

Measurement

by the

PHYSICAL

EDUCATOR

THIRD EDITION

**WHY
and
HOW**

David K. Miller

Measurement

by the
**PHYSICAL
EDUCATOR**

T H I R D E D I T I O N

**WHY
and
HOW**

David K. Miller

University of North Carolina at Wilmington

**Mc
Graw
Hill** **WCB
McGraw-Hill**

Boston, Massachusetts Burr Ridge, Illinois Dubuque, Iowa
Madison, Wisconsin New York, New York San Francisco, California St. Louis, Missouri

WCB/McGraw-Hill

A Division of The McGraw-Hill Companies

MEASUREMENT BY THE PHYSICAL EDUCATOR: WHY AND HOW

Copyright © 1998 by The McGraw-Hill Companies, Inc. All rights reserved.

Previous editions © 1988 by Benchmark Press, Inc., © 1994 by Wm. C. Brown Communications, Inc.

Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a data base or retrieval system, without the prior written permission of the publisher.



This book is printed on recycled paper containing 10% postconsumer waste.

5 6 7 8 9 0 DOC DOC 0

ISBN 0-697-29488-9

Publisher: *Ed Bartell*

Project editor: *Theresa Grutz*

Senior project manager: *Gloria G. Schiesl*

Production supervisor: *Cheryl Horch*

Designer: *Elise Lansdon*

Art editor: *Joyce Watters*

Marketing manager: *Pamela S. Cooper*

Compositor: *Shepherd, Inc.*

Typeface: *10/12 Times Roman*

Printer: *R. R. Donnelley Crawfordsville*

Library of Congress Catalog Card Number: 96-86220

<http://www.mhcollege.com>

Dedicated to the memory of Roselyn Galloway Miller

She gave herself to others;

She inspired us to be more;

She made us laugh;

She gave us all her love.

PREFACE

Purpose and Content

Students in measurement and evaluation classes often are bombarded with an abundance of information. Regrettably, some students complete the class with a little knowledge in many areas but no confidence or skills to perform the procedures and techniques presented in the class. As a professional in a school or nonschool setting, these same students often do not measure and assess knowledge, physical performance, and affective behavior in the proper way.

The purpose of this text is to help the physical education, exercise science, or kinesiology major develop the necessary confidence and skills to conduct measurement techniques properly and effectively. However, more than just measurement techniques are presented. Emphasis is placed upon the reasons for the measurement and how the results of the measurement should be used. These inclusions should help the student develop an appreciation of the need for measurement in a variety of settings. In addition, every effort has been made to present all the material in an uncomplicated way, and only practical measurement techniques are included.

Upon successful completion of the chapter objectives, the user of this text should be able to

1. Use and interpret fundamental statistical techniques;
2. Use the microcomputer to statistically analyze data;
3. Select appropriate knowledge and psychomotor tests;

4. Construct good psychomotor tests;
5. Construct good objective and subjective knowledge tests;
6. Objectively assess and grade students who participate in a physical education class;
7. Administer psychomotor and sports skills tests, interpret the results, and prescribe activities for the development of psychomotor and sports skills;
8. Administer body structure and composition tests, interpret the results, and prescribe scientifically sound methods for attainment of a healthy percent body fat;
9. Administer posture and body mechanics tests, interpret the results, and prescribe activities for the development of proper posture and body mechanics;
10. Administer psychomotor tests to special populations, interpret the results, and prescribe activities for the development of psychomotor skills; and
11. Administer affective behavior tests and interpret the results.

Audience

Until the past decade, most undergraduate physical education majors planned to teach in grades K through 12. Today many majors in physical education, exercise science, kinesiology, and other similar subject areas

anticipate a career in the nonschool environment. This book is designed for use by majors preparing for either environment—school or nonschool. With the exception of grading skills, all of the competencies presented above will be expected of the physical education major in a variety of settings.

Organization

The text is organized so that the student will develop microcomputer and fundamental statistics skills early in the course (chapters 2–4). These skills are to be demonstrated throughout the text. Chapter 5, “What Is a Good Test,” describes the criteria of a good test. Since these criteria and related terms are used throughout the text, it is recommended that this chapter be covered before the chapters that follow. Chapter 6, “Construction of Knowledge Tests,” and chapter 7, “Assessing and Grading the Students,” may be covered in the sequence presented or later in the course. It is recommended that chapter 8, “Construction of Psychomotor Tests,” and chapter 9, “Testing in the Psychomotor Domain,” be presented before any discussion of psychomotor testing. The components of health-related fitness, skill-related fitness, and good posture (chapters 10–16) are described before the presentation of health-related and skill-related fitness tests (chapter 17, “Physical Fitness”) so that the student will better understand these components. These chapters may be presented in a different sequence if the instructor wishes to do so. Chapter 18, “Special Populations”; chapter 19, “Sports Skills”; and chapter 20, “Affective Behavior,” also may be presented in a different sequence by the instructor.

Approach

The statistics information is presented in a friendly and simplified manner so that it is nonintimidating. In addition, although the text information is sometimes presented in a “nuts-and-bolts” style, it is comprehensive as well as straightforward, accurate, and practical.

This book and related assignments can be completed without the use of the microcomputer, but the discussion of the microcomputer is included in hopes that the student will develop the ability to use the microcomputer in a variety of ways. College professors are not in agree-

ment about the use of the computer in the teaching of fundamental statistics. Some professors advocate that the computer eliminates the need to understand certain statistical concepts (i.e., if the student knows the appropriate statistics to use, data can be entered into a computer and the correct answers produced). Other professors believe that the student should understand these concepts before using statistics software and the computer. Sometimes this means that the student should perform statistical procedures with pencil, paper, and a calculator. Either method, or both methods, can be used with this text.

Pedagogy

The following features of this book will assist the student in mastering the material:

- The text is readable and understandable.
- Specific objectives are stated at the beginning of each chapter.
- Key words are in bold print.
- Statistical procedures are provided in steps, or cookbook format, and examples related to physical education are provided.
- Reminders of chapter objectives are placed in the text in the form of “Are you able to do the following” questions.
- Review problems to reinforce the chapter objectives are provided at the conclusion of most chapters.

New to This Edition

The usual changes—updating of material and minor changes—are included in this edition. More significant changes and additions are as follows:

- A description of assessment is included in chapter 1, “Measurement, Evaluation, Assessment, and Statistics,” and the relationship and place of authentic assessment and grading are included in chapter 7, “Assessing and Grading the Students.” These changes address the importance of assessment in the school setting.
- The original statistics chapter is now separated into two chapters for clarity purposes—chapter 3, “Describing and Presenting a Distribution of Scores,” and chapter 4, “Investigating the

Relationship of and Differences in Scores.” This separation will enable the instructor to “break up” the statistics presentation and also enable the student to better discriminate between descriptive and inferential statistics.

- The statistical significance of correlation is described in chapter 4. This addition provides another procedure for interpretation of the correlation coefficient.
- A post hoc test (Tukey’s honestly significance difference test) is added to chapter 4. The inclusion of this test will enable students to understand what is meant by post hoc testing. In addition, students who do not have use of the appropriate computer software can conduct such tests.
- The examples of objective test items in chapter 6, “Construction of Knowledge Tests,” include the thought process measured by the test item.
- A practical agility test, sidestepping, is described in chapter 10, “Agility.”
- Two practical and easy to administer tests, the 1-Mile Walking Test and the YMCA 3-Minute Step Test, are described in chapter 12, “Cardiorespiratory Fitness.”
- Body mass index and fat distribution are discussed in chapter 15, “Anthropometric Measurement and Body Composition.” The body mass index is a practical screening procedure, and fat distribution is an important consideration when advising individuals who are overfat.
- The ACSM Fitness Test described in chapter 17, “Physical Fitness,” is especially appropriate for older adults.
- The Sport Competition Anxiety Test, Self-Motivation Inventory, and Rating of Perceived Exertion included in chapter 20, “Affective Behavior,” provide examples of tests in this area.

Acknowledgments

I wish to express my sincere appreciation to the many students and colleagues who directly and indirectly contributed to the development of the three editions of this text and to the publishers who graciously allowed the reproduction of tables. To Theresa Grutz, Deb DeBord, and all other McGraw-Hill Higher Education staff mem-

bers who contributed to the development of this edition, I say thanks for your dedication, patience, guidance, and superb skills. All authors should be fortunate enough to work with you.

I especially wish to thank the reviewers of the second and third editions. Their comments and suggestions were instrumental and provided valuable direction.

Second and Third Edition Reviewers

Dr. Rebecca Brown

Keene State College

Dr. Steve Mitchell

Kent State University—Main Campus

Shirley Houzer

Alabama A & M University

Carol Haussermann

Dana College

Ann Sebrén

Idaho State University

Michael J. Fratzke

Indiana Wesleyan University

John Dagger

UIC School of Kinesiology

Dr. Pat Floyd

Alabama State University

R. E. Stadulis

Kent State University

Robert O. Ruhling

George Mason University

Willie Lee Taylor

Greensboro College

Dr. Max Dobson

Oklahoma Christian University

Susan E. King

University of Kansas

Carol E. Plimpton

University of Toledo

Arthur W. Miller

University of Montana

Jim Helmer

Southwestern College

Charles Finke

Concordia University

CONTENTS

<i>Preface</i>	xiii	<i>Computer Software</i>	12
1 <i>Measurement, Evaluation, Assessment, and Statistics</i>	1	What Applications Software Do You Need?	12
<i>Reasons for Measurement, Evaluation, and Assessment by the Physical Educator</i>	2	Factors to Consider When Purchasing Applications Software	13
Motivation	2	You Need a Communications Program!	13
Diagnosis	2	<i>Essential Computer Skills</i>	14
Classification	3	Starting Up Your Computer	14
Achievement	3	Menus and Prompts	14
Evaluation of Instruction and Programs	3	Disk Format	14
Prediction	3	Opening, Naming, Saving, and Closing Your Files	14
Research	4	Copy Disk	15
<i>Why Statistics?</i>	4	<i>Use and Care of the Floppy Disk</i>	15
Analyze and Interpret Data	4	<i>Multimedia PCs</i>	15
Interpret Research	4	<i>Review Problems</i>	16
Standardize Test Scores	4	3 <i>Describing and Presenting a Distribution of Scores</i>	17
Determine the Worth (Validity and Reliability) of a Test	4	<i>Statistical Terms</i>	17
2 <i>Using the Microcomputer</i>	5	<i>Scales of Measurement</i>	18
<i>Terms and Concepts</i>	6	Nominal Scale	19
<i>Functions of the Microcomputer</i>	7	Ordinal Scale	19
<i>Computer Hardware</i>	7	Interval Scale	19
Input Devices	8	Ratio Scale	19
Central Processing Unit (CPU)	9	<i>Normal Distribution</i>	20
Storage (Drives and Disks)	9	<i>Analysis of Ungrouped Data</i>	22
Output	10	Score Rank	22
		Measures of Central Tendency	22

Which Measure of Central Tendency Is Best for Interpretation of Test Results?	25	Level of Significance	53
Measures of Variability	26	Standard Error of the Mean	53
Relationship of Standard Deviation and Normal Curve	31	Standard Error of the Difference Between Means	55
Which Measure of Variability Is Best for Interpretation of Test Results?	34	t-Test for Independent Groups	55
Percentiles and Percentile Ranks	34	t-Test for Dependent Groups	55
<i>Review Problems</i>	34	<i>Review Problems</i>	57
<i>Analysis of Grouped Data</i>	35	<i>Testing for Significant Difference Among Three or More Items</i>	57
Measures of Central Tendency	37	Special Terms and Symbols	57
Measures of Variability	39	Analysis of Variance for Independent Groups	58
<i>Review Problems</i>	39	Post Hoc Test	60
<i>Graphs</i>	40	Analysis of Variance for Repeated Measures	60
Histogram	40	Post Hoc Test	62
Frequency Polygon	41	Intraclass Correlation Coefficient	63
<i>Standard Scores</i>	41	<i>Statistics Software</i>	63
z-Scores	41	<i>Review Problems</i>	64
T-Scores	42		
Percentiles	43	5 What Is a Good Test?	65
<i>Review Problem</i>	43	<i>Criterion-Referenced Measurement</i>	65
4 Investigating the Relationship of and Differences in Scores	45	<i>Norm-Referenced Measurement</i>	66
<i>Correlation</i>	45	<i>Validity</i>	66
Scattergram	46	Validity of Norm-Referenced Tests	67
Spearman Rank-Difference Correlation Coefficient	47	Validity of Criterion-Referenced Tests	68
Pearson Product-Moment Correlation Coefficient	47	Factors Affecting Validity	69
<i>Interpretation of the Correlation Coefficient</i>	49	<i>Reliability</i>	69
Significance of the Correlation Coefficient	50	Reliability of Norm-Referenced Tests	70
Coefficient of Determination	50	Reliability of Criterion-Referenced Tests	71
Negative Correlation Coefficients	51	Factors Affecting Reliability	71
<i>Other Correlation Techniques</i>	51	<i>Objectivity</i>	72
Phi Coefficient	51	<i>Administrative Feasibility</i>	72
Point Biserial Coefficient	51	<i>Review Problems</i>	73
Biserial Correlation Coefficient	51		
Tetrachoric Correlation Coefficient	51	6 Construction of Knowledge Tests	75
<i>Review Problems</i>	52	<i>Steps in Construction of a Test</i>	75
<i>Testing for Significant Difference Between Two Means</i>	52	Test Planning	75
The Null Hypothesis	52	Test Item Construction	77
Degrees of Freedom	53	Test Administration	77
		Item Analysis	77
		Item Revision	79
		<i>Objective Test Items</i>	80
		True-False Items	80

Multiple-Choice Items	82	<i>Devise the Test Items</i>	104
Short-Answer and Completion Items	83	<i>Prepare the Directions</i>	104
Matching Items	84	<i>Have the Test Reviewed by</i>	
<i>Essay Test Items</i>	85	<i>Your Peers</i>	104
Guidelines for Writing Essay Items	85	<i>Administer the Test to a Small</i>	
Guidelines for Scoring Essay Items	86	<i>Group of Students</i>	105
Examples of Essay Items	86	<i>Determine the Validity, Reliability,</i>	
<i>Review Problems</i>	87	<i>and Objectivity</i>	105
		Tournament Play	105
7 Assessing and Grading the Students	89	Previously Validated Test	105
<i>Characteristics of Authentic</i>		Ratings of Experts	105
<i>Assessment</i>	90	<i>Develop the Norms</i>	106
Formal Record Keeping	90	<i>Intercorrelations</i>	106
Natural Surroundings	90	<i>Review Problems</i>	107
Formative and Summative			
Assessment	90	9 Testing in the Psychomotor Domain	109
Technique (Form) and End Result	90	<i>Test Administration Responsibilities</i>	109
Self-Assessment and Peer		Pretest Responsibilities	109
Assessment	90	Testing Responsibilities	110
Portfolio Assessment	91	Posttest Responsibilities	110
<i>Grading</i>	92	<i>Types of Psychomotor Tests</i>	111
<i>Use of Grades</i>	92		
Students	92	10 Agility	113
Parents	92	<i>Why Measure Agility?</i>	113
Teachers	93	<i>Tests of Agility</i>	114
Administrators	93	<i>Activities to Develop Agility</i>	118
<i>Factors Used in Grading</i>	93	Changes in the Height of the Body	119
Affective Factors	93	Changes in Distance	119
Cognitive Factors	94	Changes in Direction	119
Psychomotor Factors	94	Other Agility Activities	119
<i>Criteria for Grades</i>	96	<i>Review Problems</i>	120
<i>Methods of Grading</i>	96		
Norm-Referenced Grading	96	11 Balance	121
Criterion-Referenced Grading	99	<i>Why Measure Balance?</i>	121
<i>Which Method of Grading Is Best?</i>	100	<i>Tests of Balance</i>	122
<i>The Weighting of Factors</i>	100	Static Balance Tests	122
<i>Reporting of Final Grades</i>	101	Dynamic Balance Tests	123
<i>Review Problem</i>	102	<i>Activities to Develop Balance</i>	125
		Static Balance Activities	126
8 Construction of Psychomotor Tests	103	Dynamic Balance Activities	126
<i>Know What Is Required of a</i>		Recapturing Balance Activities	126
<i>Good Test</i>	103	<i>Review Problems</i>	126
<i>Define the Performance to Be</i>			
<i>Measured</i>	103	12 Cardiorespiratory Fitness	127
<i>Analyze the Performance</i>	104	<i>Why Measure Cardiorespiratory</i>	
<i>Review the Literature</i>	104	<i>Fitness?</i>	127

<i>Tests of Cardiorespiratory Fitness</i>	128	15	Anthropometric Measurement and Body Composition	169
<i>Development of Cardiorespiratory Fitness</i>	137		<i>Why Measure Body Structure and Composition?</i>	169
<i>Review Problems</i>	138		<i>Body Type Classification (Somatotyping)</i>	170
13	Flexibility	139	<i>Height-Weight Tables</i>	171
	<i>Why Measure Flexibility?</i>	139	Elbow Breadth	171
	<i>Tests of Flexibility</i>	140	Ankle Girth	174
	<i>Exercises to Develop Flexibility</i>	145	<i>Body Composition</i>	174
	Neck	148	Skinfold Tests	175
	Shoulder and Upper Chest	148	Estimating Percent Body Fat (Jackson and Pollack 1985)	178
	Upper Back	148	<i>Optimal Percent Body Fat and Desirable Body Weight</i>	183
	Lower Back	148	Cooper Method for Determining Ideal Weight (Cooper 1982)	184
	Trunk	148	<i>Body Mass Index (BMI)</i>	184
	Posterior Hip, Upper Leg, and Lower Back	148	<i>Fat Distribution</i>	184
	Anterior Hip and Thigh	148	<i>Weight Loss Programs</i>	184
	Groin Area	149	<i>Review Problems</i>	185
	Posterior Lower Leg	149		
	Foot and Ankle	149	16	Posture and Body Mechanics
	<i>Review Problems</i>	149		<i>Why Measure Posture and Body Mechanics?</i>
14	Muscular Strength, Endurance, and Power	151		<i>Measures of Posture</i>
	<i>Why Measure Muscular Strength, Endurance, and Power?</i>	151		Standing Posture Measurement
	<i>Tests of Muscular Strength and Endurance</i>	152		Foot Alignment Measurement
	Tests with Weight-Training Equipment	152		<i>Descriptions of Proper Posture and Body Mechanics</i>
	Tests Requiring Limited Equipment	153		Standing
	<i>Muscular Power</i>	163		Walking
	<i>Exercises to Develop Muscular Strength and Endurance</i>	165		Running for Speed
	Posterior Upper Arms, Shoulders, Chest, and Upper Back	165		Running for Distance
	Anterior Upper Arms, Shoulders, Chest, and Upper Back	165		Sitting
	Abdomen	166		Lifting Heavy Objects
	Lateral Trunk	166		Lifting an Object from a Height
	Lower Back and Buttocks	166		Carrying Heavy Objects
	Lateral Hips and Thighs	166		Lying
	Upper Legs	167		<i>Exercises to Correct Postural Deviations (French and Jansma 1982)</i>
	Lower Legs	167		Lumbar Lordosis
	<i>Review Problems</i>	167		Kyphosis
				Winged Scapula
				Scoliosis

	Knock Knee	194		<i>Team Sports</i>	240
	Bowlegs	195		Basketball	240
	Toeing In and Toeing Out	195		Field Hockey	243
	Flatfeet	195		Football	244
	Foot Pronation	195		Soccer	246
	<i>Review Problems</i>	195		Softball	246
				Volleyball	251
17	Physical Fitness	197		<i>Review Problems</i>	254
	<i>Why Measure Physical Fitness?</i>	198		<i>Sources of Additional Sports</i>	
	<i>Guidelines for the Administration</i>			<i>Skills Tests</i>	254
	<i>and Use of Fitness Tests (Corbin</i>			Archery	254
	<i>1987; Franks, Morrow, and</i>			Badminton	254
	<i>Plowman 1988)</i>	198		Basketball	254
	<i>Norm-Referenced Standards Versus</i>			Bowling	255
	<i>Criterion-Referenced Standards</i>			Field Hockey	255
	<i>(Going and Williams 1989;</i>			Football	255
	<i>Cureton and Warren 1990)</i>	198		Golf	255
	<i>Tests of Health-Related</i>			Handball	255
	<i>Physical Fitness</i>	199		Racquetball	255
	<i>Tests of Skill-Related</i>			Soccer	255
	<i>Physical Fitness</i>	207		Softball	255
	<i>Development of Health-Related and</i>			Swimming	255
	<i>Skill-Related Physical Fitness</i>	214		Tennis	256
	<i>Review Problems</i>	216		Volleyball	256
18	Special Populations	217	20	Affective Behavior	257
	<i>Why Measure Special Populations?</i>	218		<i>Why Measure Affective Behavior?</i>	258
	<i>Norm-Referenced or Criterion-</i>			Uses for Groups	258
	<i>Referenced Tests?</i>	219		Uses for Individuals	258
	<i>Perceptual-Motor Performance</i>			<i>Categories of Measures</i>	258
	<i>Tests</i>	219		<i>Types of Items</i>	259
	<i>Motor Performance Tests</i>	220		Likert Scale	259
	<i>Physical Fitness Tests</i>	223		Semantic Differential	259
	<i>Review Problems</i>	227		Rating Scale	260
				Questionnaire	260
19	Sports Skills	229		<i>Instruments for Measurement of</i>	
	<i>Why Measure Sports Skills?</i>	229		<i>Affective Behavior</i>	260
	<i>Individual and Dual Sports</i>	230		Social Behavior	260
	Archery	230		Attitudes	261
	Badminton	230		Sportsmanship	268
	Golf	232		Leadership	271
	Handball	233		Competition Anxiety	271
	Racquetball	235		Other Measures	274
	Tennis	236		<i>Review Problems</i>	276

<i>Sources of Additional Instruments for Measurement of Affective Behavior</i>	278
Attitudes	278
Body Image	278
Self-Esteem	278
Sportsmanship	278

REFERENCES AND ADDITIONAL READING	279
--	------------

APPENDICES	287
-------------------	------------

A	Square Root Example	287
B	Values of the Correlation Coefficient (r)	288
C	Critical Values of t (Two-Tailed Test)	289
D	F Distribution	290
E	Values of the Studentized Range (q)	294

INDEX	297
--------------	------------

1

Measurement, Evaluation, Assessment, and Statistics

*Upon completion of this chapter,
you should be able to*

1. Define statistics;
 2. Define test, measurement, evaluation, and assessment, and give examples of each;
 3. List and describe the reasons for measurement and evaluation by the physical educator; and
 4. State why the ability to use statistics is important for the physical educator.
-

“Why statistics? I don’t need statistics to be a good teacher.” “I don’t need statistics. I plan to work in a health fitness center.”

Perhaps you have made comments similar to these or have heard some of your classmates make them. If you do not plan to perform your responsibilities as they should be performed, and you do not plan to continue your professional growth as a physical educator, you are correct in this belief. However, if you want to be the best physical educator you can possibly be, the study of statistics should be included in your professional preparation.

Statistics involves the collection, organization, and analysis of numerical data. Statistical methods require the use of symbols, terminology, and techniques that may be new to you, but you should not fear these methods.

The idea that statistics is a form of higher mathematics is incorrect. To successfully perform the statistics presented in this book, you need only a basic knowledge of arithmetic and some simple algebra. The most complex formula in statistics can be reduced to a series of logical steps involving adding, subtracting, multiplying, and dividing. If you are willing to study the statistical concepts and perform the provided exercises, you will master the statistics presented to you.

Before finding an answer to “Why statistics?” you should understand the meaning of measurement and evaluation, and the reasons for measurement by the physical educator. Measurement is not a new concept to you. You measured your height and weight throughout your growing years. You have read how fast athletes have run, how high some have jumped, and how far a baseball or golf ball has been hit. All of these are examples of measurement. When you assume a position as a physical educator, you will perform measurement tasks. On many occasions this measurement will be administered in the form of a test, resulting in a score. For our purposes, a **test** is an instrument or a tool used to make a particular measurement. The tool may be written, oral, mechanical, or another variation. Examples of these tests are cardiorespiratory fitness tests, flexibility tests, and sports skills tests. On other occasions measurement may not involve a performance by a person but will consist of the measurement of a particular attribute. Anthropometric and body fat measurements are such examples. You

should recognize that in all of the preceding examples, a number, or numbers, is obtained. So we can say that **measurement** is usually thought of as quantitative; it is the process of assigning a number to a performance or an attribute of a person. Sometimes when you measure, the score is a term or phrase, but usually measurement will involve the use of numbers. Of course, measurement of objects is done, but as a physical educator you will be concerned primarily with people.

Once you have completed the measurement of a particular attribute of an individual, you must give meaning to it. For instance, if you administer a cardiorespiratory fitness test to participants of an adult fitness group, they will immediately want to know the status of their cardiorespiratory fitness. Without an interpretation of the quality of the test scores, the test has no meaning to the group. If you perform skinfold measurements on a tenth-grade physical education class, the students will want to know what the sum of the measurements means in relation to body fat; otherwise, the measurements will have no meaning. The same can be said for written tests. There must be an interpretation of the test scores if they are to have meaning. This interpretation of measurement is **evaluation**: that is, a judgment about the measurement. For measurement to be effective, it must be followed by evaluation.

It is at this point that some physical educators stop. They measure an attribute, interpret the results to individuals, and go no further. They fail to use the results of their measurement and evaluation to identify performance and behavior problems and to prescribe how the problems can be corrected. This process—measure, evaluate, identify, and prescribe—is referred to as **assessment**. Let's again use the example of skinfold measurements performed on a tenth-grade physical education class. Assume that several tenth graders are diagnosed as overfat as a result of your measurements. You should attempt to determine the eating and activity habits of the students and prescribe the proper diet and exercise program. The teaching of a skill involves the same approach. Through various methods, data are gathered about the skill level of the individuals, the data are interpreted, a diagnosis is made of any learning problems, and a prescription for correction of the learning problems is made. Assessment will be discussed for you again in a later chapter.

Are You Able to Do the Following:

- define statistics?
 - define test, measurement, evaluation, and assessment and give examples of measurement, evaluation, and assessment?
-

Reasons for Measurement, Evaluation, and Assessment by the Physical Educator

Now that you know what is meant by the terms *measurement*, *evaluation*, and *assessment*, let's look at ways you will use them in your profession.

Motivation

If used correctly, measurement can highly motivate most individuals. In anticipation of a test, students usually study the material or practice the physical tasks that are to be measured. This study or practice should improve performance. Skinfold measures might encourage overfat individuals in health fitness programs to lose body fat. A sports skills test administered to inform individuals of their ability in the sport might motivate them to improve their skills. This motivation is more likely to occur, however, if you as the instructor provide positive feedback. Always try to keep your evaluation and assessment positive rather than negative.

Finally, most everyone enjoys comparing past performances with current ones. Knowing that a second measurement will take place, students and adults often work to improve on the original score.

Diagnosis

Through measurement you can assess the weaknesses (needs) and strengths of a group or individuals. Measurement prior to the teaching of a sports skill, physical fitness session, or other events you teach as a physical educator may cause you to alter your initial approach to what you are teaching. For example, you may discover that, before you do anything else in a softball class, you need to teach the students how to throw properly. You also may find that some individuals need more or less attention

than others in the group. Identifying those students who have the ability to throw with accuracy and good form will enable you to devote more time to the students who cannot perform the skill. If you serve as an adult fitness leader, the identification of individuals with a higher level of fitness than the rest of the group will enable you to begin their program at a different level.

In certain settings, it may be possible that you are able to prescribe personal exercises or programs to correct the diagnosed weaknesses. Exercise prescription is a popular term in fitness programs, but appropriate activities may be prescribed in other programs as well. Diagnostic measurement is valuable also after a group has participated in a class for several weeks. If some students are not progressing as you feel they should, testing may help you determine why they are not.

Classification

There may be occasions when you would like to classify students into similar groups for ease of instruction. In addition, individuals usually feel more comfortable when performing with others of similar skill. Sometimes, even in so-called noncontact sports, homogeneous grouping should be done for safety reasons. Also, homogeneous grouping is occasionally necessary in aerobic and fitness classes so that individuals with a low level of fitness will not attempt to perform at the same intensity as individuals with a high level of fitness.

Achievement

The most common reason for measurement and assessment is to determine the degree of achievement of program objectives and personal goals. Students certainly like to know how far they have progressed in a given period of time, and you need to know their achievement to better evaluate the effectiveness of your instruction. Individuals in wellness programs want to know the progress toward their health goals, and measurement can often best provide this information.

Achievement often is used to determine grades in physical education. If administered properly, performance tests and knowledge tests are appropriate for grading, and they serve to decrease the need of subjective grading of the students. Many physical education teach-

ers, however, mistakenly use tests only for determining grades. The assigning of grades will be discussed at length in chapter 7.

Evaluation of Instruction and Programs

With any responsibility you assume as a physical educator, occasionally you will have to justify the effectiveness of your instruction and/or program to your employer. For instance, when budget cuts are anticipated in the public schools, physical education and the arts are often the first programs considered. It also is necessary to justify a program when budget increases are requested. Furthermore, school accreditation studies require assessment of instruction and programs. If measurement and evaluation identify instructional and/or program problems, correctional procedures are stated. Standardized forms are available for program evaluation, but if program content is professionally sound, the success and effectiveness of instruction and programs are best determined by how well the participants fulfill program objectives. This statement is true for school programs, fitness and wellness programs, and all other professional programs in which you may have responsibilities. You must be able to measure and assess instruction and programs.

Assessment of each student's skill at the beginning of an activity unit helps you determine the effectiveness of previous instruction and programs and at what point you should begin your instruction. If the students are not knowledgeable of basic rules and cannot demonstrate the elementary playing skills of an activity, it will be necessary to begin instruction at that level. In addition, there may be times when you want to compare different methods of teaching sports skills or fitness. If you can be confident that the different groups are of equal initial ability, it is possible to compare the results of test scores at the conclusion of instruction and determine if one method of teaching is better than another. This procedure will be discussed in greater detail in chapter 4.

Prediction

Measurement to predict future performance in sport has increased in popularity, but this type of testing usually

requires expertise in exercise physiology and psychology. Maximum oxygen uptake, muscle biopsies, and anxiety level are examples of tests that are used to predict future performance in sport.

Research

Research is used to find meaningful solutions to problems and as a means to expand a body of knowledge. It is of value for program evaluation, instructor evaluation, and improvement in performance, as well as other areas related to physical education. Many opportunities exist for physical educators who wish to perform research.

Now that you are aware of the primary reasons for measurement, evaluation, and assessment in physical education, you are ready to know “Why Statistics?”

Are You Able to Do the Following:

- list and describe the reasons for measurement, evaluation, and assessment by the physical educator?
-

Why Statistics?

Whether you teach, instruct in a fitness center, administer, or have responsibilities in a corporate setting, the ability to use statistics will be of value to you. Although no attempt will be made in this book to provide an extensive coverage of statistics, after you have completed chapters 3 and 4, you should have the skill to do the following.

Analyze and Interpret Data

The data gathered for any of the measurement reasons described should be statistically analyzed and interpreted. It is a mistake to gather data and make important decisions about individuals without this analysis. Decisions regarding improvement in group performance and differences in teaching methodology should not be made without statistical analysis. Also, if you are willing to statistically analyze and interpret test scores, you can better inform all participants of the test results than you can with a routine analysis of the scores. So, using statistical

analysis and interpretation, you can provide a more meaningful evaluation of your measurement.

Interpret Research

As a physical educator you should read research published in professional journals. After completion of this book you will not understand all statistical concepts, but you will understand enough to accurately interpret the results and conclusions of many studies. This ability will enable you to put into practice the conclusions of research. Too many physical educators fail to use research findings because they do not understand them. If you are to continue your professional growth, it is essential that you be able to interpret research related to physical education.

Standardize Test Scores

Many measurements performed by the physical educator will be in different units; for example, feet, seconds, and numbers. To compare such measurements, it is best to convert the scores to standardized scores. A popular form of standardized scores is percentile scores (as reported SAT scores).

Determine the Worth (Validity and Reliability) of a Test

Validity and reliability of a test may not mean much to you now, but by knowing how to interpret statements about these characteristics, you are more likely to select the appropriate test to administer to your students, clients, or customers. In addition, you will be able to estimate the validity and reliability of tests that you construct.

Are You Able to Do the Following:

- describe why the ability to use statistics is important to the physical educator?
-

You have read the reasons for measurement and evaluation and the uses of statistics by the physical educator. Before you begin your study of statistics, it may be helpful to have an understanding of the microcomputer and to have the ability to use it. Chapter 2 will help you develop basic microcomputer skills.