill colleges, who were Al Ferguson and Dr. Hugh Himan, respectively, to discuss the details of conducting this investigation. At this time, data sheets for the concomitant variables were handed to the experts. The training period proved invaluable in terms of feasibility and ease of administration. At the conclusion of this point in the investigation the collection of data began.

Data were collected on the variables mentioned during the spring semester of the 1976-77 academic year. The places were Montreat, Black Mountain, Mars Hill, and Swannanoa, North Carolina. The length of the period of collection lasted ten weeks which included measurement of all variables.

Due to environmental conditions in January and February, it was more practical to collect data on the concomitant variables during these months. After receiving permission from Allyn and Bacon and Burgess publishing companies on the personality profile and fitness aspects of the study, the researcher met with authorities and coaches to review their duties for and implementation of this research project.

CONCOMITANT VARIABLES

Personality

Personality profile sheets were completed by the respective coaches of the players. These sheets were picked up by the author at a later date. With permission, a personality profile listed in Tutko and Richards⁵ was utilized to assess personality characteristics of each subject.

The player profile consisted of the following items: drive, self-confidence, aggressiveness, coachability, determination, emotionality, conscience development, trust, responsibility, leadership, and mental toughness. The complete profile appears in Appendix B. In order to obtain valid results, the respective coaches of the subjects assessed personality due to familiarity.

Baseball Knowledge

Baseball knowledge was measured by a teacher-made test constructed by the author. The knowledge examination was administered to all subjects with validity and reliability previously reported. Each question met certain specifications for inclusion. These criteria were based on fundamentals, technique, strategy, rules, and terminology pertaining to offense and defense in baseball. This

⁵Thomas A. Tutko and Jack W. Richards, Psychology of Coaching (Boston: Allyn and Bacon, Inc., 1971), p. 49.

examination along with the personality profile and fitness test were the same for all subjects in the study. A complete knowledge examination form appears in Appendix C.

Specific times were arranged at the initial meeting for the administration of the baseball knowledge examination and for the collegiate fitness test. On February 2, 1977, the baseball knowledge examination was given to Montreat-Anderson College baseball players, N = 28. The location and time were McAlister Gymnasium at Montreat and 6:30 p.m., respectively. One hour and a half was the time allowed for all subjects to complete this phase of the tests. In this and all cases of data collection, the subjects were told they were participating in a study. No prior instruction was provided for any of the variables as the purpose was to predict factors that determine baseball ability.

The knowledge examination was administered February 21 to the subjects, N = 19, at Warren Wilson College. Dr. Hugh Himan, Warren Wilson baseball coach, assisted with the examination in the gymnasium at Warren Wilson.

Al Ferguson, baseball coach at Mars Hill College, aided the author when the examination was given to N = 21 subjects at that institution. The data were collected February 22, 1977, at Mars Hill College gymnasium.

Fitness

A measure of each subject's fitness was accomplished by administering the collegiate fitness test reported by Nelson and Johnson.⁶ The validity and reliability of each item on the fitness test were reported by the two authors in the text. The investigator administered this phase of the testing procedures to all subjects with the aid of the other coaches. The evaluation sheet for fitness appears in Appendix D.

The gymnasiums on each campus were the locations, and the testing period was February 23 to March 6. Items on the fitness test were dip strength, pull-ups, 12-minute run and sit and reach. These items seemed to measure more completely fitness attributes necessary to successful baseball play.

It was necessary to make sure all necessary equipment was available before testing. The equipment secured and available was in 2½, 5, 10, 25, 35, and 50 pound increments, along with a sack and a stopwatch.

The order of testing at each institution was pull-ups, 12-minute run, dip strength and sit and reach. A circuit or series of stations was arranged to facilitate the administration of the fitness test. In order for the

⁶Barry L. Johnson and Jack K. Nelson, Practical Measurements for Evaluation in Physical Education (Minneapolis: Burgess Publishing Co., 1974), pp. 153-154.

circuit testing to work properly, three testers were trained by the author on how to evaluate each phase of the test for which they were responsible. Students served in this capacity. They were briefed on the test and given a practice trial at administering their part.

All phases of fitness testing were completed during the specified time with the exception of the sit and reach for Mars Hill subjects. A second trip to Mars Hill College was required in order to complete the fitness test. Anyone who was late for testing was allowed to complete it as long as he was not familiarized with expected results or had not practiced in order to prejudice the results.

PERFORMANCE VARIABLES

More complicated, due to weather, was the collection of data on the performance variables and their behavioral characteristics. It was desired that testing procedures for these variables be conducted under realistic, game-type situations. March 12 was the earliest possible date for this to occur. The actual dates involved were March 14, April 11, 14, and 25.

Mars Hill and Montreat-Anderson subjects were assessed while the two teams competed on March 14 at Montreat. Mars Hill was tested again on April 14 at Mars Hill, while Montreat-Anderson was tested for the second time on April 11 while playing Warren Wilson at Montreat.

Warren Wilson was assessed again on April 25 at Swannanoa during a game with Montreat-Anderson. It became necessary to test in more than one game situation in order to test at least seventy subjects.

Hitting

The offensive variable, hitting, was measured as the subjects batted during one of the above mentioned games. They were not told the criteria under which they were being tested for hit and the other performance variables. Again, these criteria or characteristics appear under the variable section of this chapter and in complete exam sheet form in the appendix section of this work.

Components for the final performance variable, hitting, were the behavioral skills of stationary body position, dynamic body position, and bunting techniques.

These skills were:

- READY POSITION:
1. The head is stationary.
 2. The bat is stationary.
 3. The hands are four to eight inches away from the body.
 4. The shoulders are level.
 5. The knees are slightly flexed.
 6. The back elbow is parallel to the ground.

- SWING:
1. The hips rotate from a closed to open position toward the pitcher.
 2. One pivots on the rear foot.

3. The stride is equal to or less than twelve inches.
4. The wrists unlock at the point of impact of the bat and ball.
5. The arm and shoulders bring the bat to the middle of the back for the follow-through.

BUNT:

1. The shoulders are square to the pitcher.
2. The bat is held at the top of the strike zone.
3. The lead hand directs the bat.
4. The back hand does the bunting--not punting.
5. The bat gives with contact with the ball.

Running

Running, a second offensive variable, was also assessed during one of the games. If all subjects failed to run during the game, they were asked to remain afterwards to complete this phase.

The variable, running, involved the behavioral skills of body position while running and the turning methods at the bases. These skills were:

TECHNIQUE:

1. The arms are horizontal and pump in an antero-posterior manner.
2. The thighs are parallel to the ground.
3. The push off with a foot is straight toward the next base.

4. One angles out three-fourths of the distance to first base.
5. One touches the inside of the base.

Likewise, the defensive variables of fielding and throwing were measured.

Fielding

Components for the variable, fielding, were the behavioral skills of body position, hand position, and movement of the feet. These skills or characteristics were:

OUTFIELD:

1. He straddles ground balls with the opposite foot of the throwing hand ahead.
2. He looks the ball in the glove from the ground up.
3. He uses the cross-over step in moving toward the ball to the right, left, or back.
4. He catches the ball with two hands.
5. He catches a fly ball on the throwing shoulder.

INFIELD:

1. The knees are flexed when fielding ground balls.
2. Ground balls are straddled.
3. The foot on the opposite side of the throwing hand is slightly in front.
4. Ground balls are charged.
5. He uses the cross-over step and reaching step to move laterally.

6. The head is down and he fields from the ground up.
- PITCHER:
1. He faces the catcher with his shoulders and is on balance after the release.
 2. The eyes and head remain up looking toward the plate.
 3. The glove is out in front of the body after the release.
 4. The knees are flexed upon release.
 5. The weight of the body is on the balls of the feet.
- CATCHER:
1. The back is to the pitcher on pop-ups.
 2. The glove and bare hand are used to field bunts and topped balls.
 3. The left foot is slightly ahead of the right foot in ready position.
 4. To receive, the glove fingers are up and the bare hand is behind the glove.
 5. The reaching step is used to field balls to the side.
 6. The glove is open and the catcher is on the knees for low balls.

Throwing

Sub-categories for throwing were the behavioral skills of body position for throw, arm positions, and technique for throw. These skills were:

- OUTFIELD:**
1. The overhand throw is utilized.
 2. The hips close then open with the throw.
 3. The opposite shoulder of the throwing hand points at the target.
 4. The follow-through is completed.
 5. He steps toward the target in throwing.
- INFIELD:**
1. The side arm to overhand throw is used.
 2. The non-throwing shoulder points at the target.
 3. The eyes are fixed on the target.
 4. The ball is visible when throwing--not hidden.
 5. He follows through with wrist flexion.
- PITCHER:**
1. The eyes are on target from the wind-up to follow-through.
 2. He steps directly toward home plate.
 3. The back bends properly.
 4. The arm follows the body toward home plate.
 5. The hips close then open toward the batter.
 6. The non-pivot thigh is parallel to the ground as the hips close.
- CATCHER:**
1. The 3/4 to overhand throw is used.

2. 2.0 to 2.5 seconds should elapse from the time he touches the ball until the ball gets to second base.
3. No more than one step and the throw should precede the release.
4. He steps toward the target.
5. The ball is cocked at the right ear with the upper arm parallel to the ground.

They were evaluated by position and on a continuum from 1-5 as were all performance variables. At no time were the subjects informed of the characteristics of performance on the test battery. It was felt familiarity would prejudice the results.

Points 1-5 on the continuum were clearly defined with 5 being equated with optimum performance and scaled down accordingly. Specifically and applying to each performance variable, the continuum was:

- 5 The subject performs more skills than number 4 requires.
- 4 The subject performs at least 1 more skill than 3 but less than 5.
- 3 The subject performs at least 1 more skill than 2 but less than 4.
- 2 The subject performs at least 1 more skill than 1 but less than 3.
- 1 The subject performs 1 or none of the desirable skills as listed.

According to Braggio,⁷ this type of continuous measurement is assumed to be interval data and objective for analysis purposes. Scannell and Tracy⁸ substantiate this by claiming evaluation of skill performance in progress is best evaluated by continuum measurement. For fielding and all the variables except baseball knowledge, a composite score was obtained. In addition, for each performance variable, students were assessed while performing in an actual game situation. The complete test battery for the performance variables including behavioral skills appears in Appendix E.

As coaches do not possess sophisticated equipment for measurement and analysis, it was hoped that the development of this test battery would prove practical to the coach and physical educator. Again, this skills test involved only the assessment of the performance variables.

The basic structure of this battery agreed with comments by Corbin and others⁹ and Shannon and Sommers.¹⁰

⁷Dr. James Braggio, Professor of Psychology, University of North Carolina--Asheville, North Carolina, personal interview, April 22, 1977.

⁸Dall Scannell and D. B. Tracy, Testing and Measurement in the Classroom (Boston: Houghton Mifflin Co., 1975), pp. 151-159.

⁹Charles Corbin, Linus Dowell, Ruth Lindsey, and Homer Tolson, Concepts in Physical Education (Dubuque, Iowa: Wm. C. Brown Co., Publishers, 1974), p. 69.

¹⁰Shannon and Sommers, 1976.

Corbin and others claimed motor ability and motor educability skills should be taught by technique first and followed by accuracy. Shannon and Sommers substantiated the preceding statement by stating, "Look for tools, not execution; we can improve execution through experience and instruction."

Last, the criterion measure was the subjective rating by experts of baseball ability of the subjects. The rating device was developed by the method listed by Scott and French¹¹ and appears in Appendix F. All subjects were rated during an actual game situation. Rater reliability was previously reported.

During testing sessions where the researcher was not directly involved as a coach, the subjective raters and testers of performance were checked for possible questions or problems that could arise on the spot.

All data were then tabulated to allow the statistical procedures to be applied for analysis purposes. A listing of the raw data can be found in Appendix G.

STATISTICAL PROCEDURES

The data collected in this study were treated by the statistical procedure multiple stepwise linear

¹¹M. Gladys Scott and Ester French, Evaluation in Physical Education (St. Louis: C. V. Mosby Co., 1950), pp. 216-223.

regression.¹² This procedure yields a prediction equation for baseball ability utilizing the variables which add the most significance to the equation.

The precise model utilized was $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$. Y represents the dependent variable overall baseball ability, b_0 represents a constant term, X_1 represents the personality variable, X_2 represents the baseball knowledge variable, X_3 represents the fitness variable, X_4 represents the hitting performance variable, X_5 represents the running performance variable, X_6 represents the fielding performance variable, and X_7 represents the throwing performance variable. This regression model was utilized to test the hypotheses stated in Chapter 1.

In order to test the hypotheses, the design of the experiment was analysis of covariance. This model allows for the effects of the concomitant variables to be taken into account. The concomitant variables were added to the model in order to control their possible effects. The only way to accomplish this was to measure the variables since they could not otherwise be controlled. Where regression analysis is concerned, analysis of covariance accounts for regression and residual variance within the model. The

¹²Charles O. Dotson and Don R. Kirkendall, Statistics for Physical Education, Health and Recreation (New York: Harper and Row, Publishers, 1974), p. 204.

level of significance was chosen to be $p = .01$ as it was the maximum probability desired to reject a true null hypothesis.

Means and standard deviations of each variable were computed in the analysis of the data. Correlations were computed involving all variables in order to establish their relationships.

Last, a summary table of multiple correlation coefficients along with F-values was compiled. This set of data conveys the relationship of the independent variables collectively with the dependent variable and the variables to be included or excluded in the equation.

Chapter 4

ANALYSIS OF DATA

This chapter is concerned with the presentation and discussion of the results of the data that were collected and analyzed in regard to this study. Tables of data are presented and the results subsequently discussed and interpreted.

Presented in this chapter are means and standard deviations of the variables, intercorrelation coefficients among the variables, and multiple correlation coefficients. Also shown are F-values for the independent variables, an analysis of covariance table and a multiple linear regression equation which includes the significant independent variables.

The data were collected in order: (1) to test the hypotheses that were formulated; (2) to develop a predictive equation for baseball ability of college subjects through multiple linear regression; and (3) to present a skills test for baseball. Hypotheses tested were based on the beta weights of each variable being equal to the other and equal to zero or, in other words, there is no regression in the sample of subjects. Also, the weights of

each individual variable are equal to zero with the others held constant or, in other words, none of the independent variables are significant predictors of overall baseball ability.

MEANS AND STANDARD DEVIATIONS FOR THE
CONCOMITANT VARIABLES, PERFORMANCE
VARIABLES, AND CRITERION MEASURE

Data are presented and discussed in tables and proceed from general data computed to more sophisticated analyses. For comparison purposes, means and standard deviations of the variables for the seventy-one subjects are presented in Table 1.

Inspecting the means and standard deviations of the variables, it seems necessary to group them for comparison purposes. For the concomitant variables, the means seem to be average. Their standard deviations reveal 68.34 percent of the cases fall between 54.55 and 85.33 for personality; 110.15 and 150.65 for baseball knowledge; and 11.49 and 16.75 for fitness.

By grouping performance variables, one can readily see the variable, running, produced the highest mean among the four. The variable, throwing, had the lowest mean. Sixty-eight percent of the cases fall between 6.52 and 8.66 for hitting; 1.76 and 3.30 for running; 1.37 and 3.15 for fielding; and 1.37 and 3.05 for throwing. Thus, not a great deal of variation occurred for these variables.

Table 1
Means and Standard Deviations for the Concomitant Variables,
Performance Variables, and Criterion Measure

Variable	Mean	Standard Deviation
Concomitant		
1. Personality	70.04225	15.49695
2. Baseball Knowledge	130.40845	20.25592
3. Fitness	14.12676	2.63997
Performance		
4. Hitting	6.59155	2.07418
5. Running	2.53521	0.77147
6. Fielding	2.26761	0.89375
7. Throwing	2.21127	0.84372
Criterion Measure		
8. Subjective Rating of Overall Baseball Ability	2.92958	1.01874

Subjective rating, occurring alone, needs no explanation except that on a continuum of 1-5 it is a fraction below average. In other words, the subjective rating of experts revealed that they were not favorable to the overall baseball ability of the subjects.

INTERCORRELATIONS OF THE EIGHT VARIABLES

Correlations were computed to determine the relationships of the variables to one another. The correlation matrix indicating how the variables related is presented in Table 2. In presenting the results, one variable at a time will be discussed with interrelations among the other variables. An $r = .250$ and $r = .325$ is needed for significance at the $p = .05$ and $p = .01$ levels of significance, respectively, for $n - 2$ or 69 degrees of freedom.

CONCOMITANT VARIABLES

Personality

Personality was significantly correlated with baseball knowledge, hitting, running, fielding, and subjective rating of overall baseball ability. In other words, changes in the values of personality were associated with changes in the values of baseball knowledge, hitting, running, fielding, and subjective rating of overall baseball ability and in the same direction. As higher

Table 2

Correlation Matrix for the Concomitant Variables,
Performance Variables, and Criterion Measure

Variable	Personality (1)	Baseball Knowledge (2)	Fitness (3)	Hitting (4)	Running (5)	Fielding (6)	Throwing (7)	Subjective Rating of Overall Baseball Ability (8)
(1) Personality	1.000	0.345 ^b	0.231	0.358 ^b	0.331 ^b	0.385 ^b	0.138	0.510 ^b
(2) Baseball Knowledge		1.000	0.009	0.264 ^a	-0.078	0.096	0.178	0.355 ^b
(3) Fitness			1.000	0.077	0.317 ^a	0.228	-0.031	0.232
(4) Hitting				1.000	0.469 ^b	0.592 ^b	0.523 ^b	0.581 ^b
(5) Running					1.000	0.556 ^b	0.175	0.430 ^b
(6) Fielding						1.000	0.568 ^b	0.602 ^b
(7) Throwing							1.000	0.483 ^b
(8) Subjective Rating of Overall Baseball Ability								1.000

^aSignificant at p = .05 level

^bSignificant at p = .01 level

r = .250 is needed for significance at p = .05 level; 69 d.f.

r = .325 is needed for significance at p = .01 level; 69 d.f.

values are obtained for personality, higher values are expected to occur for other variables significantly correlated with personality.

Baseball Knowledge

Baseball knowledge was significantly correlated with hitting and subjective rating of overall baseball ability in addition to personality. As one's baseball knowledge increases, values for hitting and subjective rating of overall baseball ability would also increase.

Fitness

Fitness correlated significantly with only running ability. According to Fox and Matthews,¹ baseball requires more anaerobic than aerobic power, thus possibly accounting for the lack of relationship between fitness and the remaining variables in the matrix.

At a high level of performance such as skills necessary in college athletics for successful performance, it is not surprising to find personality and baseball knowledge relating significantly to subjective rating of

¹Edward L. Fox and Donald Matthews, Interval Training (Philadelphia: W. B. Saunders Publishing Co., 1974), p. 198.

overall baseball ability and certain performance variables and fitness not relating as such.²

PERFORMANCE VARIABLES

Hitting

Likewise, significant intercorrelations that exist among the performance variables were to be expected as they are necessary skills to overall baseball ability which was the criterion measure. Discussion of these relationships follows.

In addition to relating significantly with personality and baseball knowledge, the performance variable, hitting, significantly relates to running, fielding, throwing, and subjective rating of overall baseball ability.

Running

Running was significantly related to fielding and subjective rating of overall baseball ability plus other variables previously discussed. Only the upper diagonal of the matrix is complete as such a matrix is symmetric. As an

²Dr. C. Larry Wilson, personal interview, April 22, 1977, Montreat, North Carolina; Reuben B. Frost, Physical Education Foundations-Practices-Principles (Reading, Mass.: Addison-Wesley Publishing Co., 1975), pp. 207-214.

example, the relationship of fitness to hitting is the same horizontally and vertically in a matrix array.

Fielding

Fielding was related significantly to throwing and subjective rating of overall baseball ability plus other variables previously discussed. The researcher concludes that fielding and throwing being so related are as a result of both being defensive skills such as hitting and running being offensive skills and related significantly.

Throwing

Throwing related in a significant manner to subjective rating of overall baseball ability in addition to variables previously discussed.

Subjective Rating of Overall Baseball Ability

Subjective rating of overall baseball ability being significantly correlated to all independent variables except fitness is important. The main purpose of this investigation was to develop a prediction equation for overall baseball ability by position. This purpose could not be accomplished without correlation such as occurred and previously mentioned.

It should be noted that, although several significant relationships existed among the variables, one can not conclude a cause--effect relationship. Correlation

only shows strength and direction of the relations of the variables.

ANALYSIS OF COVARIANCE FOR THE DEPENDENT VARIABLE OVERALL BASEBALL ABILITY

Analysis of covariance was conducted to test for the significance of regression in predicting baseball ability. More specifically, this statistical analysis was performed to test for the possible effects personality, baseball knowledge, fitness, hitting, running, fielding, and throwing had on overall baseball ability.

The analysis of covariance for the dependent variable, overall baseball ability, as judged subjectively is presented in Table 3. F-values needed for 7, 63 degrees of freedom at $p = .05$ and $p = .01$ levels of significance, were 2.17 and 2.95, respectively.

The significance of regression as a source of variation was a result of several factors. These factors were personality, baseball knowledge, hitting, and fielding as revealed by the significant F-ratios for these variables which were 13.892, 7.665, and 52.362, respectively. Thus the F-values mentioned indicated that personality, baseball knowledge, hitting, and fielding were significant in determining the overall baseball ability of the subjects.

Stepwise multiple linear regression revealed these factors by fitting the variables one at a time into the

Table 3
Analysis of Covariance for the Dependent
Variable Overall Baseball Ability

Source of Variation	df	ss	mss	F
Regression				
Personality	7	41.041	5.863	11.686**
Baseball Knowledge	1	6.596	6.596	13.139**
Fitness	1	.491	.491	0.979
Hitting	1	3.848	3.848	7.665**
Running	1	1.022	1.022	2.036
Fielding	1	26.286	26.286	52.362**
Throwing	1	.844	.844	1.682
Residual	63	31.607	0.502	
<hr/>				
Corrected Total	70	72.648		

**Significant at the $p = .05$ and $p = .01$ levels

F = 2.17 is needed for significance at $p = .05$ level; 7, 63 d.f.

F = 2.95 is needed for significance at $p = .01$ level; 7, 63 d.f.

model. This statistical technique fits the variable that subjective rating of overall baseball ability correlates with most. The second step involves fitting another variable to the model, such that in combination with the first variable best explains what the dependent variable depends on. The third step involves adding another variable such that in combination with other variables as much of the total error involved will be explained by the regression line.³

This process continues until significance is not found by adding more independent variables. F-values, multiple correlation coefficients, and coefficients of multiple determination allow the researcher to determine where significance stops occurring. The respective F-values indicate the order of importance in fitting to the model.

Ratio of variances for fitness, running, and throwing indicated these variables were non-significant sources of variation in predicting overall baseball ability. These results are consistent if one accepts the facts that fitness for baseball players involves primarily anaerobic power and at the collegiate level of performance personality and knowledge are vital.⁴ In addition, the researcher feels

³Taro Yamane, Statistics--An Introductory Analysis (New York: Harper and Row, Publishers, 1967), pp. 806-809.

⁴Wilson, personal interview; Frost, pp. 207-214.

that hitting and fielding being significant over running and throwing should not come as a surprise as a player must hit before he runs, offensively, and he must field before he throws, defensively.

Thus, the null hypothesis that no regression exists in the sample of subjects and that no improvement was brought about by fitting the regression plane was rejected. Again, statistically, this null hypothesis was:

$$H_0: B_1 = B_2 = \dots = B_k \text{ where } K = 7 = 0.$$

In other words, it is concluded that there is regression in the sample of subjects and it was not due to chance.

The null hypothesis that the partial regression coefficients or beta weights are not significantly different from zero was also rejected. Statistically, this hypothesis was:

$$H_0: B_i = 0 \quad i = 1, 2, 3, 4, 5, 6, 7.$$

The significance of these partial regression coefficients predicting overall baseball ability was not due to chance, and they show an average change in Y when there is a unit change in X with the other independent variables held constant.

REGRESSION EQUATION AND SKILLS TEST FOR DETERMINING BASEBALL ABILITY

The prediction equation for this study is represented by:

$Y = .015 (X_1) + .009 (X_2) + .120 (X_4) + .403 (X_6) - .982$, where X_1 represents personality, X_2 represents baseball knowledge, X_4 represents hitting, and X_6 represents fielding. A composite score for predicting baseball ability can be obtained by multiplying .015 x the total score on the personality profile and adding this value to .009 x the baseball knowledge examination score + (plus) .120 x the value received on hitting + .403 x the fielding score obtained - (minus) .982 which is a constant or error term.

In order to more fully familiarize the reader with the prediction equation, as it is the main crux of the investigation, details for measuring each variable included must be provided. The personality variable was compiled by each subject's coach completing the personality profile as presented in Appendix B. This concomitant variable was assessed early in the spring semester of 1977, as were the other concomitant variables and before performance variable testing and subjective rating of overall baseball ability.

Baseball knowledge was assessed by the researcher administering the teacher-made examination listed in Appendix C to the subjects. The place and time were the gymnasiums on each college campus represented in the study and the evening of the day. The number of correct responses were recorded into a total score for data analysis. Items on the test dealt with fundamentals, strategy, rules, and techniques as pertaining to baseball.

The horizontal relationship that exists among the dependent variable and the four independent variables is represented in the form of a prediction equation. However, as it was a secondary purpose of this study to present this method of evaluation as a skills test in the area of baseball, a vertical relationship must be described.

The offensive performance variable, hitting, was measured utilizing the section in the performance variables test battery pertaining to hitting. This test battery is listed in Appendix E, and the variable is composed of behavioral characteristics associated with ready position, swing, and bunt. The defensive variable, fielding, was the other performance variable included in the prediction equation and was measured by the fielding section in the same test battery listed for hitting. This defensive variable was broken down by behavioral characteristics of the positions of outfield, infield, pitcher, and catcher for assessment.

Last, the subjective rating of overall baseball ability or the dependent variable was measured by two experts rating the overall baseball ability of the subjects according to the rating device listed in Appendix F. The rating occurred during an actual game situation involving the subjects. A continuum of 1-5 was utilized, with 5 being the best as far as becoming a college baseball player.

Due to the statistical design of the study, only seven independent variables were utilized. The performance variables were composed of behavioral skills necessary to successful baseball play.

Thus, the battery of items composing the performance variables that were significant constitute a baseball skills examination. The skills examination that assesses the baseball playing ability of the subjects contained the offensive performance variable, hitting, and the defensive performance variable, fielding.

The examination would be as follows:

Baseball Skills Examination

Hitting

- | | |
|--------------------|--|
| READY
POSITION: | <ol style="list-style-type: none"> 1. The head is stationary. 2. The bat is stationary. 3. The hands are four to eight inches away from the body. 4. The shoulders are level. 5. The knees are slightly flexed. 6. The back elbow is parallel to the ground. |
| SWING: | <ol style="list-style-type: none"> 1. The hips rotate from a closed to open position toward the pitcher. 2. One pivots on the rear foot. 3. The stride is equal to or less than twelve inches. |

4. The wrists unlock at the point of impact of the bat and ball.
 5. The arm and shoulders bring the bat to the middle of the back for the follow-through.
- BUNT:
1. The shoulders are square to the pitcher.
 2. The bat is held at the top of the strike zone.
 3. The lead hand directs the bat.
 4. The back hand does the bunting--not punting.
 5. The bat gives with contact with the ball.

For each of the three categories of hitting the following continuum evaluation applies:

- 5 The subject performs more skills than number 4 requires.
- 4 The subject performs at least 1 more skill than 3 but less than 5.
- 3 The subject performs at least 1 more skill than 2 but less than 4.
- 2 The subject performs at least 1 more skill than 1 but less than 3.
- 1 The subject performs 1 or none of the desirable skills as listed.

Fielding

- OUTFIELD:
1. He straddles ground balls with the opposite foot of the throwing hand ahead.
 2. He looks the ball in the glove from the ground up.

3. He uses the cross-over step in moving toward the ball to the right, left, or back.
4. He catches the ball with two hands.
5. He catches a fly ball on the throwing shoulder.

INFIELD:

1. The knees are flexed when fielding ground balls.
2. Ground balls are straddled.
3. The foot on the opposite side of the throwing hand is slightly in front.
4. Ground balls are charged.
5. He uses the cross-over step and reaching step to move laterally.
6. The head is down and he fields from the ground up.

PITCHER:

1. He faces the catcher with shoulders and is on balance after the release.
2. The eyes and head remain up looking toward the plate.
3. The glove is out in front of the body after the release.
4. The knees are flexed upon release.
5. The weight of the body is on the balls of the feet.

CATCHER:

1. The back is to the pitcher on pop-ups.
2. The glove and bare hand are used to field bunts and topped balls.
3. The left foot is slightly ahead of the right foot in ready position.
4. To receive, the glove fingers are up and the bare hand is behind the glove.

5. The reaching step is used to field balls to the side.
6. The glove is open and the catcher is on the knees for low balls.

For each of the categories of fielding the following continuum evaluation applies:

- 5 The subject performs more skills than number 4 requires.
- 4 The subject performs at least 1 more skill than 3 but less than 5.
- 3 The subject performs at least 1 more skill than 2 but less than 4.
- 2 The subject performs at least 1 more skill than 1 but less than 3.
- 1 The subject performs 1 or none of the desirable skills as listed.

In order to be able to evaluate properly such a skills examination, a method of establishing norms will be presented in Chapter 5.

SUMMARY OF MULTIPLE CORRELATION, COEFFICIENTS OF MULTIPLE DETERMINATION, AND F-VALUES

Conclusive data for each variable are presented in Table 4. Multiple correlation coefficients, coefficients of multiple determination, and F-values to enter are presented. The multiple correlation coefficients (R) support results that have already been presented and indicate the correlation between Y or overall baseball ability and the group of X-variables which are personality, baseball

Table 4

Summary Table of Multiple Correlations, Coefficients
of Multiple Determination, and F-values

Variables Entered	Multiple R	R ²	Increase R ²	F to Enter
Fielding	0.6015	0.3618	0.3618	39.1216
Personality	0.6728	0.4526	0.0908	11.2789
Hitting	0.7110	0.5056	0.0530	7.1771
Baseball Knowledge	0.7297	0.5325	0.0269	3.7986
Throwing	0.7393	0.5466	0.0141	2.0162
Running	0.7471	0.5582	0.0116	1.5819
Fitness	0.7516	0.5649	0.0068	0.9794

knowledge, hitting, and fielding. Statistically, R is the correlation between Y (overall baseball ability) and X_1 (personality), X_2 (baseball knowledge), X_4 (hitting), and X_6 (fielding).

Fielding, personality, hitting, and baseball knowledge reveal a successive increase in R that indicates, as each one is added, the group of independent variables relate with the dependent variable to a more significant and greater degree. Adding variable 7 (throwing) would only increase the relationship by .009 (found by subtracting the Multiple R value for baseball knowledge from the Multiple R for throwing in Table 4). The range from variable 6 (fielding) to the last variable (baseball knowledge) added with significance was .128.

Coefficients of multiple determination or R^2 plus increase in R^2 reveal a closeness of fit of the variables in the regression plane. These results further substantiate the inclusion of the variables previously listed in the prediction equation. Once variable 2 (baseball knowledge) is included, little predictive value is gained by adding throwing, running, and fitness to the finished model. At the point where baseball knowledge is added to the equation, 53.25 percent of the total deviation has been explained by the regression line. From the point where fielding was added until baseball knowledge was added, a 17.1 percent

increase was reported. However, with the addition of throwing, only a 1.4 percent increase occurs.

The F-values indicate the above as they represent values necessary to enter a variable into the equation and are actually ratios of variances of regression and error. An $F = 2.17$ for $p = .05$ and $F = 2.95$ for $p = .01$ were needed to declare significance with 7, 63 degrees of freedom. Thus, only variables 6 (fielding), 1 (personality), 4 (hitting), and 2 (baseball knowledge) have the necessary F-ratios to be entered into the prediction equation.

Chapter 5

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

An attempt at developing a multiple linear regression equation for predicting overall baseball ability was the purpose of this study. Seventy-one male, volunteer college baseball players at Montreat-Anderson College, Warren Wilson College, and Mars Hill College in North Carolina were the subjects for this study.

Data were collected on the subjects during a ten-week period in February, March, and April of the spring semester, 1977. Four experts in addition to the researcher administered tests on performance and concomitant variables for the purpose of collecting data. These experts were trained on the administration of the tests in order to familiarize them with procedures pertinent to this study.

Personality, baseball knowledge, fitness, hitting, running, fielding, throwing, and subjective rating of overall baseball ability were the variables utilized in the investigation. The first three mentioned were the concomitant variables. The four that followed were the

performance variables with subjective rating being the dependent variable or criterion measure.

A personality profile¹ was completed for each subject by their respective coaches during February, 1977. The remaining two concomitant variables were measured by the researcher administering the high school and collegiate fitness examination² and a teacher-made cognitive examination. These measurements were completed in late February and early March and were accomplished with the aid of trained testers.

Two experts administered the test battery for the performance variables in March and April during actual game situations involving the baseball teams of the institutions previously listed. In addition, two experts gave an overall baseball ability rating for each subject during the same time period. The subjects were rated according to the following:

- 5--Excellent college prospect; no mistakes, physical or mental, during evaluation period.
- 3--Average college prospect; made some physical mistakes and no more than three mental mistakes.
- 1--Not a college prospect; makes an excess of mental and physical mistakes.

¹Thomas A. Tutko and Jack W. Richards, Psychology of Coaching (Boston: Allyn and Bacon, Inc., 1971), p. 49.

²Barry L. Johnson and Jack K. Nelson, Practical Measurements for Evaluation in Physical Education (Minneapolis: Burgess Publishing Co., 1974), pp. 153-154.

The values 4 and 2 represent baseball ability between 5 and 3 and 1, respectively, and left solely to the discretion of the expert. The complete scale is represented by

1	2	3	4	5
_____	_____	_____	_____	_____

It was desired in this study to determine which, if any, of the seven independent variables were predictors of overall baseball ability. When certain of these variables were identified as being significant, it was then the desire of the investigator to present the characteristics of these variables as a test battery of items.

Means and standard deviations of the variables were computed in addition to a correlation matrix in order to describe the data. The means and standard deviations are measures of central tendency and imply average or normal, while correlation describes relationships among the variables. Analysis of covariance was the statistical technique used to analyze the data to detect possible significance of variables in the prediction of baseball ability by regression. A summary table involving multiple correlation coefficients, coefficients of multiple determination, and F-values was presented and concluding remarks.

FINDINGS

The results of this study were based on the data presented in relation to the hypotheses that were postulated. Subjective rating correlated significantly with all independent variables except fitness. Eleven other pairs of variables were significantly related and these involved independent variables intercorrelating. Fitness, however, correlated only with the variable, running, significantly.

By analysis of covariance, it was found that personality, baseball knowledge, hitting, and fielding were predictors of overall baseball ability at the $p = .01$ level of significance. Thus, the hypotheses that no regression exists in the sample of subjects and that the partial regression coefficients were not significantly different from zero were rejected. The prediction equation developed was: overall baseball ability = .015 (personality) + .009 (baseball knowledge) + .120 (hitting) + .403 (fielding) - .982. The performance variables in the prediction equation as composed of behavioral characteristics result in a test battery for baseball skills.

Multiple correlation coefficients and coefficients of multiple determination support the inclusion of the variables listed in the prediction equation. The corresponding F-values to enter the variables into the

equation were not significant for throwing, running, and fitness.

CONCLUSIONS

Conclusions that can be drawn from the findings are based on the limitations of the experimental design of the study. It was necessary to establish the validity and reliability of the variables not reporting such and to train testers in order to obtain worthwhile results.

Selection of variables for inclusion in this investigation was viable as evidenced by the analysis of data. Fielding was the most important component of overall baseball ability followed by personality, hitting, and baseball knowledge. This conclusion was logical and expected for two reasons. First, fielding generally must occur before any other defensive skill, and hitting is a necessary prerequisite to other offensive skills. Second, athletic ability is composed of many individual skills and the cognitive area of baseball knowledge and the affective area of personality were expected to lend significance.

It is further concluded that the battery of characteristics listed for hitting and fielding is not an ultimate or all-inclusive list for either. These characteristics comprise the skills examination section of predicting overall baseball ability. The lack of at least

100 subjects prevented the researcher from establishing norms for this study.

Last, as the collegiate fitness test did not yield significance, the author concludes that a comprehensive fitness measurement is not necessary for baseball. This study proved worthwhile in satisfying the need of the study.

RECOMMENDATIONS

There are several recommendations that seem warranted after considering the conclusions of the study. In further research on this topic, fitness tests which measure anaerobic power should be utilized. Even though fitness was not significant in predicting baseball ability, the baseball coach should condition his team anaerobically.

Only the variables providing significance should be used to evaluate physical education students in baseball skills or to aid the coach in selecting his team. In order for this to be more accurate, it is recommended that at least 100 subjects be tested and norms developed. A composite score on the items in the prediction equation should be converted to a T scale score and this score referred to a classification table for placement in a category such as excellent, good, average, fair, or poor.

If the necessary equipment is available, it is recommended that mechanical analysis using videotape replay be utilized to aid the researcher in measuring the skill

characteristics included in the battery of items for this investigation. This method would provide an even more objective way of measuring and evaluating baseball skills.

Finally, to substantiate the use of the skills test developed in this study, the researcher recommends correlating the predictive baseball ability of players with end-of-the-year statistics. These statistics are: on base percentage, advance runner percentage, batting average, runs batted in, fielding average, and earned run average for pitchers. The results would hopefully aid the coach to a greater degree in evaluating team performance of individual players.

APPENDIXES

APPENDIX A

LETTERS TO AND FROM COPYRIGHT HOLDERS

January 18, 1977

Allyn & Bacon, Inc.
470 Atlantic Avenue
Boston, Mass.

Dear Sir:

I respectfully request permission to reprint and use, as part of a doctoral dissertation, a portion of a book published by your company. The book is Psychology of Coaching by Tutko & Richards and the page number is 49 which contains a player profile sheet. The book was published in 1975. Thank you for your help and consideration.

Most cordially,

Linn M. Stranak
Physical Education Instructor
Montreat-Anderson College
Montreat, NC 28757

January 18, 1977

Burgess Publishing Company
Minneapolis, MN

Dear Sir:

I respectfully request permission to reprint and use as part of a doctoral dissertation a portion of a book published by your company. The book is Practical Measurements for Evaluation in Physical Education, second edition, by Johnson and Nelson. The page numbers are 153-154 which contain the high school and collegiate physical fitness test.

Thank you for your help and consideration.

Most cordially,

Linn M. Stranak
Physical Education Instructor
Montreat-Anderson College
Montreat, NC 28757

Mrs. Kay Kushino
Rights & Permissions
January 24, 1977

Linn M. Stranak
Physical Education Instructor
Montreat-Anderson College
Montreat, NC 28757

Dear Mr. Stranak:

Thank you for your January 18 letter requesting permission to produce pages 153-154, High School and Collegiate Physical Fitness Test and Table 10-1, from PRACTICAL MEASUREMENTS FOR EVALUATION OF PHYSICAL EDUCATION, by Barry L. Johnson and Jack K. Nelson, the Second Edition of which we published in 1974. It is our understanding that you wish to include this material in a doctoral dissertation which you are preparing.

We will be glad to grant permission for your use of this material as indicated, predicated on your willingness to give credit to the source of your information by citing authors, title, year of publication, and publisher, on the page where information from our publication will appear.

I trust the above will meet with your approval. Thank you for consulting with us, and we extend best wishes for your success in obtaining your doctorate.

Sincerely,

Kay Kushino

March 23, 1977

Mr. Linn M. Stranak
Physical Education Instructor
Montreat-Anderson College
Montreat, North Carolina 28757

Dear Mr. Stranak:

Allyn and Bacon is pleased to be able to grant you permission to use the player profile sheet from Tutko and Richards, PSYCHOLOGY OF COACHING as part of your doctoral dissertation.

This permission is granted provided that the material you wish to use is copyrighted by Allyn and Bacon, and that this material did not appear in our text with credit to another source.

If at a future date you decide to have your dissertation published, you must reapply for permission.

Thank you for your interest in our publication, and best wishes for success with your doctoral studies.

Sincerely,

Joanne Cutuli
Permissions Editor

APPENDIX B
PERSONALITY PROFILE

PERSONALITY PROFILE
PLAYER PROFILE SHEET

Name _____ Team _____ Position _____

1 = very low 3 = low 5 = average 7 = high 9 = very high

1. Drive 1 2 3 4 5 6 7 8 9
Desire to be a winner
2. Self-confidence 1 2 3 4 5 6 7 8 9
Sure of himself and his ability
3. Aggressiveness 1 2 3 4 5 6 7 8 9
A hard hitter--willing to assert himself
4. Coachability 1 2 3 4 5 6 7 8 9
Willing to accept coaching
5. Determination 1 2 3 4 5 6 7 8 9
Determined--stick with it
6. Emotionality 1 2 3 4 5 6 7 8 9
Can handle his feelings well
7. Conscience Development 1 2 3 4 5 6 7 8 9
Does things as correctly as possible
8. Trust 1 2 3 4 5 6 7 8 9
Accepts people at face value
9. Responsibility 1 2 3 4 5 6 7 8 9
Accepts responsibility--accepts blame
10. Leadership 1 2 3 4 5 6 7 8 9
Wants to take charge of others
11. Mental toughness 1 2 3 4 5 6 7 8 9
Can take a tough chewing out

Source: Thomas A. Tutko and Jack W. Richards, Psychology of Coaching (Boston: Allyn and Bacon, Inc., 1971, p. 49.

APPENDIX C

BASEBALL KNOWLEDGE EXAMINATION

BASEBALL KNOWLEDGE EXAMINATION*

HPER

Baseball Quiz

Mr. Stranak

Name _____



Each question is worth 4 points.

List and/or choose the best answer(s) for questions 1-17.

1. The four general classifications of the style of delivery that a pitcher may have are:
 - 1.
 - 2.
 - 3.
 - 4.
2. In teaching a pitcher to throw a curve ball, list the following in their proper order of sequence in which they should be taught.
speed, rotation, control

3. What pitches should a right-handed pitcher throw to a batter who is an overstrider? Who has an open stance? Who is a right-handed pull hitter? Who is a single hitter?
 - a.
 - b.
 - c.
 - d.
4. Three methods of signs which a catcher may use for signaling his pitchers are:
 - 1.
 - 2.
 - 3.

5. What are the duties and reasons for a cut-off man? Distinguish between cut-off man and relay man.
6. Which of the following steps used by infielders give the most balance in going after a ground ball? (a) cross-over step, (b) reaching step.
7. The advantages of a left-handed first baseman are (a) most of his throws are to his left, (b) wears glove on fair territory, (c) can make longer stretch, (d) least area to cover on unnatural side, (e) no distinct advantages.
-
8. Moving toward the ball is important as it enables the infielder to (a) get in front of the ball, (b) use up less time, (c) play to hop, (d) get a shorter throw, (e) give the batter runner less time.
-
9. What are two basic responsibilities of each of the players on the bench, on deck circle, or batter box?
- a.
- b.
- c.
10. Can an on deck batter ever become a coach during the game and its various situations? If so, how?
- a.
- b.
11. What type of lead is most commonly taken when stealing?

12. Describe 4 of the 10 points of the catcher's stance after giving the signal to the pitcher (his ready position).
1. Feet
 2. Drop step
 3. Heel toe line
 4. Knees
 5. Waist
 6. Weight
 7. Elbows
 8. Head
 9. Back
 10. Rear
13. In teaching your infielder to play every ball for a bad hop--this means?
14. Diagram the inside pivot of a shortstop and an outside pivot of second baseman at second base.
- A. 
- B. 
15. At shortstop, why is the "cross-over step" used instead of the "reaching step" for getting the jump on the ball hit to his right or left?
16. For the third baseman in charging a bunt, he should be ready for instructions from what other member(s) of his team?

17. In the actual game situation what is meant by playing a mental game?

PLACE + for TRUE AND 0 FOR FALSE. Correct the false statement to make it true.

- ___ 18. Batter--In the open stance the rear foot is closer to the plate than the front foot.
- ___ 19. Batter--The rear foot should be moved away from the plate in order to hit an inside pitch.
- ___ 20. Batter--After the hitting stride is taken, the front foot should be at a forty-five degree angle to the inside line of the batter's box.
- ___ 21. Batter--The short-strider would normally not like a fast ball.
- ___ 22. Batting power is derived from the shoulders, the hips, the arms and wrists, all in that order.
- ___ 23. Batter--The over-strider can be helped by shortening his original stance.
- ___ 24. The thicker bat handles will give the batter more "whip" as compared to the thinner bat handles.
- ___ 25. The batting tee can tell the coach more about the hitter than just checking to see if his swing is level.
- ___ 26. In the hit-and-run situation, the batter should hit in front of the runner on first base.
- ___ 27. The squeeze bunt is executed with a runner on second or first base with two outs.
- ___ 28. With a runner on first, the sacrifice bunt is best hit so that the first base man has to field the ball.
- ___ 29. In a steal, the reaching step is used by the base runner in making his break for the next base.
- ___ 30. The best signal from the pitcher in a pick-off attempt is his eyes and head.

- ___ 31. When the batter becomes a base runner, the right-handed batter should step off with his left foot as his left hand drops the bat.
- ___ 32. At double play depth, the third baseman guards the line.
- ___ 33. When a closed infield is employed, the fielders assume a position in line with the bases in all situations necessitating a closed infield.
- ___ 34. In a "game situation" play where a sacrifice is evident, the shortstop must cover second base.
- ___ 35. The first base man is the cutoff man on all fly balls to all outfield positions.
- ___ 36. The pitcher has to back up the catcher in the majority of situations where he has to assume a defensive position.
- ___ 37. When first base is vacated with no runners on base the pitcher covers first and the catcher trails the runner for a possible ensuing play.
- ___ 38. The shortstop is the cutoff man on a possible throw to second base as a result of a pop fly behind home plate.
- ___ 39. The first base coach uses mostly "visual" signals.
- ___ 40. The catcher and pitcher relay all the defensive signals or initiate them concerning infield play.
- ___ 41. A base runner is the key person involved in receiving offensive signals so as to make the strategy effective.
- ___ 42. The sacrifice and suicide bunt are the same.
- ___ 43. A runner may tag up and advance a base on a fly ball that is caught in foul territory as long as there are less than two outs.

MULTIPLE CHOICE: CHOOSE THE BEST ANSWER(S)

- ___ 44. Moving toward the ball is important as it enables the infielder to:
- a. get in front of the ball
 - b. use up less time

- c. play the hop
 - d. get a shorter throw
 - e. give the batter-runner less time
- ___ 45. The advantages of left-handed first base men are:
- a. most of his throws are to his left
 - b. wears glove on fair territory side
 - c. can make a longer stretch
 - d. least area to cover on his unnatural side
 - e. no advantage at all
- ___ 46. A second base man making a tag put-out on second base must learn to tag with:
- a. glove hand only
 - b. with glove and bare hand on ball
 - c. with a slap tag
- ___ 47. With a runner on first and less than two out, the second base man must:
- a. come in a few steps toward home plate
 - b. shade toward first base
 - c. play back on grass near second
 - d. shade toward second
 - e. no change--play normally
- ___ 48. The most difficult play or defensive situation for the second base man is:
- a. bunt situation
 - b. hit and run situation
 - c. bases loaded, less than two outs
 - d. double play to shortstop
 - e. double play to the second base man
- ___ 49. The score for a forfeited game is:
- a. 1-0
 - b. 6-0
 - c. 3-0
 - d. 9-0
- ___ 50. The defensive strategy against the double steal with runners on first and third base is:
- a. catcher throws through to second base
 - b. catcher throws directly to the pitcher
 - c. catcher fakes throw to second and throws to third base
 - d. catcher chases runner back to third base

BRIEFLY DISCUSS THE DEFENSE EMPLOYED IN THE FOLLOWING SITUATIONS (POSITIONS 1-9):

51. closed infield

52. sacrifice with runners on first and second

53. sacrifice with runners on first and second (game situation--win or lose)

54. squeeze with runner on third only

55. fly to center field (normal depth), runner on first and third

56. extra base hit to right field, no runners on base

57. pop fly causing second base to be vacated, no runner on base

58. pop fly causing shortstop to vacate position, no runners on base

59. fly ball to left field (toward the line), runner on third

60. extra base hit, right center field, no runners on base

*This test was designed by the author.

APPENDIX D

FITNESS TEST

FITNESS TEST
HIGH SCHOOL AND COLLEGIATE PHYSICAL FITNESS TEST
SCORE SHEET

Name: _____ Mr. Stranak

No.: _____

Dip Strength: $\frac{\text{Wt. Lifted}}{\text{Body Weight}} = \underline{\hspace{2cm}} =$

Chin ups: No. of repetitions =

Sit and reach: No. of inches = T-score =

12 minute run-walk: Miles to nearest quarter =

<u>Rating</u>	<u>Items</u>	<u>Raw score</u>	<u>Rating*</u>
Excellent=5	Dip strength	_____	_____
Good=4	Chin ups	_____	_____
Average=3	Sit and reach	_____	_____
Poor=2	12 min. run-walk	_____	_____
Very poor=1			

Composite = _____

*Conversion of raw scores to ratings are found in the text:
 Barry L. Johnson and Jack K. Nelson, Practical Measurements
 for Evaluation in Physical Education (Minneapolis: Burgess
 Publishing Co., 1974), pp. 153-154.

APPENDIX E

PERFORMANCE VARIABLES TEST BATTERY

PERFORMANCE VARIABLES TEST BATTERY*

BEHAVIORAL SKILLS TEST SHEET
BASEBALL

Name: _____

Mr. Stranak

OFFENSE

HITTING

- READY POSITION:
1. The head is stationary.
 2. The bat is stationary.
 3. The hands are four to eight inches away from the body.
 4. The shoulders are level.
 5. The knees are slightly flexed.
 6. The back elbow is parallel to the ground.

- 5 The subject performs more skills than number 4 requires.
- 4 The subject performs at least 1 more skill than 3 but less than 5.
- 3 The subject performs at least 1 more skill than 2 but less than 4.
- 2 The subject performs at least 1 more skill than 1 but less than 3.
- 1 The subject performs 1 or none of the desirable skills as listed.

- SWING:
1. The hips rotate from a closed to open position.
 2. One pivots on the rear foot.
 3. The stride is equal to or less than twelve inches.
 4. The wrists unlock at the point of impact of the bat and ball.
 5. The arm and shoulders bring the bat to the middle of the back for the follow-through.

- 5 The subject performs more skills than number 4 requires.
- 4 The subject performs at least 1 more skill than 3 but less than 5.
- 3 The subject performs at least 1 more skill than 2 but less than 4.

- 2 The subject performs at least 1 more skill than 1 but less than 3.
- 1 The subject performs 1 or none of the desirable skills as listed.

- BUNT:
1. The shoulders are square to the pitcher.
 2. The bat is held at the top of the strike zone.
 3. The lead hand directs the bat.
 4. The back hand does the bunting--not punting.
 5. The bat gives with contact with the ball.

- 5 The subject performs more skills than number 4 requires.
- 4 The subject performs at least 1 more skill than 3 but less than 5.
- 3 The subject performs at least 1 more skill than 2 but less than 4.
- 2 The subject performs at least 1 more skill than 1 but less than 3.
- 1 The subject performs 1 or none of the desirable skills as listed.

RUNNING

- TECHNIQUE:
1. The arms are horizontal and pump in an antero-posterior manner.
 2. The thighs are parallel to the ground.
 3. The push off with a foot is straight toward the next base.
 4. One angles out 3/4 of the distance to first base.
 5. One touches the inside of the base.

- 5 The subject performs more skills than number 4 requires.
- 4 The subject performs at least 1 more skill than 3 but less than 5.
- 3 The subject performs at least 1 more skill than 2 but less than 4.
- 2 The subject performs at least 1 more skill than 1 but less than 3.
- 1 The subject performs 1 or none of the desirable skills as listed.

DEFENSE

FIELDING

- ___ **OUTFIELD:**
1. He straddles ground balls with the opposite foot of the throwing hand ahead.
 2. He looks the ball in the glove from the ground up.
 3. He uses the cross-over step in moving toward the ball to the right, left, or back.
 4. He catches the ball with two hands.
 5. He catches a fly ball on the throwing shoulder.

- ___ **INFIELD:**
1. The knees are flexed when fielding ground balls.
 2. Ground balls are straddled.
 3. The foot on the opposite side of the throwing hand is slightly in front.
 4. Ground balls are charged.
 5. He uses the cross-over step and reaching step to move laterally.
 6. The head is down and he fields from the ground up.

- ___ **PITCHER:**
1. He faces the catcher with shoulders and is on balance after the release.
 2. The eyes and head remain up looking toward the plate.
 3. The glove is out in front of the body after the release.
 4. The knees are flexed upon release.
 5. The weight of the body is on the balls of the feet.

- ___ **CATCHER:**
1. The back is to the pitcher on pop-ups.
 2. The glove and bare hand is used to field bunts and topped balls.
 3. The left foot is slightly ahead of the right foot in ready position.
 4. To receive, the glove fingers are up and the bare hand is behind the glove.
 5. The reaching step is used to field balls to the side.
 6. The glove is open and the catcher is on the knees for low balls.

- 5 The subject performs more skills than number 4 requires.
- 4 The subject performs at least 1 more skill than 3 but less than 5.
- 3 The subject performs at least 1 more skill than 2 but less than 4.

- 2 The subject performs at least 1 more skill than 1 but less than 3.
- 1 The subject performs 1 or none of the desirable skills as listed.

THROWING

- ____ OUTFIELD:
1. The overhand throw is utilized.
 2. The hips close then open with the throw.
 3. The opposite shoulder of the throwing hand points at the target.
 4. The follow-through is completed.
 5. He steps toward the target in throwing.

- ____ INFIELD:
1. The side arm to overhand throw is used.
 2. The non-throwing shoulder points at the target.
 3. The eyes are fixed on the target.
 4. The ball is visible when throwing--not hidden.
 5. He follows through with wrist flexion.

- ____ PITCHER:
1. The eyes are on target from the wind-up to follow-through.
 2. He steps directly toward home plate.
 3. The back bends properly.
 4. The arm follows the body toward home plate.
 5. The hips close then open toward the batter.
 6. The non-pivot thigh is parallel to the ground as the hips close.

- ____ CATCHER:
1. The 3/4 to overhand throw is used.
 2. 2.0 to 2.5 seconds should elapse from the time he touches the ball until the ball gets to second base.
 3. No more than one step and the throw should precede the release.
 4. He steps toward the target.
 5. The ball is cocked at the right ear with the upper arm parallel to the ground.

- 5 The subject performs more skills than number 4 requires.
- 4 The subject performs at least 1 more skill than 3 but less than 5.

- 3 The subject performs at least 1 more skill than 2 but less than 4.
- 2 The subject performs at least 1 more skill than 1 but less than 3.
- 1 The subject performs 1 or none of the desirable skills as listed.

*This test was designed by the author.

APPENDIX F

**SUBJECTIVE RATING DEVICE FOR OVERALL
BASEBALL ABILITY**

**SUBJECTIVE RATING DEVICE FOR OVERALL
BASEBALL ABILITY***

Rater Sheets

Device for subjective rating of college
baseball players by experts

RATER:

SUBJECT:

NO:

Instructions to Rater: Place a check mark on the line under the number corresponding to your evaluation of the subject's ability.

1	2	3	4	5
_____	_____	_____	_____	_____

KEY TO NUMBERS 1 THROUGH 5

5--Excellent college prospect; no mistakes, physical or mental, during evaluation period.

3--Average college prospect; made some physical mistakes and no more than three mental mistakes.

1--Not a college prospect; makes an excess of mental and physical mistakes.

Note: Points 2 and 4 are abilities between 1 and 3 and 3 and 5, respectively. This decision is left solely to the discretion of the expert rater.

***This device was designed by the author.**

APPENDIX G

RAW DATA ON THE VARIABLES FOR THE SUBJECTS

RAW DATA ON THE VARIABLES FOR THE SUBJECTS

Subject No.	Personality	Baseball Knowledge	Fitness	Hitting	Running	Fielding	Throwing	Subjective Rating of Overall Baseball Ability
1	85	143	10	7	2	2	3	4
2	47	78	10	5	3	2	1	1
3	83	111	16	6	2	2	2	3
4	62	111	18	7	2	2	3	3
5	89	164	14	5	2	2	2	4
6	79	148	16	8	2	3	3	3
7	65	148	13	7	2	2	2	3
8	62	136	13	9	2	1	3	3
9	94	152	13	6	1	2	2	3
10	67	132	15	6	3	2	2	3
11	76	134	11	10	3	3	3	4
12	77	151	15	11	3	3	3	3
13	91	153	16	12	4	5	5	5
14	84	167	15	4	2	2	2	3

Subject No.	Personality	Baseball Knowledge	Fitness	Hitting	Running	Fielding	Throwing	Subjective Rating of Overall Baseball Ability
15	61	156	14	7	2	2	2	4
16	78	196	18	9	3	3	3	5
17	79	156	14	8	4	2	2	3
18	85	164	15	8	3	1	3	4
19	59	121	14	3	2	2	2	2
20	82	126	15	6	3	1	1	3
21	82	140	14	9	3	2	2	5
22	88	106	19	7	3	4	4	4
23	77	99	17	4	3	2	2	3
24	72	120	11	11	2	2	2	3
25	66	139	11	6	2	3	2	3
26	87	123	15	8	3	3	2	4
27	90	157	13	7	3	2	2	3
28	85	152	17	7	3	3	2	4
29	76	120	16	5	3	2	1	3

Subject No.	Personality	Baseball Knowledge	Fitness	Hitting	Running	Fielding	Throwing	Subjective Rating of Overall Baseball Ability
30	83	142	15	5	3	3	2	3
31	68	101	16	8	3	4	3	5
32	75	132	13	5	2	2	1	2
33	70	153	12	7	2	2	1	2
34	88	118	15	10	4	4	3	5
35	85	124	13	7	3	2	2	2
36	89	127	15	10	5	4	2	4
37	71	125	16	8	3	2	1	2
38	46	123	11	5	2	1	2	2
39	70	132	5	5	1	1	3	2
40	66	123	13	5	2	2	3	2
41	55	111	15	4	2	1	1	1
42	50	116	14	6	2	2	2	1
43	52	145	10	6	2	2	3	2
44	39	120	16	4	3	2	2	2

Subject No.	Personality	Baseball Knowledge	Fitness	Hitting	Running	Fielding	Throwing	Subjective Rating of Overall Baseball Ability
45	73	116	15	5	2	2	2	1
46	64	136	13	5	2	1	2	2
47	60	127	14	5	2	2	3	3
48	58	132	14	7	2	2	2	2
49	54	100	18	4	3	1	2	2
50	43	128	10	3	2	1	2	3
51	48	131	15	5	1	1	1	3
52	38	112	9	3	1	1	1	2
53	42	120	11	10	3	4	4	4
54	31	140	11	7	2	2	3	2
55	78	121	18	6	3	3	3	3
56	88	118	13	8	2	2	3	2
57	77	132	12	5	2	2	1	3
58	55	112	17	4	2	2	2	2
59	92	143	13	7	2	3	2	3

Subject No.	Personality	Baseball Knowledge	Fitness	Hitting	Running	Fielding	Throwing	Subjective Rating of Overall Baseball Ability
60	68	108	12	8	4	3	2	3
61	76	168	14	7	3	4	3	4
62	52	120	13	4	3	2	1	2
63	79	163	17	7	2	2	1	3
64	53	98	14	4	2	1	1	2
65	66	133	17	6	3	2	2	3
66	50	118	17	11	3	3	3	3
67	83	131	11	8	3	3	3	4
68	69	119	14	6	3	3	3	3
69	67	123	13	7	2	3	3	3
70	83	108	16	7	4	2	1	3

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