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THE GEBODIII PROGRAM USER'S GUIDE AND DESCRIPTION

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This report documents the latest version of the GEBOD program, GEBODIII. GEBOD generates human and dummy body data sets for use in dynamic modelling. The data sets include the body segments' geometric and mass properties, and the joints' locations and range of motion characteristics. The first part of this manual is a user's guide which describes how to install, run, and use GEBODIII. The second part is the program description which explains the program modifications since its original documentation in 1983.

The improvements and changes that have been made include: addition of dummy data sets, incorporation of human stereophotometrically generated data to calculate segment inertial properties and joint locations for adult human data sets, addition of joint characteristics for adult human data sets, addition of an option to output data for the forearm and hand segments as either combined or separated segments for the adult human data sets, a change in the unit of weight from kilograms to newtons, use of prompts to ask for filenames, and programming changes to make the program more user friendly.

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PREFACE

This manual is written in two parts. Part 1 is the user's guide which describes how to install, run, and use GEBODIII. Part 2 is the program description which explains the program modifications and computations. This manual should be used in conjunction with the report Development of an Interactive Computer Program to Produce Body Description Data, L. Douglas Baughman, July 1983, AFAMRL-TR-83-058.

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PART 1

USER'S GUIDE

1.1 INTRODUCTION

Program GEBODIII is the latest version of GEBOD (GEnerator of BOdy Data). GEBOD is a program which is used to automate the process for generating the body description portion of the Articulated Total Body (ATB) model (Obergefell, et al., 1988) input data set. GEBOD was originally developed and documented by Baughman (1983). GEBODII was released in 1988, but was not documented. This manual documents the changes made for GEBODII as well as those made for GEBODIII. GEBODIII is similar in operation to GEBOD, although the output may be quite different. The changes apparent to the user while running the program are the prompting for output filenames and the addition of the option to output data for either 15 or 17 body segments. Otherwise, the program appears unaltered. Major changes to the program include the addition of dummy data sets and the use of human stereophotometric data to calculate segment inertial properties and joint locations for adult human data sets. Refer to the introduction to Part 2, Program Description, for a brief summary of all modifications.

GEBODIII provides body data for several human subject types. They are: child (2-19 years), adult human female, adult human male, and a human based on user-supplied body dimensions. Also available are the following manikin data sets: Hybrid III dummy with seated pelvis (50th percentile), Hybrid III dummy with standing pelvis (50th percentile), and Hybrid II dummy (50th percentile). For all of the above subject types, GEBODIII provides segment data for mass, center of gravity location, contact surface dimensions, principal moments of inertia and their associated directions. Further, for the adult human female, the adult human male, and the manikin data sets, the program outputs elastic, viscous, and joint stop properties for each joint. All calculations are done in English units, but output is also available in metric units.

GEBODIII accesses up to seven files or input/output (I/O) devices. Prompts for the user are written to the console, I/O unit 6. Interactive user input is received through the console, I/O unit 5. Body description data produced by GEBODIII is written to both I/O units 3 and 9. Data written to unit I/O 3 is formatted for the ATB model input data set, and the data written to I/O unit 9 is a tabular presentation of the data. If the user selects the User-Defined Body Dimensions option, the body description data is input using an external data file through I/O unit 1. GEBOD.DAT is an external file containing data that is needed by GEBODIII, such as the subject type option titles and selected ATB input data sets available to the user. The GEBOD.DAT file is distributed with the GEBODIII program and is always assigned to I/O unit 2. GEBOD.DAT should not be changed by the user.

The user is prompted for the filenames to be assigned to I/O units 1, 3, and 9. The first time through the program, the filenames assigned to I/O units 3 and 9 must be new names. An error will occur if a file with the chosen filename already exists in the computer directory. However, on subsequent runs through the program (when the user responds "y" to the prompt asking if it is desired to produce another body description data set), the user may enter the same filenames for I/O units 3 and 9. When this is done, the output is appended to the end of the existing file rather than overwriting the file.

To install GEBODIII, the source code and GEBOD.DAT files must be copied onto the user's computer. The source code must then be compiled using the Fortran compiler available to the user. To run the program, type "GEBODIII". The user is then prompted for output file names and other required program inputs.

1.2 PROGRAM FLOW

The interactive program flow is depicted in Figure 1. After the program is started, GEBOD prompts the user for a description of the subject that is less than 60 characters long. This description can be left blank by hitting <ENTER>. The user is then prompted to provide a filename for the tabular body description output.

Next, the user is asked to choose the desired subject type from the option menu. The possible choices are:

1. Child (2-19 years)
2. Adult Human Female (based on female stereophotometric and Air Force personnel data)
3. Adult Human Male (based on male stereophotometric and Air Force flying personnel data)
4. User-Supplied Body Dimensions
5. Sitting Hybrid III Dummy (50%)
6. Standing Hybrid III Dummy (50%)
7. Hybrid II Dummy (50%)

If option 1, Child (2-19 years), is chosen, the user is asked to select the parameters which will be used to generate the subject data set. The user can select age, weight, standing height, or all of the above. If age is selected, the user is asked to specify months or years as the units in which age will be given. Then the user is asked to provide the age. A range for the possible values of age is displayed on the screen to assist the user in providing an appropriate age. Similar procedures are followed for weight and standing height, if they were selected by the user. For weight, the possible units of input are pounds or newtons. For standing height, possible units of input are inches or meters.

Options 2 and 3, Adult Human Female and Adult Human Male,

Figure 1. Interactive Flow Chart

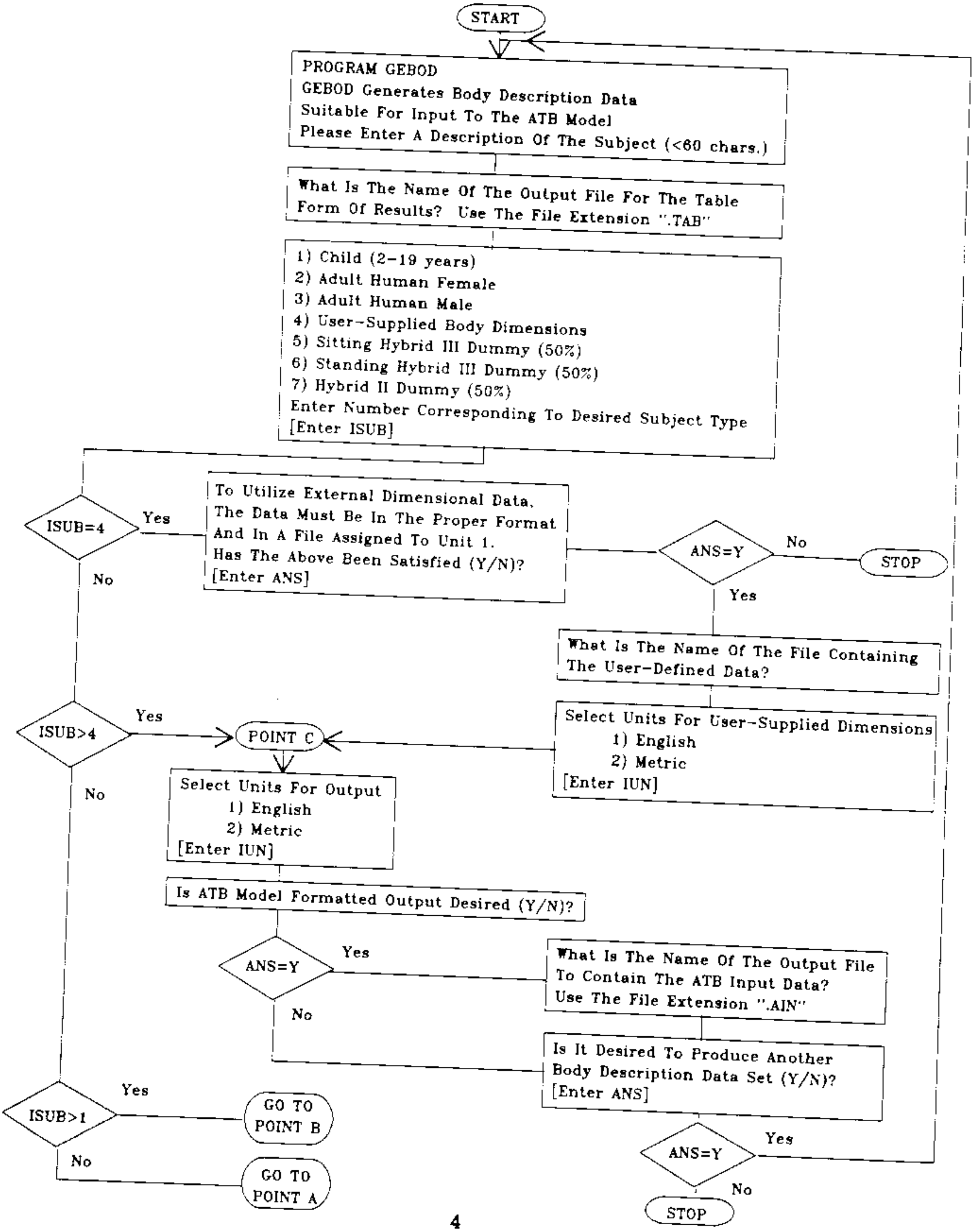


Figure 1. Interactive Flow Chart (Continued)

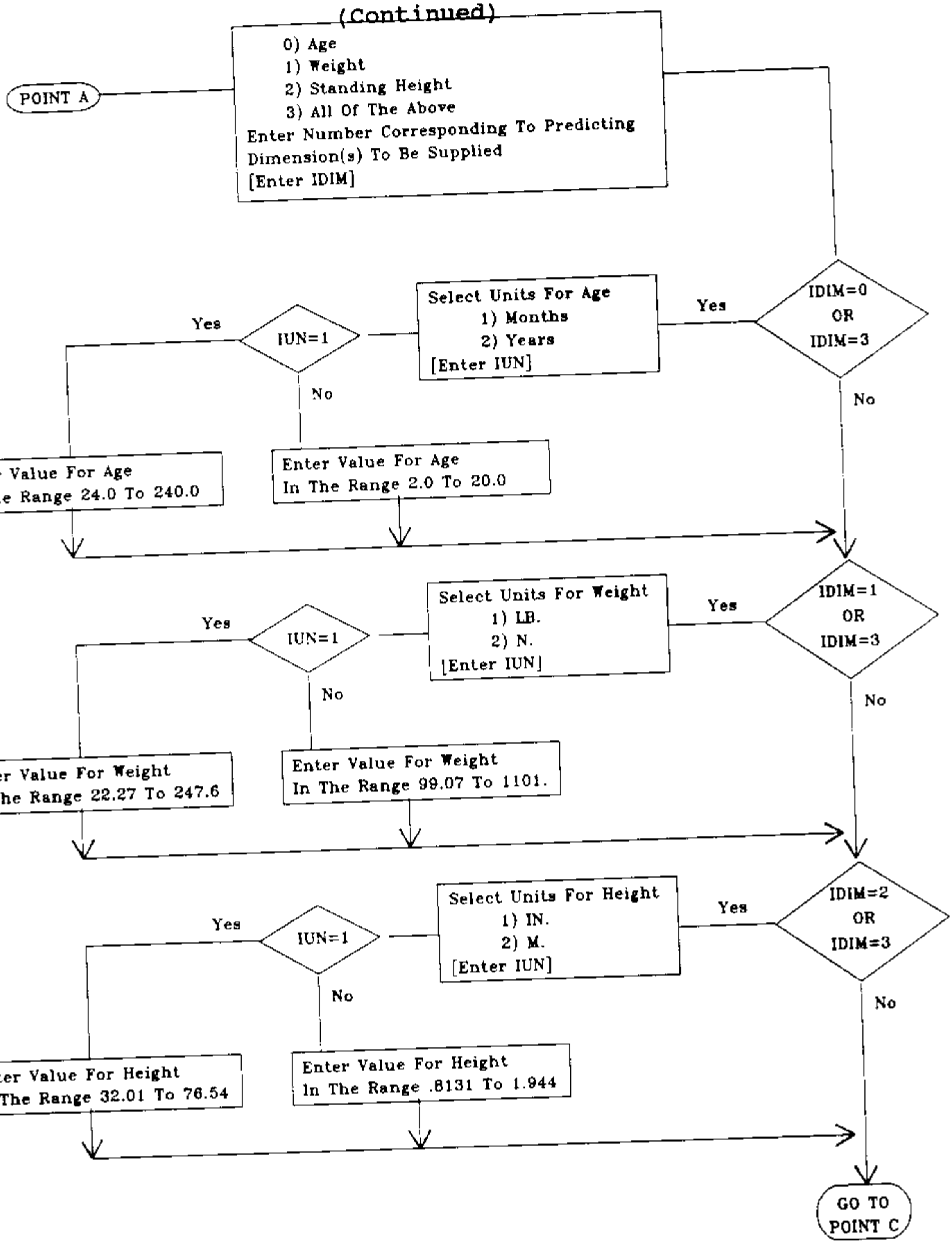


Figure 1. Interactive Flow Chart
(Continued)

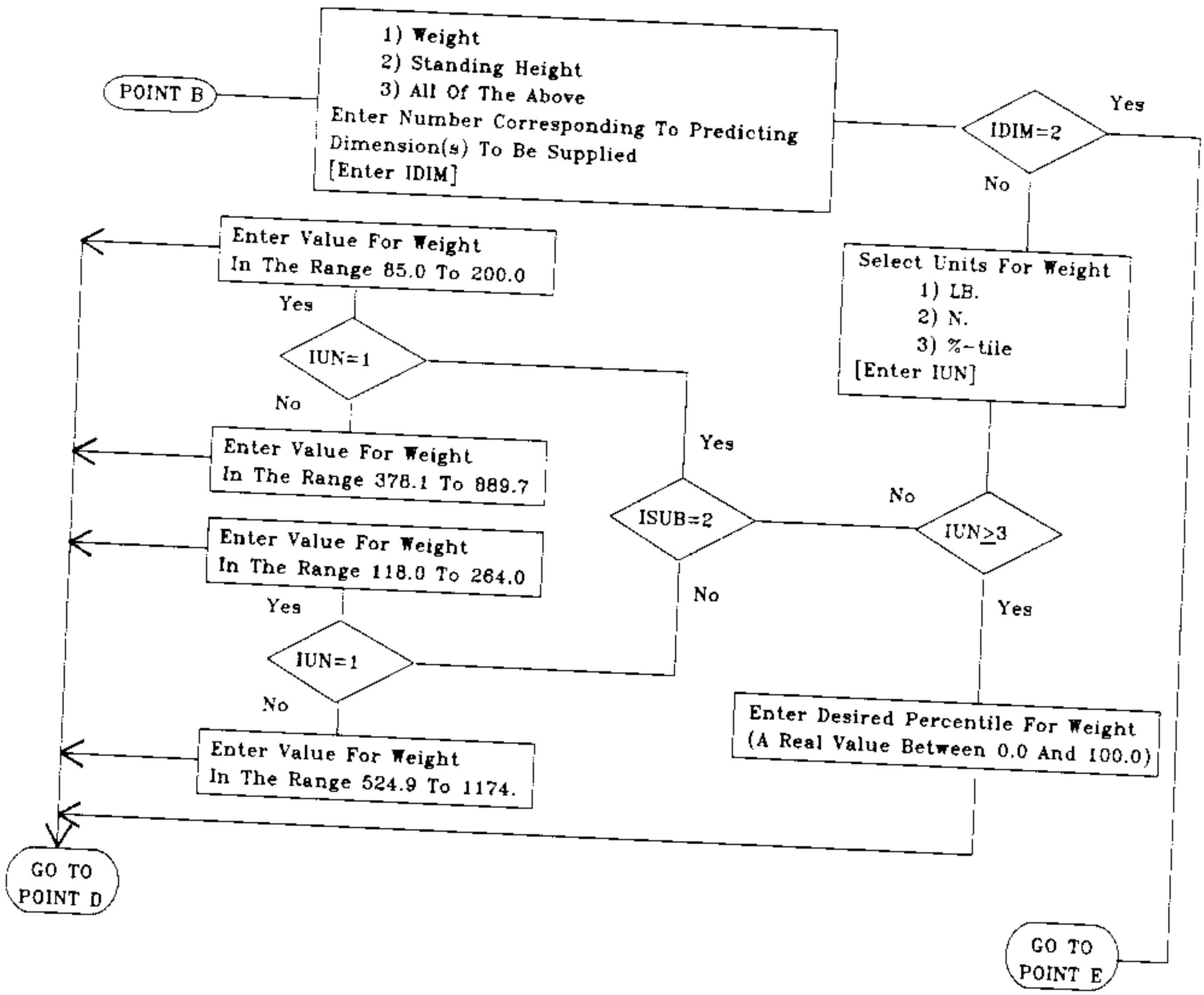
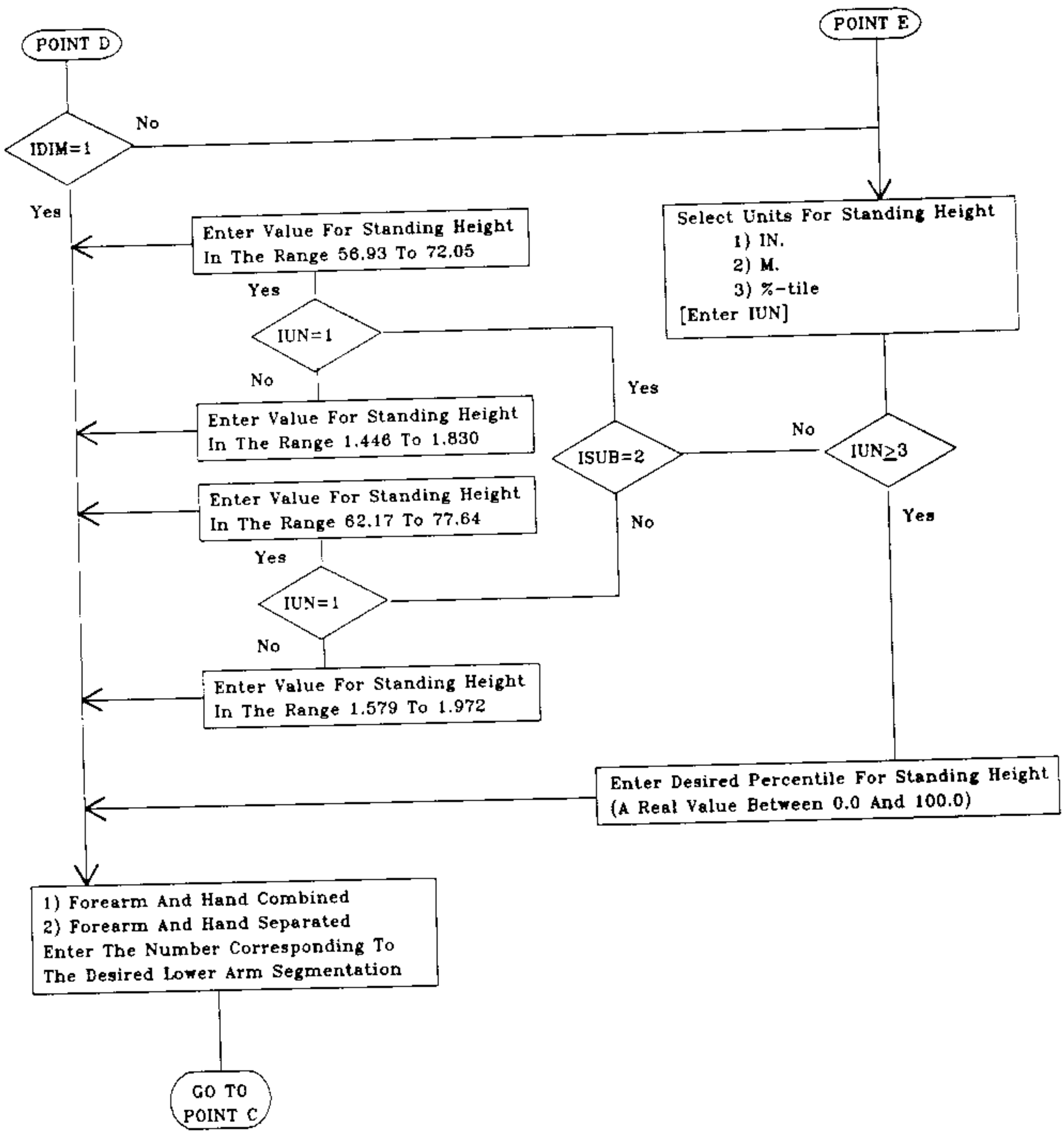


Figure 1. Interactive Flow Chart (Continued)



respectively, use the same procedure as option 1, except that the option to input age is omitted. After the specified data have been entered for these options, the program asks the user to select the desired lower arm segmentation scheme: forearm and hand combined resulting in output for 15 segments and 14 joints, or forearm and hand separated resulting in output for 17 segments and 16 joints.

If option 4, User-Supplied Body Dimensions, is selected, the user is asked to select the units in which the user-supplied body dimensions are to be provided. The choices are English (inches and pounds) or metric (meters and newtons). (See Appendix A of Baughman (1983) for more details on the use of option 4.)

The manikin options 5 through 7 refer to specific data sets stored in GEBOD.DAT; they do not require any user-supplied description of the subject.

When all user input for the description of the subject has been completed, the user is asked to select the units for output, either English (inches and pounds) or metric (meters and newtons). Next, the user is asked if ATB model formatted output is desired. If the user does not intend to use the output from this program as input to the ATB model, the user should specify "n" and the program output will consist solely of a tabular presentation of the data. If "y" is specified, the user is asked to supply the name of the file to contain this data and the program output will provide both a tabular presentation of the data and an ATB model formatted presentation of the data.

After the calculations and output are completed, the user is asked if another body description data set is to be generated. If not, execution stops. If another data set is desired, the program loops back to the beginning of the program and the input process is repeated.

1.3 REGRESSION EQUATIONS AND THEIR USE

Regression analysis is a method widely used in anthropometry for predicting various body measurements from known body measurements. All regression equations for the Adult Human Female and the Adult Human Male options used by GEBODIII are based on weight, standing height, or both. The goal was to use this limited description to achieve the best possible prediction of other body measurements for a subject. The coefficient of determination or R-square (R^2) value is an indicator of the predictive ability of a regression equation. The R^2 value associated with each regression equation is given in the appendices containing these regression equations. For example, the following regression equations to predict shoulder height can be found in Appendix D of Baughman (1983).

Shoulder Height = .7182E-01 * Weight + 42.77 R^2 = .3049
Shoulder Height = .8751 * Standing - 3.936 R^2 = .9194
Shoulder Height = .7555E-02 * Weight + .8469 * Standing - 3.096 R^2 = .9218

where Shoulder Height, generally referred to as $\hat{Y}$, is the predicted dependent variable. Predictor or independent variables are generally referred to as X_i and in the above example are Weight and Standing Height.

R^2 is calculated according to the following four steps:

1. The prediction error that would result without the use of the regression equation is calculated. This prediction error is the sum of the squared differences between the observed value of Y at each observed value of X_1 (and X_2) and the mean value of Y.

$$\Sigma(Y_i - \bar{Y})^2,\ i=1,\dots,n$$

2. The prediction error that would result from using the regression equation to predict the behavior of the dependent variable is calculated. This prediction error is the sum of the squared differences between the observed value of Y and the predicted value of Y at each observed value of X_1 (and X_2).

$$\Sigma(Y_i - \hat{Y}_i)^2, \ i=1,\ldots,n$$

3. The resulting prediction error from step 2 is subtracted from the resulting prediction error from step 1. This difference represents the reduction in the prediction error achieved by using the regression equation predictions rather than the mean.

4. This reduction is expressed as a percentage by dividing the difference from step 3 by the result from step 1 to obtain a percentage reduction in the amount of the prediction error and is equal to R^2.

The values of R^2 are always between zero and one, or equivalently, a percentage between 0 and 100 percent. A value of 0 implies that the regression equation is useless in reducing the prediction error and, therefore, has little or no predictive ability beyond that provided by using the mean value. A value of 50 percent implies that the prediction error has been reduced by 50 percent, or cut in half, by using the regression equation. Finally, a value of 100 percent indicates that no prediction error occurs when the regression equation is used.

In some instances, the regression equations used by GEBODIII may yield questionable results. This is true when one or more subjects in the regression analysis sample have extreme values for standing height and/or weight. In this case, due to the use of the least squares method, the regression line may have been disproportionately skewed toward the extreme. A user running the program may input a value for standing height and/or weight that is within the specified range of reasonable values, but end up with an unreasonable value for a predicted variable.

While R^2 is a measure of the relationship between the dependent and independent variables, it can not be used as the sole indicator of the effectiveness of the regression equation. If there is an extreme value pulling the regression line toward that value, the R^2 value may be quite high, while the regression equation may not best represent the data.

If the regression results from using GEBODIII appear to be unsatisfactory, the user should first check the measurement description and summary statistics to determine whether the predicted value is reasonable. It is important to check these descriptions, especially when comparing regression results between males and females, since the method of measurement may vary somewhat.

The following example demonstrates the importance of referring to the measurement descriptions and summary statistics to determine the usefulness of predicted body measurements. The regression equation for the ankle height of an adult male of 179.84 pounds (800 newtons) and 72.05 inches (1.83 meters) results in a predicted value of 5.6 inches (.1422 meters). The equation for an adult female of equal standing height and weight results in a predicted value of 3.01 inches (.0723 meters). These values seem to be quite different and raise suspicion regarding their validity. However, the female dimension was measured from the standing surface to the lateral malleolus landmark, while the male dimension was measured from the standing surface to the level of minimum ankle circumference, which is found above the lateral malleolus landmark. The female ankle height is, therefore, expected to be noticeably shorter than that of the male. The mean value of these measurements confirms that the predicted values are reasonable.

If the predicted value is found to be unreasonable after checking the measurement description and summary statistics, it is safe to assume that the regression line is affected by an extreme value. In this case, the mean value of that measurement instead of the predicted value generated by GEBODIII should be used.

The user should examine the tabular output of GEBODIII to determine that the predicted body measurement values are reasonable. If the user decides to change some of the body measurements predicted by the program, the User-Supplied Body Dimensions option can be used. In this case, the user must create an input file that will be read through unit 1, containing all 32 body measurements. Refer to Appendix A of Baughman (1983), for specifics on the format of the file. The user can supply the body measurements from GEBODIII and substitute alternate values in place of those predicted values which are unreasonable. The body measurements provided by running GEBODIII with this user-defined data file will reflect the new values.

The measurement descriptions and summary statistics for adult male and adult female anthropometry are provided in Appendix F of this manual. An explanation of anthropometric terms used is presented in Appendix E. The actual regression equations used for predicting anthropometry (except for the hand) are given in Appendix D of Baughman (1983). These equations have remained unchanged. The regression equations for the hand dimensions of the Adult Human Female and Adult Human Male options have been added to GEBODIII and are given in Appendix A of this manual. Also, regression equations for joint center location, principal moments of inertia, and segment volume for the Adult Human Female and Adult Human Male options have been incorporated into the program and are given in Appendix B, C, and D of this manual, respectively.

1.4 SEGMENT ELLIPSOID ALIGNMENT

The segment ellipsoid positions were obtained by using regression equations to locate the joint center with respect to the center of gravity for each segment. Using the ATB model, the ellipsoids were then visually aligned by adjusting each ellipsoid center with respect to the segment center of gravity, so that as the segments moved, the ellipsoid alignment was maintained. Currently, there is no anthropometric data available upon which to directly predict the location of the ellipsoid center with respect to the segment center of gravity; therefore, the expressions used to calculate these locations were derived by trial-and-error and are, in most cases, based on joint center locations or segment semiaxes. Section 2.3.1.3 in Part 2 of this manual describes this process in more detail.

1.4.1 ADJUSTING THE SEGMENT ELLIPSOID ALIGNMENT

There may be some instances where the user is not completely satisfied with the segment ellipsoid alignment as shown in a plot of the program output. This may occur when the subject is <u>extremely</u> tall and skinny or <u>extremely</u> short and fat. Ellipsoid alignment is easily changed by altering the ellipsoid center with respect to segment center of mass data in the B.2 cards in the ATB input data set. By adjusting the X, Y, and Z values in the local coordinate system, the user should be able to align the ellipsoids as desired.

Most ellipsoid alignments provided by GEBODIII are reasonable, and the ellipsoid centers should not be altered unless a graphic plot of the body indicates such action.

PART 2

PROGRAM DESCRIPTION

2.1 INTRODUCTION

This part describes in more detail the modifications and improvements that were made to create GEBODIII. These changes are as follows:

1) The option to output data for the Sitting Hybrid III, Standing Hybrid III, and the Hybrid II manikin data sets was added.
2) Human stereophotometric data (McConville, et al., 1980; Young, et al., 1983) were incorporated into the program in the form of regression equations used to calculate segment mass properties and joint center locations for the adult human options.
3) Joint characteristics for the adult human options were added.
4) The option to output data for either combined or separated forearm and hand segments for the adult human options was added.
5) Since kilograms is a metric unit of mass, not weight, all weight data is now output in metric units of newtons. Also the use of meters and centimeters was inconsistent for metric output in GEBOD. GEBODIII makes use of meters only.
6) The user is prompted for filenames to be used by the program.
7) Alterations to make the program more portable to other computers were made.

Changes 1, 2, 3, and 4 are described more thoroughly in the following sections.

2.2 CHILD AND USER-DEFINED BODY DIMENSIONS OPTIONS

The methods of calculating body data for subject type options 1 and 4, the Child and the User-Defined Body Dimensions options, respectively, have not been altered with this version of GEBOD. Refer to Baughman (1983) for details describing these calculations.

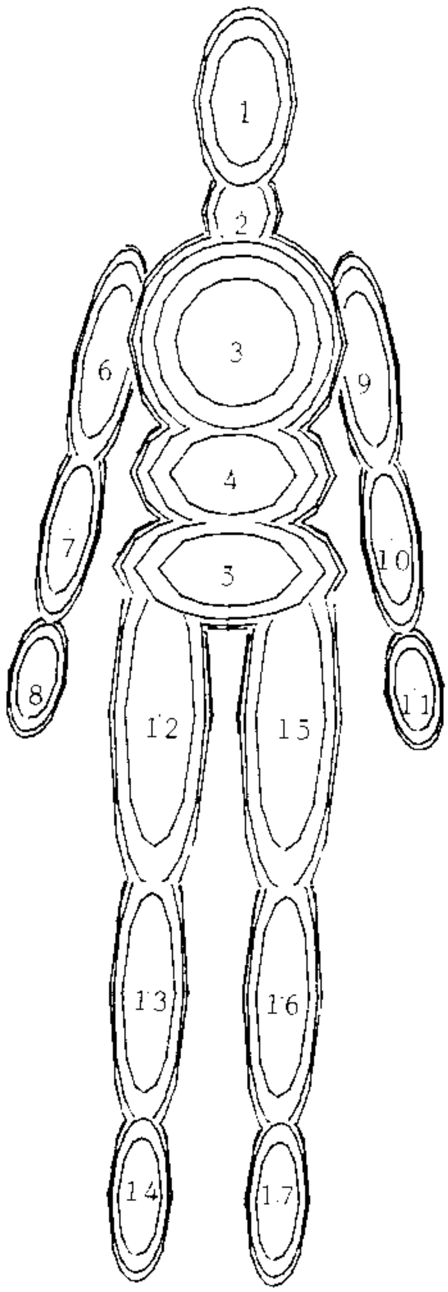
2.3 ADULT HUMAN FEMALE AND ADULT HUMAN MALE OPTIONS

The methods of calculating body data for subject type options 2 and 3 have been changed significantly. Previously, the methods used by GEBOD to calculate the segment mass properties were based on the segment ellipsoids, not directly measured body geometry or mass properties. This method was replaced with calculations from stereophotometrically generated body surface data obtained from both male and female sample populations (McConville, et al., 1980; Young, et al., 1983). Joint center locations were based on three-dimensional surface landmark data also available in the stereophotometric data sets.

With past versions of GEBOD, output was limited to body data for 15 segments where the forearm and hand were considered as one segment. Because of the many applications involving hand movement, the need arose to consider the forearm and hand segments separately, connected by the wrist joint. This option was incorporated into GEBODIII, making available body data for 17 segments. Figure 2 depicts the 17 segment configuration. Regression equations to calculate hand length, hand breadth, and hand thickness were added to GEBODIII. These equations are given in Appendix A.

2.3.1 Body Geometry

The body geometry includes the contact ellipsoid semiaxes and



1. Head
2. Neck
3. Thorax
4. Abdomen
5. Pelvis
6. Right Upper Arm
7. Right Lower Arm
8. Right Hand
9. Left Upper Arm
10. Left Lower Arm
11. Left Hand
12. Right Thigh
13. Right Calf
14. Right Foot
15. Left Thigh
16. Left Calf
17. Left Foot

Figure 2. Seventeen Segment Configuration

joint locations for each segment in the local reference axis system.

2.3.1.1 Reference axis systems

All data output by GEBODIII are described with respect to the segment local reference axis systems. Each segment's local axis system is defined such that its origin is at the segment center of mass and, when the body is in a standing position with the toes pointing down, the local axis systems' positive Z-axes point down, positive X-axes point forward, and positive Y-axes point to the right of the body.

The stereophotometric data was collected in a global axis system defined with the body in the standard anatomical position with the origin on the floor centrally located between the subject's feet and directly underneath the body. The axes are defined so that the positive X-axis points forward, positive Y-axis points to the left of the body, and positive Z-axis points upward from the origin. The hands of the female subjects were positioned with the palms facing anteriorly; the hands of the male subjects were positioned with the palms facing posteriorly.

In segmenting the data, McConville and Young defined the standard anatomical axis systems for each segment based on body surface landmarks. In general, anatomical axis systems are defined so that the positive X-axes point forward, positive Y-axes point to the body's left, and positive Z-axes point distal to proximal. Complete definitions of the anatomical axis systems are given in McConville, et al. (1980) for males and Young, et al. (1983) for females.

Based on the above definitions, the transformation from the segment anatomical axis system to the local axis system consists of a translation to the segment center of mass and a 180 degree rotation about the anatomical X-axis for all the segments except the neck and pelvis. The landmarks used to define the anatomical axis systems for these two segments result in X-axes that are not horizontal in the standing position. Therefore, the transformation from the segment anatomical axis system to the local axis system for these two segments includes a rotation about the Y-axis after the X-axis rotation. For the neck, this Y-axis rotation is +30 degrees and for the pelvis, -12 degrees. The transformation cosine matrix from the neck anatomical axis system to the neck local axis system is:

$$\begin{bmatrix} \cos(30^\circ) & 0 & \sin(30^\circ) \\ 0 & -1 & 0 \\ \sin(30^\circ) & 0 & -\cos(30^\circ) \end{bmatrix}$$

The transformation cosine matrix from the pelvis anatomical axis system to the pelvis local axis system is:

$$\begin{bmatrix} \cos(12^\circ) & 0 & -\sin(12^\circ) \\ 0 & -1 & 0 \\ -\sin(12^\circ) & 0 & -\cos(12^\circ) \end{bmatrix}$$

The transformation cosine matrix from the anatomical axis system to the local axis system for all other segments is:

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

In the stereophotometric data for the adult human female forearms, the anatomical Z-axis is represented as a vector from the ulnar styloid landmark to the radiale landmark. This vector crosses the forearm diagonally from lateral to medial which did not conform to the desired vertical alignment of the segment axes. Therefore, the anatomical axes were redefined as follows:

RIGHT FOREARM

Z axis - vector from radial styloid to radiale

Y axis - normal from Z axis to ulnar styloid

X axis - $\underline{Y} \times \underline{Z}$

Origin - at radiale

LEFT FOREARM

Z axis - vector from radial styloid to radiale

Y axis - normal from ulnar styloid to Z axis

X axis - $\underline{Y} \times \underline{Z}$

Origin - at radiale

The local reference axes for the right and left forearm segments were obtained by rotating the above anatomical axes 180 degrees about the X axis and translating the origin to the center of mass.

2.3.1.2 Segment ellipsoid semiaxes

Segment ellipsoid semiaxes are based on anthropometric dimensions. Expressions to calculate ellipsoid semiaxes for the right and left forearm and right and left hand segments are given in Table I where references to the i^{th} body measurement are made by DD_i. The body measurements are in Appendix F. The

TABLE I
EXPRESSIONS FOR FOREARM AND HAND SEMIAXES (IN)

SEGMENT	X	Y	Z
Forearms	$DD_{21}/2\pi$	$DD_{21}/2\pi$	Females: $(DD_{18} - DD_{33}) * 0.5$ Males: $(DD_{18} - DD_{33}) * 0.6$
Hands	$DD_{34}*0.5$	$DD_{34}*0.5$	$DD_{33}*0.5$

expressions to calculate ellipsoid semiaxes for all other segments have not changed from previous versions of GEBOD (Baughman, 1983).

2.3.1.3 Segment ellipsoid centers

Previous versions of GEBOD made the assumption that the segment ellipsoid center was located at the segment center of mass (CM) for most segments. For the pelvis, abdomen, thorax, and feet segments, GEBOD calculated the global location of the ellipsoid center in the Z direction based on predicted body description data and numerical integration was used to calculate the segment CM in the Z direction. Then the segment ellipsoid center Z location was subtracted from the Z location of the segment CM to give the segment ellipsoid center in the local reference axis system on the B.2 card of the ATB input data set.

No such assumptions are made in GEBODIII, since it is known that the segment CM is not, in most cases, actually located at the segment ellipsoid center. However, the exact location of the ellipsoid center with respect to segment CM is not known either. Therefore, the ellipsoid center in each local axis system was arrived at by visually aligning the segment ellipsoids with respect to each other.

Ellipsoids were aligned for an average size adult human male subject by adjusting ellipsoid centers segment-by-segment, beginning with the feet and working up to the head. The arm segments were aligned with each other and then with the rest of the body. The alignment was validated for a small and a large male subject. The ellipsoids of the adult human female were similarly aligned.

The 15 and 17 segment ellipsoid configurations align well for the adult human male. For the adult human female, the 15 segment ellipsoid configuration aligns well; however, in the 17 segment ellipsoid configuration, all segments are well aligned, except the hands. The user may wish to adjust ellipsoid locations for some subjects, as described in section 1.4.1 of Part 1, so that the hand alignment is more reasonable.

2.3.1.4 Joint center locations

The three-dimensional joint center locations were calculated in the global axis system for each male and female stereophotometric subject based on three-dimensional landmark locations. Table II contains a list of landmarks used in the expressions to define joint center locations. Table III contains a list of the expressions. The expression used to locate the hip joint center is from Andriacchi and Strickland (1985). All other expressions were obtained by experimentation. These global joint center locations were transformed to the local reference axis systems. The resulting joint center locations were then used to calculate regression equations to estimate joint center locations in the local reference axis system for adult human female and male subject type options. These regression equations are in Appendix B.

2.3.2 Inertial Properties

2.3.2.1 Segment centers of mass

The segment centers of mass are indirectly located by defining the origins of the segment local reference axis systems to be at the segment centers of mass and specifying the remaining data, such as the joint and ellipsoid center locations in the local reference axis systems.

2.3.2.2 Moments of inertia

The principal moments of inertia were calculated from the stereophotometric data for each female and male subject. These data were used to calculate regression equations to predict each segment's principal moments of inertia for the adult human female and male subject type options. These regression equations are in

TABLE II
LANDMARKS USED IN EXPRESSIONS TO DEFINE
JOINT CENTER LOCATIONS

Landmark Number	Landmark Name
1X, 1Y, 1Z	Left Tragion
2X, 2Y, 2Z	Right Tragion
3X, 3Y, 3Z	Cervicale
4X, 4Y, 4Z	Tenth Rib Midspine
5X, 5Y, 5Z	Posterior Superior Iliac Midspine
6X, 6Y, 6Z	Right Acromion
7X, 7Y, 7Z	Right Medial Humeral Epicondyle
8X, 8Y, 8Z	Right Lateral Humeral Epicondyle
9X, 9Y, 9Z	Right Radial Styloid
10X, 10Y, 10Z	Right Ulnar Styloid
11X, 11Y, 11Z	Left Acromion
12X, 12Y, 12Z	Left Medial Humeral Epicondyle
13X, 13Y, 13Z	Left Lateral Humeral Epicondyle
14X, 14Y, 14Z	Left Radial Styloid
15X, 15Y, 15Z	Left Ulnar Styloid
16X, 16Y, 16Z	Right Trochanterion
17X, 17Y, 17Z	Right Anterior Superior Iliac Spine
18X, 18Y, 18Z	Symphysion
19X, 19Y, 19Z	Right Lateral Femoral Epicondyle
20X, 20Y, 20Z	Right Medial Femoral Epicondyle
21X, 21Y, 21Z	Right Medial Malleolus
22X, 22Y, 22Z	Right Lateral Malleolus
23X, 23Y, 23Z	Left Trochanterion
24X, 24Y, 24Z	Left Anterior Superior Iliac Spine
25X, 25Y, 25Z	Left Lateral Femoral Epicondyle
26X, 26Y, 26Z	Left Medial Femoral Epicondyle
27X, 27Y, 27Z	Left Medial Malleolus
28X, 28Y, 28Z	Left Lateral Malleolus

TABLE III
EXPRESSIONS FOR JOINT CENTER LOCATIONS
IN GLOBAL AXES (IN)

Joint Name	Location	Expression
Head-Neck	X	(1X + 2X) / 2.
	Y	(1Y + 2Y) / 2.
	Z	((1Z + 3Z) / 2.) - 1.1811
Neck-Thorax	X	3X + 2.0079
	Y	3Y
	Z	3Z - 0.9843
Thorax-Abdomen	X	4X + 2.0079
	Y	4Y
	Z	4Z
Abdomen-Pelvis	X	5X + 2.0079
	Y	5Y
	Z	5Z
Right Shoulder	X	6X
	Y	6Y + 1.4961
	Z	6Z - 1.4961
Right Elbow	X	(7X + 8X) / 2.
	Y	(7Y + 8Y) / 2.
	Z	(7Z + 8Z) / 2.
Right Wrist	X	(9X + 10X) / 2.
	Y	(9Y + 10Y) / 2.
	Z	(9Z + 10Z) / 2.
Left Shoulder	X	11X
	Y	11Y - 1.4961
	Z	11Z - 1.4961
Left Elbow	X	(12X + 13X) / 2.
	Y	(12Y + 13Y) / 2.
	Z	(12Z + 13Z) / 2.
Left Wrist	X	(14X + 15X) / 2.
	Y	(14Y + 15Y) / 2.
	Z	(14Z + 15Z) / 2.
Right Hip	X	16X
	Y	(17Y + 18Y) / 2.
	Z	((17Z + 18Z) / 2.) - 0.5906
Right Knee	X	(19X + 20X) / 2.
	Y	(19Y + 20Y) / 2.
	Z	(19Z + 20Z) / 2.
Right Ankle	X	(21X + 22X) / 2.
	Y	(21Y + 22Y) / 2.
	Z	(21Z + 22Z) / 2.
Left Hip	X	23X
	Y	(18Y + 24Y) / 2.
	Z	((18Z + 24Z) / 2.) - 0.5906

TABLE III (Continued)

Left Knee	X	(25X + 26X) / 2.
	Y	(25Y + 26Y) / 2.
	Z	(25Z + 26Z) / 2.
Left Ankle	X	(27X + 28X) / 2.
	Y	(27Y + 28Y) / 2.
	Z	(27Z + 28Z) / 2.

Appendix C. Mean principal axes orientations for both the adult male and female subject type options were determined with respect to the local axes and used for all subjects.

2.3.2.3 Segment weights

The stereophotometric data were used to calculate the volume of each segment for each female and male subject. The volumes were used to calculate regression equations to predict segment volumes for the adult human female and male subject type options. These regression equations are in Appendix D. The estimated volumes are transformed to weights using the relationship, weight (slugs) = volume (in^3) * density ($slugs/in^3$), where density is a constant 1.12287E-3. The segment weights are then converted to pounds and adjusted so that their sum equals the total body weight.

2.3.3 Joint Characteristics

Most of the joints' elastic, viscous, and joint stop characteristics were obtained from a number of sources, including Engin and Chen (1987), and adjusted to provide physically realistic ATB model results. For the joints that did not have a complete set of properties available, the characteristics were estimated based on data from the other joints. These characteristics have been used in ATB simulations by Armstrong Laboratory (AL) with good results for several years.

2.3.4 Comparison of Stereophotometric Data Distributions with Air Force Distributions

Originally, the only actual human data used by GEBOD was from the 1967 and 1968 USAF anthropometric surveys. When the idea was conceived to incorporate into GEBODIII the inertial property data provided by the stereophotometric surveys, it became necessary to compare the USAF and stereophotometric surveys to determine the compatibility of the data.

Selection of the male stereophotometric data subjects was based on the 1967 USAF survey stature and weight distribution. Figure 3 is a bivariate plot of the 1967 USAF stature and weight distribution overlaid with the male stereophotometric stature and weight distribution. The slope of the two data distributions show that the relationship between stature and weight for the two survey distributions is similar, as expected. This demonstrates the soundness of using the male stereophotometric data to obtain inertial properties in GEBODIII.

Selection of the female stereophotometric data subjects was based on a civilian female stature and weight distribution. Figure 4 is a bivariate plot of the 1968 USAF stature and weight distribution overlaid with the female stereophotometric stature and weight distribution. It shows that the stereophotometric females are shorter and heavier than the USAF females; therefore, the relationship between stature and weight is different for the two surveys. In spite of this difference, comparisons of GEBODII and GEBODIII to the actual data of several stereophotometric subjects have shown a vast improvement by using the stereophotometric data to produce inertial property output, over using the geometric approximations.

FIGURE 3

BIVARIATE PLOT FOR STATURE AND WEIGHT
1967 USAF AND STEREOMETRIC MALES

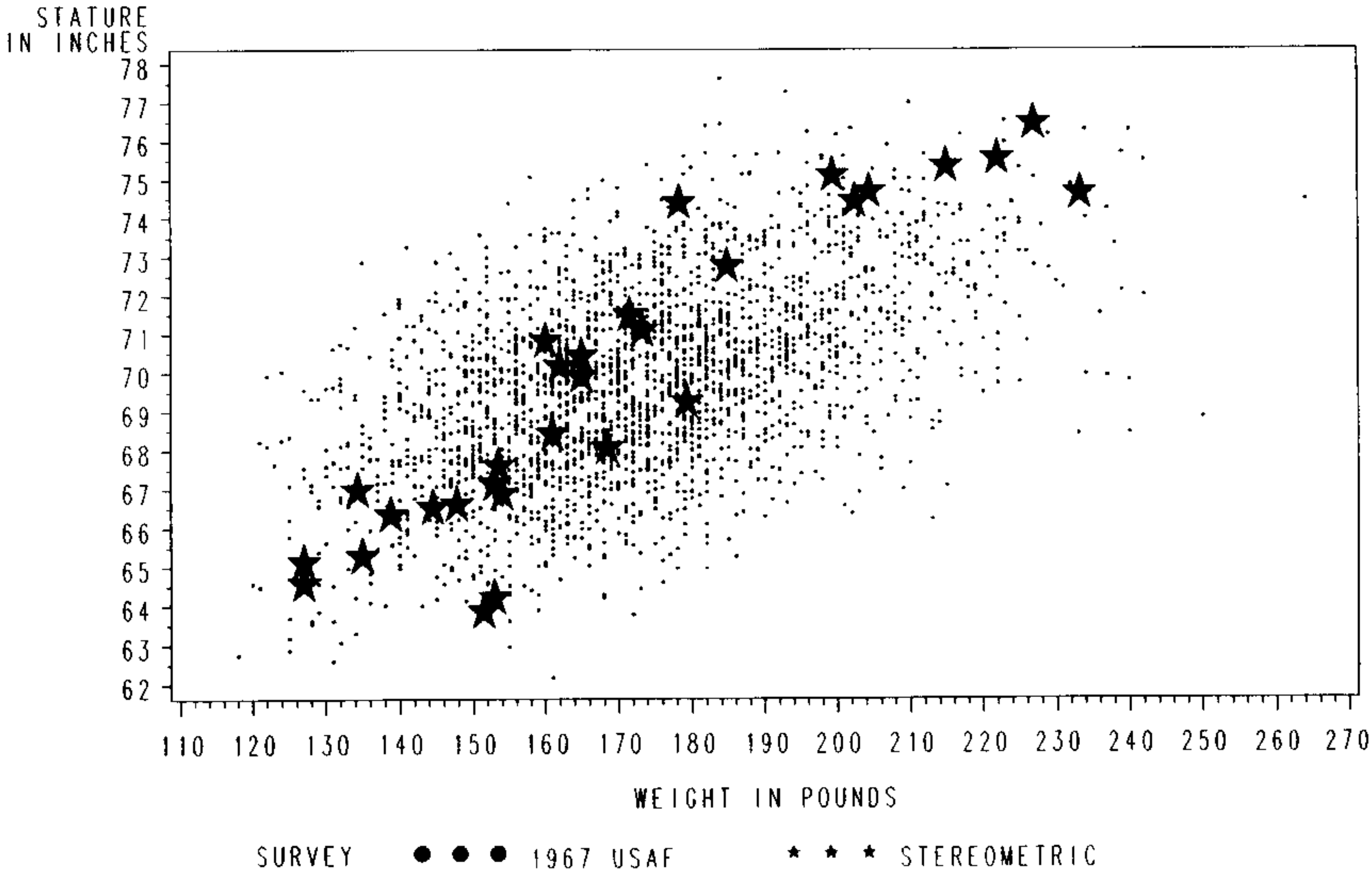
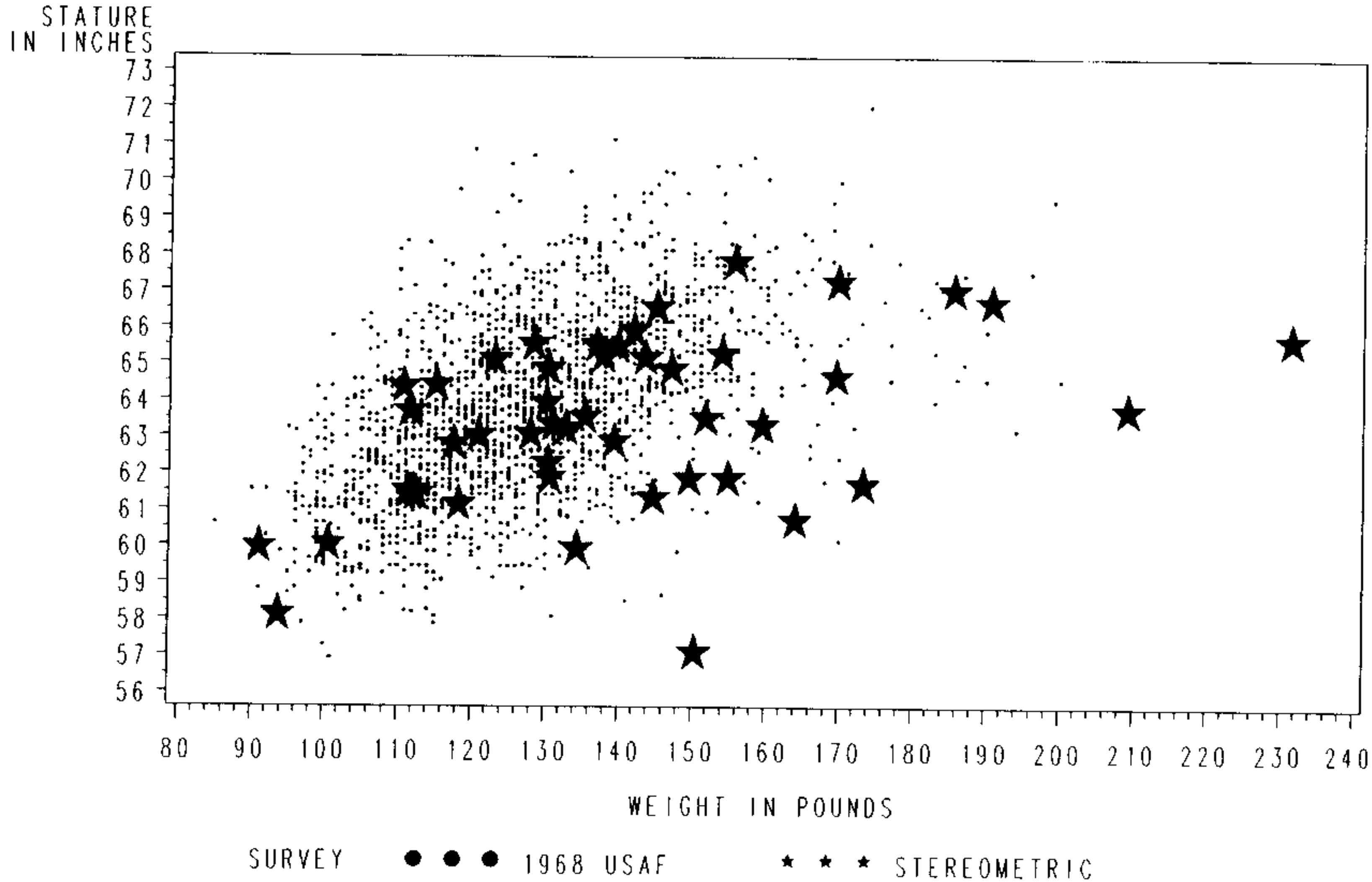


FIGURE 4

BIVARIATE PLOT FOR STATURE AND WEIGHT
1968 USAF AND STEREOMETRIC FEMALES



2.4 DUMMY DATA SETS

Output is available for the following dummy data sets: Hybrid III with seated pelvis (50^{th} percentile), Hybrid III with standing pelvis (50^{th} percentile), and Hybrid II (50^{th} percentile). The data set for the Hybrid II dummy, also known as the Part 572 dummy, was developed by Fleck, Butler, and DeLeys (1982), to be used in validating the Crash Victim Simulator (CVS), an earlier version of the ATB model. The development of the Hybrid III dummy data sets is fully documented in Kaleps, et al. (1988). The user can choose input and output in English (pounds, inches) or metric (newtons, meters) units, and the output format can be in ATB input format, tabular format, or both. Since these data sets were compiled under different efforts, the amount of data varies somewhat. For example, the Hybrid III data sets include surface deformation properties, whereas the Hybrid II data set does not.

Because the dummy data sets do not change, they are stored in the GEBOD.DAT file which is read by GEBODIII. The ATB formatted input data set for each dummy is stored in English and metric units, in the GEBOD.DAT data file. In the file, each data set is preceded by a line which indicates how many lines are in the following data set and provides a data set title. This title is used to find the data set to be used. When a title match is found, GEBODIII simply reads the appropriate English or metric data from GEBOD.DAT and writes it to the appropriate output units.

APPENDIX A

HAND DIMENSION REGRESSION EQUATIONS

This appendix contains a complete listing of the hand dimension regression equations developed for the adult human female and the adult human male options. The regression equations for the adult human female are based on the 1968 U.S. Air Force survey (Clauser, et al., 1972) and the equations for the adult human male are based on the 1967 U.S. Air Force survey (Grunhofer and Kroh, 1975). The predicting variables are weight (lb) and standing height (in). The predicted hand dimensions are in inches. At the top of each set of regression equations are listed the range of values, mean, and standard deviation of the predicting variables within that subject type option. For each hand dimension, a separate regression equation is given against each of the predicting variables. The last regression equation is a multiple regression equation based on both predicting variables. With each regression equation, the coefficient of determination (R^2) is given. Since hand depth was not measured in the 1968 U.S. Air Force survey, the regression equations given for female hand depth are based on the 1967 U.S. Air Force survey and, therefore, are the same as the equations given for the males. The regression equations are based on 1905 female subjects and 2420 male subjects.

REGRESSION EQUATIONS FOR ADULT FEMALE HAND DIMENSIONS

PREDICTING VARIABLES

WEIGHT	RANGE:	85.00	200.00	MEAN:	127.30	S.D.:	16.590
STANDING HEIGHT	RANGE:	56.93	72.05	MEAN:	63.82	S.D.:	2.364

REGRESSION EQUATIONS FOR HAND BREADTH

HAND BREADTH	=	0.003847 *WEIGHT	+2.480278			R**2 = 0.1736
HAND BREADTH	=	0.024549 *STANDING	+1.403283			R**2 = 0.1436
HAND BREADTH	=	0.002769 *WEIGHT	+0.014202	*STANDING	+1.711157	R**2 = 0.2080

REGRESSION EQUATIONS FOR HAND LENGTH

HAND LENGTH	=	0.008718 *WEIGHT	+6.122934			R**2 = 0.1466
HAND LENGTH	=	0.096038 *STANDING	+1.103882			R**2 = 0.3614
HAND LENGTH	=	0.001995 *WEIGHT	+0.088582	*STANDING	+1.325739	R**2 = 0.3669

REGRESSION EQUATIONS FOR HAND DEPTH (BASED ON MALE DATA)

HAND DEPTH	=	0.000996 *WEIGHT	+0.912979			R**2 = 0.0667
HAND DEPTH	=	0.006630 *STANDING	+0.623029			R**2 = 0.0381
HAND DEPTH	=	0.000828 *WEIGHT	+0.002881	*STANDING	+0.741114	R**2 = 0.0720

REGRESSION EQUATIONS FOR ADULT MALE HAND DIMENSIONS

PREDICTING VARIABLES

WEIGHT	RANGE:	118.00	264.00	MEAN:	173.60	S.D.:	21.440
STANDING HEIGHT	RANGE:	62.17	77.64	MEAN:	69.82	S.D.:	2.437

REGRESSION EQUATIONS FOR HAND BREADTH

HAND BREADTH	=	0.003424 *WEIGHT	+2.906047			R**2 = 0.1995
HAND BREADTH	=	0.027691 *STANDING	+1.567278			R**2 = 0.1685
HAND BREADTH	=	0.002455 *WEIGHT	+0.016569	*STANDING	+1.917571	R**2 = 0.2439

REGRESSION EQUATIONS FOR HAND LENGTH

HAND LENGTH	=	0.005839 *WEIGHT	+6.504896			R**2 = 0.1503
HAND LENGTH	=	0.086296 *STANDING	+1.493816			R**2 = 0.4239
HAND LENGTH	=	0.001076 *WEIGHT	+0.081423	*STANDING	+1.647298	R**2 = 0.4276

REGRESSION EQUATIONS FOR HAND DEPTH

HAND DEPTH	=	0.000996 *WEIGHT	+0.912979			R**2 = 0.0667
HAND DEPTH	=	0.006630 *STANDING	+0.623029			R**2 = 0.0381
HAND DEPTH	=	0.000828 *WEIGHT	+0.002881	*STANDING	+0.741114	R**2 = 0.0720

APPENDIX B
JOINT CENTER LOCATION REGRESSION EQUATIONS

This appendix contains a complete listing of the regression equations for the joint center locations in the local axis system developed for the adult human female and the adult human male options. The regression equations are based on human stereophotometric surface landmark location data (McConville, et al., 1980; Young, et al., 1983). The predicting variables are weight (lb) and standing height (in). The predicted joint center locations are in inches. At the top of each set of regression equations are listed the range of values, mean, and standard deviation of the predicting variables within that subject type option. A joint center location is described by a three-dimensional location in each adjoining segment in that segment's local reference axis system. For the X, Y, and Z location of each joint location, a separate regression equation is given against each of the predicting variables. The last regression equation is a multiple regression equation based on both predicting variables. With each regression equation, the coefficient of determination (R^2) is given. The regression equations are based on 46 female subjects and 31 male subjects.

REGRESSION EQUATIONS FOR ADULT FEMALE JOINT CENTER LOCATIONS

PREDICTING VARIABLES

WEIGHT	RANGE:	85.00	200.00	MEAN:	127.30	S.D.:	16.590
STANDING HEIGHT	RANGE:	56.93	72.05	MEAN:	63.82	S.D.:	2.364

REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT PELVIS X COORDINATE

ABDOMEN-PELVIS WRT PELVIS	=	-0.011939 *WEIGHT	-0.084100			R**2 = 0.3959
ABDOMEN-PELVIS WRT PELVIS	=	-0.006868 *STANDING	-1.330381			R**2 = 0.0009
ABDOMEN-PELVIS WRT PELVIS	=	-0.014132 *WEIGHT	+0.062264	*STANDING	-3.727573	R**2 = 0.4601

REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT PELVIS Y COORDINATE

ABDOMEN-PELVIS WRT PELVIS	=	-0.002634 *WEIGHT	+0.343410			R**2 = 0.1700
ABDOMEN-PELVIS WRT PELVIS	=	-0.021026 *STANDING	+1.306908			R**2 = 0.0780
ABDOMEN-PELVIS WRT PELVIS	=	-0.002288 *WEIGHT	-0.009832	*STANDING	+0.918761	R**2 = 0.1842

REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT PELVIS Z COORDINATE

ABDOMEN-PELVIS WRT PELVIS	=	-0.015625 *WEIGHT	+0.553757			R**2 = 0.5264
ABDOMEN-PELVIS WRT PELVIS	=	-0.025001 *STANDING	-0.060794			R**2 = 0.0097
ABDOMEN-PELVIS WRT PELVIS	=	-0.017813 *WEIGHT	+0.062141	*STANDING	-3.082532	R**2 = 0.5760

REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT ABDOMEN X COORDINATE

THORAX-ABDOMEN WRT ABDOMEN	=	-0.016965	*WEIGHT	+0.758479				R**2 = 0.6359
THORAX-ABDOMEN WRT ABDOMEN	=	-0.022146	*STANDING	-0.226130				R**2 = 0.0078
THORAX-ABDOMEN WRT ABDOMEN	=	-0.019554	*WEIGHT	+0.073510	*STANDING	-3.543103		R**2 = 0.7070

REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT ABDOMEN Y COORDINATE

THORAX-ABDOMEN WRT ABDOMEN	=	-0.001232	*WEIGHT	+0.152484				R**2 = 0.0547
THORAX-ABDOMEN WRT ABDOMEN	=	-0.006846	*STANDING	+0.413536				R**2 = 0.0122
THORAX-ABDOMEN WRT ABDOMEN	=	-0.001197	*WEIGHT	-0.000992	*STANDING	+0.210518		R**2 = 0.0549

REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT ABDOMEN Z COORDINATE

THORAX-ABDOMEN WRT ABDOMEN	=	0.001250	*WEIGHT	-1.282322				R**2 = 0.0119
THORAX-ABDOMEN WRT ABDOMEN	=	0.016781	*STANDING	-2.171454				R**2 = 0.0154
THORAX-ABDOMEN WRT ABDOMEN	=	0.000796	*WEIGHT	+0.012887	*STANDING	-2.036457		R**2 = 0.0194

REGRESSION EQUATIONS FOR NECK-THORAX WRT THORAX X COORDINATE

NECK-THORAX WRT THORAX	=	-0.009617	*WEIGHT	+0.994733				R**2 = 0.3981
NECK-THORAX WRT THORAX	=	0.001555	*STANDING	-0.458953				R**2 = 0.0001
NECK-THORAX WRT THORAX	=	-0.011684	*WEIGHT	+0.058713	*STANDING	-2.440950		R**2 = 0.4865

```
REGRESSION EQUATIONS FOR NECK-THORAX WRT THORAX Y COORDINATE
NECK-THORAX WRT THORAX     =  -0.001619 *WEIGHT    +0.270258                        R**2 = 0.0917
NECK-THORAX WRT THORAX     =  -0.002989 *STANDING  +0.231867                        R**2 = 0.0022
NECK-THORAX WRT THORAX     =  -0.001829 *WEIGHT    +0.005958 *STANDING  -0.078373   R**2 = 0.0991

REGRESSION EQUATIONS FOR NECK-THORAX WRT THORAX Z COORDINATE
NECK-THORAX WRT THORAX     =  -0.012330 *WEIGHT    -5.068301                        R**2 = 0.3482
NECK-THORAX WRT THORAX     =  -0.154705 *STANDING  +3.014805                        R**2 = 0.3946
NECK-THORAX WRT THORAX     =  -0.008315 *WEIGHT    -0.114029 *STANDING  +1.604334   R**2 = 0.5256

REGRESSION EQUATIONS FOR HEAD-NECK WRT NECK X COORDINATE
HEAD-NECK WRT NECK         =   0.001385 *WEIGHT    -0.874711                        R**2 = 0.0086
HEAD-NECK WRT NECK         =  -0.025848 *STANDING  +0.961229                        R**2 = 0.0216
HEAD-NECK WRT NECK         =   0.002773 *WEIGHT    -0.039412 *STANDING  +1.431563   R**2 = 0.0502

REGRESSION EQUATIONS FOR HEAD-NECK WRT NECK Y COORDINATE
HEAD-NECK WRT NECK         =  -0.000777 *WEIGHT    +0.102504                        R**2 = 0.0207
HEAD-NECK WRT NECK         =   0.002285 *STANDING  -0.151979                        R**2 = 0.0013
HEAD-NECK WRT NECK         =  -0.001036 *WEIGHT    +0.007351 *STANDING  -0.327647   R**2 = 0.0317
```

REGRESSION EQUATIONS FOR HEAD-NECK WRT NECK Z COORDINATE

HEAD-NECK WRT NECK	=	-0.000979	*WEIGHT	-2.031634			R**2 = 0.0116
HEAD-NECK WRT NECK	=	-0.026838	*STANDING	-0.465923			R**2 = 0.0628
HEAD-NECK WRT NECK	=	-0.000041	*WEIGHT	-0.026639	*STANDING	-0.472829	R**2 = 0.0629

REGRESSION EQUATIONS FOR LEFT HIP WRT PELVIS X COORDINATE

LEFT HIP WRT PELVIS	=	-0.004163	*WEIGHT	+1.208000			R**2 = 0.0367
LEFT HIP WRT PELVIS	=	-0.009597	*STANDING	+1.230671			R**2 = 0.0014
LEFT HIP WRT PELVIS	=	-0.004621	*WEIGHT	+0.013008	*STANDING	+0.446799	R**2 = 0.0388

REGRESSION EQUATIONS FOR LEFT HIP WRT PELVIS Y COORDINATE

LEFT HIP WRT PELVIS	=	-0.007290	*WEIGHT	-1.228729			R**2 = 0.4431
LEFT HIP WRT PELVIS	=	-0.013859	*STANDING	-1.376161			R**2 = 0.0115
LEFT HIP WRT PELVIS	=	-0.008218	*WEIGHT	+0.026342	*STANDING	-2.770156	R**2 = 0.4776

REGRESSION EQUATIONS FOR LEFT HIP WRT PELVIS Z COORDINATE

LEFT HIP WRT PELVIS	=	0.004525	*WEIGHT	+2.157463			R**2 = 0.2473
LEFT HIP WRT PELVIS	=	0.013873	*STANDING	+1.914401			R**2 = 0.0167
LEFT HIP WRT PELVIS	=	0.004876	*WEIGHT	-0.009982	*STANDING	+2.741591	R**2 = 0.2545

```
REGRESSION EQUATIONS FOR LEFT KNEE WRT THIGH X COORDINATE
LEFT KNEE WRT THIGH         =  0.003749 *WEIGHT    +0.226837                            R**2 = 0.0658
LEFT KNEE WRT THIGH         = -0.019642 *STANDING  +2.001882                            R**2 = 0.0130
LEFT KNEE WRT THIGH         =  0.005364 *WEIGHT    -0.045884 *STANDING  +2.911839       R**2 = 0.1245


REGRESSION EQUATIONS FOR LEFT KNEE WRT THIGH Y COORDINATE
LEFT KNEE WRT THIGH         = -0.001190 *WEIGHT    -0.391704                            R**2 = 0.0232
LEFT KNEE WRT THIGH         = -0.029322 *STANDING  +1.301907                            R**2 = 0.1012
LEFT KNEE WRT THIGH         = -0.000191 *WEIGHT    -0.028390 *STANDING  +1.269591       R**2 = 0.1017


REGRESSION EQUATIONS FOR LEFT KNEE WRT THIGH Z COORDINATE
LEFT KNEE WRT THIGH         =  0.001195 *WEIGHT    +9.148730                            R**2 = 0.0031
LEFT KNEE WRT THIGH         =  0.193124 *STANDING  -2.942030                            R**2 = 0.5754
LEFT KNEE WRT THIGH         = -0.006771 *WEIGHT    +0.226249 *STANDING  -4.090649       R**2 = 0.6567


REGRESSION EQUATIONS FOR LEFT ANKLE WRT CALF X COORDINATE
LEFT ANKLE WRT CALF         =  0.004811 *WEIGHT    -0.109920                            R**2 = 0.1557
LEFT ANKLE WRT CALF         =  0.009918 *STANDING  -0.061637                            R**2 = 0.0048
LEFT ANKLE WRT CALF         =  0.005390 *WEIGHT    -0.016450 *STANDING  +0.852695       R**2 = 0.1665
```

```
REGRESSION EQUATIONS FOR LEFT ANKLE WRT CALF Y COORDINATE
LEFT ANKLE WRT CALF        =  0.002479 *WEIGHT    +0.490224                          R**2 = 0.2546
LEFT ANKLE WRT CALF        =  0.002794 *STANDING  +0.662149                          R**2 = 0.0023
LEFT ANKLE WRT CALF        =  0.002876 *WEIGHT    -0.011276 *STANDING  +1.150037     R**2 = 0.2859

REGRESSION EQUATIONS FOR LEFT ANKLE WRT CALF Z COORDINATE
LEFT ANKLE WRT CALF        =  0.010244 *WEIGHT    +7.665443                          R**2 = 0.3177
LEFT ANKLE WRT CALF        =  0.169399 *STANDING  -1.644392                          R**2 = 0.6253
LEFT ANKLE WRT CALF        =  0.005169 *WEIGHT    +0.144112 *STANDING  -0.767549     R**2 = 0.6923

REGRESSION EQUATIONS FOR LEFT SHOULDER WRT THORAX X COORDINATE
LEFT SHOULDER WRT THORAX   = -0.005016 *WEIGHT    -0.624416                          R**2 = 0.0653
LEFT SHOULDER WRT THORAX   = -0.025529 *STANDING  +0.289319                          R**2 = 0.0122
LEFT SHOULDER WRT THORAX   = -0.004974 *WEIGHT    -0.001195 *STANDING  -0.554493     R**2 = 0.0653

REGRESSION EQUATIONS FOR LEFT SHOULDER WRT THORAX Y COORDINATE
LEFT SHOULDER WRT THORAX   = -0.007228 *WEIGHT    -4.502333                          R**2 = 0.2780
LEFT SHOULDER WRT THORAX   = -0.048877 *STANDING  -2.418194                          R**2 = 0.0915
LEFT SHOULDER WRT THORAX   = -0.006653 *WEIGHT    -0.016329 *STANDING  -3.546826     R**2 = 0.2865
```

```
REGRESSION EQUATIONS FOR LEFT SHOULDER WRT THORAX Z COORDINATE
LEFT SHOULDER WRT THORAX    = -0.009839 *WEIGHT    -2.292073                             R**2 = 0.2738
LEFT SHOULDER WRT THORAX    = -0.104962 *STANDING  +2.984474                             R**2 = 0.2243
LEFT SHOULDER WRT THORAX    = -0.007421 *WEIGHT    -0.068658 *STANDING  +1.725595        R**2 = 0.3532
```

```
REGRESSION EQUATIONS FOR LEFT ELBOW WRT UPPER ARM X COORDINATE
LEFT ELBOW WRT UPPER ARM    = -0.002178 *WEIGHT    +0.306781                             R**2 = 0.1352
LEFT ELBOW WRT UPPER ARM    =  0.004684 *STANDING  -0.297477                             R**2 = 0.0045
LEFT ELBOW WRT UPPER ARM    = -0.002831 *WEIGHT    +0.018533 *STANDING  -0.777683        R**2 = 0.1935
```

```
REGRESSION EQUATIONS FOR LEFT ELBOW WRT UPPER ARM Y COORDINATE
LEFT ELBOW WRT UPPER ARM    =  0.001552 *WEIGHT    +0.094641                             R**2 = 0.0784
LEFT ELBOW WRT UPPER ARM    = -0.021026 *STANDING  +1.648055                             R**2 = 0.1036
LEFT ELBOW WRT UPPER ARM    =  0.002770 *WEIGHT    -0.034576 *STANDING  +2.117934        R**2 = 0.3103
```

```
REGRESSION EQUATIONS FOR LEFT ELBOW WRT UPPER ARM Z COORDINATE
LEFT ELBOW WRT UPPER ARM    =  0.001443 *WEIGHT    +4.768148                             R**2 = 0.0160
LEFT ELBOW WRT UPPER ARM    =  0.101351 *STANDING  -1.462191                             R**2 = 0.5685
LEFT ELBOW WRT UPPER ARM    = -0.002569 *WEIGHT    +0.113917 *STANDING  -1.897919        R**2 = 0.6105
```

```
REGRESSION EQUATIONS FOR LEFT WRIST WRT FOREARM X COORDINATE
LEFT WRIST WRT FOREARM       = -0.002159 *WEIGHT    -0.398799                          R**2 = 0.2280
LEFT WRIST WRT FOREARM       =  0.002610 *STANDING  -0.868622                          R**2 = 0.0024
LEFT WRIST WRT FOREARM       = -0.002719 *WEIGHT    +0.015910 *STANDING  -1.329823     R**2 = 0.3019


REGRESSION EQUATIONS FOR LEFT WRIST WRT FOREARM Y COORDINATE
LEFT WRIST WRT FOREARM       =  0.002050 *WEIGHT    +0.268465                          R**2 = 0.0911
LEFT WRIST WRT FOREARM       =  0.006644 *STANDING  +0.135630                          R**2 = 0.0069
LEFT WRIST WRT FOREARM       =  0.002195 *WEIGHT    -0.004092 *STANDING  +0.507902     R**2 = 0.0932


REGRESSION EQUATIONS FOR LEFT WRIST WRT FOREARM Z COORDINATE
LEFT WRIST WRT FOREARM       =  0.005970 *WEIGHT    +4.827643                          R**2 = 0.2493
LEFT WRIST WRT FOREARM       =  0.088721 *STANDING  +0.036891                          R**2 = 0.3964
LEFT WRIST WRT FOREARM       =  0.003438 *WEIGHT    +0.071904 *STANDING  +0.620039     R**2 = 0.4648


REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT ABDOMEN X COORDINATE
ABDOMEN-PELVIS WRT ABDOMEN   = -0.019772 *WEIGHT    +0.143418                          R**2 = 0.6802
ABDOMEN-PELVIS WRT ABDOMEN   = -0.021236 *STANDING  -1.294467                          R**2 = 0.0056
ABDOMEN-PELVIS WRT ABDOMEN   = -0.022984 *WEIGHT    +0.091198 *STANDING  -5.193227     R**2 = 0.7664
```

```
REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT ABDOMEN Y COORDINATE
ABDOMEN-PELVIS WRT ABDOMEN    =  -0.002098 *WEIGHT    +0.328813                           R**2 = 0.0836
ABDOMEN-PELVIS WRT ABDOMEN    =   0.011969 *STANDING  -0.726543                           R**2 = 0.0196
ABDOMEN-PELVIS WRT ABDOMEN    =  -0.003043 *WEIGHT    +0.026858 *STANDING  -1.242811      R**2 = 0.1653


REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT ABDOMEN Z COORDINATE
ABDOMEN-PELVIS WRT ABDOMEN    =  -0.006352 *WEIGHT    +3.602727                           R**2 = 0.1045
ABDOMEN-PELVIS WRT ABDOMEN    =  -0.026823 *STANDING  +4.410323                           R**2 = 0.0134
ABDOMEN-PELVIS WRT ABDOMEN    =  -0.006533 *WEIGHT    +0.005138 *STANDING  +3.302052      R**2 = 0.1049


REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT THORAX X COORDINATE
THORAX-ABDOMEN WRT THORAX     =  -0.009861 *WEIGHT    +0.983155                           R**2 = 0.4431
THORAX-ABDOMEN WRT THORAX     =  -0.003191 *STANDING  -0.203739                           R**2 = 0.0003
THORAX-ABDOMEN WRT THORAX     =  -0.011778 *WEIGHT    +0.054425 *STANDING  -2.201607      R**2 = 0.5236


REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT THORAX Y COORDINATE
THORAX-ABDOMEN WRT THORAX     =  -0.001615 *WEIGHT    +0.263659                           R**2 = 0.1030
THORAX-ABDOMEN WRT THORAX     =  -0.005550 *STANDING  +0.388480                           R**2 = 0.0088
THORAX-ABDOMEN WRT THORAX     =  -0.001715 *WEIGHT    +0.002837 *STANDING  +0.097628      R**2 = 0.1049
```

```
REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT THORAX Z COORDINATE
THORAX-ABDOMEN WRT THORAX     =  -0.000672 *WEIGHT    +6.499148                                R**2 = 0.0018
THORAX-ABDOMEN WRT THORAX     =   0.116738 *STANDING  -1.005807                                R**2 = 0.3878
THORAX-ABDOMEN WRT THORAX     =  -0.005777 *WEIGHT    +0.145001 *STANDING  -1.985855           R**2 = 0.4971
```

```
REGRESSION EQUATIONS FOR NECK-THORAX WRT NECK X COORDINATE
NECK-THORAX WRT NECK          =  -0.007552 *WEIGHT    +1.201707                                R**2 = 0.3833
NECK-THORAX WRT NECK          =   0.007321 *STANDING  -0.327148                                R**2 = 0.0026
NECK-THORAX WRT NECK          =  -0.009435 *WEIGHT    +0.053479 *STANDING  -1.927716           R**2 = 0.4978
```

```
REGRESSION EQUATIONS FOR NECK-THORAX WRT NECK Y COORDINATE
NECK-THORAX WRT NECK          =  -0.000118 *WEIGHT    +0.087301                                R**2 = 0.0005
NECK-THORAX WRT NECK          =   0.001304 *STANDING  -0.012118                                R**2 = 0.0004
NECK-THORAX WRT NECK          =  -0.000198 *WEIGHT    +0.002273 *STANDING  -0.045733           R**2 = 0.0016
```

```
REGRESSION EQUATIONS FOR NECK-THORAX WRT NECK Z COORDINATE
NECK-THORAX WRT NECK          =  -0.001914 *WEIGHT    +1.874695                                R**2 = 0.0169
NECK-THORAX WRT NECK          =   0.009939 *STANDING  +0.974095                                R**2 = 0.0033
NECK-THORAX WRT NECK          =  -0.002735 *WEIGHT    +0.023319 *STANDING  +0.510109           R**2 = 0.0319
```

```
REGRESSION EQUATIONS FOR HEAD-NECK WRT HEAD X COORDINATE
HEAD-NECK WRT HEAD        = -0.001043 *WEIGHT    +0.447425                          R**2 = 0.0118
HEAD-NECK WRT HEAD        = -0.012418 *STANDING  +1.088722                          R**2 = 0.0120
HEAD-NECK WRT HEAD        = -0.000732 *WEIGHT    -0.008838 *STANDING  +0.964575     R**2 = 0.0168


REGRESSION EQUATIONS FOR HEAD-NECK WRT HEAD Y COORDINATE
HEAD-NECK WRT HEAD        =  0.000004 *WEIGHT    -0.008092                          R**2 = 0.0000
HEAD-NECK WRT HEAD        = -0.002926 *STANDING  +0.178242                          R**2 = 0.0050
HEAD-NECK WRT HEAD        =  0.000130 *WEIGHT    -0.003560 *STANDING  +0.200243     R**2 = 0.0062


REGRESSION EQUATIONS FOR HEAD-NECK WRT HEAD Z COORDINATE
HEAD-NECK WRT HEAD        = -0.000348 *WEIGHT    +2.562778                          R**2 = 0.0030
HEAD-NECK WRT HEAD        =  0.012146 *STANDING  +1.742763                          R**2 = 0.0263
HEAD-NECK WRT HEAD        = -0.000937 *WEIGHT    +0.016730 *STANDING  +1.583809     R**2 = 0.0442


REGRESSION EQUATIONS FOR LEFT HIP WRT THIGH X COORDINATE
LEFT HIP WRT THIGH        =  0.000587 *WEIGHT    +0.796702                          R**2 = 0.0015
LEFT HIP WRT THIGH        =  0.013522 *STANDING  +0.021085                          R**2 = 0.0058
LEFT HIP WRT THIGH        =  0.000134 *WEIGHT    +0.012865 *STANDING  +0.043868     R**2 = 0.0059
```

REGRESSION EQUATIONS FOR LEFT HIP WRT THIGH Y COORDINATE

LEFT HIP WRT THIGH	=	0.003034	*WEIGHT	+1.338086			R**2 = 0.1030
LEFT HIP WRT THIGH	=	0.033907	*STANDING	-0.386833			R**2 = 0.0926
LEFT HIP WRT THIGH	=	0.002223	*WEIGHT	+0.023035	*STANDING	-0.009823	R**2 = 0.1384

REGRESSION EQUATIONS FOR LEFT HIP WRT THIGH Z COORDINATE

LEFT HIP WRT THIGH	=	-0.002696	*WEIGHT	-5.490560			R**2 = 0.0266
LEFT HIP WRT THIGH	=	-0.143511	*STANDING	+3.239372			R**2 = 0.5424
LEFT HIP WRT THIGH	=	0.002848	*WEIGHT	-0.157442	*STANDING	+3.722436	R**2 = 0.5670

REGRESSION EQUATIONS FOR LEFT KNEE WRT CALF X COORDINATE

LEFT KNEE WRT CALF	=	0.000358	*WEIGHT	+0.555212			R**2 = 0.0027
LEFT KNEE WRT CALF	=	-0.015328	*STANDING	+1.578664			R**2 = 0.0359
LEFT KNEE WRT CALF	=	0.001085	*WEIGHT	-0.020634	*STANDING	+1.762649	R**2 = 0.0566

REGRESSION EQUATIONS FOR LEFT KNEE WRT CALF Y COORDINATE

LEFT KNEE WRT CALF	=	-0.001305	*WEIGHT	+0.739006			R**2 = 0.0688
LEFT KNEE WRT CALF	=	-0.003399	*STANDING	+0.770943			R**2 = 0.0034
LEFT KNEE WRT CALF	=	-0.001432	*WEIGHT	+0.003604	*STANDING	+0.528090	R**2 = 0.0719

```
REGRESSION EQUATIONS FOR LEFT KNEE WRT CALF Z COORDINATE
LEFT KNEE WRT CALF     = -0.001815 *WEIGHT    -5.912482                         R**2 = 0.0179
LEFT KNEE WRT CALF     = -0.112359 *STANDING  +0.964099                         R**2 = 0.4941
LEFT KNEE WRT CALF     =  0.002587 *WEIGHT    -0.125014 *STANDING  +1.402925    R**2 = 0.5242

REGRESSION EQUATIONS FOR LEFT ANKLE WRT FOOT X COORDINATE
LEFT ANKLE WRT FOOT    =  0.000096 *WEIGHT    -1.759546                         R**2 = 0.0003
LEFT ANKLE WRT FOOT    = -0.011883 *STANDING  -0.991690                         R**2 = 0.0345
LEFT ANKLE WRT FOOT    =  0.000621 *WEIGHT    -0.014923 *STANDING  -0.886272    R**2 = 0.0453

REGRESSION EQUATIONS FOR LEFT ANKLE WRT FOOT Y COORDINATE
LEFT ANKLE WRT FOOT    = -0.000619 *WEIGHT    +0.327165                         R**2 = 0.0276
LEFT ANKLE WRT FOOT    = -0.001436 *STANDING  +0.331144                         R**2 = 0.0011
LEFT ANKLE WRT FOOT    = -0.000686 *WEIGHT    +0.001922 *STANDING  +0.214693    R**2 = 0.0292

REGRESSION EQUATIONS FOR LEFT ANKLE WRT FOOT Z COORDINATE
LEFT ANKLE WRT FOOT    = -0.000618 *WEIGHT    -1.390017                         R**2 = 0.0272
LEFT ANKLE WRT FOOT    = -0.026004 *STANDING  +0.173574                         R**2 = 0.3464
LEFT ANKLE WRT FOOT    =  0.000359 *WEIGHT    -0.027762 *STANDING  +0.234536    R**2 = 0.3540
```

```
REGRESSION EQUATIONS FOR LEFT SHOULDER WRT UPPER ARM X COORDINATE
LEFT SHOULDER WRT UPPER ARM    = -0.000450 *WEIGHT    -0.943311                            R**2 = 0.0036
LEFT SHOULDER WRT UPPER ARM    = -0.003679 *STANDING  -0.773132                            R**2 = 0.0017
LEFT SHOULDER WRT UPPER ARM    = -0.000387 *WEIGHT    -0.001787 *STANDING  -0.838722       R**2 = 0.0040

REGRESSION EQUATIONS FOR LEFT SHOULDER WRT UPPER ARM Y COORDINATE
LEFT SHOULDER WRT UPPER ARM    =  0.000301 *WEIGHT    +0.307212                            R**2 = 0.0013
LEFT SHOULDER WRT UPPER ARM    = -0.030760 *STANDING  +2.302225                            R**2 = 0.0967
LEFT SHOULDER WRT UPPER ARM    =  0.001672 *WEIGHT    -0.038941 *STANDING  +2.585896       R**2 = 0.1296

REGRESSION EQUATIONS FOR LEFT SHOULDER WRT UPPER ARM Z COORDINATE
LEFT SHOULDER WRT UPPER ARM    = -0.010772 *WEIGHT    -3.607257                            R**2 = 0.4711
LEFT SHOULDER WRT UPPER ARM    = -0.118178 *STANDING  +2.376788                            R**2 = 0.4082
LEFT SHOULDER WRT UPPER ARM    = -0.007986 *WEIGHT    -0.079112 *STANDING  +1.022113       R**2 = 0.6225

REGRESSION EQUATIONS FOR LEFT ELBOW WRT FOREARM X COORDINATE
LEFT ELBOW WRT FOREARM         = -0.003082 *WEIGHT    +0.571416                            R**2 = 0.1963
LEFT ELBOW WRT FOREARM         =  0.010734 *STANDING  -0.544126                            R**2 = 0.0171
LEFT ELBOW WRT FOREARM         = -0.004179 *WEIGHT    +0.031179 *STANDING  -1.253089       R**2 = 0.3160
```

REGRESSION EQUATIONS FOR LEFT ELBOW WRT FOREARM Y COORDINATE

LEFT ELBOW WRT FOREARM	=	0.002733	*WEIGHT	-0.439706			R**2 = 0.2903
LEFT ELBOW WRT FOREARM	=	0.011124	*STANDING	-0.760839			R**2 = 0.0346
LEFT ELBOW WRT FOREARM	=	0.002828	*WEIGHT	-0.002710	*STANDING	-0.281113	R**2 = 0.2920

REGRESSION EQUATIONS FOR LEFT ELBOW WRT FOREARM Z COORDINATE

LEFT ELBOW WRT FOREARM	=	-0.001266	*WEIGHT	-3.837578			R**2 = 0.0301
LEFT ELBOW WRT FOREARM	=	-0.062200	*STANDING	-0.067568			R**2 = 0.5233
LEFT ELBOW WRT FOREARM	=	0.001117	*WEIGHT	-0.067663	*STANDING	+0.121867	R**2 = 0.5427

REGRESSION EQUATIONS FOR LEFT WRIST WRT HAND X COORDINATE

LEFT WRIST WRT HAND	=	-0.001162	*WEIGHT	+0.177910			R**2 = 0.0120
LEFT WRIST WRT HAND	=	-0.004494	*STANDING	+0.299369			R**2 = 0.0013
LEFT WRIST WRT HAND	=	-0.001213	*WEIGHT	+0.001441	*STANDING	+0.093573	R**2 = 0.0121

REGRESSION EQUATIONS FOR LEFT WRIST WRT HAND Y COORDINATE

LEFT WRIST WRT HAND	=	0.000030	*WEIGHT	+0.556676			R**2 = 0.0001
LEFT WRIST WRT HAND	=	0.001113	*STANDING	+0.490214			R**2 = 0.0007
LEFT WRIST WRT HAND	=	-0.000011	*WEIGHT	+0.001169	*STANDING	+0.488283	R**2 = 0.0007

```
REGRESSION EQUATIONS FOR LEFT WRIST WRT HAND Z COORDINATE                              R**2 = 0.0228
LEFT WRIST WRT HAND            = -0.000769 *WEIGHT    -1.983893                         R**2 = 0.2176
LEFT WRIST WRT HAND            = -0.027999 *STANDING  -0.314857                         R**2 = 0.2198
LEFT WRIST WRT HAND            =  0.000263 *WEIGHT    -0.029283 *STANDING  -0.270318

REGRESSION EQUATIONS FOR LEFT ELBOW WRT FOREARM + HAND X COORDINATE                    R**2 = 0.2196
LEFT ELBOW WRT FOREARM + HAND  = -0.003248 *WEIGHT    +0.846465                         R**2 = 0.0001
LEFT ELBOW WRT FOREARM + HAND  =  0.000803 *STANDING  +0.337849                         R**2 = 0.2701
LEFT ELBOW WRT FOREARM + HAND  = -0.003958 *WEIGHT    +0.020166 *STANDING  -0.333610

REGRESSION EQUATIONS FOR LEFT ELBOW WRT FOREARM + HAND Y COORDINATE                    R**2 = 0.1429
LEFT ELBOW WRT FOREARM + HAND  =  0.002549 *WEIGHT    -0.665277                         R**2 = 0.0336
LEFT ELBOW WRT FOREARM + HAND  =  0.014558 *STANDING  -1.230285                         R**2 = 0.1437
LEFT ELBOW WRT FOREARM + HAND  =  0.002460 *WEIGHT    +0.002525 *STANDING  -0.813010

REGRESSION EQUATIONS FOR LEFT ELBOW WRT FOREARM + HAND Z COORDINATE                    R**2 = 0.0238
LEFT ELBOW WRT FOREARM + HAND  =  0.001749 *WEIGHT    -6.363632                         R**2 = 0.3509
LEFT ELBOW WRT FOREARM + HAND  = -0.079112 *STANDING  -1.095296                         R**2 = 0.5444
LEFT ELBOW WRT FOREARM + HAND  =  0.005479 *WEIGHT    -0.105913 *STANDING  -0.165942
```

REGRESSION EQUATIONS FOR ADULT MALE JOINT CENTER LOCATIONS

PREDICTING VARIABLES

WEIGHT	RANGE: 118.00	264.00	MEAN: 173.60	S.D.: 21.440
STANDING HEIGHT	RANGE: 62.17	77.64	MEAN: 69.82	S.D.: 2.437

REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT PELVIS X COORDINATE

```
ABDOMEN-PELVIS WRT PELVIS   = -0.007468 *WEIGHT    +0.336494                           R**2 = 0.2171
ABDOMEN-PELVIS WRT PELVIS   = -0.055467 *STANDING  +2.940071                           R**2 = 0.2056
ABDOMEN-PELVIS WRT PELVIS   = -0.004973 *WEIGHT    -0.020925 *STANDING  +1.373596      R**2 = 0.2221
```

REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT PELVIS Y COORDINATE

```
ABDOMEN-PELVIS WRT PELVIS   =  0.001240 *WEIGHT    -0.190457                           R**2 = 0.0645
ABDOMEN-PELVIS WRT PELVIS   =  0.014645 *STANDING  -1.002466                           R**2 = 0.1544
ABDOMEN-PELVIS WRT PELVIS   = -0.002943 *WEIGHT    +0.035087 *STANDING  -1.929495      R**2 = 0.2168
```

REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT PELVIS Z COORDINATE

```
ABDOMEN-PELVIS WRT PELVIS   = -0.005949 *WEIGHT    -1.587701                           R**2 = 0.1774
ABDOMEN-PELVIS WRT PELVIS   = -0.046001 *STANDING  +0.613143                           R**2 = 0.1821
ABDOMEN-PELVIS WRT PELVIS   = -0.002704 *WEIGHT    -0.027220 *STANDING  -0.238589      R**2 = 0.1884
```

```
REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT ABDOMEN X COORDINATE
THORAX-ABDOMEN WRT ABDOMEN    =  -0.008732 *WEIGHT    -0.225546                          R**2 = 0.4097
THORAX-ABDOMEN WRT ABDOMEN    =  -0.054611 *STANDING  +2.102789                          R**2 = 0.2750
THORAX-ABDOMEN WRT ABDOMEN    =  -0.012925 *WEIGHT    +0.035172 *STANDING  -1.968791     R**2 = 0.4293

REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT ABDOMEN Y COORDINATE
THORAX-ABDOMEN WRT ABDOMEN    =   0.000424 *WEIGHT    +0.045566                          R**2 = 0.0030
THORAX-ABDOMEN WRT ABDOMEN    =   0.005690 *STANDING  -0.279903                          R**2 = 0.0092
THORAX-ABDOMEN WRT ABDOMEN    =  -0.001483 *WEIGHT    +0.015994 *STANDING  -0.747169     R**2 = 0.0154

REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT ABDOMEN Z COORDINATE
THORAX-ABDOMEN WRT ABDOMEN    =  -0.001523 *WEIGHT    -0.617623                          R**2 = 0.0669
THORAX-ABDOMEN WRT ABDOMEN    =  -0.012164 *STANDING  -0.027172                          R**2 = 0.0732
THORAX-ABDOMEN WRT ABDOMEN    =  -0.000425 *WEIGHT    -0.009209 *STANDING  -0.161189     R**2 = 0.0741

REGRESSION EQUATIONS FOR NECK-THORAX WRT THORAX X COORDINATE
NECK-THORAX WRT THORAX        =  -0.004370 *WEIGHT    +0.506433                          R**2 = 0.1844
NECK-THORAX WRT THORAX        =  -0.021594 *STANDING  +1.270817                          R**2 = 0.0773
NECK-THORAX WRT THORAX        =  -0.010448 *WEIGHT    +0.050980 *STANDING  -2.020320     R**2 = 0.2584
```

REGRESSION EQUATIONS FOR NECK-THORAX WRT THORAX Y COORDINATE

NECK-THORAX WRT THORAX = 0.000351 *WEIGHT -0.081110 R**2 = 0.0047

NECK-THORAX WRT THORAX = 0.006307 *STANDING -0.461996 R**2 = 0.0262

NECK-THORAX WRT THORAX = -0.002332 *WEIGHT +0.022507 *STANDING -[illegible].196661 R**2 = 0.0621

REGRESSION EQUATIONS FOR NECK-THORAX WRT THORAX Z COORDINATE

NECK-THORAX WRT THORAX = -0.018898 *WEIGHT -4.412312 R**2 = 0.6222

NECK-THORAX WRT THORAX = -0.145204 *STANDING +2.514372 R**2 = 0.6305

NECK-THORAX WRT THORAX = -0.009230 *WEIGHT -0.081093 *STANDING -0.393043 R**2 = 0.6560

REGRESSION EQUATIONS FOR HEAD-NECK WRT NECK X COORDINATE

HEAD-NECK WRT NECK = -0.002543 *WEIGHT +0.025044 R**2 = 0.0286

HEAD-NECK WRT NECK = -0.030706 *STANDING +1.737397 R**2 = 0.0716

HEAD-NECK WRT NECK = 0.006505 *WEIGHT -0.075888 *STANDING +3.786370 R**2 = 0.1038

REGRESSION EQUATIONS FOR HEAD-NECK WRT NECK Y COORDINATE

HEAD-NECK WRT NECK = 0.001546 *WEIGHT -0.173776 R**2 = 0.0554

HEAD-NECK WRT NECK = 0.004449 *STANDING -0.221235 R**2 = 0.0079

HEAD-NECK WRT NECK = 0.005912 *WEIGHT -0.036615 *STANDING +1.640983 R**2 = 0.1470

```
REGRESSION EQUATIONS FOR HEAD-NECK WRT NECK Z COORDINATE                                R**2 = 0.3484
HEAD-NECK WRT NECK        =  -0.005257 *WEIGHT    -1.917117                             R**2 = 0.2998
HEAD-NECK WRT NECK        =  -0.037224 *STANDING  -0.211768                             R**2 = 0.3490
HEAD-NECK WRT NECK        =  -0.004769 *WEIGHT    -0.004100 *STANDING  -1.713902

REGRESSION EQUATIONS FOR LEFT HIP WRT PELVIS X COORDINATE                               R**2 = 0.0566
LEFT HIP WRT PELVIS       =   0.003450 *WEIGHT    -1.409181                             R**2 = 0.0602
LEFT HIP WRT PELVIS       =   0.027144 *STANDING  -2.718103                             R**2 = 0.0614
LEFT HIP WRT PELVIS       =   0.001244 *WEIGHT    +0.018500 *STANDING  -2.326116

REGRESSION EQUATIONS FOR LEFT HIP WRT PELVIS Y COORDINATE                               R**2 = 0.0315
LEFT HIP WRT PELVIS       =  -0.003493 *WEIGHT    -1.525887                             R**2 = 0.1251
LEFT HIP WRT PELVIS       =  -0.021645 *STANDING  -0.608464                             R**2 = 0.2004
LEFT HIP WRT PELVIS       =  -0.005308 *WEIGHT    +0.015223 *STANDING  -2.280386

REGRESSION EQUATIONS FOR LEFT HIP WRT PELVIS Z COORDINATE                               R**2 = 0.2082
LEFT HIP WRT PELVIS       =   0.007201 *WEIGHT    +0.213696                             R**2 = 0.1503
LEFT HIP WRT PELVIS       =   0.046697 *STANDING  -1.822410                             R**2 = 0.2126
LEFT HIP WRT PELVIS       =   0.009509 *WEIGHT    -0.019355 *STANDING  +1.173000
```

```
REGRESSION EQUATIONS FOR LEFT KNEE WRT THIGH X COORDINATE
LEFT KNEE WRT THIGH      =  0.001399 *WEIGHT     -0.473292                          R**2 = 0.0210
LEFT KNEE WRT THIGH      =  0.011302 *STANDING   -1.024659                          R**2 = 0.0235
LEFT KNEE WRT THIGH      =  0.000301 *WEIGHT     +0.009211 *STANDING  -0.929842     R**2 = 0.0237

REGRESSION EQUATIONS FOR LEFT KNEE WRT THIGH Y COORDINATE
LEFT KNEE WRT THIGH      = -0.002624 *WEIGHT     +0.076015                          R**2 = 0.3286
LEFT KNEE WRT THIGH      = -0.017356 *STANDING   +0.841626                          R**2 = 0.2466
LEFT KNEE WRT THIGH      = -0.003231 *WEIGHT     +0.005090 *STANDING  -0.176244     R**2 = 0.3322

REGRESSION EQUATIONS FOR LEFT KNEE WRT THIGH Z COORDINATE
LEFT KNEE WRT THIGH      =  0.019553 *WEIGHT     +6.437359                          R**2 = 0.6807
LEFT KNEE WRT THIGH      =  0.168181 *STANDING   -1.983336                          R**2 = 0.8644
LEFT KNEE WRT THIGH      = -0.002902 *WEIGHT     +0.188340 *STANDING  -2.897506     R**2 = 0.8670

REGRESSION EQUATIONS FOR LEFT ANKLE WRT CALF X COORDINATE
LEFT ANKLE WRT CALF      =  0.001353 *WEIGHT     +0.160367                          R**2 = 0.0265
LEFT ANKLE WRT CALF      =  0.011264 *STANDING   -0.396212                          R**2 = 0.0315
LEFT ANKLE WRT CALF      =  0.000059 *WEIGHT     +0.010855 *STANDING  -0.377643     R**2 = 0.0315
```

```
REGRESSION EQUATIONS FOR LEFT ANKLE WRT CALF Y COORDINATE
LEFT ANKLE WRT CALF        =  0.001027 *WEIGHT    +0.579538                              R**2 = 0.0833
LEFT ANKLE WRT CALF        =  0.007310 *STANDING  +0.243695                              R**2 = 0.0724
LEFT ANKLE WRT CALF        =  0.000904 *WEIGHT    +0.001030 *STANDING  +0.528482         R**2 = 0.0835

REGRESSION EQUATIONS FOR LEFT ANKLE WRT CALF Z COORDINATE
LEFT ANKLE WRT CALF        =  0.022061 *WEIGHT    +5.987117                              R**2 = 0.6751
LEFT ANKLE WRT CALF        =  0.190912 *STANDING  -3.594633                              R**2 = 0.8678
LEFT ANKLE WRT CALF        = -0.004078 *WEIGHT    +0.219241 *STANDING  -4.879344         R**2 = 0.8718

REGRESSION EQUATIONS FOR LEFT SHOULDER WRT THORAX X COORDINATE
LEFT SHOULDER WRT THORAX   = -0.003569 *WEIGHT    -0.330012                              R**2 = 0.0306
LEFT SHOULDER WRT THORAX   = -0.021080 *STANDING  +0.534831                              R**2 = 0.0183
LEFT SHOULDER WRT THORAX   = -0.006147 *WEIGHT    +0.021617 *STANDING  -1.401451         R**2 = 0.0339

REGRESSION EQUATIONS FOR LEFT SHOULDER WRT THORAX Y COORDINATE
LEFT SHOULDER WRT THORAX   = -0.010585 *WEIGHT    -4.756775                              R**2 = 0.4825
LEFT SHOULDER WRT THORAX   = -0.081562 *STANDING  -0.860951                              R**2 = 0.4917
LEFT SHOULDER WRT THORAX   = -0.005011 *WEIGHT    -0.046756 *STANDING  -2.439382         R**2 = 0.5103
```

```
REGRESSION EQUATIONS FOR LEFT SHOULDER WRT THORAX Z COORDINATE
LEFT SHOULDER WRT THORAX    = -0.019759 *WEIGHT    -0.941024                            R**2 = 0.7469
LEFT SHOULDER WRT THORAX    = -0.145784 *STANDING  +5.879542                            R**2 = 0.6979
LEFT SHOULDER WRT THORAX    = -0.013836 *WEIGHT    -0.049677 *STANDING  +1.521159       R**2 = 0.7608

REGRESSION EQUATIONS FOR LEFT ELBOW WRT UPPER ARM X COORDINATE
LEFT ELBOW WRT UPPER ARM    =  0.000236 *WEIGHT    -0.687652                            R**2 = 0.0041
LEFT ELBOW WRT UPPER ARM    = -0.000164 *STANDING  -0.636033                            R**2 = 0.0000
LEFT ELBOW WRT UPPER ARM    =  0.001486 *WEIGHT    -0.010484 *STANDING  -0.168033       R**2 = 0.0281

REGRESSION EQUATIONS FOR LEFT ELBOW WRT UPPER ARM Y COORDINATE
LEFT ELBOW WRT UPPER ARM    =  0.002549 *WEIGHT    -0.032913                            R**2 = 0.3721
LEFT ELBOW WRT UPPER ARM    =  0.015905 *STANDING  -0.709936                            R**2 = 0.2486
LEFT ELBOW WRT UPPER ARM    =  0.003801 *WEIGHT    -0.010496 *STANDING  +0.487316       R**2 = 0.3907

REGRESSION EQUATIONS FOR LEFT ELBOW WRT UPPER ARM Z COORDINATE
LEFT ELBOW WRT UPPER ARM    =  0.010936 *WEIGHT    +3.729019                            R**2 = 0.6643
LEFT ELBOW WRT UPPER ARM    =  0.087840 *STANDING  -0.545825                            R**2 = 0.7356
LEFT ELBOW WRT UPPER ARM    =  0.002694 *WEIGHT    +0.069127 *STANDING  +0.302829       R**2 = 0.7426
```

REGRESSION EQUATIONS FOR LEFT WRIST WRT FOREARM X COORDINATE

LEFT WRIST WRT FOREARM	=	-0.000335 *WEIGHT	+0.421124			R**2 = 0.0017
LEFT WRIST WRT FOREARM	=	-0.002143 *STANDING	+0.513798			R**2 = 0.0012
LEFT WRIST WRT FOREARM	=	-0.000462 *WEIGHT	+0.001068	*STANDING	+0.368203	R**2 = 0.0018

REGRESSION EQUATIONS FOR LEFT WRIST WRT FOREARM Y COORDINATE

LEFT WRIST WRT FOREARM	=	-0.001105 *WEIGHT	+0.209175			R**2 = 0.0900
LEFT WRIST WRT FOREARM	=	-0.005287 *STANDING	+0.390359			R**2 = 0.0354
LEFT WRIST WRT FOREARM	=	-0.002761 *WEIGHT	+0.013894	*STANDING	-0.479452	R**2 = 0.1320

REGRESSION EQUATIONS FOR LEFT WRIST WRT FOREARM Z COORDIANTE

LEFT WRIST WRT FOREARM	=	0.012050 *WEIGHT	+4.379713			R**2 = 0.6704
LEFT WRIST WRT FOREARM	=	0.104273 *STANDING	-0.853654			R**2 = 0.8617
LEFT WRIST WRT FOREARM	=	-0.002226 *WEIGHT	+0.119738	*STANDING	-1.554957	R**2 = 0.8656

REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT ABDOMEN X COORDINATE

ABDOMEN-PELVIS WRT ABDOMEN	=	-0.009768 *WEIGHT	-0.707969			R**2 = 0.4324
ABDOMEN-PELVIS WRT ABDOMEN	=	-0.073331 *STANDING	+2.751955			R**2 = 0.4183
ABDOMEN-PELVIS WRT ABDOMEN	=	-0.005966 *WEIGHT	-0.031889	*STANDING	+0.872569	R**2 = 0.4460

```
REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT ABDOMEN Y COORDINATE
ABDOMEN-PELVIS WRT ABDOMEN   =  0.002777 *WEIGHT    -0.319296                              R**2 = 0.1224
ABDOMEN-PELVIS WRT ABDOMEN   =  0.025420 *STANDING  -1.622431                              R**2 = 0.1760
ABDOMEN-PELVIS WRT ABDOMEN   = -0.001476 *WEIGHT    +0.035671 *STANDING  -[illegible].087294    R**2 = 0.1820

REGRESSION EQUATIONS FOR ABDOMEN-PELVIS WRT ABDOMEN Z COORDINATE
ABDOMEN-PELVIS WRT ABDOMEN   =  0.002103 *WEIGHT    +1.966064                              R**2 = 0.0130
ABDOMEN-PELVIS WRT ABDOMEN   =  0.001903 *STANDING  +2.191356                              R**2 = 0.0002
ABDOMEN-PELVIS WRT ABDOMEN   =  0.010917 *WEIGHT    -0.073932 *STANDING  +5.630429         R**2 = 0.0604

REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT THORAX X COORDINATE
THORAX-ABDOMEN WRT THORAX    = -0.004447 *WEIGHT    +0.471228                              R**2 = 0.1976
THORAX-ABDOMEN WRT THORAX    = -0.021669 *STANDING  +1.227710                              R**2 = 0.0805
THORAX-ABDOMEN WRT THORAX    = -0.010845 *WEIGHT    +0.053662 *STANDING  -2.188490         R**2 = 0.2825

REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT THORAX Y COORDINATE
THORAX-ABDOMEN WRT THORAX    =  0.000258 *WEIGHT    -0.052755                              R**2 = 0.0026
THORAX-ABDOMEN WRT THORAX    =  0.004892 *STANDING  -0.350661                              R**2 = 0.0162
THORAX-ABDOMEN WRT THORAX    = -0.001894 *WEIGHT    +0.018048 *STANDING  -0.947308         R**2 = 0.0405
```

```
REGRESSION EQUATIONS FOR THORAX-ABDOMEN WRT THORAX Z COORDINATE                                R**2 = 0.4827
THORAX-ABDOMEN WRT THORAX     =  0.011163 *WEIGHT    +5.473922                                 R**2 = 0.5855
THORAX-ABDOMEN WRT THORAX     =  0.093852 *STANDING  +0.817770                                 R**2 = 0.5856
THORAX-ABDOMEN WRT THORAX     = -0.000152 *WEIGHT    +0.094911 *STANDING  +0.769741

REGRESSION EQUATIONS FOR NECK-THORAX WRT NECK X COORDINATE                                     R**2 = 0.3759
NECK-THORAX WRT NECK          = -0.005924 *WEIGHT    +0.970814                                 R**2 = 0.1980
NECK-THORAX WRT NECK          = -0.032818 *STANDING  +2.254789                                 R**2 = 0.4501
NECK-THORAX WRT NECK          = -0.011702 *WEIGHT    +0.048470 *STANDING  -1.431534

REGRESSION EQUATIONS FOR NECK-THORAX WRT NECK Y COORDINATE                                     R**2 = 0.0013
NECK-THORAX WRT NECK          = -0.000261 *WEIGHT    -0.090962                                 R**2 = 0.0435
NECK-THORAX WRT NECK          =  0.011608 *STANDING  -0.946521                                 R**2 = 0.3394
NECK-THORAX WRT NECK          = -0.009571 *WEIGHT    +0.078094 *STANDING  -3.961594

REGRESSION EQUATIONS FOR NECK-THORAX WRT NECK Z COORDINATE                                     R**2 = 0.0013
NECK-THORAX WRT NECK          =  0.000381 *WEIGHT    +1.742971                                 R**2 = 0.0004
NECK-THORAX WRT NECK          =  0.001530 *STANDING  +1.701043                                 R**2 = 0.0024
NECK-THORAX WRT NECK          =  0.001158 *WEIGHT    -0.006514 *STANDING  +2.065822
```

```
REGRESSION EQUATIONS FOR HEAD-NECK WRT HEAD X COORDINATE
HEAD-NECK WRT HEAD   =  -0.000144 *WEIGHT     +0.308559                            R**2 = 0.0004
HEAD-NECK WRT HEAD   =   0.001555 *STANDING   +0.175426                            R**2 = 0.0008
HEAD-NECK WRT HEAD   =  -0.001915 *WEIGHT     +0.014854 *STANDING  -0.427684       R**2 = 0.0125

REGRESSION EQUATIONS FOR HEAD-NECK WRT HEAD Y COORDINATE
HEAD-NECK WRT HEAD   =   0.000205 *WEIGHT     -0.021428                            R**2 = 0.0035
HEAD-NECK WRT HEAD   =   0.000182 *STANDING   +0.000749                            R**2 = 0.0000
HEAD-NECK WRT HEAD   =   0.001066 *WEIGHT     -0.007220 *STANDING  +0.336399       R**2 = 0.0165

REGRESSION EQUATIONS FOR HEAD-NECK WRT HEAD Z COORDINATE
HEAD-NECK WRT HEAD   =  -0.001653 *WEIGHT     +2.690120                            R**2 = 0.0647
HEAD-NECK WRT HEAD   =  -0.007078 *STANDING   +2.903101                            R**2 = 0.0204
HEAD-NECK WRT HEAD   =  -0.004709 *WEIGHT     +0.025629 *STANDING  +1.419823       R**2 = 0.1106

REGRESSION EQUATIONS FOR LEFT HIP WRT THIGH X COORDINATE
LEFT HIP WRT THIGH   =   0.008018 *WEIGHT     -1.745973                            R**2 = 0.2395
LEFT HIP WRT THIGH   =   0.041092 *STANDING   -3.251331                            R**2 = 0.1080
LEFT HIP WRT THIGH   =   0.018149 *WEIGHT     -0.084976 *STANDING  +2.465770       R**2 = 0.3188
```

```
REGRESSION EQUATIONS FOR LEFT HIP WRT THIGH Y COORDINATE                                  R**2 = 0.4474
LEFT HIP WRT THIGH          =   0.005854 *WEIGHT    +0.946000                             R**2 = 0.3682
LEFT HIP WRT THIGH          =   0.040538 *STANDING  -0.889305                             R**2 = 0.4474
LEFT HIP WRT THIGH          =   0.005940 *WEIGHT    -0.000721 *STANDING  +0.981737

REGRESSION EQUATIONS FOR LEFT HIP WRT THIGH Z COORDINATE                                  R**2 = 0.4001
LEFT HIP WRT THIGH          =  -0.012406 *WEIGHT    -5.428231                             R**2 = 0.6082
LEFT HIP WRT THIGH          =  -0.116746 *STANDING  +0.616039                             R**2 = 0.6429
LEFT HIP WRT THIGH          =   0.008809 *WEIGHT    -0.177933 *STANDING  +3.390843

REGRESSION EQUATIONS FOR LEFT KNEE WRT CALF X COORDINATE                                  R**2 = 0.0980
LEFT KNEE WRT CALF          =   0.002519 *WEIGHT    +0.214312                             R**2 = 0.0369
LEFT KNEE WRT CALF          =   0.011798 *STANDING  -0.180944                             R**2 = 0.1482
LEFT KNEE WRT CALF          =   0.006473 *WEIGHT    -0.033166 *STANDING  +1.858137

REGRESSION EQUATIONS FOR LEFT KNEE WRT CALF Y COORDINATE                                  R**2 = 0.1105
LEFT KNEE WRT CALF          =   0.001446 *WEIGHT    +0.313320                             R**2 = 0.0271
LEFT KNEE WRT CALF          =   0.005467 *STANDING  +0.177735                             R**2 = 0.2211
LEFT KNEE WRT CALF          =   0.004624 *WEIGHT    -0.026653 *STANDING  +1.634335
```

REGRESSION EQUATIONS FOR LEFT KNEE WRT CALF Z COORDINATE						
LEFT KNEE WRT CALF	=	-0.010462 *WEIGHT	-5.139949			R**2 = 0.4213
LEFT KNEE WRT CALF	=	-0.105511 *STANDING	+0.450460			R**2 = 0.7355
LEFT KNEE WRT CALF	=	0.012325 *WEIGHT	-0.191127	*STANDING	+4.333065	R**2 = 0.8360

REGRESSION EQUATIONS FOR LEFT ANKLE WRT FOOT X COORDINATE						
LEFT ANKLE WRT FOOT	=	-0.003922 *WEIGHT	-2.088906			R**2 = 0.2652
LEFT ANKLE WRT FOOT	=	-0.029067 *STANDING	-0.725991			R**2 = 0.2500
LEFT ANKLE WRT FOOT	=	-0.002656 *WEIGHT	-0.010619	*STANDING	-1.562600	R**2 = 0.2709

REGRESSION EQUATIONS FOR LEFT ANKLE WRT FOOT Y COORDINATE						
LEFT ANKLE WRT FOOT	=	0.001036 *WEIGHT	+0.140367			R**2 = 0.0565
LEFT ANKLE WRT FOOT	=	0.003455 *STANDING	+0.075380			R**2 = 0.0108
LEFT ANKLE WRT FOOT	=	0.003630 *WEIGHT	-0.021757	*STANDING	+1.218738	R**2 = 0.1301

REGRESSION EQUATIONS FOR LEFT ANKLE WRT FOOT Z COORDINATE						
LEFT ANKLE WRT FOOT	=	-0.002927 *WEIGHT	-0.870575			R**2 = 0.2768
LEFT ANKLE WRT FOOT	=	-0.022221 *STANDING	+0.183444			R**2 = 0.2737
LEFT ANKLE WRT FOOT	=	-0.001618 *WEIGHT	-0.010984	*STANDING	-0.326148	R**2 = 0.2883

REGRESSION EQUATIONS FOR LEFT SHOULDER WRT UPPER ARM X COORDINATE

LEFT SHOULDER WRT UPPER ARM	=	0.000830 *WEIGHT	+0.370250		R**2 = 0.0100
LEFT SHOULDER WRT UPPER ARM	=	0.004095 *STANDING	+0.225499		R**2 = 0.0042
LEFT SHOULDER WRT UPPER ARM	=	0.001988 *WEIGHT	-0.009715 *STANDING	+0.851770	R**2 = 0.0141

REGRESSION EQUATIONS FOR LEFT SHOULDER WRT UPPER ARM Y COORDINATE

LEFT SHOULDER WRT UPPER ARM	=	-0.001289 *WEIGHT	+0.438159		R**2 = 0.0216
LEFT SHOULDER WRT UPPER ARM	=	-0.011100 *STANDING	+0.994151		R**2 = 0.0275
LEFT SHOULDER WRT UPPER ARM	=	0.000199 *WEIGHT	-0.012485 *STANDING	+1.056967	R**2 = 0.0276

REGRESSION EQUATIONS FOR LEFT SHOULDER WRT UPPER ARM Z COORDINATE

LEFT SHOULDER WRT UPPER ARM	=	-0.017979 *WEIGHT	-2.702344		R**2 = 0.8340
LEFT SHOULDER WRT UPPER ARM	=	-0.133190 *STANDING	+3.541350		R**2 = 0.7856
LEFT SHOULDER WRT UPPER ARM	=	-0.012218 *WEIGHT	-0.048317 *STANDING	-0.307549	R**2 = 0.8518

REGRESSION EQUATIONS FOR LEFT ELBOW WRT FOREARM X COORDINATE

LEFT ELBOW WRT FOREARM	=	-0.001087 *WEIGHT	-0.343308		R**2 = 0.0606
LEFT ELBOW WRT FOREARM	=	-0.009549 *STANDING	+0.138748		R**2 = 0.0803
LEFT ELBOW WRT FOREARM	=	0.000299 *WEIGHT	-0.011628 *STANDING	+0.233035	R**2 = 0.0811

```
REGRESSION EQUATIONS FOR LEFT ELBOW WRT FOREARM Y COORDINATE
LEFT ELBOW WRT FOREARM   =  0.000202 *WEIGHT    -0.262384                        R**2 = 0.0013
LEFT ELBOW WRT FOREARM   =  0.000980 *STANDING  -0.296420                        R**2 = 0.0005
LEFT ELBOW WRT FOREARM   =  0.000497 *WEIGHT    -0.002470 *STANDING  -0.139945   R**2 = 0.0019

REGRESSION EQUATIONS FOR LEFT ELBOW WRT FOREARM Z COORDINATE
LEFT ELBOW WRT FOREARM   = -0.008121 *WEIGHT    -3.248134                        R**2 = 0.6328
LEFT ELBOW WRT FOREARM   = -0.068772 *STANDING  +0.173893                        R**2 = 0.7790
LEFT ELBOW WRT FOREARM   =  0.000458 *WEIGHT    -0.071954 *STANDING  +0.318213   R**2 = 0.7793

REGRESSION EQUATIONS FOR LEFT WRIST WRT HAND X COORDINATE
LEFT WRIST WRT HAND      = -0.001576 *WEIGHT    +0.381869                        R**2 = 0.0315
LEFT WRIST WRT HAND      = -0.015469 *STANDING  +1.194259                        R**2 = 0.0520
LEFT WRIST WRT HAND      =  0.001561 *WEIGHT    -0.026309 *STANDING  +1.685847   R**2 = 0.0573

REGRESSION EQUATIONS FOR LEFT WRIST WRT HAND Y COORDINATE
LEFT WRIST WRT HAND      = -0.000876 *WEIGHT    -0.409282                        R**2 = 0.0359
LEFT WRIST WRT HAND      = -0.009216 *STANDING  +0.085499                        R**2 = 0.0682
LEFT WRIST WRT HAND      =  0.001297 *WEIGHT    -0.018228 *STANDING  +0.494186   R**2 = 0.0817
```

```
                                               R**2 = 0.4129
                                               R**2 = 0.4873
                                               R**2 = 0.4876
NATE
    -2.065060
NG  -0.740092
T    -0.025368 *STANDING  -0.807723
                                               R**2 = 0.0500
                                               R**2 = 0.0640
                                               R* * = 0.0642

 + HAND X COORDINATE
          -0.248755
EIGHT     +0.415082
STANDING  -0.015052 *STANDING  +0.497303
*WEIGHT
                                               R**2 = 0.0003
                                               R**2 = 0.0002
                                               R**2 = 0.0003

FOREARM + HAND Y COORDINATE
             -0.323101
0104 *WEIGHT     -0.349634
00634 *STANDING    -0.000523 *STANDING  -0.297182
00167 *WEIGHT
                                               R**2 = 0.4954
                                               R**2 = 0.7253
                                               R**2 = 0.7548

FOREARM + HAND Z COORDINATE
              -5.421995
4 *WEIGHT     -0.717790
 *STANDING    -0.131946 *STANDING  +1.117759
 IGHT
```

APPENDIX C

PRINCIPAL MOMENTS OF INERTIA REGRESSION EQUATIONS

This appendix contains a complete listing of the X, Y, and Z principal moments of inertia regression equations developed for the adult human female and the adult human male options. The regression equations are based on human stereophotometric data (McConville, et al., 1980; Young, et al., 1983). The predicting variables are weight (lb) and standing height (in). The predicted principal moments of inertia are in slugs-inches squared. At the top of each set of regression equations are listed the range of values, mean, and standard deviation of the predicting variables within that subject type option. For the principal moments of each segment, a separate regression equation is given against each of the predicting variables. The last regression equation is a multiple regression equation based on both predicting variables. With each regression equation, the coefficient of determination (R^2) is given. The regression equations are based on 46 female subjects and 31 male subjects.

REGRESSION EQUATIONS FOR THE ADULT FEMALE PRINCIPAL MOMENTS OF INERTIA

PREDICTING VARIABLES								
WEIGHT	RANGE:	85.00	200.00	MEAN:	127.30	S.D.:	16.590
STANDING HEIGHT	RANGE:	56.93	72.05	MEAN:	63.82	S.D.:	2.364

REGRESSION EQUATIONS FOR PELVIS X MOMENT

PELVIS X MOMENT	=	0.163756 *WEIGHT -13.500050	R**2 = 0.8909
PELVIS X MOMENT	=	0.559154 *STANDING -25.921050	R**2 = 0.0748
PELVIS X MOMENT	=	0.174048 *WEIGHT -0.292277 *STANDING +3.603102	R**2 = 0.9078

REGRESSION EQUATIONS FOR PELVIS Y MOMENT

PELVIS Y MOMENT	=	0.161932 *WEIGHT -15.090490	R**2 = 0.8391
PELVIS Y MOMENT	=	0.347382 *STANDING -14.325520	R**2 = 0.0278
PELVIS Y MOMENT	=	0.180853 *WEIGHT -0.537341 *STANDING +16.353070	R**2 = 0.8942

REGRESSION EQUATIONS FOR PELVIS Z MOMENT

PELVIS Z MOMENT	=	0.256230 *WEIGHT -22.912750	R**2 = 0.8749
PELVIS Z MOMENT	=	0.647401 *STANDING -27.906070	R**2 = 0.0402
PELVIS Z MOMENT	=	0.282011 *WEIGHT -0.732180 *STANDING +19.932170	R**2 = 0.9175

```
REGRESSION EQUATIONS FOR ABDOMEN X MOMENT
ABDOMEN X MOMENT     =   0.031055 *WEIGHT    -2.473941                               R**2 = 0.2987
ABDOMEN X MOMENT     =  -0.101966 *STANDING  +8.374269                               R**2 = 0.0232
ABDOMEN X MOMENT     =   0.041855 *WEIGHT    -0.306717 *STANDING +15.474200          R**2 = 0.4722

REGRESSION EQUATIONS FOR ABDOMEN Y MOMENT
ABDOMEN Y MOMENT     =   0.025354 *WEIGHT    -2.300540                               R**2 = 0.2752
ABDOMEN Y MOMENT     =  -0.120106 *STANDING  +8.895873                               R**2 = 0.0445
ABDOMEN Y MOMENT     =   0.035739 *WEIGHT    -0.294939 *STANDING +14.958350          R**2 = 0.4971

REGRESSION EQUATIONS FOR ABDOMEN Z MOMENT
ABDOMEN Z MOMENT     =   0.054539 *WEIGHT    -4.781197                               R**2 = 0.3359
ABDOMEN Z MOMENT     =  -0.168868 *STANDING +13.622860                               R**2 = 0.0232
ABDOMEN Z MOMENT     =   0.073073 *WEIGHT    -0.526336 *STANDING +26.018390          R**2 = 0.5223

REGRESSION EQUATIONS FOR THORAX X MOMENT
THORAX X MOMENT      =   0.301112 *WEIGHT   -12.786380                               R**2 = 0.7948
THORAX X MOMENT      =   1.634667 *STANDING -74.125640                               R**2 = 0.1686
THORAX X MOMENT      =   0.294236 *WEIGHT   + 0.195281 *STANDING -24.213590          R**2 = 0.7968
```

```
REGRESSION EQUATIONS FOR THORAX Y MOMENT
THORAX Y MOMENT      =   0.239654 *WEIGHT   -11.027040                               R**2 = 0.7959
THORAX Y MOMENT      =   1.409968 *STANDING -66.762300                               R**2 = 0.1983
THORAX Y MOMENT      =   0.229547 *WEIGHT    +0.287040 *STANDING -27.823750          R**2 = 0.8027


REGRESSION EQUATIONS FOR THORAX Z MOMENT
THORAX Z MOMENT      =   0.241791 *WEIGHT   -14.322190                               R**2 = 0.8408
THORAX Z MOMENT      =   0.882539 *STANDING -36.276030                               R**2 = 0.0806
THORAX Z MOMENT      =   0.254565 *WEIGHT    -0.362777 *STANDING  +6.906433          R**2 = 0.8521


REGRESSION EQUATIONS FOR NECK X MOMENT
NECK X MOMENT        =   0.000609 *WEIGHT    +0.024464                               R**2 = 0.2657
NECK X MOMENT        =   0.007888 *STANDING  -0.390459                               R**2 = 0.3209
NECK X MOMENT        =   0.000400 *WEIGHT    +0.005931 *STANDING  -0.322579          R**2 = 0.4158


REGRESSION EQUATIONS FOR NECK Y MOMENT
NECK Y MOMENT        =   0.000637 *WEIGHT    +0.049083                               R**2 = 0.2170
NECK Y MOMENT        =   0.008916 *STANDING  -0.427217                               R**2 = 0.3065
NECK Y MOMENT        =   0.000390 *WEIGHT    +0.007010 *STANDING  -0.361095          R**2 = 0.3738
```

```
REGRESSION EQUATIONS FOR NECK Z MOMENT
NECK Z MOMENT          =   0.001055 *WEIGHT    +0.004830                                  R**2 = 0.4597
NECK Z MOMENT          =   0.007630 *STANDING  -0.330893                                  R**2 = 0.1732
NECK Z MOMENT          =   0.000950 *WEIGHT    +0.002985 *STANDING  -0.169815             R**2 = 0.4816


REGRESSION EQUATIONS FOR HEAD X MOMENT
HEAD X MOMENT          =   0.003316 *WEIGHT    +1.350839                                  R**2 = 0.1717
HEAD X MOMENT          =   0.014106 *STANDING  +0.922638                                  R**2 = 0.0224
HEAD X MOMENT          =   0.003406 *WEIGHT    -0.002556 *STANDING  +1.500424             R**2 = 0.1723


REGRESSION EQUATIONS FOR HEAD Y MOMENT
HEAD Y MOMENT          =   0.003768 *WEIGHT    +1.486574                                  R**2 = 0.1671
HEAD Y MOMENT          =   0.017871 *STANDING  +0.883056                                  R**2 = 0.0271
HEAD Y MOMENT          =   0.003792 *WEIGHT    -0.000679 *STANDING  +1.526312             R**2 = 0.1671


REGRESSION EQUATIONS FOR HEAD Z MOMENT
HEAD Z MOMENT          =   0.002513 *WEIGHT    +1.021677                                  R**2 = 0.2127
HEAD Z MOMENT          =   0.010754 *STANDING  +0.693090                                  R**2 = 0.0280
HEAD Z MOMENT          =   0.002578 *WEIGHT    -0.001858 *STANDING  +1.130428             R**2 = 0.2134
```

```
REGRESSION EQUATIONS FOR THIGH X MOMENT
THIGH X MOMENT     =   0.010001 *WEIGHT    +0.181037                              R**2 = 0.6511
THIGH X MOMENT     =   0.086858 *STANDING  -3.923329                              R**2 = 0.3535
THIGH X MOMENT     =   0.008388 *WEIGHT    +0.045824 *STANDING  -2.500468         R**2 = 0.7326


REGRESSION EQUATIONS FOR THIGH Y MOMENT
THIGH Y MOMENT     =   0.009711 *WEIGHT    +0.192135                              R**2 = 0.6421
THIGH Y MOMENT     =   0.085729 *STANDING  -3.881509                              R**2 = 0.3602
THIGH Y MOMENT     =   0.008085 *WEIGHT    +0.046176 *STANDING  -2.509969         R**2 = 0.7286


REGRESSION EQUATIONS FOR THIGH Z MOMENT
THIGH Z MOMENT     =   0.001081 *WEIGHT    -0.049435                              R**2 = 0.7459
THIGH Z MOMENT     =   0.004096 *STANDING  -0.157097                              R**2 = 0.0771
THIGH Z MOMENT     =   0.001132 *WEIGHT    -0.001441 *STANDING  +0.034888         R**2 = 0.7538


REGRESSION EQUATIONS FOR CALF X MOMENT
CALF X MOMENT      =   0.028391 *WEIGHT    -0.062710                              R**2 = 0.5802
CALF X MOMENT      =   0.239876 *STANDING -11.289330                              R**2 = 0.2981
CALF X MOMENT      =   0.024095 *WEIGHT    +0.122004 *STANDING  -7.202003         R**2 = 0.6440
```

```
REGRESSION EQUATIONS FOR CALF Y MOMENT
CALF Y MOMENT      =   0.028043 *WEIGHT    -0.030029                                R**2 = 0.5785
CALF Y MOMENT      =   0.240618 *STANDING -11.352770                                R**2 = 0.3066
CALF Y MOMENT      =   0.023643 *WEIGHT    +0.124957 *STANDING  -7.342105           R**2 = 0.6469


REGRESSION EQUATIONS FOR CALF Z MOMENT
CALF Z MOMENT      =   0.006683 *WEIGHT    -0.412023                                R**2 = 0.7348
CALF Z MOMENT      =   0.030000 *STANDING  -1.374711                                R**2 = 0.1066
CALF Z MOMENT      =   0.006798 *WEIGHT    -0.003254 *STANDING  -0.221596           R**2 = 0.7358


REGRESSION EQUATIONS FOR FOOT Z MOMENT
FOOT Z MOMENT      =   0.000298 *WEIGHT    +0.013433                                R**2 = 0.3877
FOOT Z MOMENT      =   0.003700 *STANDING  -0.179437                                R**2 = 0.4296
FOOT Z MOMENT      =   0.000203 *WEIGHT    +0.002708 *STANDING  -0.145019           R**2 = 0.5782


REGRESSION EQUATIONS FOR FOOT Y MOMENT
FOOT Y MOMENT      =   0.001336 *WEIGHT    +0.055107                                R**2 = 0.4350
FOOT Y MOMENT      =   0.018162 *STANDING  -0.909509                                R**2 = 0.5785
FOOT Y MOMENT      =   0.000842 *WEIGHT    +0.014045 *STANDING  -0.766749           R**2 = 0.7214
```

```
REGRESSION EQUATIONS FOR FOOT X MOMENT
FOOT X MOMENT       =  0.001379 *WEIGHT    +0.059885                          R**2 = 0.4444
FOOT X MOMENT       =  0.018299 *STANDING  -0.907403                          R**2 = 0.5633
FOOT X MOMENT       =  0.000887 *WEIGHT    +0.013958 *STANDING  -0.756870     R**2 = 0.7157


REGRESSION EQUATIONS FOR UPPER ARM X MOMENT
UPPER ARM X MOMENT  =  0.008832 *WEIGHT    -0.318302                          R**2 = 0.7883
UPPER ARM X MOMENT  =  0.071212 *STANDING  -3.594248                          R**2 = 0.3689
UPPER ARM X MOMENT  =  0.007641 *WEIGHT    +0.033833 *STANDING  -2.298105     R**2 = 0.8572


REGRESSION EQUATIONS FOR UPPER ARM Y MOMENT
UPPER ARM Y MOMENT  =  0.010102 *WEIGHT    -0.444038                          R**2 = 0.8268
UPPER ARM Y MOMENT  =  0.072898 *STANDING  -3.648074                          R**2 = 0.3099
UPPER ARM Y MOMENT  =  0.009104 *WEIGHT    +0.028364 *STANDING  -2.103820     R**2 = 0.8656


REGRESSION EQUATIONS FOR UPPER ARM Z MOMENT
UPPER ARM Z MOMENT  =  0.003440 *WEIGHT    -0.280054                          R**2 = 0.8998
UPPER ARM Z MOMENT  =  0.013084 *STANDING  -0.625907                          R**2 = 0.0937
UPPER ARM Z MOMENT  =  0.003599 *WEIGHT    -0.004524 *STANDING  -0.015321     R**2 = 0.9090
```

REGRESSION EQUATIONS FOR FOREARM X MOMENT

```
FOREARM X MOMENT    =  0.003558 *WEIGHT    -0.061760                          R**2 = 0.6509
FOREARM X MOMENT    =  0.026886 *STANDING  -1.267104                          R**2 = 0.2675
FOREARM X MOMENT    =  0.003155 *WEIGHT    +0.011453 *STANDING  -0.731933     R**2 = 0.6911
```

REGRESSION EQUATIONS FOR FOREARM Y MOMENT

```
FOREARM Y MOMENT    =  0.003352 *WEIGHT    -0.051225                          R**2 = 0.6341
FOREARM Y MOMENT    =  0.026467 *STANDING  -1.259055                          R**2 = 0.2846
FOREARM Y MOMENT    =  0.002923 *WEIGHT    +0.012167 *STANDING  -0.763188     R**2 = 0.6839
```

REGRESSION EQUATIONS FOR FOREARM Z MOMENT

```
FOREARM Z MOMENT    =  0.000969 *WEIGHT    -0.057900                          R**2 = 0.7556
FOREARM Z MOMENT    =  0.003471 *STANDING  -0.141681                          R**2 = 0.0698
FOREARM Z MOMENT    =  0.001023 *WEIGHT    -0.001535 *STANDING  +0.031913     R**2 = 0.7669
```

REGRESSION EQUATIONS FOR HAND X MOMENT

```
HAND X MOMENT       =  0.000389 *WEIGHT    +0.025665                          R**2 = 0.3857
HAND X MOMENT       =  0.003603 *STANDING  -0.148178                          R**2 = 0.2377
HAND X MOMENT       =  0.000317 *WEIGHT    +0.002052 *STANDING  -0.094394     R**2 = 0.4495
```

```
REGRESSION EQUATIONS FOR HAND Y MOMENT
HAND Y MOMENT          =   0.000320 *WEIGHT    +0.022715                              R**2 = 0.3766
HAND Y MOMENT          =   0.003186 *STANDING  -0.134415                              R**2 = 0.2684
HAND Y MOMENT          =   0.000251 *WEIGHT    +0.001957 *STANDING  -0.091781         R**2 = 0.4604


REGRESSION EQUATIONS FOR HAND Z MOMENT
HAND Z MOMENT          =   0.000112 *WEIGHT    +0.005927                              R**2 = 0.3822
HAND Z MOMENT          =   0.000718 *STANDING  -0.023783                              R**2 = 0.1120
HAND Z MOMENT          =   0.000105 *WEIGHT    +0.000202 *STANDING  -0.005915         R**2 = 0.3896


REGRESSION EQUATIONS FOR FOREARM PLUS HAND X MOMENT
FOREARM + HAND X MOMENT=   0.010001 *WEIGHT    +0.181037                              R**2 = 0.6511
FOREARM + HAND X MOMENT=   0.086858 *STANDING  -3.923329                              R**2 = 0.3535
FOREARM + HAND X MOMENT=   0.008388 *WEIGHT    +0.045824 *STANDING  -2.500468         R**2 = 0.7326


REGRESSION EQUATIONS FOR FOREARM PLUS HAND Y MOMENT
FOREARM + HAND Y MOMENT=   0.009711 *WEIGHT    +0.192135                              R**2 = 0.6421
FOREARM + HAND Y MOMENT=   0.085729 *STANDING  -3.881509                              R**2 = 0.3602
FOREARM + HAND Y MOMENT=   0.008085 *WEIGHT    +0.046176 *STANDING  -2.509969         R**2 = 0.7286
```

REGRESSION EQUATIONS FOR FOREARM PLUS HAND Z MOMENT

FOREARM + HAND Z MOMENT=	0.001081	*WEIGHT	-0.049435				R**2 = 0.7459
FOREARM + HAND Z MOMENT=	0.004096	*STANDING	-0.157097				R**2 = 0.0771
FOREARM + HAND Z MOMENT=	0.001132	*WEIGHT	-0.001441	*STANDING	+0.034888		R**2 = 0.7538

REGRESSION EQUATIONS FOR ADULT MALE PRINCIPAL MOMENTS OF INERTIA

```
PREDICTING VARIABLES
WEIGHT              RANGE:  118.00     264.00      MEAN:  173.60     S.D.:  21.440
STANDING HEIGHT     RANGE:   62.17      77.64      MEAN:   69.82     S.D.:   2.437

REGRESSION EQUATIONS FOR PELVIS X MOMENT
PELVIS X MOMENT       =   0.117920 *WEIGHT    -9.541327                                R**2 = 0.8049
PELVIS X MOMENT       =   0.771563 *STANDING -43.364990                                R**2 = 0.5914
PELVIS X MOMENT       =   0.150906 *WEIGHT    -0.276669 *STANDING  +4.171488           R**2 = 0.8179

REGRESSION EQUATIONS FOR PELVIS Y MOMENT
PELVIS Y MOMENT       =   0.111156 *WEIGHT    -9.275152                                R**2 = 0.7515
PELVIS Y MOMENT       =   0.721944 *STANDING -40.783950                                R**2 = 0.5441
PELVIS Y MOMENT       =   0.145972 *WEIGHT    -0.292018 *STANDING  +5.198404           R**2 = 0.7668

REGRESSION EQUATIONS FOR PELVIS Z MOMENT
PELVIS Z MOMENT       =   0.138637 *WEIGHT   -11.424750                                R**2 = 0.7516
PELVIS Z MOMENT       =   0.895104 *STANDING -50.351390                                R**2 = 0.5378
PELVIS Z MOMENT       =   0.185753 *WEIGHT    -0.395182 *STANDING  +8.162018           R**2 = 0.7696
```

```
REGRESSION EQUATIONS FOR ABDOMEN X MOMENT
ABDOMEN X MOMENT   =  0.016729 *WEIGHT    -1.190717                              R**2 = 0.4715
ABDOMEN X MOMENT   =  0.106385 *STANDING  -5.774367                              R**2 = 0.3273
ABDOMEN X MOMENT   =  0.023542 *WEIGHT    -0.057141 *STANDING  +1.641403         R**2 = 0.4877

REGRESSION EQUATIONS FOR ABDOMEN Y MOMENT
ABDOMEN Y MOMENT   =  0.009820 *WEIGHT    -0.755341                              R**2 = 0.4073
ABDOMEN Y MOMENT   =  0.059706 *STANDING  -3.254342                              R**2 = 0.2585
ABDOMEN Y MOMENT   =  0.015721 *WEIGHT    -0.049498 *STANDING  +1.697984         R**2 = 0.4378

REGRESSION EQUATIONS FOR ABDOMEN Z MOMENT
ABDOMEN Z MOMENT   =  0.026073 *WEIGHT    -1.943402                              R**2 = 0.4752
ABDOMEN Z MOMENT   =  0.163224 *STANDING  -8.906807                              R**2 = 0.3197
ABDOMEN Z MOMENT   =  0.038481 *WEIGHT    -0.104076 *STANDING  +3.214991         R**2 = 0.4976

REGRESSION EQUATIONS FOR THORAX X MOMENT
THORAX X MOMENT    =  0.530761 *WEIGHT   -39.709080                              R**2 = 0.9315
THORAX X MOMENT    =  3.724962 *STANDING -209.56920                              R**2 = 0.7875
THORAX X MOMENT    =  0.504281 *WEIGHT    +0.222097 *STANDING -50.717090         R**2 = 0.9320
```

REGRESSION EQUATIONS FOR THORAX Y MOMENT

THORAX Y MOMENT	=	0.401215 *WEIGHT	-31.048660		R**2 = 0.9176
THORAX Y MOMENT	=	2.804530 *STANDING	-158.66330		R**2 = 0.7696
THORAX Y MOMENT	=	0.389010 *WEIGHT	+0.102369 *STANDING	-36.122420	R**2 = 0.9178

REGRESSION EQUATIONS FOR THORAX Z MOMENT

THORAX Z MOMENT	=	0.339041 *WEIGHT	-26.329640		R**2 = 0.9561
THORAX Z MOMENT	=	2.289070 *STANDING	-128.51820		R**2 = 0.7480
THORAX Z MOMENT	=	0.384835 *WEIGHT	-0.384092 *STANDING	-7.292557	R**2 = 0.9597

REGRESSION EQUATIONS FOR NECK X MOMENT

NECK X MOMENT	=	0.001387 *WEIGHT	-0.057555		R**2 = 0.5120
NECK X MOMENT	=	0.008977 *STANDING	-0.448591		R**2 = 0.3683
NECK X MOMENT	=	0.001842 *WEIGHT	-0.003815 *STANDING	+0.131522	R**2 = 0.5234

REGRESSION EQUATIONS FOR NECK Y MOMENT

NECK Y MOMENT	=	0.001538 *WEIGHT	-0.046986		R**2 = 0.5249
NECK Y MOMENT	=	0.009658 *STANDING	-0.459772		R**2 = 0.3551
NECK Y MOMENT	=	0.002251 *WEIGHT	-0.005980 *STANDING	+0.249402	R**2 = 0.5483

```
REGRESSION EQUATIONS FOR NECK Z MOMENT
NECK Z MOMENT        =   0.002032 *WEIGHT    -0.080039                          R**2 = 0.5675
NECK Z MOMENT        =   0.012447 *STANDING  -0.603564                          R**2 = 0.3654
NECK Z MOMENT        =   0.003190 *WEIGHT    -0.009710 *STANDING  +0.401225     R**2 = 0.6057

REGRESSION EQUATIONS FOR HEAD X MOMENT
HEAD X MOMENT        =   0.003680 *WEIGHT    +1.541396                          R**2 = 0.1550
HEAD X MOMENT        =   0.029540 *STANDING  +0.104170                          R**2 = 0.1715
HEAD X MOMENT        =   0.000918 *WEIGHT    +0.023162 *STANDING  +0.393387     R**2 = 0.1732

REGRESSION EQUATIONS FOR HEAD Y MOMENT
HEAD Y MOMENT        =   0.004619 *WEIGHT    +1.686967                          R**2 = 0.1563
HEAD Y MOMENT        =   0.037161 *STANDING  -0.122760                          R**2 = 0.1737
HEAD Y MOMENT        =   0.001097 *WEIGHT    +0.029538 *STANDING  +0.222949     R**2 = 0.1752

REGRESSION EQUATIONS FOR HEAD Z MOMENT
HEAD Z MOMENT        =   0.002481 *WEIGHT    +1.179516                          R**2 = 0.1883
HEAD Z MOMENT        =   0.018242 *STANDING  +0.327581                          R**2 = 0.1747
HEAD Z MOMENT        =   0.001784 *WEIGHT    +0.005853 *STANDING  +0.889437     R**2 = 0.1914
```

```
REGRESSION EQUATIONS FOR THIGH X MOMENT
THIGH X MOMENT        =   0.025793 *WEIGHT    -1.226292                                 R**2 = 0.7960
THIGH X MOMENT        =   0.198665 *STANDING -10.713900                                 R**2 = 0.8106
THIGH X MOMENT        =   0.012263 *WEIGHT    +0.113484 *STANDING  -6.850978            R**2 = 0.8415


REGRESSION EQUATIONS FOR THIGH Y MOMENT
THIGH Y MOMENT        =   0.025638 *WEIGHT    -1.215490                                 R**2 = 0.7976
THIGH Y MOMENT        =   0.197470 *STANDING -10.645990                                 R**2 = 0.8122
THIGH Y MOMENT        =   0.012191 *WEIGHT    +0.112791 *STANDING  -6.805867            R**2 = 0.8431


REGRESSION EQUATIONS FOR THIGH Z MOMENT
THIGH Z MOMENT        =   0.001576 *WEIGHT    -0.089792                                 R**2 = 0.7937
THIGH Z MOMENT        =   0.010433 *STANDING  -0.550339                                 R**2 = 0.5971
THIGH Z MOMENT        =   0.001932 *WEIGHT    -0.002988 *STANDING  +0.058323            R**2 = 0.8022


REGRESSION EQUATIONS FOR CALF X MOMENT
CALF X MOMENT         =   0.059151 *WEIGHT    -3.966057                                 R**2 = 0.8120
CALF X MOMENT         =   0.472882 *STANDING -26.931780                                 R**2 = 0.8908
CALF X MOMENT         =   0.016127 *WEIGHT    +0.360857 *STANDING -21.851520            R**2 = 0.9011
```

REGRESSION EQUATIONS FOR CALF Y MOMENT

```
CALF Y MOMENT   =  0.059948 *WEIGHT    -4.009954                          R**2 = 0.8125
CALF Y MOMENT   =  0.478795 *STANDING -27.253020                          R**2 = 0.8896
CALF Y MOMENT   =  0.016664 *WEIGHT    +0.363043 *STANDING -22.003800     R**2 = 0.9004
```

REGRESSION EQUATIONS FOR CALF Z MOMENT

```
CALF Z MOMENT   =  0.006279 *WEIGHT    -0.366041                          R**2 = 0.8423
CALF Z MOMENT   =  0.045091 *STANDING  -2.447107                          R**2 = 0.7456
CALF Z MOMENT   =  0.005253 *WEIGHT    +0.008599 *STANDING  -0.792265     R**2 = 0.8470
```

REGRESSION EQUATIONS FOR FOOT Z MOMENT

```
FOOT Z MOMENT   =  0.000680 *WEIGHT    -0.031023                          R**2 = 0.7643
FOOT Z MOMENT   =  0.005213 *STANDING  -0.279382                          R**2 = 0.7704
FOOT Z MOMENT   =  0.000342 *WEIGHT    +0.002840 *STANDING  -0.171776     R**2 = 0.8036
```

REGRESSION EQUATIONS FOR FOOT Y MOMENT

```
FOOT Y MOMENT   =  0.003810 *WEIGHT    -0.199205                          R**2 = 0.6925
FOOT Y MOMENT   =  0.030630 *STANDING  -1.690426                          R**2 = 0.7683
FOOT Y MOMENT   =  0.000920 *WEIGHT    +0.024242 *STANDING  -1.400724     R**2 = 0.7752
```

```
REGRESSION EQUATIONS FOR FOOT X MOMENT
FOOT X MOMENT        =   0.003966 *WEIGHT    -0.201562                           R**2 = 0.7064
FOOT X MOMENT        =   0.031694 *STANDING  -1.740607                           R**2 = 0.7744
FOOT X MOMENT        =   0.001088 *WEIGHT    +0.024139 *STANDING  -1.397969      R**2 = 0.7836


REGRESSION EQUATIONS FOR UPPER ARM X MOMENT
UPPER ARM X MOMENT   =   0.014407 *WEIGHT    -1.124170                           R**2 = 0.8534
UPPER ARM X MOMENT   =   0.102891 *STANDING  -5.859214                           R**2 = 0.7471
UPPER ARM X MOMENT   =   0.012455 *WEIGHT    +0.016378 *STANDING  -1.935950      R**2 = 0.8567


REGRESSION EQUATIONS FOR UPPER ARM Y MOMENT
UPPER ARM Y MOMENT   =   0.015635 *WEIGHT    -1.253754                           R**2 = 0.8512
UPPER ARM Y MOMENT   =   0.110026 *STANDING  -6.278232                           R**2 = 0.7235
UPPER ARM Y MOMENT   =   0.014648 *WEIGHT    +0.008278 *STANDING  -1.664030      R**2 = 0.8519


REGRESSION EQUATIONS FOR UPPER ARM Z MOMENT
UPPER ARM Z MOMENT   =   0.003008 *WEIGHT    -0.243573                           R**2 = 0.7795
UPPER ARM Z MOMENT   =   0.019116 *STANDING  -1.066814                           R**2 = 0.5403
UPPER ARM Z MOMENT   =   0.004244 *WEIGHT    -0.010361 *STANDING  +0.269960      R**2 = 0.8068
```

REGRESSION EQUATIONS FOR FOREARM X MOMENT

FOREARM X MOMENT	=	0.008108 *WEIGHT	-0.490309		R**2 = 0.8397
FOREARM X MOMENT	=	0.060581 *STANDING	-3.342158		R**2 = 0.8047
FOREARM X MOMENT	=	0.005150 *WEIGHT	+0.024805 *STANDING	-1.719764	R**2 = 0.8629

REGRESSION EQUATIONS FOR FOREARM Y MOMENT

FOREARM Y MOMENT	=	0.008330 *WEIGHT	-0.507917		R**2 = 0.8418
FOREARM Y MOMENT	=	0.061938 *STANDING	-3.416692		R**2 = 0.7986
FOREARM Y MOMENT	=	0.005504 *WEIGHT	+0.023708 *STANDING	-1.682993	R**2 = 0.8619

REGRESSION EQUATIONS FOR FOREARM Z MOMENT

FOREARM Z MOMENT	=	0.001237 *WEIGHT	-0.080312		R**2 = 0.7807
FOREARM Z MOMENT	=	0.008022 *STANDING	-0.430113		R**2 = 0.5636
FOREARM Z MOMENT	=	0.001633 *WEIGHT	-0.003318 *STANDING	+0.084157	R**2 = 0.7972

REGRESSION EQUATIONS FOR HAND X MOMENT

HAND X MOMENT	=	0.000903 *WEIGHT	-0.017110		R**2 = 0.6547
HAND X MOMENT	=	0.006996 *STANDING	-0.352180		R**2 = 0.6751
HAND X MOMENT	=	0.000399 *WEIGHT	+0.004227 *STANDING	-0.226637	R**2 = 0.6970

REGRESSION EQUATIONS FOR HAND Y MOMENT

```
HAND Y MOMENT          =   0.000736 *WEIGHT    -0.013369                          R**2 = 0.6358
HAND Y MOMENT          =   0.005787 *STANDING  -0.292308                          R**2 = 0.6741
HAND Y MOMENT          =   0.000270 *WEIGHT    +0.003913 *STANDING  -0.207325     R**2 = 0.6888
```

REGRESSION EQUATIONS FOR HAND Z MOMENT

```
HAND Z MOMENT          =   0.000290 *WEIGHT    -0.006137                          R**2 = 0.7508
HAND Z MOMENT          =   0.002093 *STANDING  -0.102979                          R**2 = 0.6714
HAND Z MOMENT          =   0.000235 *WEIGHT    +0.000459 *STANDING  -0.028883     R**2 = 0.7564
```

REGRESSION EQUATIONS FOR FOREARM PLUS HAND X MOMENT

```
FOREARM + HAND X MOMENT=   0.025793 *WEIGHT    -1.226292                          R**2 = 0.7960
FOREARM + HAND X MOMENT=   0.198665 *STANDING -10.713900                          R**2 = 0.8106
FOREARM + HAND X MOMENT=   0.012263 *WEIGHT    +0.113484 *STANDING  -6.850978     R**2 = 0.8415
```

REGRESSION EQUATIONS FOR FOREARM PLUS HAND Y MOMENT

```
FOREARM + HAND Y MOMENT=   0.025638 *WEIGHT    -1.215490                          R**2 = 0.7976
FOREARM + HAND Y MOMENT=   0.197470 *STANDING -10.645990                          R**2 = 0.8122
FOREARM + HAND Y MOMENT=   0.012191 *WEIGHT    +0.112791 *STANDING  -6.805867     R**2 = 0.8431
```

REGRESSION EQUATIONS FOR FOREARM PLUS HAND Z MOMENT

```
FOREARM + HAND Z MOMENT=   0.001576 *WEIGHT    -0.089792                           R**2 = 0.7937
FOREARM + HAND Z MOMENT=   0.010433 *STANDING  -0.550339                           R**2 = 0.5971
FOREARM + HAND Z MOMENT=   0.001932 *WEIGHT    -0.002988 *STANDING  +0.058323      R**2 = 0.8022
```

APPENDIX D

VOLUME REGRESSION EQUATIONS

This appendix contains a complete listing of the segment volume regression equations developed for the adult human female and the adult human male options. The regression equations are based on human stereophotometric volume data (McConville, et al., 1980; Young, et al., 1983). The predicting variables are weight (lb) and standing height (in). The predicted segment volumes are in cubic inches. At the top of each set of regression equations are listed the range of values, mean, and standard deviation of the predicting variables within that subject type option. For the volume of each segment, a separate regression equation is given against each of the predicting variables. The last regression equation is a multiple regression equation based on both predicting variables. With each regression equation, the coefficient of determination (R^2) is given. The regression equations are based on 46 female subjects and 31 male subjects.

REGRESSION EQUATIONS FOR ADULT FEMALE SEGMENT VOLUME

PREDICTING VARIABLES

WEIGHT	RANGE:	85.00	200.00	MEAN:	127.30	S.D.:	16.590
STANDING HEIGHT	RANGE:	56.93	72.05	MEAN:	63.82	S.D.:	2.364

REGRESSION EQUATIONS FOR PELVIS VOLUME

```
PELVIS VOLUME   =   6.726632 *WEIGHT   -329.739300                        R**2 = 0.8796
PELVIS VOLUME   =  20.382420 *STANDING -675.801500                        R**2 = 0.0581
PELVIS VOLUME   =   7.259390 *WEIGHT    -15.130090 *STANDING +555.627400  R**2 = 0.9061
```

REGRESSION EQUATIONS FOR ABDOMEN VOLUME

```
ABDOMEN VOLUME  =   1.381251 *WEIGHT    -22.733250                        R**2 = 0.1825
ABDOMEN VOLUME  =  -7.833098 *STANDING +669.115500                        R**2 = 0.0423
ABDOMEN VOLUME  =   2.001907 *WEIGHT    -17.626310 *STANDING+1008.704000  R**2 = 0.3596
```

REGRESSION EQUATIONS FOR THORAX VOLUME

```
THORAX VOLUME   =   7.337825 *WEIGHT    +75.115720                        R**2 = 0.8692
THORAX VOLUME   =  35.735550 *STANDING -1159.42000                        R**2 = 0.1484
THORAX VOLUME   =   7.344659 *WEIGHT     -0.194087 *STANDING  +86.472870  R**2 = 0.8692
```

```
REGRESSION EQUATIONS FOR NECK VOLUME
NECK VOLUME          =    0.128394 *WEIGHT    +26.857100                              R**2 = 0.2260
NECK VOLUME          =    1.911736 *STANDING  -76.406010                              R**2 = 0.3607
NECK VOLUME          =    0.073788 *WEIGHT     +1.550769 *STANDING  -63.889100        R**2 = 0.4224

REGRESSION EQUATIONS FOR HEAD VOLUME
HEAD VOLUME          =    0.264502 *WEIGHT   +200.341900                              R**2 = 0.2018
HEAD VOLUME          =    1.134469 *STANDING +165.596000                              R**2 = 0.0267
HEAD VOLUME          =    0.271286 *WEIGHT     -0.192644 *STANDING +211.614900        R**2 = 0.2025

REGRESSION EQUATIONS FOR THIGH VOLUME
THIGH VOLUME         =    4.303679 *WEIGHT     +7.249268                              R**2 = 0.8300
THIGH VOLUME         =   28.505460 *STANDING -1195.84300                              R**2 = 0.2621
THIGH VOLUME         =    3.986669 *WEIGHT     +9.002912 *STANDING -519.573000        R**2 = 0.8517

REGRESSION EQUATIONS FOR CALF VOLUME
CALF VOLUME          =    1.181796 *WEIGHT    +24.553420                              R**2 = 0.7279
CALF VOLUME          =    7.057509 *STANDING -256.930700                              R**2 = 0.1868
CALF VOLUME          =    1.127505 *WEIGHT     +1.541819 *STANDING  -65.669080        R**2 = 0.7352
```

```
REGRESSION EQUATIONS FOR FOOT VOLUME
FOOT VOLUME          =    0.140151 *WEIGHT     +21.595400                                R**2 = 0.4114
FOOT VOLUME          =    1.821366 *STANDING   -74.274540                                R**2 = 0.5001
FOOT VOLUME          =    0.091837 *WEIGHT      +1.372106 *STANDING   -58.695980         R**2 = 0.6463


REGRESSION EQUATIONS FOR UPPER ARM VOLUME
UPPER ARM VOLUME     =    0.771218 *WEIGHT     -13.685230                                R**2 = 0.9243
UPPER ARM VOLUME     =    3.988159 *STANDING  -158.182600                                R**2 = 0.1779
UPPER ARM VOLUME     =    0.762054 *WEIGHT      +0.260234 *STANDING   -28.913310         R**2 = 0.9250


REGRESSION EQUATIONS FOR FOREARM VOLUME
FOREARM VOLUME       =    0.368884 *WEIGHT      +4.717636                                R**2 = 0.7614
FOREARM VOLUME       =    1.873929 *STANDING   -62.260620                                R**2 = 0.1414
FOREARM VOLUME       =    0.365933 *WEIGHT      +0.083808 *STANDING    -0.186533         R**2 = 0.7616


REGRESSION EQUATIONS FOR HAND VOLUME
HAND VOLUME          =    0.064923 *WEIGHT     +11.545190                                R**2 = 0.4192
HAND VOLUME          =    0.496572 *STANDING   -10.828770                                R**2 = 0.1765
HAND VOLUME          =    0.057309 *WEIGHT      +0.216218 *STANDING    -1.107230         R**2 = 0.4468
```

REGRESSION EQUATIONS FOR FOREARM PLUS HAND VOLUME

```
FOREARM + HAND VOLUME  =    0.433808 *WEIGHT    +16.262700                              R**2 = 0.7521
FOREARM + HAND VOLUME  =    2.370267 *STANDING  -73.074510                              R**2 = 0.1616
FOREARM + HAND VOLUME  =    0.423253 *WEIGHT     +0.299737 *STANDING   -1.277008        R**2 = 0.7543
```

REGRESSION EQUATIONS FOR ADULT MALE SEGMENT VOLUME

PREDICTING VARIABLES

WEIGHT	RANGE:	118.00	264.00	MEAN:	173.60	S.D.:	21.440
STANDING HEIGHT	RANGE:	62.17	77.64	MEAN:	69.82	S.D.:	2.437

REGRESSION EQUATIONS FOR PELVIS VOLUME

```
PELVIS VOLUME   =  4.765337 *WEIGHT   -116.890400                            R**2 = 0.7760
PELVIS VOLUME   = 31.264240 *STANDING -1489.63800                            R**2 = 0.5733
PELVIS VOLUME   =  6.039989 *WEIGHT   -10.691090 *STANDING +413.002000       R**2 = 0.7875
```

REGRESSION EQUATIONS FOR ABDOMEN VOLUME

```
ABDOMEN VOLUME  =  0.759174 *WEIGHT   +13.403290                             R**2 = 0.2698
ABDOMEN VOLUME  =  4.660814 *STANDING -182.934400                            R**2 = 0.1745
ABDOMEN VOLUME  =  1.184239 *WEIGHT   -3.565218 *STANDING +190.109500        R**2 = 0.2873
```

REGRESSION EQUATIONS FOR THORAX VOLUME

```
THORAX VOLUME   =  9.568200 *WEIGHT   -142.278600                            R**2 = 0.9522
THORAX VOLUME   = 65.865370 *STANDING -3114.55300                            R**2 = 0.7745
THORAX VOLUME   =  9.983014 *WEIGHT   -3.479255 *STANDING  +30.167790        R**2 = 0.9526
```

```
REGRESSION EQUATIONS FOR NECK VOLUME
NECK VOLUME         =    0.283901 *WEIGHT    +15.277530                                R**2 = 0.5468
NECK VOLUME         =    1.825996 *STANDING  -63.947340                                R**2 = 0.3883
NECK VOLUME         =    0.385245 *WEIGHT     -0.850014 *STANDING  +57.407520          R**2 = 0.5613


REGRESSION EQUATIONS FOR HEAD VOLUME
HEAD VOLUME         =    0.251318 *WEIGHT    +223.758300                               R**2 = 0.1628
HEAD VOLUME         =    1.927238 *STANDING +131.907200                                R**2 = 0.1643
HEAD VOLUME         =    0.125367 *WEIGHT     +1.056407 *STANDING +171.398700          R**2 = 0.1712


REGRESSION EQUATIONS FOR THIGH VOLUME
THIGH VOLUME        =    3.366777 *WEIGHT    +22.178710                                R**2 = 0.9117
THIGH VOLUME        =   24.206470 *STANDING -1095.67700                                R**2 = 0.8089
THIGH VOLUME        =    2.797834 *WEIGHT     +4.771981 *STANDING -214.339100          R**2 = 0.9171


REGRESSION EQUATIONS FOR CALF VOLUME
CALF VOLUME         =    1.252436 *WEIGHT    +21.243680                                R**2 = 0.8473
CALF VOLUME         =    9.460768 *STANDING -426.461700                                R**2 = 0.8298
CALF VOLUME         =    0.724384 *WEIGHT     +4.429010 *STANDING -198.275400          R**2 = 0.8785
```

REGRESSION EQUATIONS FOR FOOT VOLUME

```
FOOT VOLUME      =   0.291110 *WEIGHT    +9.215927                               R**2 = 0.7735
FOOT VOLUME      =   2.257187 *STANDING -98.911440                               R**2 = 0.7981
FOOT VOLUME      =   0.128008 *WEIGHT    +1.368013 *STANDING  -58.588170         R**2 = 0.8238
```

REGRESSION EQUATIONS FOR UPPER ARM VOLUME

```
UPPER ARM VOLUME =   0.757131 *WEIGHT    -10.831830                              R**2 = 0.8642
UPPER ARM VOLUME =   5.123630 *STANDING -239.858200                              R**2 = 0.6793
UPPER ARM VOLUME =   0.851218 *WEIGHT    -0.789154 *STANDING  +28.281800         R**2 = 0.8670
```

REGRESSION EQUATIONS FOR FOREARM VOLUME

```
FOREARM VOLUME   =   0.451460 *WEIGHT    +6.405045                               R**2 = 0.8453
FOREARM VOLUME   =   3.096293 *STANDING -133.036500                              R**2 = 0.6825
FOREARM VOLUME   =   0.478980 *WEIGHT    -0.230826 *STANDING  +17.845720         R**2 = 0.8460
```

REGRESSION EQUATIONS FOR HAND VOLUME

```
HAND VOLUME      =   0.122105 *WEIGHT    +10.425090                              R**2 = 0.7538
HAND VOLUME      =   0.899664 *STANDING  -31.637040                              R**2 = 0.7023
HAND VOLUME      =   0.086374 *WEIGHT    +0.299688 *STANDING   -4.428604         R**2 = 0.7672
```

```
REGRESSION EQUATIONS FOR FOREARM PLUS HAND VOLUME
FOREARM + HAND VOLUME  =   0.573555 *WEIGHT    +16.831600                          R**2 = 0.8482
FOREARM + HAND VOLUME  =   3.996506 *STANDING -164.711900                          R**2 = 0.7069
FOREARM + HAND VOLUME  =   0.564920 *WEIGHT      +0.072425 *STANDING  +13.241960   R**2 = 0.8483
```

APPENDIX E

ANTHROPOMETRIC TERMS AND LANDMARK DESCRIPTIONS

Abduct: to move from the axis of the body or one of its parts.

Acromiale Landmark (right and left): the most lateral point on the lateral margin of the acromial process of each scapula--a point on the tip of each shoulder.

Acomion: same as acromiale.

Ankle Landmark: the level of the minimum circumference of the ankle as established by measuring. Proximal to the malleoli (rounded bony prominences on either side of ankle).

Anterior: pertaining to the front of the body; as opposed to posterior.

Anterior Superior Iliac Spine (right and left) (females): the inferior point of each anterior superior iliac spine of the ilium.

Anterior Superior Iliac Spine (right and left) (males): the most prominent point of each anterior superior iliac spine of the ilium.

Axilla: the arm pit.

Biceps Landmark: the level of maximum bulge of the tensed biceps when the arm is bent to a right angle.

Biceps Circumference Landmark: same as biceps landmark.

Brow Ridges: the bony ridges of the anterior forehead which lie above the orbits of the eye.

Bustpoint Landmarks: most anterior protrusion of the right bra pocket.

Buttock Landmark: the maximum posterior protrusion of the right buttock.

Calf Landmark (right and left): the level of the maximum circumference of the calf as established by measurement.

Cervicale: the superior tip of the spine of the 7th cervical vertebra. (The protrusion of the spinal column at the base of the neck.)

Clavicale (right and left): The point on the most imminent prominence of the superior aspect of the medial end of each clavicle.

Dactylion: the tip of the middle finger.

Distal: the end of a body segment farthest from the head; opposed to proximal.

Epicondyle: bony eminence at the distal end of the humerus and femur.

Extend: to move adjacent segments so that the angle between them is increased as when the leg is straightened; opposite of flex.

Femoral Epicondyle, Lateral (right and left): the lateral point on the lateral epicondyle of each femur.

Femoral Epicondyle, Medial (right and left): the medial point on the medial epicondyle of each femur.

Femur: the thigh bone.

Flex: to move a joint in such a direction as to bring together the two parts which it connects, as when the elbow is bent.

Forearm Landmark: a level one tape width (6mm) distal to the crotch of the elbow with the elbow flexed 90 degrees.

Frankfort Plane: the standard horizontal plane or orientation of the head. The plane is established by a line passing through the right tragion and the lowest point of the right orbit (eye socket).

Glabella: the most anterior point of the forehead between the brow ridges in the midsagittal plane.

Gluteal Furrow: the furrow at the juncture of the buttock and thigh.

Humeral Epicondyle, Lateral (right and left): the lateral point on the lateral epicondyle of each humerus with the arm in the anatomical position.

Humeral Epicondyle, Medial (right and left): the medial point on the medial epicondyle of each humerus with the arm in the anatomical position.

Humerus: the upper arm bone.

Hyperextend: to overextend a limb or part of the body.

Ilium: the upper one of three bones composing either lateral half of the pelvis.

Inferior: below in relation to another structure; lower.

Lateral: lying near or toward the sides of the body; opposed to medial.

Lower Arm Circumference Landmark: the level of maximum circumference of the tensed lower arm when the arm is bent to a right angle.

Malleolus, Lateral (right and left): the most lateral point on the lateral bony protrusion of each ankle.

Malleolus, Medial (right and left): the most medial point on the medial bony protrusion of each ankle.

Medial: lying near or towards the midline of the body; opposed to lateral.

Menton: the point of the tip of the chin in the midsagittal plane.

Metacarpal: pertaining to the long bones of the hand between the wrist and the phalanges.

Metatarsal: pertaining to the long bones of the foot between the tarsus and the phalanges.

Midpatella: a point one-half the distance between the superior and inferior margins of the patella.

Midsagittal Plane: the vertical plane which divides the body into right and left halves.

Neck Landmarks: at the level of the juncture of the neck with the shoulders. This level is established by laying a string tie or a tape around the base of the neck.

Occiput: a bone forming the posterior base of the skull.

Omphalion: the level of the midpoint of the naval.

Patella: the kneecap.

Phalanges: the bones of the fingers and toes.

Popliteal: pertaining to the area of the back of the leg directly behind the knee.

Posterior: pertaining to the back of the body; as opposed to anterior.

Posterior Superior Iliac Midspine: the point on the mid-spine made at the level of the posterior superior iliac spines. A dimple often indicates the site of this iliac spine.

Proximal: the end of a body segment nearest the head; opposed to distal.

Radial Styloid (right and left): the distal end of each radius.

Radiale: the uppermost point on the lateral margin of the head of the radius.

Radius: the bone of the forearm on the thumb side of the arm.

Scapula: the shoulder blade.

Scye: a tailoring term to designate the armhole of a garment. Refers here to landmarks which approximate the lower level of the axilla.

Stylion: same as radial styloid.

Superior: above in relation to another structure; higher.

Suprapatella: the superior point on the patella while it is in the relaxed position.

Symphysion (females): the anterior point in the midsagittal plane on the notch of the superior border of the pubic symphysis, the anterior juncture of the pelvic bones.

Symphysion (males): the lowest point on the superior border of the pubic symphysis, the anterior juncture of the pelvic bones.

Tenth Rib: the inferior point on the inferior border of the lowest of the two tenth ribs. The midspine landmark is made at this level but marked on the midspine.

Tibiale: the uppermost point of the medial margin of the tibia (shin bone).

Tragion (right and left): the point located at the notch just above the tragus of each ear. This point corresponds to the upper edge of the ear hole.

Tragus: the small cartilaginous flap of flesh in front of the ear hole.

Trochanterion (right and left): the superior point on the greater trochanter of each femur.

Ulna: one of the bones of the forearm on the little finger side of the arm.

Ulnar Styliod (right and left): the most distal point of each ulna.

Vertex: the top of the head.

Waist Landmark: the level established by the subject placing an elastic tape around her "natural waist".

Wrist Landmark (females): the level of the extension of the radial stylion point across the anterior surface of the forearm perpendicular to the long axis of the forearm.

Wrist Landmark (males): the level of minimum circumference of the wrist just above (toward the elbow) the bony prominences on each side of the wrist.

APPENDIX F

ANTHROPOMETRY DESCRIPTIONS

Appendix F contains a description of each body dimension required by GEBODIII given in the order as referenced by the program. Neither the 1967 nor the 1968 USAF anthropometric survey included all the needed measurements. When a needed measurement was not taken from a survey, that measurement was derived from available measurements. A description of the available measurements is given. Since hand depth was not measured in the 1968 USAF female survey, refer to the male description. The first set of descriptions are for the adult human female and are taken directly from the 1968 survey report, Clauser, et al. (1972). The second set of descriptions are for the adult human male and are taken directly from the 1967 survey report, Grunhofer and Kroh (1975).

ADULT HUMAN FEMALE ANTHROPOMETRY DESCRIPTIONS

The number in parentheses following each description is the number by which this variable is identified in the original 1968 USAF survey.

0. WEIGHT: Subject stands on scales (nude or wearing lightweight undergarments) with feet parallel and weight distributed equally on both feet. (2)

1. STANDING HEIGHT: Subject stands erect, head in the Frankfort plane, heels together, and weight distributed equally on both feet. With the arm of the anthropometer firmly touching the scalp, measure the vertical distance from the standing surface to the top of the head. (7)

2. SHOULDER HEIGHT: Subject stands erect looking straight ahead, heels together, and weight distributed equally on both feet. With an anthropometer, measure the vertical distance from the standing surface to the right acromiale landmark. (10)

3. ARMPIT HEIGHT: Measurement derived by subtracting Scye Circumference divided by π from Shoulder Height (see above).

    Scye Circumference: Subject stands erect looking straight ahead. The right arm is abducted sufficiently to allow placement of a tape into the axilla. With a tape passing through the axilla, over the anterior and posterior-vertical scye landmarks and over the right acromiale landmark, measure the circumference of the scye. The axillary tissue is not compressed. (53)

4. WAIST HEIGHT: Subject stands erect looking straight ahead,

heels together, and weight distributed equally on both feet. With an anthropometer, measure the vertical distance from the standing surface to the anterior waist landmark. (13)

5. SEATED HEIGHT: Subject sits erect, head in the Frankfort plane, upper arms hanging relaxed, forearms and hands extended forward horizontally. With the anthropometer arm firmly touching the scalp, measure the vertical distance from the sitting surface to the top of the head. (23)

6. HEAD LENGTH: Subject sits. With a spreading caliper, measure in the midsagittal plane the maximum length of the head between the glabella landmark and the occiput. (96)

7. HEAD BREADTH: Subject sits. With a spreading caliper measure the maximum horizontal breadth of the head above the level of the ears. (97)

8. HEAD TO CHIN HEIGHT: Subject stands under the headboard looking straight ahead. The headboard is adjusted so that its vertical and horizontal planes are in firm contact with the back and the top of the head. Positioning the head in the Frankfort plane and using the special gauge, measure the vertical distance from the horizontal plane to the menton landmark. (104)

9. NECK CIRCUMFERENCE: Subject sits erect, head in the Frankfort plane. A piece of dental tape is placed around the neck, passing over all four neck landmarks. The measurer marks off with her thumbnail a length of tape corresponding to the subject's neck circumference, and then measures this tape segment with a standard tape. (36)

10. SHOULDER BREADTH: Subject sits erect looking straight ahead, upper arms hanging relaxed, forearms and hands

extended forward horizontally. With a beam caliper, measure the distance between the acromiale landmarks. (63)

11. CHEST DEPTH: Subject stands erect looking straight ahead, heels together, and weight distributed equally on both feet. With a beam caliper, measure the horizontal depth of the trunk at the level of the bustpoint landmarks. The reading is made at the point of maximum quiet inspiration. (74)

12. CHEST BREADTH: Subject stands erect looking straight ahead with arms slightly abducted. With a beam caliper, measure the horizontal distance across the trunk at the level of the bustpoint landmarks. (74)

13. WAIST DEPTH: Subject stands erect looking straight ahead, arms at sides, heels together, and weight distributed equally on both feet. With a beam caliper, measure the horizontal depth of the trunk at the level of the waist landmarks. The reading is made at the point of maximum quiet inspiration. The subject must not pull in her stomach. (75)

14. WAIST BREADTH: Subject stands erect looking straight ahead with arms slightly abducted. With a beam caliper, measure the horizontal breadth across the trunk at the level of the waist landmarks. (67)

15. BUTTOCK DEPTH: Subject stands erect, heels together and weight distributed equally on both feet. With a beam caliper, measure the horizontal depth of the trunk at the level of the buttock landmark. (77)

16. HIP BREADTH, STANDING: Subject stands erect, heels together and weight distributed equally on both feet. With a beam caliper, measure the maximum horizontal breadth of the hips. (68)

17. SHOULDER TO ELBOW LENGTH: Subject stands erect looking straight ahead and with arms relaxed. With a beam caliper held parallel to the long axis of the right upper arm, measure the distance from the acromiale landmark to the radiale landmark. (31)

18. FOREARM-HAND LENGTH: Measurement derived by summing Radiale-Stylion Length and Hand Length (see below).

Radiale-Stylion Length: Subject stands erect with arms relaxed. With a beam caliper held parallel to the long axis of the right forearm, measure the distance from the radiale landmark to the stylion landmark. (32)

19. BICEPS CIRCUMFERENCE: Subject stands with right arm slightly abducted. With a tape held in a plane perpendicular to the long axis of the upper arm, measure the circumference of the arm at the level of the biceps landmark. (55)

20. ELBOW CIRCUMFERENCE: Subject stands, right upper arm raised so that its long axis is horizontal, elbow flexed 90 degrees, fist tightly clenched and biceps strongly contracted. With a tape passing over the tip and through the crotch of the elbow, measure the circumference of the elbow. (59)

21. FOREARM CIRCUMFERENCE: Subject stands erect with right arm slightly abducted and hand relaxed. With a tape held in a

plane perpendicular to the long axis of the forearm, measure the circumference of the arm at the level of the forearm landmark. (60)

22. WRIST CIRCUMFERENCE: Subject stands with right arm slightly abducted. With a tape held in a plane perpendicular to the long axis of the forearm and hand, measure the circumference of the wrist at the level of the stylion landmark. (62)

23. KNEE HEIGHT, SEATED: Measurement derived by summing Knee Circumference (see below) divided by 2π and Tibiale Height.

Tibiale Height: Subject stands erect, heels together, and weight distributed equally on both feet. With an anthropometer, measure the vertical distance from the standing surface to the tibiale landmark on the right leg. (18)

24. THIGH CIRCUMFERENCE: Subject stands erect, heels approximately 10 cm apart, and weight distributed equally on both feet. With a tape held in a plane perpendicular to the long axis of the right thigh measure the circumference of the thigh at the level of the lowest point on the gluteal furrow. Where the furrow is deeply indented, the measurement is made just distal to the furrow.

25. UPPER LEG CIRCUMFERENCE: Measurement derived by summing the Thigh Circumference (45) (see above) and the Knee Circumference (46) (see below) and dividing the sum by two to obtain the average.

26. KNEE CIRCUMFERENCE: Subject stands erect, heels approximately 10 cm apart, and weight distributed equally on both feet. With a tape held in a plane perpendicular to the long axis of the right leg, measure the circumference of the

knee at the level of the midpatella landmark. The subject must not tense her knee during the measurement. (46)

27. CALF CIRCUMFERENCE: Subject stands erect, heels approximately 10 cm apart, and weight distributed equally on both feet. With a tape held in a plane perpendicular to the long axis of the right lower leg, measure the circumference of the calf at the level of the calf landmark. (47)

28. ANKLE CIRCUMFERENCE: Subject stands erect with weight distributed equally on both feet. With a tape held in a plane perpendicular to the long axis of the right lower leg, measure the circumference of the leg at the level of the ankle landmark. (49)

29. ANKLE HEIGHT, OUTSIDE: Subject stands with weight distributed equally on both feet. With the special measuring block, measure the vertical distance from the standing surface to the lateral malleolus landmark on the right leg. (21)

30. FOOT BREADTH: Subject stands erect, right foot in the measuring box, left foot on a board of equal height, and weight distributed equally. The right foot is positioned so that its long axis is parallel to the side of the box, the heel touches the rear of the box, and the medial metatarsal-phalangeal joint touches the widest part of the foot, measure on the scale of the box the breadth of the foot. (95)

31. FOOT LENGTH: Subject stands erect, right foot in the measuring box, left foot on a board of equal height, and weight distributed equally. The right foot is positioned so that its long axis is parallel to the side of the box, the heel touches the rear of the box, and the medial metatarsal-

phalangeal joint touches the side of the box. With the measuring block touching the tip of the most protruding toe, measure on the scale of the box the length of the foot. (94)

32. HAND BREADTH: Subject sits, right forearm and hand raised with palm down. The fingers are together and straight but not hyper-extended. With a sliding caliper, measure the breadth of the hand between metacarpal-phalangeal joints II and V. (92)

33. HAND LENGTH: Subject sits, right forearm and hand raised with palm up. The fingers are together and straight but not hyper-extended. With the bar of a sliding caliper parallel to the long axis of the hand, measure the distance from the wrist landmark to the dactylion. (91)

ADULT HUMAN MALE ANTHROPOMETRIC DESCRIPTIONS

The number in parentheses following each description is the number by which this variable is identified in the original 1967 USAF survey.

0. WEIGHT: Subject is nude. The scale is read to the nearest pound. (2)

1. STANDING HEIGHT: Subject stands erect with head in the Frankfort plane. With the anthropometer arm touching the scalp, measure the vertical distance from the standing surface to the top of the head. (13)

2. SHOULDER HEIGHT: Subject stands erect. Using the anthropometer, measure the vertical distance from the standing surface to the right acromiale landmark. (15)

3. ARMPIT HEIGHT: Measurement derived by subtracting Scye Circumference divided by π from Shoulder Height (see above).

   Scye Circumference: Subject stands, his right arm initially raised, and then lowered after the tape is in place. Measure the circumference of the scye with the tape placed as high as possible in the right armpit and passing vertically over the shoulder. (103)

4. WAIST HEIGHT: Subject stands erect, his head in the Frankfort plane. Using an anthropometer, measure the distance from the standing surface to the omphalion landmark. The subject must not pull in his stomach. (21)

5. SEATED HEIGHT: Subject sits erect, his head in the Frankfort plane, his upper arms hanging relaxed, and his

forearms and hands extended forward horizontally. Using an anthropometer, measure the vertical distance from the sitting surface to the top of the head. (32)

6. HEAD LENGTH: Subject sits. With a spreading caliper, measure the maximum length of the head between the glabella and the occiput in the midsagittal plane. (150)

7. HEAD BREADTH: Subject sits. Holding the spreading caliper near the tips, measure the maximum breadth of the head in a line perpendicular to the midsagittal plane. (156)

8. HEAD TO CHIN HEIGHT: Subject stands comfortably under the headboard with his head oriented in the Frankfort plane. The headboard slide is then adjusted so that its wall and ceiling surfaces are in firm contact with the back and vertex of the subject's head. His head is rechecked for orientation and for continued contact at both points. Using the headboard caliper, measure the vertical distance from vertex to the menton landmark. (179)

9. NECK CIRCUMFERENCE: Subject stands erect, his head in the Frankfort plane. Holding the tape perpendicular to the long axis of the neck, measure the maximum circumference of the neck, including the Adam's apple. (66)

10. SHOULDER BREADTH: Subject sits erect, his head in the Frankfort plane, his arms hanging relaxed, and his forearms and hands extended forward horizontally. Using a beam caliper, measure the horizontal distance between the right and left acromiale landmarks. (50)

11. CHEST DEPTH: Subject stands erect, his head in the Frankfort plane. With a beam caliper, measure the horizontal depth of the trunk at the level of the nipples.

The reading is made at the point of maximum quiet inspiration. (62)

12. CHEST BREADTH: Subject stands erect, his head in the Frankfort plane, and his arms slightly abducted. Using a beam caliper, measure the horizontal distance across the trunk at the level of the nipples. (52)

13. WAIST DEPTH: Subject stands erect, his head in the Frankfort plane. Using a beam caliper, measure the horizontal depth of the trunk at the level of the omphalion landmark. The reading is made at the point of maximum quiet inspiration. The subject must not pull in his stomach. (63)

14. WAIST BREADTH: Subject stands erect, his head in the Frankfort plane. Using a beam caliper, measure the horizontal distance across the trunk at the level of the omphalion landmark. (53)

15. BUTTOCK DEPTH: Subject stands erect, his head in the Frankfort plane. Using a beam caliper, measure the horizontal depth of the trunk at the level of maximum protrusion of the buttocks. (64)

16. HIP BREADTH, STANDING: Subject stands erect, feet together. Using a beam caliper, measure the horizontal distance across the widest portion of the hips. (55)

17. SHOULDER TO ELBOW LENGTH: Subject sits erect, his head in the Frankfort plane, his arms hanging relaxed, and his forearms and hands extended forward horizontally. Using a beam caliper, measure the vertical distance from the right acromiale landmark to the bottom of the elbow (olecranon process). (42)

18. FOREARM-HAND LENGTH: Measurement derived by adding the Elbow-Wrist Length and Wrist Height, and then subtracting Dactylion Height.

Elbow-Wrist Length: Subject stands erect, his right upper arm hanging at side, his lower arm and hand extended forward horizontally. Using the beam caliper, measure the distance from the tip of the right elbow to the stylion landmark. (44)

Wrist Height: Subject stands erect, his arms hanging naturally at his sides. Using the anthropometer, measure the vertical distance from the standing surface to the stylion landmark on the right wrist. (17)

Dactylion Height: Subject stands erect with his arms hanging at his sides, his elbows fully extended and his fingers pointing to the standing surface. Using the anthropometer, measure the vertical distance from the standing surface to the tip of the right middle finger. (18)

19. BICEPS CIRCUMFERENCE: Measurement derived by summing Biceps Circumference, Extended, Right; Biceps Circumference, Extended, Left; Biceps Circumference, Flexed, Right; and Biceps Circumference, Flexed, Left. This sum is then divided by four to obtain the average.

Biceps Circumference, Extended, Right: Subject stands erect, his right arm extended with the hand about 30 cm from the side of the body. Holding the tape perpendicular to the long axis of the upper arm, measure the circumference of the arm at the biceps circumference landmark. (104)

Biceps Circumference, Extended, Left: Subject stands erect, his left arm extended with the hand about 30 cm from the side of the body. Holding the tape perpendicular to the long axis of the upper arm, measure the circumference of the arm at the biceps circumference landmark. (105)

Biceps Circumference, Flexed, Right: Subject bends his right arm to about a right angle and makes a fist while holding the upper arm horizontally. Using the tape, measure the circumference of the arm at the biceps circumference landmark. (106)

Biceps Circumference, Flexed, Left: Subject bends his left arm to about a right angle and makes a fist while holding the upper arm horizontally. Using the tape, measure the circumference of the arm at the biceps circumference landmark. (107)

20. ELBOW CIRCUMFERENCE: Subject bends his right arm to about a right angle and makes a fist while holding the upper arm horizontally. With the tape passing over the tip and through the crotch of the elbow, measure the circumference of the elbow. (109)

21. FOREARM CIRCUMFERENCE: Subject stands, his right elbow extended and his hand about 30 cm from the side of the body. Holding the tape perpendicular to the long axis of the arm, measure the circumference of the arm at the level of the lower arm circumference landmark. (110)

22. WRIST CIRCUMFERENCE: Subject stands, his right elbow extended, with the hand about 30 cm from the side of the body. Holding the tape perpendicular to the long axis of

the lower arm, measure the circumference of the wrist at the level of the wrist landmark. (112)

23. KNEE HEIGHT, SEATED: Subject sits with his feet resting on a surface adjusted so that the knees are bent at about right angles. Using an anthropometer, measure the vertical distance from the footrest surface to the suprapatella landmark on the right knee. (37)

24. THIGH CIRCUMFERENCE: Subject stands with his legs slightly apart. Holding the tape in a plane at right angles to the long axis of the right leg at the level of the lowest point on the gluteal furrow, measure the circumference of the upper thigh. (96)

25. UPPER LEG CIRCUMFERENCE: Subject stands erect. Holding a tape in a horizontal plane, measure the circumference of the knee at the level of the center of the relaxed patella. (98)

26. KNEE CIRCUMFERENCE: Subject sits erect, his feet resting on a surface so that the knees are bent at about right angles. With the tape passing under the popliteal area of the right leg and brought up at about a 45-degree angle over the knee, measure the maximum circumference of the right knee. (99)

27. CALF CIRCUMFERENCE: Subject stands with legs slightly apart. Holding a tape in a plane perpendicular to the long axis of the leg, measure the maximum circumference of the right calf. (100)

28. ANKLE CIRCUMFERENCE: Subject stands with legs slightly apart. Holding a tape in a plane perpendicular to the long axis of the leg, measure the minimum circumference of the right ankle. (102)

29. ANKLE HEIGHT, OUTSIDE: Subject stands with his right foot slightly forward and his weight equally distributed on both feet. Touch the measuring-block scale against the lateral side of the foot and measure the height of the landmark indicating the minimum circumference of the right ankle. (31)

30. FOOT BREADTH: Subject stands with his right foot in the foot box, the foot just touching the side and rear walls, its long axis parallel to the side wall, and his weight equally distributed on both feet. With the block touching the widest part of the foot, measure foot width from the side wall, using the scale on the floor of the box. (127)

31. FOOT LENGTH: Subject stands with his right foot in the foot box, the foot just touching the side and rear walls, its long axis parallel to the side wall, and his weight equally distributed on both feet. With the block touching the tip of the longest toe, measure foot length from the rear wall, using the scale on the floor of the box. (125)

32. HAND BREADTH: Subject sits with his right hand resting on a table, palm up, fingers extended and together. The thumb is held away from the hand. Using the sliding caliper, measure the maximum breadth from Metacarpale II to Metacarpale V. (136)

33. HAND LENGTH: Subject sits with his right hand resting flat on a table, palm up, fingers extended and together. With the bar of the sliding caliper parallel to the long axis of the hand, measure the distance from the wrist landmark to the tip of the longest finger. (134)

34. HAND DEPTH: Subject's right hand is held palm down with fingers extended and together, narrow profile towards the

measurerer. Maintaining light pressure on the spreading caliper, measure the thickness of the hand at the metacarpal-phalangeal joint of the third finger. (140)

APPENDIX G
SUMMARY STATISTICS

The summary statistics given in Appendix G lists, for each variable (in alphabetical order), the mean, standard deviation (STD), a measure of symmetry in distribution (SKEW), a measure of kurtosis in distribution (KURT), the coefficient of variation (CV), minimum dimensional value (MIN), and the maximum dimensional value (MAX). The 1968 USAF survey statistics are based on N = 1905; the 1967 USAF survey statistics are based on N = 2420. Weight is expressed in pounds and all other dimensional values are expressed in inches. The statistics for both surveys were obtained using the Anthropometric Data Base at the Center for Anthropometric Research Data (Robinson, Robinette, and Zehner, 1989). The computational methods used to calculate these statistics can be found in Clauser, et al. (1972). The symmetry statistic (skewness) as given in that reference is subtracted from 3.00, so that a symmetric distribution approaches a skewness value of 0.0 rather than 3.0.

SUMMARY STATISTICS

1968 USAF FEMALES

VARIABLE NAME	MEAN	STD	SKEW	KURT	CV	MIN	MAX
ANKLE CIRC	8.29	.50	.26	-.05	6.11	6.8	10.0
ANKLE HT, OUTSIDE	2.66	.23	.04	.23	8.67	1.9	3.4
BICEPS CIRC	10.08	.90	.62	1.04	8.96	7.6	14.7
BUTTOCK DEPTH	8.32	.70	.54	.95	8.46	6.3	12.0
CALF CIRC	13.44	.88	.25	.29	6.58	10.5	17.5
CHEST BREADTH	11.02	.75	.47	.39	6.84	8.7	14.1
CHEST DEPTH	9.30	.75	.66	.71	8.17	7.2	12.7
ELBOW CIRC	10.62	.70	.26	.31	6.61	8.4	14.0
FOOT BREADTH	3.49	.19	.26	.55	5.61	2.7	4.3
FOOT LENGTH	9.47	.44	.12	-.14	4.69	8.2	10.8
FOREARM CIRC	9.24	.54	.38	.63	5.87	7.7	11.8
HAND BREADTH	2.97	.15	-.01	.03	5.16	2.4	3.4
HAND LENGTH	7.23	.37	.25	.02	5.22	6.0	8.6
HEAD BREADTH	5.71	.23	.11	.16	4.10	4.9	6.7
HEAD LENGTH	7.24	.26	.03	-.05	3.69	6.4	8.1
HEAD TO CHIN HT	8.62	.44	.15	.31	5.20	7.2	10.5
HIP BR, STANDING	13.76	.87	.39	.44	6.34	11.2	17.3
KNEE CIRC	14.29	.89	.45	.44	6.24	12.0	17.9
NECK CIRC	13.28	.66	.30	.11	4.97	11.2	15.7
RADIALE-STYLION LTH	9.20	.53	.14	.03	5.85	7.5	11.0
SCYE CIRC	14.60	.90	.42	.64	6.17	11.2	19.2
SEATED HEIGHT	33.70	1.24	.08	-.14	3.70	29.6	37.9
SHOULDER BREADTH	14.11	.64	.09	.19	4.57	12.1	16.3
SHOULDER HEIGHT	51.91	2.15	.14	-.21	4.16	45.7	59.8
SHOULDER TO ELBOW L	12.20	.64	-.02	.02	5.24	9.9	14.3
STANDING HEIGHT	63.82	2.36	.16	-.22	3.70	56.9	72.0
TIBIALE HEIGHT	16.52	.93	.22	.02	5.66	13.4	19.5
THIGH CIRC	21.83	1.66	.32	.42	7.61	17.1	28.3
WAIST BREADTH	9.49	.76	.52	.55	8.02	7.4	12.8
WAIST DEPTH	6.69	.65	1.14	2.42	9.83	5.1	10.0
WAIST HEIGHT	39.48	1.77	.15	-.14	4.49	34.3	45.4

SUMMARY STATISTICS
1968 USAF FEMALES
(CONTINUED)

VARIABLE NAME	MEAN	STD	SKEW	KURT	CV	MIN	MAX
WEIGHT	127.28	16.59	.64	.86	13.03	85.0	200.0
WRIST CIRC	5.88	.27	.26	.14	4.76	4.9	6.9

SUMMARY STATISTICS
1967 USAF MALES

VARIABLE NAME	MEAN	STD	SKEW	KURT	CV	MIN	MAX
ANKLE CIRC	8.82	.49	.19	.12	5.64	7.1	10.5
ANKLE HT, OUTSIDE	5.40	.45	.36	-.04	8.35	4.0	7.0
BICEPS CIRC, EX, L	11.96	.92	.10	.00	7.70	8.6	15.1
BICEPS CIRC, EX, R	12.12	.92	.12	.00	7.59	9.1	15.2
BICEPS CIRC, FL, L	12.64	.88	.16	.06	6.99	9.9	15.7
BICEPS CIRC, FL, R	12.88	.88	.12	.05	6.90	9.9	16.0
BUTTOCK DEPTH	9.43	.80	.19	.14	8.57	6.7	13.3
CALF CIRC	14.64	.89	.11	.09	6.10	11.8	17.7
CHEST BREADTH	12.90	.83	.34	.24	6.46	10.2	16.3
CHEST DEPTH	9.65	.75	.12	-.02	7.87	7.5	12.4
DACTYLION HEIGHT	26.44	1.38	.11	-.07	5.23	22.4	31.0
ELBOW CIRC	12.29	.68	.18	-.02	5.59	10.1	14.5
ELBOW-WRIST LTH	11.80	.55	.10	.06	4.71	10.0	13.6
FOOT BREADTH	3.84	.19	.31	.20	5.07	3.3	4.6
FOOT LENGTH	10.64	.46	.15	.09	4.40	9.1	12.3
FOREARM CIRC	11.08	.57	.10	-.07	5.19	9.2	12.8
HAND BREADTH	3.50	.16	.12	-.04	4.66	2.9	4.0
HAND DEPTH	1.09	.08	.02	.74	7.56	.7	1.4
HAND LENGTH	7.52	.32	.16	.02	4.29	6.5	8.7
HEAD BREADTH	6.14	.21	.13	-.06	3.48	5.4	6.9
HEAD LENGTH	7.82	.26	.10	.18	3.39	6.8	8.8
HEAD TO CHIN HT	8.96	.40	-.02	-.13	4.49	7.5	10.2
HIP BR, STANDING	13.88	.74	.28	.57	5.35	11.2	17.5
KNEE CIRC	15.47	.83	.30	.22	5.40	13.1	19.1
KNEE HT, SEATED	21.95	.98	.09	.03	4.46	18.7	25.2
NECK CIRC	15.09	.75	.29	.19	4.98	12.8	17.7
SCYE CIRC	19.03	1.09	.08	.00	5.76	15.9	23.3
SEATED HEIGHT	36.68	1.25	.09	-.03	3.41	31.8	41.2
SHOULDER BREADTH	16.03	.76	-.07	.19	4.77	13.3	18.6
SHOULDER HEIGHT	57.16	2.26	.02	-.08	3.96	50.3	64.7
SHOULDER TO ELBOW L	14.15	.67	.11	-.05	4.77	12.0	16.8

SUMMARY STATISTICS

1967 USAF MALES

(CONTINUED)

VARIABLE NAME	MEAN	STD	SKEW	KURT	CV	MIN	MAX
STANDING HEIGHT	69.81	2.43	.06	-.14	3.49	62.1	77.6
THIGH CIRC	23.15	1.74	.11	.17	7.54	17.9	29.8
UPPER LEG CIRC	15.22	.81	.19	.28	5.36	12.4	18.9
WAIST BREADTH	12.18	.94	.33	.60	7.72	9.2	17.3
WAIST DEPTH	8.78	.85	.37	.37	9.78	6.4	13.2
WAIST HEIGHT	41.91	1.85	.04	-.06	4.44	36.1	48.7
WEIGHT	173.59	21.45	.31	.09	12.35	117.9	264.0
WRIST CIRC	6.92	.36	.35	.07	5.23	5.9	8.1
WRIST HEIGHT	34.08	1.55	.12	-.05	4.55	29.6	39.5

APPENDIX H
EXAMPLE OUTPUT LISTINGS

Appendix H contains an example output listing for the 15 segment configuration, and an example output listing for the 17 segment configuration.

SAMPLE FIFTEEN SEGMENT OUTPUT

ADULT HUMAN MALE

SELECTED BODY DIMENSIONS

WEIGHT	168.5	LB.
STANDING HEIGHT	68.10	IN.

COMPUTED BODY DIMENSIONS

0	WEIGHT	168.5	LB.
1	STANDING HEIGHT	68.10	IN.
2	SHOULDER HEIGHT	55.66	IN.
3	ARMPIT HEIGHT	49.66	IN.
4	WAIST HEIGHT	40.69	IN.
5	SEATED HEIGHT	36.00	IN.
6	HEAD LENGTH	7.783	IN.
7	HEAD BREADTH	6.127	IN.
8	HEAD TO CHIN HEIGHT	8.885	IN.
9	NECK CIRCUMFERENCE	15.06	IN.
10	SHOULDER BREADTH	15.87	IN.
11	CHEST DEPTH	9.635	IN.
12	CHEST BREADTH	12.84	IN.
13	WAIST DEPTH	8.791	IN.
14	WAIST BREADTH	12.11	IN.
15	BUTTOCK DEPTH	9.416	IN.
16	HIP BREADTH,STANDING	13.74	IN.
17	SHOULDER TO ELBOW LENGTH	13.80	IN.
18	FOREARM-HAND LENGTH	19.00	IN.
19	BICEPS CIRCUMFERENCE	12.41	IN.
20	ELBOW CIRCUMFERENCE	12.16	IN.
21	FOREARM CIRCUMFERENCE	11.03	IN.
22	WRIST CIRCUMFERENCE	6.861	IN.
23	KNEE HEIGHT,SEATED	21.36	IN.
24	THIGH CIRCUMFERENCE	23.10	IN.
25	UPPER LEG CIRCUMFERENCE	15.06	IN.
26	KNEE CIRCUMFERENCE	15.30	IN.
27	CALF CIRCUMFERENCE	14.59	IN.
28	ANKLE CIRCUMFERENCE	8.755	IN.
29	ANKLE HEIGHT,OUTSIDE	5.247	IN.
30	FOOT BREADTH	3.794	IN.
31	FOOT LENGTH	10.43	IN.

WEIGHT CORRECTION FACTOR = .963

SAMPLE FIFTEEN SEGMENT OUTPUT

CRASH VICTIM PARAMETERS (3-D)

CARDS B.2

SEGMENT			WEIGHT	PRINCIPAL MOMENT OF INERTIA (LB-SEC**2-IN)			SEGMENT CONTACT ELLIPSOID SEMIAXIS (IN)			CENTER (IN)			PRINCIPAL AXES (DEG)		
I	SYM	PLOT	(LB.)	X	Y	Z	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL
1	LT	1	24.444	.8965	.8257	1.0458	4.708	6.871	3.548	-.471	.000	.352	.00	.00	.00
2	CT	2	5.109	.1431	.0813	.2176	4.396	6.055	3.893	-1.465	.000	-.411	.00	.00	.00
3	UT	3	51.324	4.1149	3.0331	2.6163	4.817	6.419	6.735	.000	.000	.000	.00	14.40	.00
4	N	4	2.242	.0152	.0185	.0231	2.396	2.396	2.977	-.479	.000	1.719	.00	.00	.00
5	H	5	9.200	.1771	.2016	.1324	3.892	3.063	5.641	-1.112	.000	.000	.00	36.00	.00
6	RUL	6	20.249	.2453	.2441	.0150	3.037	3.037	11.482	.000	-.322	.000	.00	.00	.00
7	RLL	7	7.841	.4534	.4606	.0565	2.322	2.322	8.752	.929	-1.197	.000	.00	.00	.00
8	RF	8	1.953	.0358	.0338	.0066	2.624	1.897	5.216	2.099	-.697	.000	-4.00	8.40	-6.10
9	LUL	9	20.249	.2453	.2441	.0150	3.037	3.037	11.482	.000	.322	.000	.00	.00	.00
10	LLL	A	7.841	.4534	.4606	.0565	2.322	2.322	8.752	.929	1.197	.000	.00	.00	.00
11	LF	B	1.953	.0358	.0338	.0066	2.624	1.897	5.216	2.099	.697	.000	4.00	8.40	6.10
12	RUA	C	4.104	.1065	.1140	.0233	1.975	1.975	6.898	.000	-.240	.000	.00	.00	.00
13	RLA	D	3.944	.2453	.2441	.0150	1.756	1.756	9.499	.000	.609	1.187	.00	.00	.00
14	LUA	E	4.104	.1065	.1140	.0233	1.975	1.975	6.898	.000	.240	.000	.00	.00	.00
15	LLA	F	3.944	.2453	.2441	.0150	1.756	1.756	9.499	.000	-.609	1.187	.00	.00	.00

CARDS B.3

JOINT					LOCATION(IN) - SEG(JNT)			LOCATION(IN) - SEG(J+1)			JOINT AXIS(DEG) - SEG(JNT)			JOINT AXIS(DEG) - SEG(J+1)		
J	SYM	PLOT	JNT	PIN	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL	YAW	PITCH	ROLL
1	P	M	1	0	-1.40	.00	-2.31	-2.30	.00	2.44	.00	.00	.00	.00	5.00	.00
2	W	N	2	0	-1.75	.00	-.86	-.36	.00	7.21	.00	.00	.00	.00	5.00	.00
3	NP	O	3	0	-.31	.00	-7.47	-1.00	.00	1.52	.00	.00	.00	.00	10.00	.00
4	HP	P	4	0	1.15	.00	-2.56	.26	.00	2.37	.00	.00	.00	.00	10.00	.00
5	RH	Q	1	0	-.54	2.14	1.60	-.26	-1.93	-7.24	.00	.00	.00	.00	-45.00	.00
6	RK	R	6	1	-.25	.37	9.44	.69	-.60	-6.61	.00	.00	.00	.00	60.00	.00
7	RA	S	7	0	.37	-.75	9.36	1.35	-.35	-2.73	.00	90.00	.00	.00	10.00	.00
8	LH	T	1	0	-.54	-2.14	1.60	-.26	1.93	-7.24	.00	.00	.00	.00	-45.00	.00
9	LK	U	9	1	-.25	-.37	9.44	.69	.60	-6.61	.00	.00	.00	.00	60.00	.00
10	LA	V	10	0	.37	.75	9.36	1.35	.35	-2.73	.00	90.00	.00	.00	10.00	.00
11	RS	W	3	0	-.97	6.47	-4.19	.53	-.24	-5.66	.00	.00	.00	.00	-4.10	.00
12	RE	X	12	1	-.63	-.41	5.46	-.48	.30	-6.89	.00	.00	.00	.00	-70.00	.00
13	LS	Y	3	0	-.97	-6.47	-4.19	.53	.24	-5.66	.00	.00	.00	.00	-4.10	.00
14	LE	Z	14	1	-.63	.41	5.46	-.48	-.30	-6.89	.00	.00	.00	.00	-70.00	.00

JOINT TORQUE CHARACTERISTICS

CARDS B.4

JOINT		FLEXURAL SPRING CHARACTERISTICS SPRING COEF. (IN.LB. /DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)	TORSIONAL SPRING CHARACTERISTICS SPRING COEF. (IN.LB. /DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)
1	P	.000	10.000	.000	.700	20.000	.000	10.000	.000	.700	5.000
2	W	.000	10.000	.000	.700	20.000	.000	10.000	.000	.700	35.000
3	NP	.000	5.000	.000	.700	25.000	.000	10.000	.000	.700	35.000
4	HP	.000	5.000	.000	.700	25.000	.000	10.000	.000	.700	35.000
5	RH	.000	10.000	.000	.700	70.000	.000	.800	.000	.700	40.000
6	RK	.000	1.800	.000	.700	60.000	.000	.000	.000	.000	.000
7	RA	.000	7.000	.000	.700	35.000	.000	10.000	.000	.700	26.000
8	LH	.000	10.000	.000	.700	70.000	.000	.800	.000	.700	40.000
9	LK	.000	1.800	.000	.700	60.000	.000	.000	.000	.000	.000
10	LA	.000	7.000	.000	.700	35.000	.000	10.000	.000	.700	26.000
11	RS	.000	10.000	.000	.700	122.500	.000	10.000	.000	.700	65.000
12	RE	.000	1.800	.000	.700	70.000	.000	.000	.000	.000	.000
13	LS	.000	10.000	.000	.700	122.500	.000	10.000	.000	.700	65.000
14	LE	.000	1.800	.000	.700	70.000	.000	.000	.000	.000	.000

CARDS B.5

JOINT VISCOUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS

JOINT		VISCOUS COEFFICIENT (IN.LB. SEC./DEG)	COULOMB FRICTION COEF. (IN.LB.)	FULL FRICTION ANGULAR VELOCITY (DEG/SEC.)	MAX TORQUE FOR A LOCKED JOINT (IN.LB.)	MIN TORQUE FOR UNLOCKED JOINT (IN.LB.)	MIN. ANG. VELOCITY FOR UNLOCKED JOINT (RAD/SEC.)	IMPULSE RESTITUTION COEFFICIENT
1	P	.100	.00	30.00	.00	.00	.00	.00
2	W	.100	.00	30.00	.00	.00	.00	.00
3	NP	.100	.00	30.00	.00	.00	.00	.00
4	HP	.100	.00	30.00	.00	.00	.00	.00
5	RH	.100	.00	30.00	.00	.00	.00	.00
6	RK	.100	.00	30.00	.00	.00	.00	.00
7	RA	.100	.00	30.00	.00	.00	.00	.00
8	LH	.100	.00	30.00	.00	.00	.00	.00
9	LK	.100	.00	30.00	.00	.00	.00	.00
10	LA	.100	.00	30.00	.00	.00	.00	.00
11	RS	.100	.00	30.00	.00	.00	.00	.00
12	RE	.100	.00	30.00	.00	.00	.00	.00
13	LS	.100	.00	30.00	.00	.00	.00	.00
14	LE	.100	.00	30.00	.00	.00	.00	.00

SEGMENT INTEGRATION CONVERGENCE TEST INPUT

SEGMENT		ANGULAR VELOCITIES (RAD/SEC.)			LINEAR VELOCITIES (IN./SEC.)			ANGULAR ACCELERATIONS (RAD/SEC.**2)			LINEAR ACCELERATIONS (IN./SEC.**2)		
NO.	SYM	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR
1	LT	.010	.010	.0100	.010	.010	.0100	.100	.100	.1000	.100	.100	.0100
2	CT	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
3	UT	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
4	N	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
5	H	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
6	RUL	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
7	RLL	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
8	RF	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
9	LUL	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
10	LLL	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
11	LF	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
12	RUA	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
13	RLA	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
14	LUA	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
15	LLA	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000

SAMPLE SEVENTEEN SEGMENT OUTPUT

ADULT HUMAN MALE

SELECTED BODY DIMENSIONS

WEIGHT	168.5	LB.
STANDING HEIGHT	68.10	IN.

COMPUTED BODY DIMENSIONS

0	WEIGHT	168.5	LB.
1	STANDING HEIGHT	68.10	IN.
2	SHOULDER HEIGHT	55.66	IN.
3	ARMPIT HEIGHT	49.66	IN.
4	WAIST HEIGHT	40.69	IN.
5	SEATED HEIGHT	36.00	IN.
6	HEAD LENGTH	7.783	IN.
7	HEAD BREADTH	6.127	IN.
8	HEAD TO CHIN HEIGHT	8.885	IN.
9	NECK CIRCUMFERENCE	15.06	IN.
10	SHOULDER BREADTH	15.87	IN.
11	CHEST DEPTH	9.635	IN.
12	CHEST BREADTH	12.84	IN.
13	WAIST DEPTH	8.791	IN.
14	WAIST BREADTH	12.11	IN.
15	BUTTOCK DEPTH	9.416	IN.
16	HIP BREADTH,STANDING	13.74	IN.
17	SHOULDER TO ELBOW LENGTH	13.80	IN.
18	FOREARM-HAND LENGTH	19.00	IN.
19	BICEPS CIRCUMFERENCE	12.41	IN.
20	ELBOW CIRCUMFERENCE	12.16	IN.
21	FOREARM CIRCUMFERENCE	11.03	IN.
22	WRIST CIRCUMFERENCE	6.861	IN.
23	KNEE HEIGHT,SEATED	21.36	IN.
24	THIGH CIRCUMFERENCE	23.10	IN.
25	UPPER LEG CIRCUMFERENCE	15.06	IN.
26	KNEE CIRCUMFERENCE	15.30	IN.
27	CALF CIRCUMFERENCE	14.59	IN.
28	ANKLE CIRCUMFERENCE	8.755	IN.
29	ANKLE HEIGHT,OUTSIDE	5.247	IN.
30	FOOT BREADTH	3.794	IN.
31	FOOT LENGTH	10.43	IN.
32	HAND BREADTH	3.460	IN.
33	HAND LENGTH	7.374	IN.
34	HAND DEPTH	1.077	IN.

WEIGHT CORRECTION FACTOR = .963

SAMPLE SEVENTEEN SEGMENT OUTPUT

CRASH VICTIM PARAMETERS (3-D)

CARDS B.2

SEGMENT			WEIGHT	PRINCIPAL MOMENT OF INERTIA (LB-SEC**2-IN)			SEGMENT CONTACT ELLIPSOID SEMIAXIS (IN)			CENTER (IN)			PRINCIPAL AXES (DEG)		
I	SYM	PLOT	(LB.)	X	Y	Z	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL
1	LT	1	24.444	.8965	.8257	1.0458	4.708	6.871	3.548	-.471	.000	.352	.00	.00	.00
2	CT	2	5.109	.1431	.0813	.2176	4.396	6.055	3.893	-1.465	.000	-.411	.00	.00	.00
3	UT	3	51.324	4.1149	3.0331	2.6163	4.817	6.419	6.735	.000	.000	.000	.00	14.40	.00
4	N	4	2.242	.0152	.0185	.0231	2.396	2.396	2.977	-.479	.000	1.719	.00	.00	.00
5	H	5	9.200	.1771	.2016	.1324	3.892	3.063	5.641	-1.112	.000	.000	.00	36.00	.00
6	RUL	6	20.249	.2453	.2441	.0150	3.037	3.037	11.482	.000	-.322	.000	.00	.00	.00
7	RLL	7	7.841	.4534	.4606	.0565	2.322	2.322	8.752	.929	-1.197	.000	.00	.00	.00
8	RF	8	1.953	.0358	.0338	.0066	2.624	1.897	5.216	2.099	-.697	.000	-4.00	8.40	-6.10
9	LUL	9	20.249	.2453	.2441	.0150	3.037	3.037	11.482	.000	.322	.000	.00	.00	.00
10	LLL	A	7.841	.4534	.4606	.0565	2.322	2.322	8.752	.929	1.197	.000	.00	.00	.00
11	LF	B	1.953	.0358	.0338	.0066	2.624	1.897	5.216	2.099	.697	.000	4.00	8.40	6.10
12	RUA	C	4.104	.1065	.1140	.0233	1.975	1.975	6.898	.000	-.240	.000	.00	.00	.00
13	RLA	D	2.882	.0698	.0716	.0111	1.756	1.756	5.812	.000	.449	.000	.00	.00	.00
14	RH	E	1.062	.0107	.0087	.0035	.538	1.730	3.687	.000	1.057	.000	-14.00	6.00	-7.70
15	LUA	F	4.104	.1065	.1140	.0233	1.975	1.975	6.898	.000	.240	.000	.00	.00	.00
16	LLA	G	2.882	.0698	.0716	.0111	1.756	1.756	5.812	.000	-.449	.000	.00	.00	.00
17	LH	H	1.062	.0107	.0087	.0035	.538	1.730	3.687	.000	-1.057	.000	14.00	6.00	7.70

CARDS B.3

JOINT					LOCATION(IN) - SEG(JNT)			LOCATION(IN) - SEG(J+1)			JOINT AXIS(DEG) - SEG(JNT)			JOINT AXIS(DEG) - SEG(J+1)		
J	SYM	PLOT	JNT	PIN	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL	YAW	PITCH	ROLL
1	P	K	1	0	-1.40	.00	-2.31	-2.30	.00	2.44	.00	.00	.00	.00	5.00	.00
2	W	L	2	0	-1.75	.00	-.86	-.36	.00	7.21	.00	.00	.00	.00	5.00	.00
3	NP	M	3	0	-.31	.00	-7.47	-1.00	.00	1.52	.00	.00	.00	.00	10.00	.00
4	HP	N	4	0	1.15	.00	-2.56	.26	.00	2.37	.00	.00	.00	.00	10.00	.00
5	RH	O	1	0	-.54	2.14	1.60	-.26	-1.93	-7.24	.00	.00	.00	.00	-45.00	.00
6	RK	P	6	1	-.25	.37	9.44	.69	-.60	-6.61	.00	.00	.00	.00	60.00	.00
7	RA	Q	7	0	.37	-.75	9.36	1.35	-.35	-2.73	.00	90.00	.00	.00	10.00	.00
8	LH	R	1	0	-.54	-2.14	1.60	-.26	1.93	-7.24	.00	.00	.00	.00	-45.00	.00
9	LK	S	9	1	-.25	-.37	9.44	.69	.60	-6.61	.00	.00	.00	.00	60.00	.00
10	LA	T	10	0	.37	.75	9.36	1.35	.35	-2.73	.00	90.00	.00	.00	10.00	.00
11	RS	U	3	0	-.97	6.47	-4.19	.53	-.24	-5.66	.00	.00	.00	.00	-4.10	.00
12	RE	V	12	1	-.63	-.41	5.46	-.51	.22	-4.50	.00	.00	.00	.00	-70.00	.00
13	RW	W	13	0	.36	-.00	6.22	.16	.53	-2.57	.00	.00	.00	.00	.00	.00
14	LS	X	3	0	-.97	-6.47	-4.19	.53	.24	-5.66	.00	.00	.00	.00	-4.10	.00
15	LE	Y	15	1	-.63	.41	5.46	-.51	-.22	-4.50	.00	.00	.00	.00	-70.00	.00
16	LW	Z	16	0	.36	.00	6.22	.16	-.53	-2.57	.00	.00	.00	.00	.00	.00

JOINT TORQUE CHARACTERISTICS

CARDS B.4

JOINT		FLEXURAL SPRING CHARACTERISTICS: SPRING COEF. (IN.-LB. /DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)	TORSIONAL SPRING CHARACTERISTICS: SPRING COEF. (IN.-LB. /DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)
1	P	.000	10.000	.000	.700	20.000	.000	10.000	.000	.700	5.000
2	W	.000	10.000	.000	.700	20.000	.000	10.000	.000	.700	35.000
3	NP	.000	5.000	.000	.700	25.000	.000	10.000	.000	.700	35.000
4	HP	.000	5.000	.000	.700	25.000	.000	10.000	.000	.700	35.000
5	RH	.000	10.000	.000	.700	70.000	.000	.800	.000	.700	40.000
6	RK	.000	1.800	.000	.700	60.000	.000	.000	.000	.000	.000
7	RA	.000	7.000	.000	.700	35.000	.000	10.000	.000	.700	26.000
8	LH	.000	10.000	.000	.700	70.000	.000	.800	.000	.700	40.000
9	LK	.000	1.800	.000	.700	60.000	.000	.000	.000	.000	.000
10	LA	.000	7.000	.000	.700	35.000	.000	10.000	.000	.700	26.000
11	RS	.000	10.000	.000	.700	122.500	.000	10.000	.000	.700	65.000
12	RE	.000	1.800	.000	.700	70.000	.000	.000	.000	.000	.000
13	RW	.000	1.800	.000	.700	35.000	.000	1.800	.000	.700	45.000
14	LS	.000	10.000	.000	.700	122.500	.000	10.000	.000	.700	65.000
15	LE	.000	1.800	.000	.700	70.000	.000	.000	.000	.000	.000
16	LW	.000	1.800	.000	.700	35.000	.000	1.800	.000	.700	45.000

CARDS B.5

JOINT VISCOUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS

JOINT		VISCOUS COEFFICIENT (IN.-LB. SEC./DEG)	COULOMB FRICTION COEF. (IN.-LB.)	FULL FRICTION ANGULAR VELOCITY (DEG/SEC.)	MAX TORQUE FOR A LOCKED JOINT (IN.-LB.)	MIN TORQUE FOR UNLOCKED JOINT (IN.-LB.)	MIN. ANG. VELOCITY FOR UNLOCKED JOINT (RAD/SEC.)	IMPULSE RESTITUTION COEFFICIENT
1	P	.100	.00	30.00	.00	.00	.00	.00
2	W	.100	.00	30.00	.00	.00	.00	.00
3	NP	.100	.00	30.00	.00	.00	.00	.00
4	HP	.100	.00	30.00	.00	.00	.00	.00
5	RH	.100	.00	30.00	.00	.00	.00	.00
6	RK	.100	.00	30.00	.00	.00	.00	.00
7	RA	.100	.00	30.00	.00	.00	.00	.00
8	LH	.100	.00	30.00	.00	.00	.00	.00
9	LK	.100	.00	30.00	.00	.00	.00	.00
10	LA	.100	.00	30.00	.00	.00	.00	.00
11	RS	.100	.00	30.00	.00	.00	.00	.00
12	RE	.100	.00	30.00	.00	.00	.00	.00
13	RW	.100	.00	30.00	.00	.00	.00	.00
14	LS	.100	.00	30.00	.00	.00	.00	.00
15	LE	.100	.00	30.00	.00	.00	.00	.00
16	LW	.100	.00	30.00	.00	.00	.00	.00

SEGMENT INTEGRATION CONVERGENCE TEST INPUT

SEGMENT		ANGULAR VELOCITIES (RAD/SEC.)			LINEAR VELOCITIES (IN/SEC.)			ANGULAR ACCELERATIONS (RAD/SEC.**2)			LINEAR ACCELERATIONS (IN/SEC.**2)		
NO.	SYM	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR
1	LT	.010	.010	.0100	.010	.010	.0100	.100	.100	.1000	.100	.100	.0100
2	CT	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
3	UT	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
4	N	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
5	H	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
6	RUL	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
7	RLL	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
8	RF	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
9	LUL	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
10	LLL	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
11	LF	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
12	RUA	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
13	RLA	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
14	RH	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
15	LUA	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
16	LLA	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000
17	LH	.010	.010	.0100	.000	.000	.0000	.100	.100	.1000	.000	.000	.0000

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