

```

> data_set <- read.csv("Example_WearableComputing_weight_lifting_exercises_biceps_curl_variations.csv")
> view(data_set)
> # remove irrelevant collumns viz. name, cvtd_timestamp, new_window
> data <- data_set[,-c(1,4,5)]
> str(data)
'data.frame': 4024 obs. of 156 variables:
 $ raw_timestamp_part_1 : int 1322489729 1322489729 1322489729 1322489729 1322489729 ...
729 1322489729 1322489729 1322489729 1322489729 1322489729 1322489729 ...
 $ raw_timestamp_part_2 : int 34670 62641 70653 82654 90637 170626 190
665 242723 267551 274689 ...
 $ num_window           : int 1 1 1 1 1 1 1 1 1 1 ...
 $ roll_belt            : num 3.7 3.66 3.58 3.56 3.57 3.45 3.31 2.91 2
.31 2 ...
 $ pitch_belt           : num 41.6 42.8 43.7 44.4 45.1 45.6 46.2 46.9
47.4 47.7 ...
 $ yaw_belt             : num -82.8 -82.5 -82.3 -82.1 -81.9 -81.9 -81.
9 -82.2 -82.6 -82.8 ...
 $ total_accel_belt     : int 3 2 1 1 1 1 3 4 2 3 ...
 $ kurtosis_roll_belt   : num NA NA NA NA NA NA NA NA NA NA ...
 $ kurtosis_pitch_belt  : Factor w/ 80 levels "", "-0.06016",...: 1 1 1 1
1 1 1 1 1 1 ...
 $ kurtosis_yaw_belt    : Factor w/ 2 levels "", "#DIV/0!": 1 1 1 1 1 1
1 1 1 1 ...
 $ skewness_roll_belt   : num NA NA NA NA NA NA NA NA NA NA ...
 $ skewness_roll_belt.1 : Factor w/ 82 levels "", "-0.045472",...: 1 1 1
1 1 1 1 1 1 1 ...
 $ skewness_yaw_belt    : Factor w/ 2 levels "", "#DIV/0!": 1 1 1 1 1 1
1 1 1 1 ...
 $ max_roll_belt        : num NA NA NA NA NA NA NA NA NA NA ...
 $ max_pitch_belt       : int NA NA NA NA NA NA NA NA NA NA ...
 $ max_yaw_belt         : num NA NA NA NA NA NA NA NA NA NA ...
 $ min_roll_belt        : num NA NA NA NA NA NA NA NA NA NA ...
 $ min_pitch_belt       : int NA NA NA NA NA NA NA NA NA NA ...
 $ min_yaw_belt         : num NA NA NA NA NA NA NA NA NA NA ...
 $ amplitude_roll_belt  : num NA NA NA NA NA NA NA NA NA NA ...
 $ amplitude_pitch_belt : int NA NA NA NA NA NA NA NA NA NA ...
 $ amplitude_yaw_belt   : int NA NA NA NA NA NA NA NA NA NA ...
 $ var_total_accel_belt : num NA NA NA NA NA NA NA NA NA NA ...
 $ avg_roll_belt        : num NA NA NA NA NA NA NA NA NA NA ...
 $ stddev_roll_belt     : num NA NA NA NA NA NA NA NA NA NA ...
 $ var_roll_belt        : num NA NA NA NA NA NA NA NA NA NA ...
 $ avg_pitch_belt       : num NA NA NA NA NA NA NA NA NA NA ...
 $ stddev_pitch_belt    : num NA NA NA NA NA NA NA NA NA NA ...
 $ var_pitch_belt       : num NA NA NA NA NA NA NA NA NA NA ...
 $ avg_yaw_belt         : num NA NA NA NA NA NA NA NA NA NA ...
 $ stddev_yaw_belt      : num NA NA NA NA NA NA NA NA NA NA ...
 $ var_yaw_belt         : num NA NA NA NA NA NA NA NA NA NA ...
 $ gyros_belt_x         : num 2.02 1.96 1.88 1.8 1.77 1.75 1.78 1.75 1
.65 1.48 ...
 $ gyros_belt_y         : num 0.18 0.14 0.08 0.03 0 -0.03 -0.06 -0.06
-0.03 -0.06 ...
 $ gyros_belt_z         : num 0.02 0.05 0.05 0.08 0.13 0.16 0.15 0.23
0.33 0.21 ...
 $ accel_belt_x         : int -3 -2 -2 -6 -4 1 1 2 -1 -18 ...
 $ accel_belt_y         : int -18 -13 -6 -5 -9 -9 -24 -36 -19 18 ...
 $ accel_belt_z         : int 22 16 8 7 0 -5 -8 -9 -7 1 ...
 $ magnet_belt_x        : int 387 405 409 422 418 432 438 440 443 449
...
 $ magnet_belt_y        : int 525 512 511 513 508 510 508 503 507 499
...

```

```

$ magnet_belt_z      : int   -267 -254 -244 -221 -208 -189 -176 -163
-140 -132 ...
$ roll_arm           : num    132 129 125 120 115 110 104 98.6 93.2 88
.5 ...
$ pitch_arm          : num   -43.7 -45.3 -46.8 -48.1 -49.1 -49.6 -49.
9 -49.7 -49 -48.1 ...
$ yaw_arm            : num   -53.6 -49 -43.7 -38.1 -31.7 -25.8 -18.5
-11.4 -4.49 1.82 ...
$ total_accel_arm    : int    38 38 35 35 34 33 29 28 27 22 ...
$ var_accel_arm      : num    NA NA NA NA NA NA NA NA NA NA ...
$ avg_roll_arm       : num    NA NA NA NA NA NA NA NA NA NA ...
$ stddev_roll_arm    : num    NA NA NA NA NA NA NA NA NA NA ...
$ var_roll_arm       : num    NA NA NA NA NA NA NA NA NA NA ...
$ avg_pitch_arm      : num    NA NA NA NA NA NA NA NA NA NA ...
$ stddev_pitch_arm   : num    NA NA NA NA NA NA NA NA NA NA ...
$ var_pitch_arm      : num    NA NA NA NA NA NA NA NA NA NA ...
$ avg_yaw_arm        : num    NA NA NA NA NA NA NA NA NA NA ...
$ stddev_yaw_arm     : num    NA NA NA NA NA NA NA NA NA NA ...
$ var_yaw_arm        : num    NA NA NA NA NA NA NA NA NA NA ...
$ gyros_arm_x        : num    2.65 2.79 2.91 3.08 3.2 3.31 3.5 3.53 3.
4 3.48 ...
$ gyros_arm_y        : num   -0.61 -0.64 -0.69 -0.72 -0.77 -0.83 -0.8
3 -0.83 -0.83 -0.8 ...
$ gyros_arm_z        : num   -0.02 -0.11 -0.15 -0.23 -0.25 -0.3 -0.31
-0.21 -0.11 -0.15 ...
$ accel_arm_x        : int    143 146 156 158 163 160 165 153 143 135
...
$ accel_arm_y        : int    30 35 44 52 55 59 67 70 78 96 ...
$ accel_arm_z        : int   -346 -339 -307 -305 -288 -274 -225 -218
-205 -134 ...
$ magnet_arm_x       : int    556 599 613 646 670 696 721 725 740 741
...
$ magnet_arm_y       : int   -205 -206 -198 -186 -175 -174 -161 -152
-133 -115 ...
$ magnet_arm_z       : int   -374 -335 -319 -268 -241 -193 -121 -105
-43 14 ...
$ kurtosis_roll_arm  : Factor w/ 89 levels """,-0.11926",...: 1 1 1 1
1 1 1 1 1 1 ...
$ kurtosis_pitch_arm : Factor w/ 85 levels """,-0.10176",...: 1 1 1 1
1 1 1 1 1 1 ...
$ kurtosis_yaw_arm   : Factor w/ 82 levels """,-0.06791",...: 1 1 1 1
1 1 1 1 1 1 ...
$ skewness_roll_arm  : Factor w/ 89 levels """,-0.00696",...: 1 1 1 1
1 1 1 1 1 1 ...
$ skewness_pitch_arm : Factor w/ 85 levels """,-0.01247",...: 1 1 1 1
1 1 1 1 1 1 ...
$ skewness_yaw_arm   : Factor w/ 82 levels """,-0.0046","-0.008",...:
1 1 1 1 1 1 1 1 1 1 ...
$ max_roll_arm       : num    NA NA NA NA NA NA NA NA NA NA ...
$ max_pitch_arm      : num    NA NA NA NA NA NA NA NA NA NA ...
$ max_yaw_arm        : int    NA NA NA NA NA NA NA NA NA NA ...
$ min_roll_arm       : num    NA NA NA NA NA NA NA NA NA NA ...
$ min_pitch_arm      : num    NA NA NA NA NA NA NA NA NA NA ...
$ min_yaw_arm        : int    NA NA NA NA NA NA NA NA NA NA ...
$ amplitude_roll_arm : num    NA NA NA NA NA NA NA NA NA NA ...
$ amplitude_pitch_arm : num    NA NA NA NA NA NA NA NA NA NA ...
$ amplitude_yaw_arm  : int    NA NA NA NA NA NA NA NA NA NA ...
$ roll_dumbbell      : num    51.2 55.8 55.5 55.9 55.2 ...
$ pitch_dumbbell     : num    11.7 9.65 6.88 11.08 11.43 ...
$ yaw_dumbbell       : num    104.3 100.2 101.1 99.8 100.4 ...
$ kurtosis_roll_dumbbell : num    NA NA NA NA NA NA NA NA NA NA ...
$ kurtosis_pitch_dumbbell : num    NA NA NA NA NA NA NA NA NA NA ...

```

```

$ kurtosis_yaw_dumbbell : Factor w/ 2 levels "", "#DIV/0!": 1 1 1 1 1 1
1 1 1 1 ...
$ skewness_roll_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ skewness_pitch_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ skewness_yaw_dumbbell : Factor w/ 2 levels "", "#DIV/0!": 1 1 1 1 1 1
1 1 1 1 ...
$ max_roll_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ max_pitch_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ max_yaw_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ min_roll_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ min_pitch_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ min_yaw_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ amplitude_roll_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ amplitude_pitch_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
$ amplitude_yaw_dumbbell : int NA NA NA NA NA NA NA NA NA NA NA ...
$ total_accel_dumbbell : int 4 4 4 5 4 4 4 4 4 4 ...
$ var_accel_dumbbell : num NA NA NA NA NA NA NA NA NA NA NA ...
[1] list output truncated
> dim(data)
[1] 4024 156
> sum(is.na(data))
[1] 310944
> library(caTools)
> # remove irrelevant columns viz. name, cvtd_timestamp, new_window
> data <- data_set[, -c(1,4,5,11:35,49:58,68:82,86:100,102:111,124:138,140:
149)]
> sum(is.na(data))
[1] 0

> dim(data)
[1] 4024 56
> sum(is.na(data)) # there are no missing values
[1] 0
> library(caTools)
> set.seed(123)
> split = sample.split(data$classe, SplitRatio = 0.7)
> train = subset(data, split == TRUE) # train data
> test = subset(data, split == FALSE) # test data
> library(nnet) ; library(MASS)
> model <- multinom(classe ~., data = train)
# weights: 285 (224 variable)
initial value 4532.177161
iter 10 value 2757.312860
iter 20 value 1202.506590
iter 30 value 925.161020
iter 40 value 851.683573
iter 50 value 445.978613
iter 60 value 316.478916
iter 70 value 295.623930
iter 70 value 295.623930
iter 80 value 232.180439
iter 90 value 215.713723
iter 90 value 215.713723
iter 100 value 156.102458
final value 156.102458
stopped after 100 iterations
> summary(model)
Call:
multinom(formula = classe ~ ., data = train)

Coefficients:

```

	(Intercept)	raw_timestamp_part_1	raw_timestamp_part_2	num_window	
roll_belt	pitch_belt				
B	1.286166e-08	8.962616e-09	1.128675e-06	0.036388577	0.
0010266370	-0.0004072068				
C	-1.603066e-09	-3.758704e-09	1.065608e-06	0.018947361	0.
0044238241	-0.0012485841				
D	2.203816e-09	-2.767160e-09	-3.708567e-07	-0.009766738	0.
0005574347	0.0038323809				
E	3.077002e-08	6.859400e-09	-7.681324e-07	0.007995789	-0.
0026663994	-0.0045305956				
	yaw_belt	total_accel_belt	gyros_belt_x	gyros_belt_y	gyros_belt_z
accel_belt_x					
B	0.003279427	-0.0007163652	-2.183617e-05	1.804418e-05	-4.660377e-05
0.0050085943					
C	0.009076370	0.0007298242	5.929460e-05	-1.349332e-06	-3.334631e-05
0.0008275134					
D	-0.002015069	-0.0001571560	4.184202e-05	-3.627225e-05	-2.999760e-04
-0.0044363556					
E	0.003167538	-0.0001593284	1.314435e-05	2.068968e-05	3.338087e-04
0.0065339444					
	accel_belt_y	accel_belt_z	magnet_belt_x	magnet_belt_y	magnet_belt_z
roll_arm	pitch_arm				
B	0.003787169	0.0009017705	-0.0007351203	0.0025952533	0.030589329
001534042	-0.042072242				-0.
C	0.001856723	-0.0061088965	0.0034712191	0.0011510410	0.003955785
006365757	0.012825862				0.
D	0.002845748	0.0046405659	-0.0011012390	0.0006237185	0.004356354
002164793	-0.012750528				-0.
E	-0.006712133	0.0004121083	0.0181528428	-0.0016594264	0.007511491
008517833	0.002482121				0.
	yaw_arm	total_accel_arm	gyros_arm_x	gyros_arm_y	gyros_arm_z
accel_arm_x	accel_arm_y				
B	-0.010984235	-0.009208846	-0.0041476018	0.0022330624	1.223618e-04
.0251657242	0.015387139				-0.
C	0.004482884	-0.000792231	0.0004580050	-0.0005097588	3.786635e-05
.0002479447	-0.005029888				0
D	0.004272662	-0.004136209	0.0007586599	-0.0002770227	1.278360e-06
.0093472989	0.005812127				0
E	0.012026565	0.001239127	0.0003145666	-0.0001309977	4.399033e-06
.0195025646	0.003679356				-0.
	accel_arm_z	magnet_arm_x	magnet_arm_y	magnet_arm_z	roll_dumbbell
pitch_dumbbell	yaw_dumbbell				
B	0.031266710	-0.0021176544	0.0131018863	-0.0345563603	-0.012314893
0.004597288	0.002557387				-
C	0.010102966	-0.0018866912	-0.0136026255	0.0007480537	-0.004791811
0.001554659	-0.005552050				-
D	-0.006146669	0.0006082433	-0.0102229788	0.0057854053	0.016282631
0.006092612	0.013246850				
E	0.013736441	0.0065402946	-0.0008041326	-0.0126873658	-0.020372116
0.010594547	-0.006413446				-
	total_accel_dumbbell	gyros_dumbbell_x	gyros_dumbbell_y	gyros_dumbbell_z	
accel_dumbbell_x					
B	0.0009031854	-1.806878e-04	-0.0004353960	0.0004905790	
0.003605810					
C	0.0024748315	1.258235e-04	0.0004065638	-0.0003332795	
-0.005315784					
D	-0.0023202024	-9.254722e-05	0.0003326588	-0.0001526534	
-0.005886001					
E	0.0016288598	1.355429e-04	-0.0004210509	0.0000806895	
0.024133984					
	accel_dumbbell_y	accel_dumbbell_z	magnet_dumbbell_x	magnet_dumbbell_y	magnet_dumbbell_z

```

B      0.002000078      0.003779658      -0.001932990      -0.008309944
-0.002936508
C      -0.014354232      0.008962474      -0.008648331      -0.001913403
-0.006615611
D      -0.016331989      -0.002662942      -0.009078766      0.007307273
0.005384055
E      0.025799510      0.016947832      -0.013656301      -0.001970933
0.011153597
  roll_forearm pitch_forearm yaw_forearm total_accel_forearm gyros_forea
rm_x gyros_forearm_y
B 0.007403015 0.001381364 -0.0006562523 0.006790624 6.334239
e-04 -0.0025001486
C 0.013935343 -0.001508266 -0.0003943302 0.004760143 -4.812016
e-05 0.0006164480
D -0.002581436 0.004536335 0.0103693563 0.002522485 2.521452
e-05 -0.0003830419
E 0.001437224 0.004638303 0.0084837358 -0.005107979 -7.968898
e-05 0.0002931523
  gyros_forearm_z accel_forearm_x accel_forearm_y accel_forearm_z magnet_f
orearm_x magnet_forearm_y
B -0.0003783251 -0.0008552337 0.015571217 0.014796933 0.00
67591556 -0.018485232
C 0.0001895517 0.0161842198 0.017009173 0.006860611 0.00
54372162 -0.020438679
D -0.0001047314 -0.0176500984 -0.008462494 0.014614309 -0.00
20672866 -0.006860282
E 0.0001749709 0.0037014690 0.005847717 0.007635865 0.00
02647701 -0.007769549
  magnet_forearm_z
B 0.018010438
C 0.018692215
D 0.011368119
E 0.004440576

Std. Errors:
  (Intercept) raw_timestamp_part_1 raw_timestamp_part_2 num_window r
oll_belt pitch_belt
B NaN 1.893431e-10 4.329732e-07 1.844599e-12 1.59
1780e-13 1.533606e-13
C 1.442397e-19 1.920776e-10 1.401957e-07 3.947470e-13 7.79
3620e-14 8.633346e-14
D 4.197485e-19 4.614863e-10 4.044217e-07 7.683178e-13 1.11
5606e-12 3.167292e-14
E 3.214429e-19 4.374836e-10 4.220291e-07 5.244728e-13 1.66
7784e-12 9.096711e-14
  yaw_belt total_accel_belt gyros_belt_x gyros_belt_y gyros_belt_z acc
el_belt_x accel_belt_y
B 1.317373e-13 3.991061e-14 7.544627e-15 1.665578e-15 8.668490e-15 4.5
63680e-14 3.202720e-13
C 1.407678e-13 1.353863e-14 2.400161e-15 8.480095e-16 5.867655e-15 1.2
89464e-13 5.109659e-14
D 6.531361e-13 4.481122e-14 3.314208e-14 1.331121e-14 8.902281e-14 1.2
51356e-12 4.079196e-13
E 1.000317e-12 2.752233e-14 3.576191e-14 1.325297e-14 8.647571e-14 1.3
55035e-12 1.213828e-13
  accel_belt_z magnet_belt_x magnet_belt_y magnet_belt_z roll_arm p
itch_arm yaw_arm
B 4.033651e-13 1.978032e-12 3.971358e-13 6.975325e-13 5.130311e-12 1.90
5511e-13 8.260343e-12
C 1.236593e-13 9.301885e-13 2.928707e-14 2.754921e-13 3.156976e-13 1.16
9908e-12 1.205542e-11

```

D	2.152333e-12	4.676004e-13	3.422605e-13	4.124739e-12	1.006313e-11	8.957900e-12	1.659304e-11
E	3.040069e-12	3.229030e-13	3.939637e-13	4.385374e-12	9.065679e-12	9.478371e-12	1.774947e-11
	total_accel_arm	gyros_arm_x	gyros_arm_y	gyros_arm_z	accel_arm_x	accel_arm_y	accel_arm_z
B	1.680490e-12	7.231246e-13	4.499754e-13	1.823452e-14	2.380511e-11	1.038107e-11	1.384469e-11
C	2.826193e-12	4.410748e-13	2.868655e-13	2.626020e-14	3.281252e-11	9.974665e-12	1.293026e-11
D	1.309767e-12	4.858473e-13	2.403854e-13	9.249037e-14	3.283159e-11	2.564076e-11	5.206795e-11
E	1.393163e-12	4.654418e-13	2.336091e-13	9.461178e-14	3.170157e-11	2.595932e-11	5.390309e-11
	magnet_arm_x	magnet_arm_y	magnet_arm_z	roll_dumbbell	pitch_dumbbell	yaw_dumbbell	
B	8.699233e-11	2.999682e-11	4.595839e-11	9.845659e-12	7.467794e-12	8.812587e-12	
C	9.713388e-11	3.937867e-11	5.545749e-11	5.560063e-12	5.262835e-12	6.690463e-12	
D	9.110407e-11	7.935177e-11	1.179633e-10	2.328691e-12	2.532414e-12	1.152202e-12	
E	9.039766e-11	8.098563e-11	1.200623e-10	1.419238e-12	2.644496e-12	1.451401e-12	
	total_accel_dumbbell	gyros_dumbbell_x	gyros_dumbbell_y	gyros_dumbbell_z	accel_dumbbell_x		
B	4.414814e-13	1.065064e-13	1.334324e-13	9.340023e-14	7.682885e-12		
C	4.065781e-13	7.381777e-14	1.402061e-13	9.434030e-14	6.196693e-12		
D	9.069797e-13	2.529338e-14	7.810257e-14	1.662699e-14	3.645251e-12		
E	9.278850e-13	2.780112e-14	7.362004e-14	1.626572e-14	3.774691e-12		
	accel_dumbbell_y	accel_dumbbell_z	magnet_dumbbell_x	magnet_dumbbell_y	magnet_dumbbell_z		
B	1.054714e-11	2.839570e-12	3.379103e-11	2.012859e-11	1.303956e-11		
C	6.891425e-12	2.473545e-12	2.735098e-11	1.447545e-11	9.103789e-12		
D	6.828945e-12	3.848007e-12	1.696902e-11	1.941103e-11	9.995863e-12		
E	7.667747e-12	3.331122e-12	1.302464e-11	2.481543e-11	1.051185e-11		
	roll_forearm	pitch_forearm	yaw_forearm	total_accel_forearm	gyros_forearm_x	gyros_forearm_y	
B	2.728021e-11	9.018714e-13	1.700149e-11	3.638910e-13	2.653649e-14	2.783338e-13	
C	2.518035e-11	3.085210e-12	1.325541e-11	3.692206e-13	4.302843e-14	1.791572e-13	
D	2.288230e-11	3.524746e-12	2.137706e-11	2.820305e-13	9.655373e-15	7.730689e-13	
E	2.296534e-11	4.080618e-12	2.214215e-11	3.467012e-13	1.452366e-14	7.872019e-13	
	gyros_forearm_z	accel_forearm_x	accel_forearm_y	accel_forearm_z	magnet_forearm_x	magnet_forearm_y	
B	1.001845e-13	4.505555e-12	3.974840e-11	7.511877e-12	1.940762e-11	9.140918e-11	
C	6.135298e-14	1.038447e-11	4.637119e-11	9.510576e-12	9.761770e-12	1.106340e-10	
D	2.724565e-13	5.744338e-12	1.625896e-11	3.573046e-12	4.531128e-11	4.330977e-11	

```

E    2.761110e-13    6.494673e-12    1.488252e-11    3.776004e-12    4.70
3891e-11    3.944464e-11
magnet_forearm_z
B    4.905211e-11
C    6.055926e-11
D    2.511892e-11
E    2.506356e-11

Residual Deviance: 312.2049
AIC: 760.2049

```

```

> final <- multinom(classe ~ raw_timestamp_part_1 + num_window + roll_belt
+ pitch_belt +
+ yaw_belt + total_accel_belt + gyros_belt_x + gyros_b
elt_y +
+ gyros_belt_z + accel_belt_x + accel_belt_y + accel_b
elt_z +
+ magnet_belt_x + magnet_belt_y + magnet_belt_z + roll
_arm +
+ pitch_arm + yaw_arm + total_accel_arm + gyros_arm_x
+ gyros_arm_y +
+ gyros_arm_z + accel_arm_x + accel_arm_y + accel_arm_
z + magnet_arm_y +
+ magnet_arm_z + roll_dumbbell + pitch_dumbbell + yaw_
dumbbell +
+ gyros_dumbbell_x + gyros_dumbbell_z + accel_dumbbell
_x +
+ accel_dumbbell_y + accel_dumbbell_z + magnet_dumbbell
l_x +
+ magnet_dumbbell_y + magnet_dumbbell_z + roll_forearm
+ pitch_forearm +
+ yaw_forearm + total_accel_forearm + gyros_forearm_x
+ gyros_forearm_y +
+ gyros_forearm_z + accel_forearm_x + accel_forearm_y
+ accel_forearm_z +
+ magnet_forearm_x + magnet_forearm_y + magnet_forearm
_z, data = train)
# weights: 265 (208 variable)
initial value 4532.177161
iter 10 value 1695.817687
iter 20 value 823.145181
iter 30 value 724.071332
iter 40 value 357.227728
iter 50 value 289.194690
iter 50 value 289.194690
iter 60 value 201.646078
iter 70 value 105.292085
iter 80 value 76.164403
iter 90 value 57.973059
iter 100 value 49.430197
final value 49.430197
stopped after 100 iterations
> final
Call:
multinom(formula = classe ~ raw_timestamp_part_1 + num_window +
roll_belt + pitch_belt + yaw_belt + total_accel_belt + gyros_belt_x +
gyros_belt_y + gyros_belt_z + accel_belt_x + accel_belt_y +
accel_belt_z + magnet_belt_x + magnet_belt_y + magnet_belt_z +
roll_arm + pitch_arm + yaw_arm + total_accel_arm + gyros_arm_x +
gyros_arm_y + gyros_arm_z + accel_arm_x + accel_arm_y + accel_arm_z +

```



```

magnet_arm_y + magnet_arm_z + roll_dumbbell + pitch_dumbbell +
yaw_dumbbell + gyros_dumbbell_x + gyros_dumbbell_z + accel_dumbbell_x
+
accel_dumbbell_y + accel_dumbbell_z + magnet_dumbbell_x +
magnet_dumbbell_y + magnet_dumbbell_z + roll_forearm + pitch_forearm +
yaw_forearm + total_accel_forearm + gyros_forearm_x + gyros_forearm_y
+
gyros_forearm_z + accel_forearm_x + accel_forearm_y + accel_forearm_z
+
magnet_forearm_x + magnet_forearm_y + magnet_forearm_z, data = train)

```

Coefficients:

	(Intercept)	raw_timestamp_part_1	num_window	roll_belt	pitch_belt
t					
B	2.236996e-09	-1.363158e-09	0.09105180	-0.0048339198	-0.00114186
4	-0.005088154				
C	4.494416e-09	-2.195099e-08	0.04043045	0.0060653121	-0.00183343
1	0.010231355				
D	-4.286441e-10	-2.797434e-08	-0.02413039	-0.0008663083	0.00528777
6	-0.006181941				
E	3.340052e-08	2.144261e-08	0.02269082	-0.0036644520	-0.00699047
4	0.009706589				
	total_accel_belt	gyros_belt_x	gyros_belt_y	gyros_belt_z	accel_belt_x
accel_belt_y	accel_belt_z				
B	-0.0034695300	-1.725407e-04	3.202847e-05	-1.791988e-04	0.005522384
0.004046689	0.019442560				
C	0.0011722424	2.711960e-04	-1.643575e-05	2.464993e-05	-0.002186109
0.002454132	-0.008387581				
D	-0.0015899760	9.948438e-05	-6.790312e-05	-5.471208e-04	-0.006243753
0.003994443	0.010726061				
E	0.0009475916	-5.727850e-05	7.624242e-05	6.062901e-04	0.011859843
-0.008821349	-0.002486073				
	magnet_belt_x	magnet_belt_y	magnet_belt_z	roll_arm	pitch_arm
yaw_arm	total_accel_arm				
B	-0.021459955	0.0280579103	0.071911618	0.003798006	-0.06576813
5097131	-0.0208380039				
C	0.007047188	-0.0007373633	-0.008946121	0.019143671	0.03876987
3903727	-0.0117818993				
D	-0.004494439	0.0014234456	-0.001797440	-0.002427299	-0.01689625
1780834	0.0003814782				
E	0.025647016	-0.0056357674	0.016470815	0.019009746	0.01069149
3081535	-0.0010059266				
	gyros_arm_x	gyros_arm_y	gyros_arm_z	accel_arm_x	accel_arm_y
1_arm_z	magnet_arm_y				
B	-0.0136631649	7.976717e-03	0.0001970857	-0.05704138	0.021008371
3476960	0.031921773				
C	0.0025245032	-2.212564e-03	0.0002045377	-0.01685926	-0.004174773
7857859	-0.051624345				
D	0.0004537182	1.180763e-05	-0.0002996302	0.03288859	-0.001635021
6528067	-0.018772245				
E	0.0008257342	-6.560845e-04	0.0002976939	-0.03988844	0.022885775
7278992	-0.002718483				
	magnet_arm_z	roll_dumbbell	pitch_dumbbell	yaw_dumbbell	gyros_dumbbell_x
gyros_dumbbell_z					
B	-0.06237601	-0.007141826	-0.020049687	0.008375728	-0.0008487920
0.0016483160					
C	0.01507292	-0.004422265	0.004605364	0.005811493	0.0003230252
-0.0012762521					
D	0.02225466	0.023570751	0.010568385	0.027368428	-0.0001990213
-0.0003307281					
E	-0.03772053	-0.030077984	-0.017389277	-0.021913405	0.0002969471
0.0001542316					


```

    accel_dumbbell_x accel_dumbbell_y accel_dumbbell_z magnet_dumbbell_x mag
net_dumbbell_y
B      0.004025183      0.01887781      0.01304531      0.006073832
-0.024380679
C      -0.011994461     -0.03696102      0.03148393     -0.011762556
-0.020482381
D      -0.006274208     -0.02829597     -0.01092769     -0.022455773
0.048481796
E       0.035197146      0.04121934      0.03266806     -0.019823353
-0.005658537
    magnet_dumbbell_z roll_forearm pitch_forearm yaw_forearm total_accel_fo
rearm gyros_forearm_x
B      -0.004437042  0.023174767  0.0004713158 -0.016731752      0.0207
93016  2.453234e-03
C      -0.010555326  0.041341274  0.0003490628 -0.004882358      0.0123
33997  6.541527e-05
D      -0.018808938 -0.003670976  0.0138553269  0.018909946      0.0075
84437  1.026190e-04
E       0.036497263  0.007166679  0.0013250337  0.016361177     -0.0124
58468 -4.443229e-04
    gyros_forearm_y gyros_forearm_z accel_forearm_x accel_forearm_y accel_fo
rearm_z magnet_forearm_x
B      -1.096523e-02 -1.697679e-03      0.004155049      0.03401914      0.00
4183016 0.015509573
C      -5.693345e-05 -9.110254e-05      0.029864708      0.02577970      0.00
2581164 0.017710500
D       7.816097e-04  1.800418e-04     -0.040467072     -0.01966517      0.00
8147917 -0.010237055
E      -1.034282e-04  7.203492e-05      0.019704081      0.02519823      0.02
1296631 -0.003299594
    magnet_forearm_y magnet_forearm_z
B      -0.03992453      0.0463339909
C      -0.04187582      0.0488198263
D      -0.01242610      0.0110447932
E      -0.01985137     -0.0003666157

Residual Deviance: 98.86039
AIC: 514.8604

```

```

> summary(final)
Call:
multinom(formula = classe ~ raw_timestamp_part_1 + num_window +
  roll_belt + pitch_belt + yaw_belt + total_accel_belt + gyros_belt_x +
  gyros_belt_y + gyros_belt_z + accel_belt_x + accel_belt_y +
  accel_belt_z + magnet_belt_x + magnet_belt_y + magnet_belt_z +
  roll_arm + pitch_arm + yaw_arm + total_accel_arm + gyros_arm_x +
  gyros_arm_y + gyros_arm_z + accel_arm_x + accel_arm_y + accel_arm_z +
  magnet_arm_y + magnet_arm_z + roll_dumbbell + pitch_dumbbell +
  yaw_dumbbell + gyros_dumbbell_x + gyros_dumbbell_z + accel_dumbbell_x
+
  accel_dumbbell_y + accel_dumbbell_z + magnet_dumbbell_x +
  magnet_dumbbell_y + magnet_dumbbell_z + roll_forearm + pitch_forearm +
  yaw_forearm + total_accel_forearm + gyros_forearm_x + gyros_forearm_y
+
  gyros_forearm_z + accel_forearm_x + accel_forearm_y + accel_forearm_z
+
  magnet_forearm_x + magnet_forearm_y + magnet_forearm_z, data = train)

Coefficients:

```

	(Intercept)	raw_timestamp_part_1	num_window	roll_belt	pitch_belt	roll_belt	pitch_belt
t	2.236996e-09	-1.363158e-09	0.09105180	-0.0048339198	-0.00114186		
B	-0.005088154						
4	4.494416e-09	-2.195099e-08	0.04043045	0.0060653121	-0.00183343		
C	0.010231355						
1	-4.286441e-10	-2.797434e-08	-0.02413039	-0.0008663083	0.00528777		
D	-0.006181941						
6	3.340052e-08	2.144261e-08	0.02269082	-0.0036644520	-0.00699047		
E	0.009706589						
4							
	total_accel_belt	gyros_belt_x	gyros_belt_y	gyros_belt_z	accel_belt_x	accel_belt_y	accel_belt_z
B	-0.0034695300	-1.725407e-04	3.202847e-05	-1.791988e-04	0.005522384		
0.004046689	0.019442560						
C	0.0011722424	2.711960e-04	-1.643575e-05	2.464993e-05	-0.002186109		
0.002454132	-0.008387581						
D	-0.0015899760	9.948438e-05	-6.790312e-05	-5.471208e-04	-0.006243753		
0.003994443	0.010726061						
E	0.0009475916	-5.727850e-05	7.624242e-05	6.062901e-04	0.011859843		
-0.008821349	-0.002486073						
	magnet_belt_x	magnet_belt_y	magnet_belt_z	roll_arm	pitch_arm	roll_arm	pitch_arm
yaw_arm	total_accel_arm						
B	-0.021459955	0.0280579103	0.071911618	0.003798006	-0.06576813	-0.02	
5097131	-0.0208380039						
C	0.007047188	-0.0007373633	-0.008946121	0.019143671	0.03876987	0.02	
3903727	-0.0117818993						
D	-0.004494439	0.0014234456	-0.001797440	-0.002427299	-0.01689625	-0.00	
1780834	0.0003814782						
E	0.025647016	-0.0056357674	0.016470815	0.019009746	0.01069149	0.02	
3081535	-0.0010059266						
	gyros_arm_x	gyros_arm_y	gyros_arm_z	accel_arm_x	accel_arm_y	accel_arm_z	magnet_arm_y
B	-0.0136631649	7.976717e-03	0.0001970857	-0.05704138	0.021008371	0.04	
3476960	0.031921773						
C	0.0025245032	-2.212564e-03	0.0002045377	-0.01685926	-0.004174773	0.00	
7857859	-0.051624345						
D	0.0004537182	1.180763e-05	-0.0002996302	0.03288859	-0.001635021	-0.01	
6528067	-0.018772245						
E	0.0008257342	-6.560845e-04	0.0002976939	-0.03988844	0.022885775	0.03	
7278992	-0.002718483						
	magnet_arm_z	roll_dumbbell	pitch_dumbbell	yaw_dumbbell	gyros_dumbbell_x	gyros_dumbbell_y	gyros_dumbbell_z
B	-0.06237601	-0.007141826	-0.020049687	0.008375728	-0.0008487920		
0.0016483160							
C	0.01507292	-0.004422265	0.004605364	0.005811493	0.0003230252		
-0.0012762521							
D	0.02225466	0.023570751	0.010568385	0.027368428	-0.0001990213		
-0.0003307281							
E	-0.03772053	-0.030077984	-0.017389277	-0.021913405	0.0002969471		
0.0001542316							
	accel_dumbbell_x	accel_dumbbell_y	accel_dumbbell_z	magnet_dumbbell_x	magnet_dumbbell_y		
B	0.004025183	0.01887781	0.01304531	0.006073832			
-0.024380679							
C	-0.011994461	-0.03696102	0.03148393	-0.011762556			
-0.020482381							
D	-0.006274208	-0.02829597	-0.01092769	-0.022455773			
0.048481796							
E	0.035197146	0.04121934	0.03266806	-0.019823353			
-0.005658537							
	magnet_dumbbell_z	roll_forearm	pitch_forearm	yaw_forearm	total_accel_forearm	gyros_forearm_x	

B	-0.004437042	0.023174767	0.0004713158	-0.016731752	0.0207	
93016	2.453234e-03					
C	-0.010555326	0.041341274	0.0003490628	-0.004882358	0.0123	
33997	6.541527e-05					
D	-0.018808938	-0.003670976	0.0138553269	0.018909946	0.0075	
84437	1.026190e-04					
E	0.036497263	0.007166679	0.0013250337	0.016361177	-0.0124	
58468	-4.443229e-04					
gyros_forearm_y gyros_forearm_z accel_forearm_x accel_forearm_y accel_forearm_z magnet_forearm_x						
B	-1.096523e-02	-1.697679e-03	0.004155049	0.03401914	0.00	
4183016	0.015509573					
C	-5.693345e-05	-9.110254e-05	0.029864708	0.02577970	0.00	
2581164	0.017710500					
D	7.816097e-04	1.800418e-04	-0.040467072	-0.01966517	0.00	
8147917	-0.010237055					
E	-1.034282e-04	7.203492e-05	0.019704081	0.02519823	0.02	
1296631	-0.003299594					
magnet_forearm_y magnet_forearm_z						
B	-0.03992453	0.0463339909				
C	-0.04187582	0.0488198263				
D	-0.01242610	0.0110447932				
E	-0.01985137	-0.0003666157				
Std. Errors:						
(Intercept) raw_timestamp_part_1 num_window roll_belt pitch_belt yaw_belt						
B	1.289777e-19	1.706501e-10	9.503846e-18	1.627086e-17	3.507766e-18	
1.004031e-18						
C	2.457477e-19	3.251476e-10	2.141019e-17	3.013940e-17	6.333887e-18	
7.733794e-19						
D	1.215895e-18	1.608732e-09	3.226374e-17	8.186366e-19	7.674979e-18	
1.133883e-16						
E	1.176744e-18	1.556938e-09	5.258754e-17	7.251690e-17	1.773989e-17	
5.968324e-17						
total_accel_belt gyros_belt_x gyros_belt_y gyros_belt_z accel_belt_x accel_belt_y accel_belt_z						
B	2.590896e-18	5.886290e-20	4.532352e-21	5.873163e-20	5.471791e-18	8.906424e-18
2.323839e-17						
C	4.798937e-18	1.162626e-19	7.216148e-21	1.115351e-19	1.016891e-17	1.743652e-17
4.253783e-17						
D	3.587810e-18	1.105971e-20	1.850568e-20	1.345357e-19	2.103331e-17	1.482614e-18
2.389211e-17						
E	1.291258e-17	2.916276e-19	1.565030e-20	7.216347e-19	3.459927e-17	4.549685e-17
9.785106e-17						
magnet_belt_x magnet_belt_y magnet_belt_z roll_arm pitch_arm yaw_arm total_accel_arm						
B	3.022570e-18	7.393457e-17	4.997686e-17	5.546128e-17	6.704723e-18	8.430989e-17
2.831770e-18						
C	3.491811e-19	1.436349e-16	9.066805e-17	2.717741e-17	3.391661e-18	1.218772e-17
6.081187e-18						
D	5.165961e-19	7.294147e-16	3.779746e-16	7.955097e-17	3.819338e-17	4.637900e-17
1.974668e-17						
E	1.292492e-17	6.783128e-16	4.534427e-16	3.481909e-17	2.546126e-17	8.362140e-17
3.405447e-17						
gyros_arm_x gyros_arm_y gyros_arm_z accel_arm_x accel_arm_y accel_arm_z magnet_arm_y						
B	9.098726e-19	4.398910e-19	3.790563e-20	3.406499e-17	2.437789e-17	4.092270e-17
6.069455e-17						
C	8.190068e-20	1.283379e-19	2.117975e-20	3.889764e-17	3.617581e-18	7.966507e-18
5.111921e-17						

```

D 1.701341e-18 5.079584e-19 3.522974e-19 1.510558e-17 1.056285e-16 4.27323
2e-17 6.369871e-19
E 1.100189e-18 6.683111e-19 6.916372e-19 6.585145e-17 1.910074e-17 1.41437
2e-16 2.086086e-16
magnet_arm_z roll_dumbbell pitch_dumbbell yaw_dumbbell gyros_dumbbell_x
gyros_dumbbell_z
B 8.232175e-17 1.070253e-17 9.512748e-18 2.115266e-17 6.521144e-20
4.000531e-20
C 6.588564e-17 1.423756e-17 2.307518e-18 1.984333e-17 1.384238e-19
1.034230e-19
D 4.151328e-16 4.319632e-17 1.132785e-17 1.148090e-16 6.019352e-20
2.340041e-20
E 3.387306e-16 7.416724e-17 7.384508e-17 6.434542e-17 8.611212e-20
6.020422e-21
accel_dumbbell_x accel_dumbbell_y accel_dumbbell_z magnet_dumbbell_x mag
net_dumbbell_y
B 9.857717e-18 1.119280e-17 1.209581e-17 8.781590e-17
6.346295e-17
C 4.338462e-18 1.524084e-17 1.590679e-17 8.537480e-17
1.520607e-16
D 8.378879e-18 2.333674e-17 2.476604e-17 6.271992e-16
3.956658e-16
E 1.350387e-16 1.005679e-16 3.640172e-17 4.319807e-16
1.237012e-16
magnet_dumbbell_z roll_forearm pitch_forearm yaw_forearm total_accel_fo
rearm gyros_forearm_x
B 1.610612e-17 2.202720e-17 1.103112e-17 1.380901e-17 4.24645
0e-18 2.668999e-19
C 3.576154e-17 1.602152e-17 4.297630e-18 1.188324e-17 9.40943
9e-18 1.855843e-20
D 5.877386e-18 8.511953e-17 4.837392e-17 7.485575e-17 4.34501
0e-17 2.933953e-20
E 6.799727e-17 1.107671e-16 5.238683e-17 1.906894e-17 4.30226
0e-17 3.149971e-19
gyros_forearm_y gyros_forearm_z accel_forearm_x accel_forearm_y accel_fo
rearm_z magnet_forearm_x
B 1.328172e-18 2.902488e-19 5.022358e-17 7.569670e-17 2.195
057e-17 8.864237e-17
C 1.844195e-19 8.866300e-20 1.547405e-17 4.174947e-17 4.420
712e-17 6.386250e-17
D 1.016503e-18 3.094208e-19 1.434339e-16 2.539318e-16 2.242
803e-16 6.590090e-16
E 1.951326e-18 5.880521e-19 2.938107e-16 2.678555e-16 2.662
172e-16 8.307565e-17
magnet_forearm_y magnet_forearm_z
B 2.788504e-16 1.339348e-16
C 9.695325e-17 1.430405e-16
D 3.833278e-16 6.270757e-16
E 9.354359e-16 5.448831e-16

Residual Deviance: 98.86039
AIC: 514.8604

```

```

> # b. Goodness of Fit
> library(car)
Loading required package: carData
> chisq.test(table(test$classe), prop.table(table(predicted)))

```

Pearson's Chi-squared test

```
data: table(test$classe) and prop.table(table(predicted))
X-squared = 20, df = 16, p-value = 0.2202
```

```
# c. Report the accuracy measures
> # Accuracy
> conf <- table(test$classe, predicted)
> OAA <- (conf[1,1]+conf[2,2]+conf[3,3]+conf[4,4]+conf[5,5]) / sum(conf)
> OAA
[1] 0.9900662
```

```
> coef(final)
      (Intercept) raw_timestamp_part_1 num_window      roll_belt pitch_belt
t yaw_belt
B 2.236996e-09      -1.363158e-09  0.09105180 -0.0048339198 -0.00114186
4 -0.005088154
C 4.494416e-09      -2.195099e-08  0.04043045  0.0060653121 -0.00183343
1 0.010231355
D -4.286441e-10      -2.797434e-08 -0.02413039 -0.0008663083  0.00528777
6 -0.006181941
E 3.340052e-08       2.144261e-08  0.02269082 -0.0036644520 -0.00699047
4 0.009706589
total_accel_belt gyros_belt_x gyros_belt_y gyros_belt_z accel_belt_x
accel_belt_y accel_belt_z
B -0.0034695300 -1.725407e-04  3.202847e-05 -1.791988e-04  0.005522384
0.004046689 0.019442560
C 0.0011722424  2.711960e-04 -1.643575e-05  2.464993e-05 -0.002186109
0.002454132 -0.008387581
D -0.0015899760  9.948438e-05 -6.790312e-05 -5.471208e-04 -0.006243753
0.003994443 0.010726061
E 0.0009475916 -5.727850e-05  7.624242e-05  6.062901e-04  0.011859843
-0.008821349 -0.002486073
magnet_belt_x magnet_belt_y magnet_belt_z      roll_arm pitch_arm
yaw_arm total_accel_arm
B -0.021459955 0.0280579103  0.071911618  0.003798006 -0.06576813 -0.02
5097131 -0.0208380039
C 0.007047188 -0.0007373633 -0.008946121  0.019143671  0.03876987  0.02
3903727 -0.0117818993
D -0.004494439 0.0014234456 -0.001797440 -0.002427299 -0.01689625 -0.00
1780834 0.0003814782
E 0.025647016 -0.0056357674  0.016470815  0.019009746  0.01069149  0.02
3081535 -0.0010059266
gyros_arm_x gyros_arm_y gyros_arm_z accel_arm_x accel_arm_y acce
l_arm_z magnet_arm_y
B -0.0136631649 7.976717e-03  0.0001970857 -0.05704138  0.021008371  0.04
3476960 0.031921773
C 0.0025245032 -2.212564e-03  0.0002045377 -0.01685926 -0.004174773  0.00
7857859 -0.051624345
D 0.0004537182 1.180763e-05 -0.0002996302  0.03288859 -0.001635021 -0.01
6528067 -0.018772245
E 0.0008257342 -6.560845e-04  0.0002976939 -0.03988844  0.022885775  0.03
7278992 -0.002718483
magnet_arm_z roll_dumbbell pitch_dumbbell yaw_dumbbell gyros_dumbbell_x
gyros_dumbbell_z
B -0.06237601 -0.007141826 -0.020049687  0.008375728 -0.0008487920
0.0016483160
C 0.01507292 -0.004422265  0.004605364  0.005811493  0.0003230252
-0.0012762521
```

```

D 0.02225466 0.023570751 0.010568385 0.027368428 -0.0001990213
-0.0003307281
E -0.03772053 -0.030077984 -0.017389277 -0.021913405 0.0002969471
0.0001542316
  accel_dumbbell_x accel_dumbbell_y accel_dumbbell_z magnet_dumbbell_x mag
net_dumbbell_y
B 0.004025183 0.01887781 0.01304531 0.006073832
-0.024380679
C -0.011994461 -0.03696102 0.03148393 -0.011762556
-0.020482381
D -0.006274208 -0.02829597 -0.01092769 -0.022455773
0.048481796
E 0.035197146 0.04121934 0.03266806 -0.019823353
-0.005658537
  magnet_dumbbell_z roll_forearm pitch_forearm yaw_forearm total_accel_fo
rearm gyros_forearm_x
B -0.004437042 0.023174767 0.0004713158 -0.016731752 0.0207
93016 2.453234e-03
C -0.010555326 0.041341274 0.0003490628 -0.004882358 0.0123
33997 6.541527e-05
D -0.018808938 -0.003670976 0.0138553269 0.018909946 0.0075
84437 1.026190e-04
E 0.036497263 0.007166679 0.0013250337 0.016361177 -0.0124
58468 -4.443229e-04
  gyros_forearm_y gyros_forearm_z accel_forearm_x accel_forearm_y accel_fo
rearm_z magnet_forearm_x
B -1.096523e-02 -1.697679e-03 0.004155049 0.03401914 0.00
4183016 0.015509573
C -5.693345e-05 -9.110254e-05 0.029864708 0.02577970 0.00
2581164 0.017710500
D 7.816097e-04 1.800418e-04 -0.040467072 -0.01966517 0.00
8147917 -0.010237055
E -1.034282e-04 7.203492e-05 0.019704081 0.02519823 0.02
1296631 -0.003299594
  magnet_forearm_y magnet_forearm_z
B -0.03992453 0.0463339909
C -0.04187582 0.0488198263
D -0.01242610 0.0110447932
E -0.01985137 -0.0003666157

```

```

> coef(final)
      (Intercept) raw_timestamp_part_1 num_window roll_belt pitch_bel
t yaw_belt
B 2.236996e-09 -1.363158e-09 0.09105180 -0.0048339198 -0.00114186
4 -0.005088154
C 4.494416e-09 -2.195099e-08 0.04043045 0.0060653121 -0.00183343
1 0.010231355
D -4.286441e-10 -2.797434e-08 -0.02413039 -0.0008663083 0.00528777
6 -0.006181941

```

```

E 3.340052e-08      2.144261e-08  0.02269082 -0.0036644520 -0.00699047
4 0.009706589
  total_accel_belt gyros_belt_x gyros_belt_y gyros_belt_z accel_belt_x
accel_belt_y accel_belt_z
B -0.0034695300 -1.725407e-04  3.202847e-05 -1.791988e-04  0.005522384
0.004046689  0.019442560
C 0.0011722424  2.711960e-04 -1.643575e-05  2.464993e-05 -0.002186109
0.002454132 -0.008387581
D -0.0015899760  9.948438e-05 -6.790312e-05 -5.471208e-04 -0.006243753
0.003994443  0.010726061
E 0.0009475916 -5.727850e-05  7.624242e-05  6.062901e-04  0.011859843
-0.008821349 -0.002486073
  magnet_belt_x magnet_belt_y magnet_belt_z      roll_arm  pitch_arm
yaw_arm total_accel_arm
B -0.021459955  0.0280579103  0.071911618  0.003798006 -0.06576813 -0.02
5097131 -0.0208380039
C 0.007047188 -0.0007373633 -0.008946121  0.019143671  0.03876987  0.02
3903727 -0.0117818993
D -0.004494439  0.0014234456 -0.001797440 -0.002427299 -0.01689625 -0.00
1780834 0.0003814782
E 0.025647016 -0.0056357674  0.016470815  0.019009746  0.01069149  0.02
3081535 -0.0010059266
  gyros_arm_x gyros_arm_y gyros_arm_z accel_arm_x accel_arm_y acce
l_arm_z magnet_arm_y
B -0.0136631649  7.976717e-03  0.0001970857 -0.05704138  0.021008371  0.04
3476960 0.031921773
C 0.0025245032 -2.212564e-03  0.0002045377 -0.01685926 -0.004174773  0.00
7857859 -0.051624345
D 0.0004537182  1.180763e-05 -0.0002996302  0.03288859 -0.001635021 -0.01
6528067 -0.018772245
E 0.0008257342 -6.560845e-04  0.0002976939 -0.03988844  0.022885775  0.03
7278992 -0.002718483
  magnet_arm_z roll_dumbbell pitch_dumbbell yaw_dumbbell gyros_dumbbell_x
gyros_dumbbell_z
B -0.06237601 -0.007141826 -0.020049687  0.008375728 -0.0008487920
0.0016483160
C 0.01507292 -0.004422265  0.004605364  0.005811493  0.0003230252
-0.0012762521
D 0.02225466  0.023570751  0.010568385  0.027368428 -0.0001990213
-0.0003307281
E -0.03772053 -0.030077984 -0.017389277 -0.021913405  0.0002969471
0.0001542316
  accel_dumbbell_x accel_dumbbell_y accel_dumbbell_z magnet_dumbbell_x mag
net_dumbbell_y
B 0.004025183 0.01887781 0.01304531 0.006073832
-0.024380679
C -0.011994461 -0.03696102 0.03148393 -0.011762556
-0.020482381
D -0.006274208 -0.02829597 -0.01092769 -0.022455773
0.048481796
E 0.035197146 0.04121934 0.03266806 -0.019823353
-0.005658537
  magnet_dumbbell_z roll_forearm pitch_forearm yaw_forearm total_accel_fo
rearm gyros_forearm_x
B -0.004437042 0.023174767 0.0004713158 -0.016731752 0.0207
93016 2.453234e-03
C -0.010555326 0.041341274 0.0003490628 -0.004882358 0.0123
33997 6.541527e-05
D -0.018808938 -0.003670976 0.0138553269 0.018909946 0.0075
84437 1.026190e-04
E 0.036497263 0.007166679 0.0013250337 0.016361177 -0.0124
58468 -4.443229e-04

```


	gyros_forearm_y	gyros_forearm_z	accel_forearm_x	accel_forearm_y	accel_forearm_z
B	-1.096523e-02	-1.697679e-03	0.004155049	0.03401914	0.00
4183016	0.015509573				
C	-5.693345e-05	-9.110254e-05	0.029864708	0.02577970	0.00
2581164	0.017710500				
D	7.816097e-04	1.800418e-04	-0.040467072	-0.01966517	0.00
8147917	-0.010237055				
E	-1.034282e-04	7.203492e-05	0.019704081	0.02519823	0.02
1296631	-0.003299594				
	magnet_forearm_y	magnet_forearm_z			
B	-0.03992453	0.0463339909			
C	-0.04187582	0.0488198263			
D	-0.01242610	0.0110447932			
E	-0.01985137	-0.0003666157			