Coursera Project: Data Cleaning – Code Book

Source Data

The source data can be found here:
http://archive.ics.uci.edu/ml/datasets/Human+Activity+Recognition+Using+Smartphones#
but was obtained through here:
https://d396qusza40orc.cloudfront.net/getdata%2Fprojectfiles%2FUCI%20HAR%20Dataset.zip
The authenticity of the second source has not been verified.

Data Collection

The experiments have been carried out with a group of 30 volunteers within an age bracket of 19-48 years. Each person performed six activities (WALKING, WALKING_UPSTAIRS, WALKING_DOWNSTAIRS, SITTING, STANDING, LAYING) wearing a smartphone (Samsung Galaxy S II) on the waist.
The experiments have been video-recorded to label the data manually in the respective category.

Using its embedded accelerometer and gyroscope, the source data captured 3-axial linear acceleration and 3-axial angular velocity at a constant rate of 50Hz. (XYZ' is used to denote 3-axial signals in the X, Y and Z directions)
The sensor signals (accelerometer and gyroscope) were pre-processed by applying noise filters and then sampled in fixed-width sliding windows of 2.56 sec and 50% overlap (128 readings/window).

The sensor acceleration signal, which has gravitational and body motion components (tBodyAcc-XYZ and tGravityAcc-XYZ), was separated using a Butterworth low-pass filter into body acceleration and gravity. The gravitational force is assumed to have only low frequency components, therefore a filter with 0.3 Hz cutoff frequency was used. From each window, a vector of features was obtained by calculating variables from the time and frequency domain.

Subsequently, the body linear acceleration and angular velocity were derived in time to obtain Jerk signals (tBodyAccJerk-XYZ and tBodyGyroJerk-XYZ). Also the magnitude of these three-dimensional signals were calculated using the Euclidean norm (tBodyAccMag, tGravityAccMag, tBodyAccJerkMag, tBodyGyroMag, tBodyGyroJerkMag).

Finally a Fast Fourier Transform (FFT) was applied to some of these signals producing frequency domain signals -- fBodyAcc-XYZ, fBodyAccJerk-XYZ, fBodyGyro-XYZ, fBodyAccJerkMag, fBodyGyroMag, fBodyGyroJerkMag.

The mean and standard deviations were calculated for all of the above variables.

Output Data Explanations

The dataset aggregates the source data by subject and activity type.
Example: Person:1-SITTING(4), means that the variables provided are **aggregate mean** for all underlying observations for volunteer, identified as #1 while he was preforming activity labeled as “Sitting” (“Sitting” is also coded as activity #4).

The means for the following variable are provided in the output dataset.

Variable Mean:	Component	Measured by:	Dimension	Measures:	Domain:	Notes:
tBodyAcc-mean()-X	Body	Accelerometer	X	Mean value	Time	
tBodyAcc-mean()-Y	Body	Accelerometer	Y	Mean value	Time	
tBodyAcc-mean()-Z	Body	Accelerometer	Z	Mean value	Time	
tGravityAcc-mean()-X	Gravity	Accelerometer	X	Mean value	Time	
tGravityAcc-mean()-Y	Gravity	Accelerometer	Y	Mean value	Time	
tGravityAcc-mean()-Z	Gravity	Accelerometer	Z	Mean value	Time	
tBodyAccJerk-mean()-X	Body	Accelerometer	X	Mean value	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyAccJerk-mean()-Y	Body	Accelerometer	Y	Mean value	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyAccJerk-mean()-Z	Body	Accelerometer	Z	Mean value	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyGyro-mean()-X	Body	Gyroscope	X	Mean value	Time	
tBodyGyro-mean()-Y	Body	Gyroscope	Y	Mean value	Time	
tBodyGyro-mean()-Z	Body	Gyroscope	Z	Mean value	Time	
tBodyGyroJerk-mean()-X	Body	Gyroscope	X	Mean value	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyGyroJerk-mean()-Y	Body	Gyroscope	Y	Mean value	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyGyroJerk-mean()-Z	Body	Gyroscope	Z	Mean value	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyAccMag-mean()	Body	Accelerometer	n/a	Mean value	Time	The magnitude of these three-dimensional signals were calculated.
tGravityAccMag-mean()	Gravity	Accelerometer	n/a	Mean value	Time	The magnitude of these three-dimensional signals were calculated.
tBodyAccJerkMag-mean()	Body	Accelerometer	n/a	Mean value	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were calculated.
tBodyGyroMag-mean()	Body	Gyroscope	n/a	Mean value	Time	The magnitude of these three-dimensional signals were calculated.
tBodyGyroJerkMag-mean()	Body	Gyroscope	n/a	Mean value	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were calculated.
fBodyAcc-mean()-X	Body	Accelerometer	X	Mean value	Frequency	
fBodyAcc-mean()-Y	Body	Accelerometer	Y	Mean value	Frequency	
fBodyAcc-mean()-Z	Body	Accelerometer	Z	Mean value	Frequency	
fBodyAcc-meanFreq()-X	Body	Accelerometer	X	Weighted average of the frequency components to obtain a mean frequency	Frequency	
fBodyAcc-meanFreq()-Y	Body	Accelerometer	Y	Weighted	Frequency	

Variable Mean:	Component	Measured by:	Dimension	Measures:	Domain:	Notes:
				average of the frequency components to obtain a mean frequency		
fBodyAcc-meanFreq()-Z	Body	Accelerometer	Z	Weighted average of the frequency components to obtain a mean frequency	Frequency	
fBodyAccJerk-mean()-X	Body	Accelerometer	X	Mean value	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
fBodyAccJerk-mean()-Y	Body	Accelerometer	Y	Mean value	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
fBodyAccJerk-mean()-Z	Body	Accelerometer	Z	Mean value	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
fBodyAccJerk-meanFreq()-X	Body	Accelerometer	X	Weighted average of the frequency components to obtain a mean frequency	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
fBodyAccJerk-meanFreq()-Y	Body	Accelerometer	Y	Weighted average of the frequency components to obtain a mean frequency	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
fBodyAccJerk-meanFreq()-Z	Body	Accelerometer	Z	Weighted average of the frequency components to obtain a mean frequency	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
fBodyGyro-mean()-X	Body	Gyroscope	X	Mean value	Frequency	
fBodyGyro-mean()-Y	Body	Gyroscope	Y	Mean value	Frequency	
fBodyGyro-mean()-Z	Body	Gyroscope	Z	Mean value	Frequency	
fBodyGyro-meanFreq()-X	Body	Gyroscope	X	Weighted average of the frequency components to obtain a mean frequency	Frequency	
fBodyGyro-meanFreq()-Y	Body	Gyroscope	Y	Weighted average of the frequency components to obtain a mean frequency	Frequency	
fBodyGyro-meanFreq()-Z	Body	Gyroscope	Z	Weighted average of the frequency components to obtain a mean	Frequency	

Variable Mean:	Component	Measured by:	Dimension	Measures:	Domain:	Notes:
				frequency		
fBodyAccMag-mean()	Body	Accelerometer	n/a	Mean value	Frequency	The magnitude of these three-dimensional signals were calculated.
fBodyAccMag-meanFreq()	Body	Accelerometer	n/a	Weighted average of the frequency components to obtain a mean frequency	Frequency	The magnitude of these three-dimensional signals were calculated.
fBodyBodyAccJerkMag-mean()	Body	Accelerometer	n/a	Mean value	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were calculated.
fBodyBodyAccJerkMag-meanFreq()	Body	Accelerometer	n/a	Weighted average of the frequency components to obtain a mean frequency	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were calculated.
fBodyBodyGyroMag-mean()	Body	Gyroscope	n/a	Mean value	Frequency	The magnitude of these three-dimensional signals were calculated.
fBodyBodyGyroMag-meanFreq()	Body	Gyroscope	n/a	Weighted average of the frequency components to obtain a mean frequency	Frequency	The magnitude of these three-dimensional signals were calculated.
fBodyBodyGyroJerkMag-mean()	Body	Gyroscope	n/a	Mean value	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were calculated.
fBodyBodyGyroJerkMag-meanFreq()	Body	Gyroscope	n/a	Weighted average of the frequency components to obtain a mean frequency	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were calculated.
tBodyAcc-std()-X	Body	Accelerometer	X	Standard Deviation	Time	
tBodyAcc-std()-Y	Body	Accelerometer	Y	Standard Deviation	Time	
tBodyAcc-std()-Z	Body	Accelerometer	Z	Standard Deviation	Time	
tGravityAcc-std()-X	Gravity	Accelerometer	X	Standard Deviation	Time	
tGravityAcc-std()-Y	Gravity	Accelerometer	Y	Standard Deviation	Time	
tGravityAcc-std()-Z	Gravity	Accelerometer	Z	Standard Deviation	Time	
tBodyAccJerk-std()-X	Body	Accelerometer	X	Standard Deviation	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyAccJerk-std()-Y	Body	Accelerometer	Y	Standard Deviation	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyAccJerk-std()-Z	Body	Accelerometer	Z	Standard Deviation	Time	Body linear acceleration and angular velocity were derived in time

Variable Mean:	Component	Measured by:	Dimension	Measures:	Domain:	Notes:
						to obtain Jerk signals.
tBodyGyro-std()-X	Body	Gyroscope	X	Standard Deviation	Time	
tBodyGyro-std()-Y	Body	Gyroscope	Y	Standard Deviation	Time	
tBodyGyro-std()-Z	Body	Gyroscope	Z	Standard Deviation	Time	
tBodyGyroJerk-std()-X	Body	Gyroscope	X	Standard Deviation	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyGyroJerk-std()-Y	Body	Gyroscope	Y	Standard Deviation	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyGyroJerk-std()-Z	Body	Gyroscope	Z	Standard Deviation	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
tBodyAccMag-std()	Body	Accelerometer	n/a	Standard Deviation	Time	The magnitude of these three-dimensional signals were calculated.
tGravityAccMag-std()	Gravity	Accelerometer	n/a	Standard Deviation	Time	The magnitude of these three-dimensional signals were calculated.
tBodyAccJerkMag-std()	Body	Accelerometer	n/a	Standard Deviation	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were calculated.
tBodyGyroMag-std()	Body	Gyroscope	n/a	Standard Deviation	Time	The magnitude of these three-dimensional signals were calculated.
tBodyGyroJerkMag-std()	Body	Gyroscope	n/a	Standard Deviation	Time	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were calculated.
fBodyAcc-std()-X	Body	Accelerometer	X	Standard Deviation	Frequency	
fBodyAcc-std()-Y	Body	Accelerometer	Y	Standard Deviation	Frequency	
fBodyAcc-std()-Z	Body	Accelerometer	Z	Standard Deviation	Frequency	
fBodyAccJerk-std()-X	Body	Accelerometer	X	Standard Deviation	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
fBodyAccJerk-std()-Y	Body	Accelerometer	Y	Standard Deviation	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
fBodyAccJerk-std()-Z	Body	Accelerometer	Z	Standard Deviation	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals.
fBodyGyro-std()-X	Body	Gyroscope	X	Standard Deviation	Frequency	
fBodyGyro-std()-Y	Body	Gyroscope	Y	Standard Deviation	Frequency	
fBodyGyro-std()-Z	Body	Gyroscope	Z	Standard Deviation	Frequency	
fBodyAccMag-std()	Body	Accelerometer	n/a	Standard Deviation	Frequency	The magnitude of these three-dimensional signals were calculated.
fBodyBodyAccJerkMag-std()	Body	Accelerometer	n/a	Standard Deviation	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were

Variable Mean:	Component	Measured by:	Dimension	Measures:	Domain:	Notes:
						calculated.
fBodyBodyGyroMag-std()	Body	Gyroscope	n/a	Standard Deviation	Frequency	The magnitude of these three-dimensional signals were calculated.
fBodyBodyGyroJerkMag-std()	Body	Gyroscope	n/a	Standard Deviation	Frequency	Body linear acceleration and angular velocity were derived in time to obtain Jerk signals. The magnitude of these three-dimensional signals were calculated.

License for Source Data:

[1] Davide Anguita, Alessandro Ghio, Luca Oneto, Xavier Parra and Jorge L. Reyes-Ortiz. A Public Domain Dataset for Human Activity Recognition Using Smartphones. 21th European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning, ESANN 2013. Bruges, Belgium 24-26 April 2013.

Other Related Publications:

[2] Davide Anguita, Alessandro Ghio, Luca Oneto, Xavier Parra, Jorge L. Reyes-Ortiz. Energy Efficient Smartphone-Based Activity Recognition using Fixed-Point Arithmetic. Journal of Universal Computer Science. Special Issue in Ambient Assisted Living: Home Care. Volume 19, Issue 9. May 2013

[3] Davide Anguita, Alessandro Ghio, Luca Oneto, Xavier Parra and Jorge L. Reyes-Ortiz. Human Activity Recognition on Smartphones using a Multiclass Hardware-Friendly Support Vector Machine. 4th International Workshop of Ambient Assited Living, IWAAL 2012, Vitoria-Gasteiz, Spain, December 3-5, 2012. Proceedings. Lecture Notes in Computer Science 2012, pp 216-223.

[4] Jorge Luis Reyes-Ortiz, Alessandro Ghio, Xavier Parra-Llanas, Davide Anguita, Joan Cabestany, Andreu Catal�. Human Activity and Motion Disorder Recognition: Towards Smarter Interactive Cognitive Environments. 21th European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning, ESANN 2013. Bruges, Belgium 24-26 April 2013.

Jorge L. Reyes-Ortiz, Alessandro Ghio, Luca Oneto, Davide Anguita and Xavier Parra. November 2013.