

SANTECH, INC.

MeterPlus

Version 4.3

MeterPlus™

Software Support for ActiGraph

New Version 4.3 is now available
Compatible with the new GT3X+ model

For physical activity researchers: A user-friendly software application to screen, clean & score ActiGraph accelerometer data.



SANTECH

Promoting health with mobile technology for behavior change.



Where did MeterPlus™ come from?

MeterPlus™ was developed from over 15 years of research by **Dr. James Sallis** & team at San Diego State University.

Our experience includes six National Institutes of Health grants and over 10,000 participants ranging from children to older adults.

MeterPlus is now being used by over 100 research groups in 26 countries!



What's different about MeterPlus™?

- Anyone can use it, no programming skills required
- Windows-based, with user-friendly interface
- Will batch-process your files
- Analyzes activity counts, step counts, energy expenditure, time spent in different incline positions, tri-axial activity, bouts of activity and time-filtered activity all in one program



What's different about MeterPlus™?

- Stores multiple profiles of cut-points making age-specific scoring possible
- Maximum flexibility in setting parameters for valid wearing time, cut-points, bouts of activity, time filters, and more...



5 Steps

1. Convert

Convert DAT files to CSV files with a one-click utility

2. Screen

Screen data files individually for enough valid wear time.

3. Clean

Eliminate non-wear time and save days of data you really want to keep.

4. Score

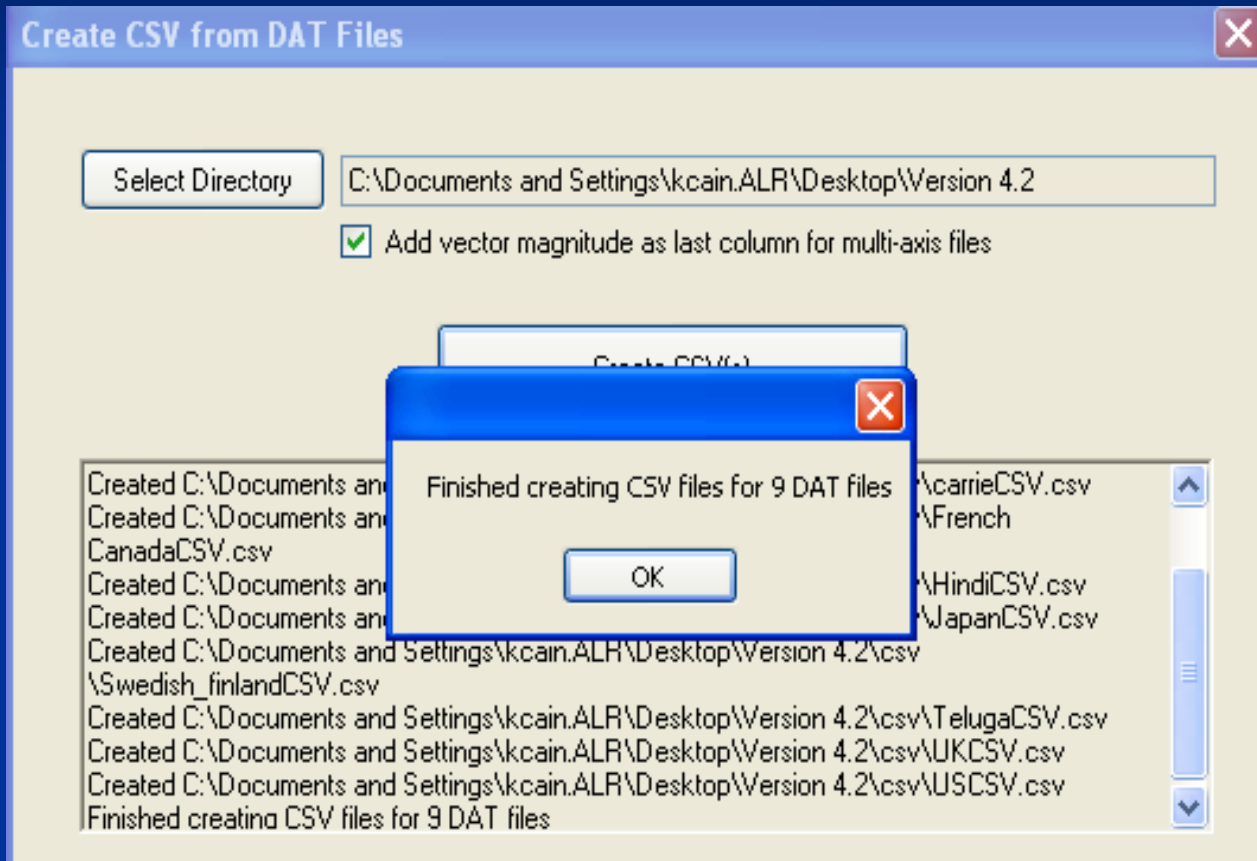
Batch score your files and create one comma-delimited file containing variables for your entire sample.

5. Analyze

Import the comma-delimited file into statistical software and analyze.

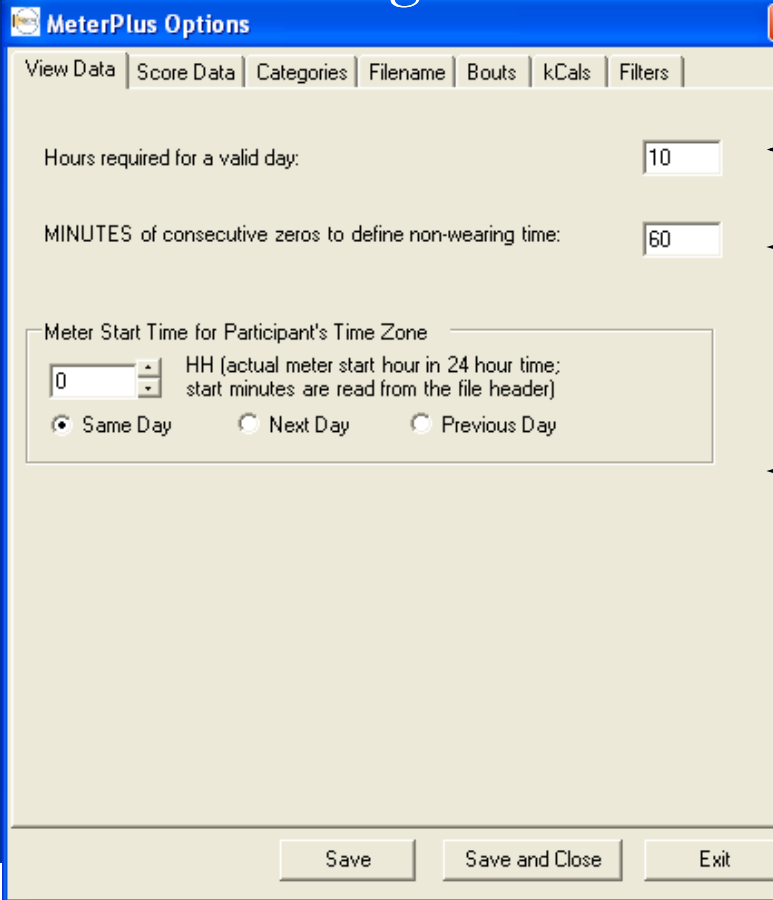


Step 1. Convert DAT files to CSV files



Step 2. Screen data

MeterPlus™ has a straightforward interface to program settings to screen for valid wearing time. This screening tool can be used to evaluate whether enough usable data have been gathered.



- Minimum valid wearing hours
- Define non-wear time based on continuous scanning
- Time zone adjustments if necessary



Step 3. Clean data

MeterPlus Options

View Data | Score Data | Categories | Filename | Bouts | kCals | Filters

Hours required for a valid day: 10

MINUTES of consecutive zeros to define non-wearing time: 60

Value to use for undefined field: NULL

Replace strings of zeros with the following value: -999

(Zeros will only be replaced if there is a string that meets the criteria set above to make an hour invalid.)

Output: Totals and Daily for Valid and Invalid Days

- Totals for Valid Days Only
- Totals for Valid and Invalid Days
- Totals and Daily for Valid and Invalid Days
- Daily for Valid Hours Only
- Hourly for Valid and Invalid Days

Parameter:

Directory to save .mpd files: C:\Documents and Settings\kcairn\Desktop\colombia checks

Save Save and Close Exit

The definition of “wearing” is controlled by the user to exclude periods of time when the device was removed.

Non-wear within valid days is coded as such during this cleaning process.

User selects level of output: Summary, Daily, Hourly, for valid days only or all days.



Save wear time

The user selects the days to be scored. Days without enough valid wearing time can be excluded from this process so they are not included in the final data set.

The screenshot shows the MeterPlus4.3 (ActiGraph Version) - Default.mpo application window. The main window displays a table with the following data:

Date	Valid Hours	Valid Day?	Day Of Week	Parameter
10/7/2007	13	Yes	Sunday	Activity
10/8/2007	14	Yes	Monday	Activity
10/9/2007	13	Yes	Tuesday	Activity
10/10/2007	13	Yes	Wednesday	Activity
10/11/2007	13	Yes	Thursday	Activity
10/12/2007	13	Yes	Friday	Activity
10/13/2007	13	Yes	Saturday	Activity
10/14/2007	4	No	Sunday	Activity
10/15/2007	5	No	Monday	Activity
10/16/2007	6	No	Tuesday	Activity

A confirmation dialog box titled "MeterPlus" is overlaid on the right side of the main window. It contains the following text:

7 days were successfully saved to
C:\Documents and Settings\kcaain\Desktop\colombia checks\1012002001_1_Activity.mpd

An "OK" button is located at the bottom of the dialog box. A yellow arrow points to the "Save Selected Days" button in the main application window's toolbar.



Analyze multiple types of data

The screenshot shows the MeterPlus software interface. The main window displays a table of data with columns: Date, Valid Hours, Valid Day?, Day Of Week, and Parameter. The data includes various dates from 11/2/2009 to 11/6/2009, with parameters such as Activity, Steps, Heart, and Workout Activity. A red arrow points from the 'Heart' parameter in the table to the 'Heart' option in the 'Parameter' dropdown of the 'MeterPlus Options' dialog box.

MeterPlus - kelli.mpo
File Tools Reports Help
C:\Documents and Settings\kccain.ALK\Desktop\Version 4.2\Actitrainer MODE=3.csv Mode = 3

Date	Valid Hours	Valid Day?	Day Of Week	Parameter
11/2/2009	10	Yes	Monday	Activity
11/3/2009	14	Yes	Tuesday	Activity
11/4/2009	13	Yes	Wednesday	Activity
11/5/2009	15	Yes	Thursday	Activity
11/6/2009	6	No	Friday	Activity
11/2/2009	9	No	Monday	Steps
11/3/2009	13	Yes	Tuesday	Steps
11/4/2009	11	Yes	Wednesday	Steps
11/5/2009	13	Yes	Thursday	Steps
11/6/2009	4	No	Friday	Steps
11/2/2009	0	No	Monday	Heart
11/3/2009	0	No	Tuesday	Heart
11/4/2009	5	No	Wednesday	Heart
11/5/2009	1	No	Thursday	Heart
11/6/2009	1	No	Friday	Heart
11/2/2009	1	No	Monday	Workout Activity
11/3/2009	0	No	Tuesday	Workout Activity
11/4/2009	0	No	Wednesday	Workout Activity
11/5/2009	0	No	Thursday	Workout Activity
11/6/2009	0	No	Friday	Workout Activity
11/2/2009	1	No	Monday	Workout Steps
11/3/2009	0	No	Tuesday	Workout Steps
11/4/2009	0	No	Wednesday	Workout Steps
11/5/2009	0	No	Thursday	Workout Steps

MeterPlus Options
View Data Score Data Categories Filename Bouts kCals Filters
Hours required for a valid day: 10
Number of consecutive zeros to make an hour invalid: 20
Value to use for undefined field: NULL
Replace strings of zeros with the following value: -999
(Zeros will only be replaced if there is a string that meets the criteria set above to make an hour invalid.)
Output: Totals and Daily for Valid and Invalid Days
Parameter: ---Select---
Directory to save: C:\Documents and Settings\kccain.ALK\Desktop\Version 4.2\Actitrainer MODE=3.csv
Activity
Steps
3rd Axis
2nd Axis
Heart
Luz
Incline
Save Save and Close Exit



Activity Cut-points

- MeterPlus™ is the only program on the market that allows the user to program activity cut-points for numerous groups. This allows for age-specific scoring, which is useful for accurate analysis of activity levels in children and older adults.



Program cut-points

The screenshot shows the 'MeterPlus Options' dialog box with the 'Categories' tab selected. It displays a table of categories and their associated min and max values. The categories are: NIK (age 6 to 11), TEAN (age 12 to 16), Adult (age 18 to 64) with sub-categories (not_wearing, sedentary, light, moderate, hard, very_hard), and Senior (age 65 to 100). Buttons for 'Add Group', 'Add Category', 'Edit', and 'Delete' are at the bottom.

Group/Category Name	Min Value	Max Value
+ NIK (age 6 to 11)		
+ TEAN (age 12 to 16)		
- Adult (age 18 to 64)		
not_wearing	-999	-999
sedentary	0	100
light	101	1952
moderate	1953	5724
hard	5725	9498
very_hard	9499	100000
+ Senior (age 65 to 100)		

Create Groups

The screenshot shows the 'Edit Category Form' dialog box. It has a 'Name' field containing 'Child', an 'Age from' field with a spinner set to '9', and a 'to' field with a spinner set to '10'. There are 'OK' and 'Cancel' buttons at the bottom.

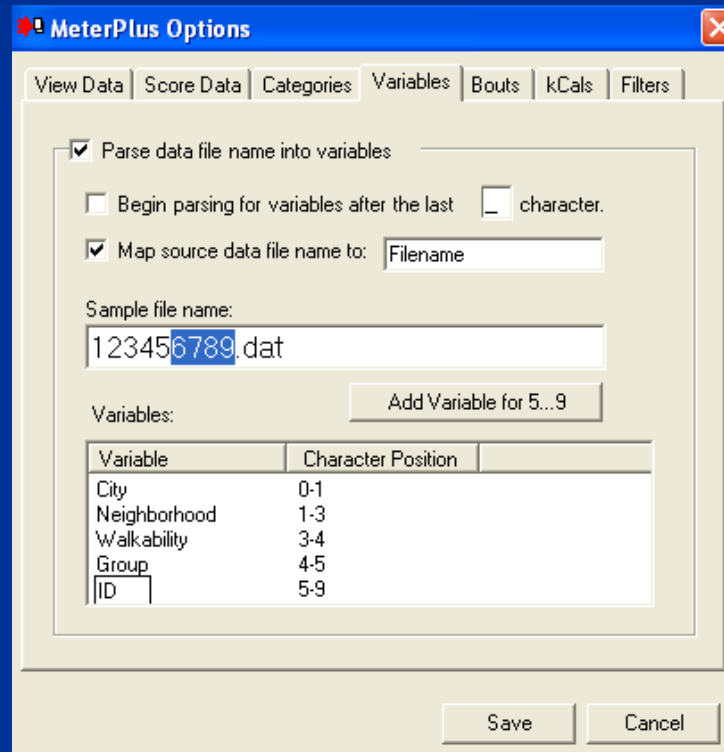
Add/Edit Cut-points

The screenshot shows the 'CutPointForm' dialog box. It has a 'Name' field containing 'moderate', a 'Meter values from' field with a spinner set to '1953', and a 'to' field with a spinner set to '5724'. There are 'OK' and 'Cancel' buttons at the bottom.



Filename variables

The user has the option of creating variables from the file name. This may be helpful to define a group or time point that is coded with the filename.



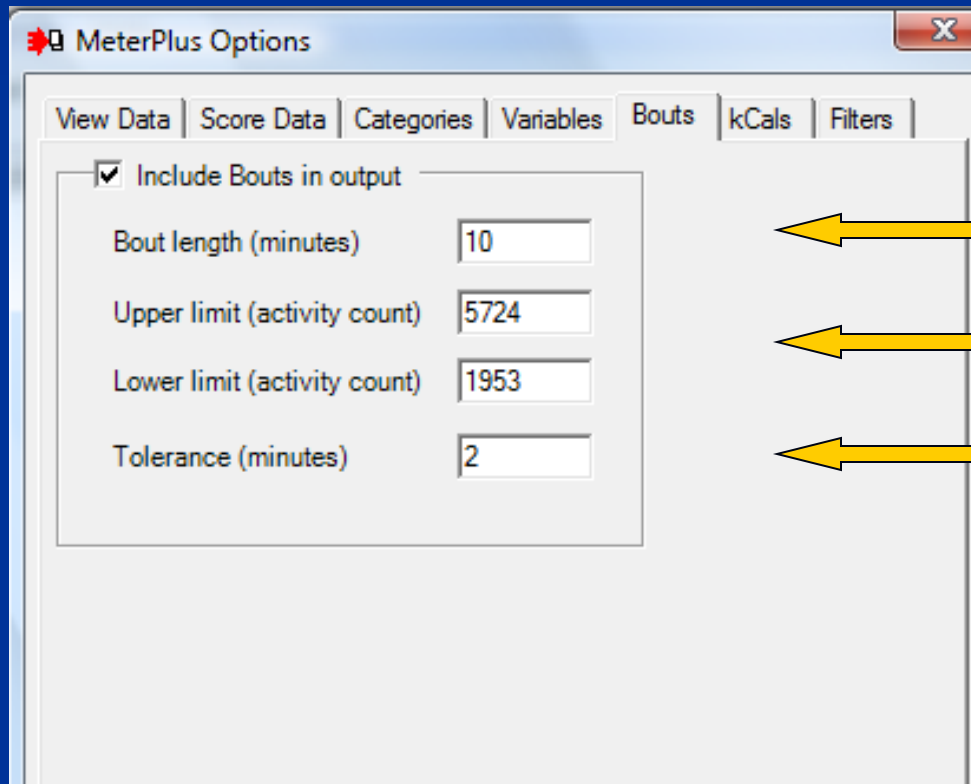
Activity and Sedentary Bouts

- MeterPlus™ analyzes bouts of activity and sedentary time, both important indicators of health outcomes.



Settings for bouts

The user designates the intensity that must be maintained, the minimum length of the bout and the tolerance for gaps within the bout.



The screenshot shows the 'MeterPlus Options' dialog box with the 'Bouts' tab selected. The 'Include Bouts in output' checkbox is checked. Below it are four input fields: 'Bout length (minutes)' with the value 10, 'Upper limit (activity count)' with the value 5724, 'Lower limit (activity count)' with the value 1953, and 'Tolerance (minutes)' with the value 2. Three yellow arrows point from the text labels on the right to these three input fields.

Setting	Value
Bout length (minutes)	10
Upper limit (activity count)	5724
Lower limit (activity count)	1953
Tolerance (minutes)	2

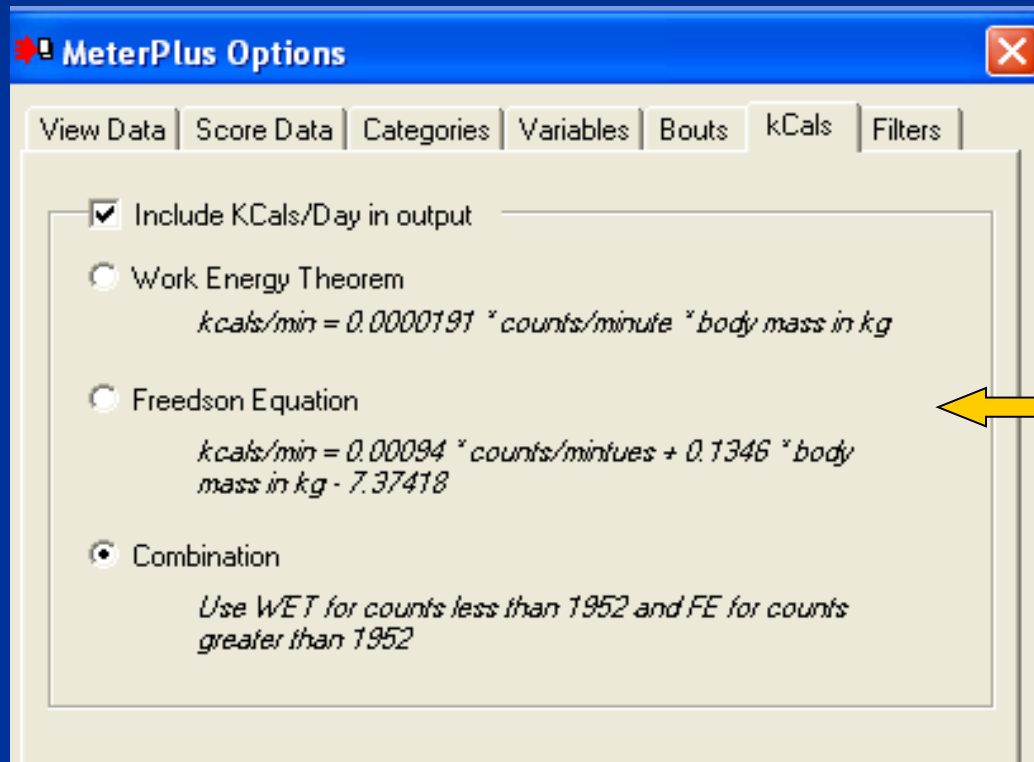
Minimum length

Intensity

Allowable interruption

Energy expenditure

MeterPlus™ allows the user to select which formula to use when analyzing energy expenditure.

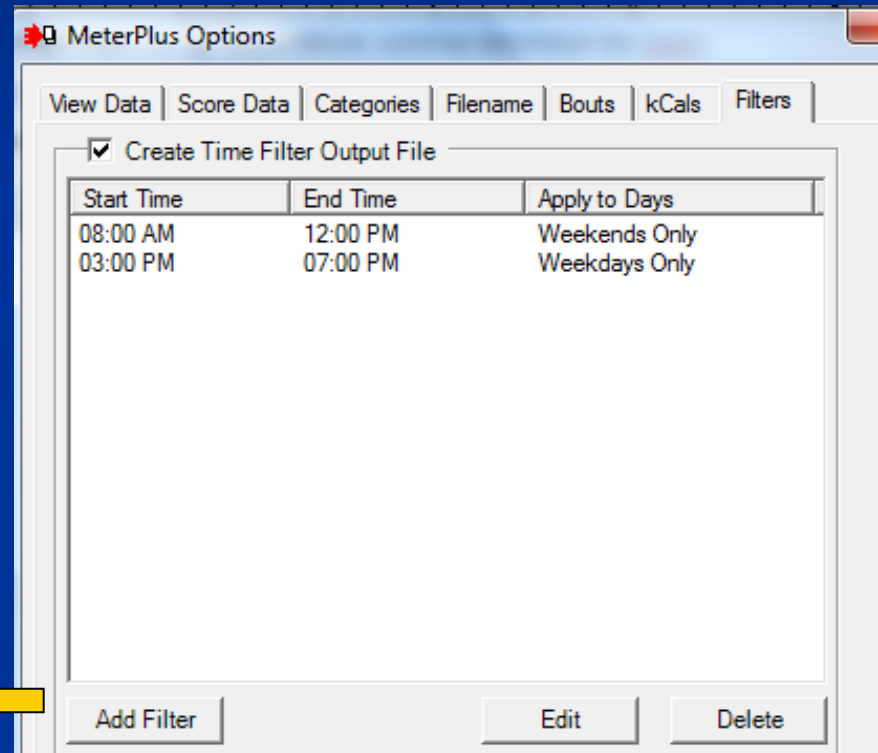
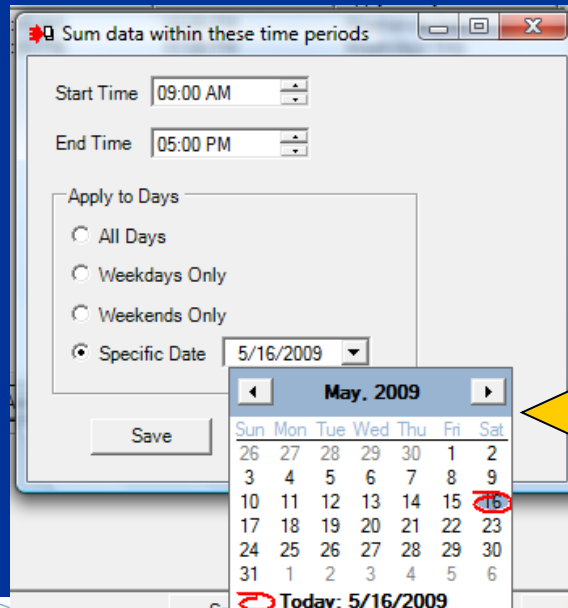


Choice of 3 algorithms



Time filters

MeterPlus™ allows the user to select days of the week & times per day (e.g., after-school hours) to summarize activity.



Age and weight files

Links to subject age and body weight files allow for age-defined cut-points to be applied within the same batch (i.e., age-specific scoring) and different body weights to be used for each subject in the energy expenditure calculations.

Participant Age Data for Scoring

Participant Age Data

Age file for participants: ...
Leave blank if you don't have an age file.

If a participant's age is unknown, use the following category group or specify an age:

Category Group:
Adult (age 18 to 64)
NIK (age 6 to 11)
TEAN (age 12 to 16)
Senior (age 65 to 100)

Participant Weight Data

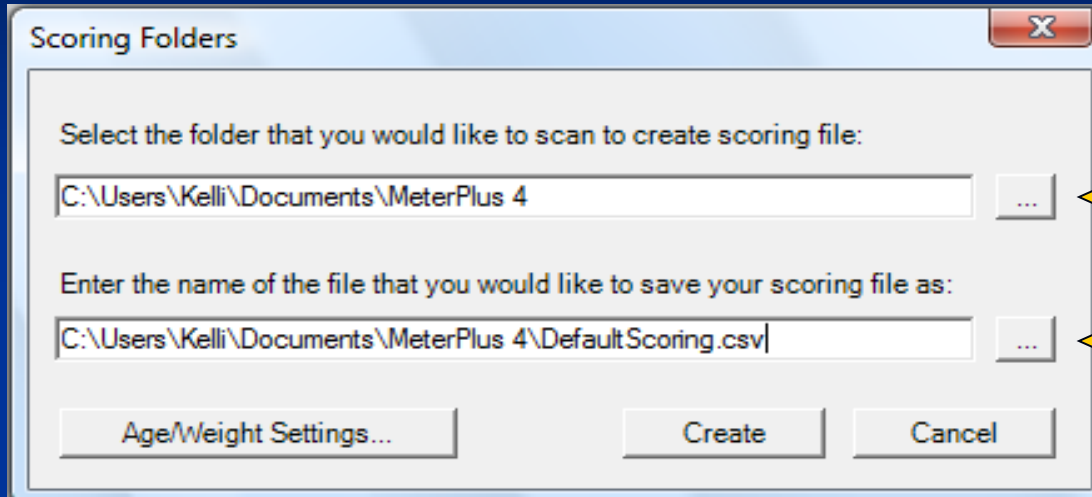
You have specified to include Kcals in the output so you need to provide the participant's weight for scoring.

Weight file for participants: ...
Leave blank if you don't have a weight file.

If a participant's weight is unknown, use the following weight:

Weight: (in Kg)

Step 4. Batch score data



Scoring Folders

Select the folder that you would like to scan to create scoring file:

C:\Users\Kelli\Documents\MeterPlus 4

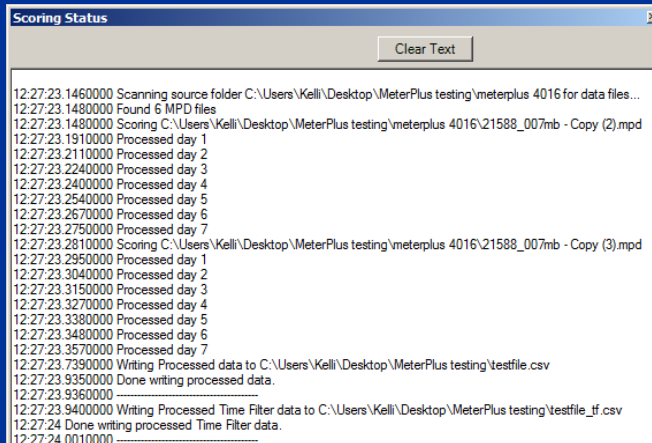
Enter the name of the file that you would like to save your scoring file as:

C:\Users\Kelli\Documents\MeterPlus 4\DefaultScoring.csv

Age/Weight Settings... Create Cancel

Where to find individual files to process

Where to save processed file for entire sample



Scoring Status

Clear Text

```
12:27:23.1460000 Scanning source folder C:\Users\Kelli\Desktop\MeterPlus testing\meterplus 4016 for data files...
12:27:23.1480000 Found 6 MPD files
12:27:23.1480000 Scoring C:\Users\Kelli\Desktop\MeterPlus testing\meterplus 4016\21588_007mb - Copy (2).mpd
12:27:23.1910000 Processed day 1
12:27:23.2110000 Processed day 2
12:27:23.2240000 Processed day 3
12:27:23.2400000 Processed day 4
12:27:23.2540000 Processed day 5
12:27:23.2670000 Processed day 6
12:27:23.2750000 Processed day 7
12:27:23.2810000 Scoring C:\Users\Kelli\Desktop\MeterPlus testing\meterplus 4016\21588_007mb - Copy (3).mpd
12:27:23.2950000 Processed day 1
12:27:23.3040000 Processed day 2
12:27:23.3150000 Processed day 3
12:27:23.3270000 Processed day 4
12:27:23.3380000 Processed day 5
12:27:23.3480000 Processed day 6
12:27:23.3570000 Processed day 7
12:27:23.7390000 Writing Processed data to C:\Users\Kelli\Desktop\MeterPlus testing\testfile.csv
12:27:23.9350000 Done writing processed data.
12:27:23.9360000
12:27:23.9400000 Writing Processed Time Filter data to C:\Users\Kelli\Desktop\MeterPlus testing\testfile_tf.csv
12:27:24.0010000 Done writing processed Time Filter data.
12:27:24.0010000
```

One step



Create



Output

File type	Description
CSV	comma-delimited file containing the results of the batch scoring including activity counts, step counts, bouts and energy expenditure.
SPS	SPSS syntax file that will import CSV file into SPSS
tf.CSV	comma-delimited file containing the time-filtered activity variables only (if selected as output)



Output:

Activity variables

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	SN	city	neighbo	walka	group	id	Filename	Date	TotDays	VldDays	VldHours	TotVdnot_wearin	TotVdsedent	TotVdligh	TotVdmod	Tc
2	50168	1	1	1	0	7310	101107310.DAT	11/12/2003	8	8	102	5434	3585	2404	93	
3	51165	5	33	1	0	0210	533100210.dat	11/24/2005	8	8	97	5915	4516	1087	8	
4	50293	6	15	4	0	0120	6154100120.dat	1/22/2008	7	7	89	4808	3438	1720	114	
5																

Start date, number of valid days, number of valid hours and number of epochs in each activity category across all valid days.

- A. *Date* = 1/22/2008 is first day of wearing time that was saved
- B. *VldDays* = 7 valid days in file
- C. *VldHours* = 89 valid hours
- D. *TotVdNot_wearing* = 4808 epochs of non-wearing time across the 7 valid days
- E. *TotVdsedentary* = 3438 epochs of sedentary activity across the 7 valid days
- F. *TotVdlight* = 1720 epochs of light activity across the 7 valid days
- G. *TotVdmoderate* = 114 epochs of moderate activity across the 7 valid days

Output: Bouts

	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ
1	D1_bout_num	D1_bout_length	D1_bout_avg	D1B1_st_time	D1B1_end_time	D1B2_st_time	D1B2_end_time	D1B3_st_time	D1B3_end_time	D1B4_st_time
2	A 1	B 14	C 14	D 11/12/2003 13:47	E 11/12/2003 14:01	NULL	NULL	NULL	NULL	NULL
3	1	10	10	11/24/2005 9:00	11/24/2005 9:10	NULL	NULL	NULL	NULL	NULL
4	4	119	29.75	1/22/2008 0:00	1/22/2008 0:17	1/22/2008 6:59	1/22/2008 8:07	1/22/2008 8:32	1/22/2008 8:55	1/22/2008 9:53
5										
6										

Number of bouts, total and average length of bouts, start and end times of each bout.

- A. *D1_bout_num* = 1 bout of activity in Day 1 for this subject
- B. *D1_bout_length* = Total bout length in Day 1 is 14 minutes
- C. *D1_bout_avg* = Average bout length in Day 1 is 14 minutes
- D. *D1B1_st_time* = The 1st bout in Day 1 started on 11/12/03 at 13:47
- E. *D1B1_end_time* = The 1st bout in Day 1 ended on 11/12/03 at 14:01

Output: Energy expenditure

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS
1	Tot_kcal	KCal_mean	KCal_peak	KCal_not_w	KCal_sedentary	KCal_light	KCal_moderate	KCal_hard	KCal_very_hard	D1Date	D1Day	D1vday
2	1195.47	149.43	224.58	0	49.81	1145.66	0	0	0	11/12/2003	Wednesday	1
3	463.31	57.91	95.95	0	31.55	431.76	0	0	0	11/24/2005	Thursday	1
4	863.27	123.32	167.77	0	33.68	829.59	0	0	0	1/22/2008	Tuesday	1
5												

Total caloric expenditure, mean caloric expenditure, peak caloric expenditure and caloric expenditure in each activity category.

- A. *Tot_kcal* = 1195.47 calories spent in activity across all valid days
- B. *KCal_mean* = 149.43 calories spent on average across all valid days
- C. *KCal_peak* = 224.58 peak calories spent on a day
- D. *KCal_sedentary* = 49.81 calories spent in sedentary activities across all valid days
- E. *KCal_light* = 1145.66 calories spent in light activities across all valid days
- F. *KCal_moderate* = 0 calories spent in moderate activities across all valid days

Output:

Time-filtered variables

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Filename	1Day	1Date	D1T1_st_t	D1T1_end	D1T1_epo	D1T1_not	D1T1_sed	D1T1_ligh	D1T1_mor	D1T1_har	D1T1_very	D1T2_st_t	D1T2_end	D1T2_
2	10110731C	Wednesday	11-12-200	07:00 AM	11:00 PM	960	301	609	45	6	NULL	NULL	NULL	NULL	NULL
3	53310021C	Thursday	11-24-200	07:00 AM	11:00 PM	960	120	722	118	1	NULL	NULL	NULL	NULL	NULL
4	615410012	Tuesday	01-22-200	07:00 AM	11:00 PM	960	361	427	167	A 6	NULL	NULL	NULL	NULL	NULL
5															
6															
7															

Activity counts during each defined time period, within each activity category, for each day of data.

A. *D1T1_moderate* = 6 epochs of moderate activity occurring during 7am & 11pm on day 1, Tuesday Jan. 22nd



Specifications

- Works with ActiGraph 7164, 71256, GT1M, ActiTrainer, GT3X, and GT3X+ models.
- Compatible with data collected with a 1, 2, 3, 5, 10, 15, 20, 30 and 60 second epoch
- PC version available only
- Works with all modes of data collection (single plane activity, step counts, heart rate, tri-axial, inclinometer, etc.)



Contact information

- Visit website for more information and to purchase: www.MeterPlusSoftware.com
- For questions about software or other services available, contact Kelli Cain at kcain@projects.sdsu.edu

