Using commercial tracker in physical activity research: promises and challenges

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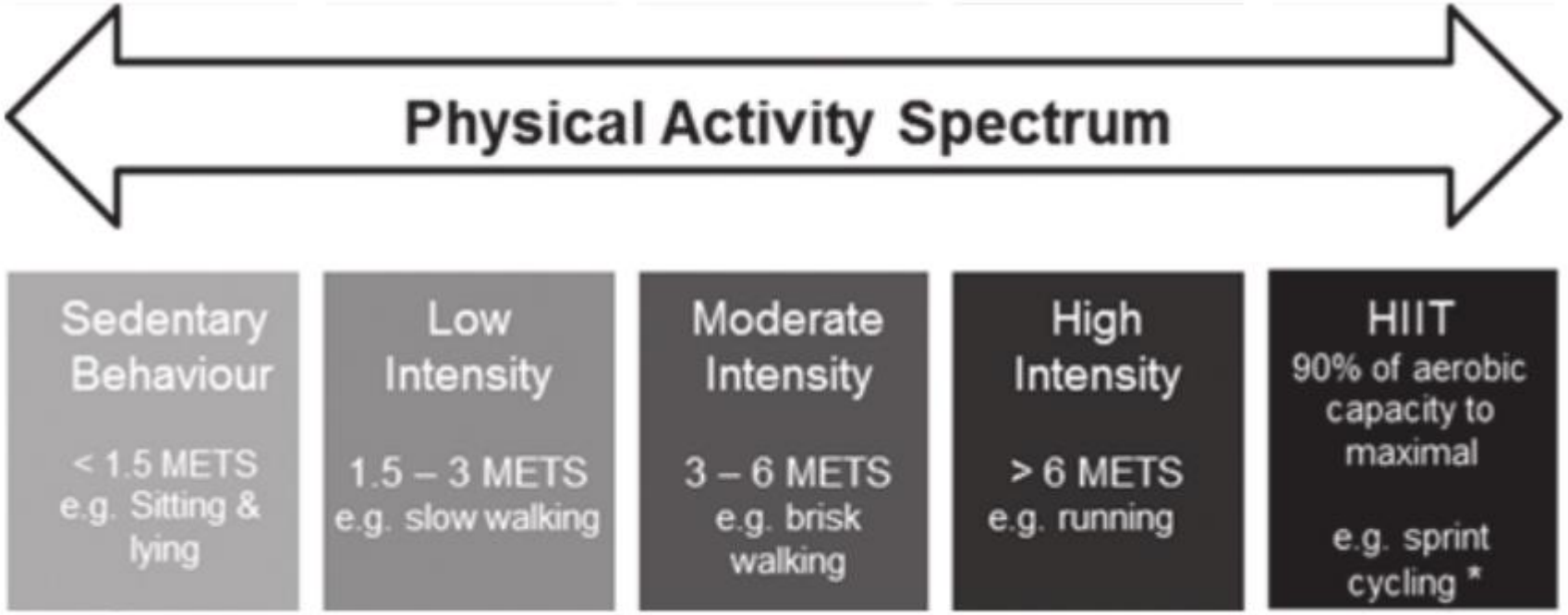
Content

- Introduction on physical activity (PA)
- Benefits and challenges of commercial activity trackers (CAT)
- Activity tracking in FitMum
- **Input and feedback**

Introduction PA

- World Health Organization (WHO) considers physical inactivity as the fourth risk factor for death
- Physical inactivity level still high worldwide (Guthold et al, 2018)
- WHO recommends at least 150 minutes/week which is not limited to leisure time activities (in home, office, for transportation…etc)

Nimmo et al, 2013



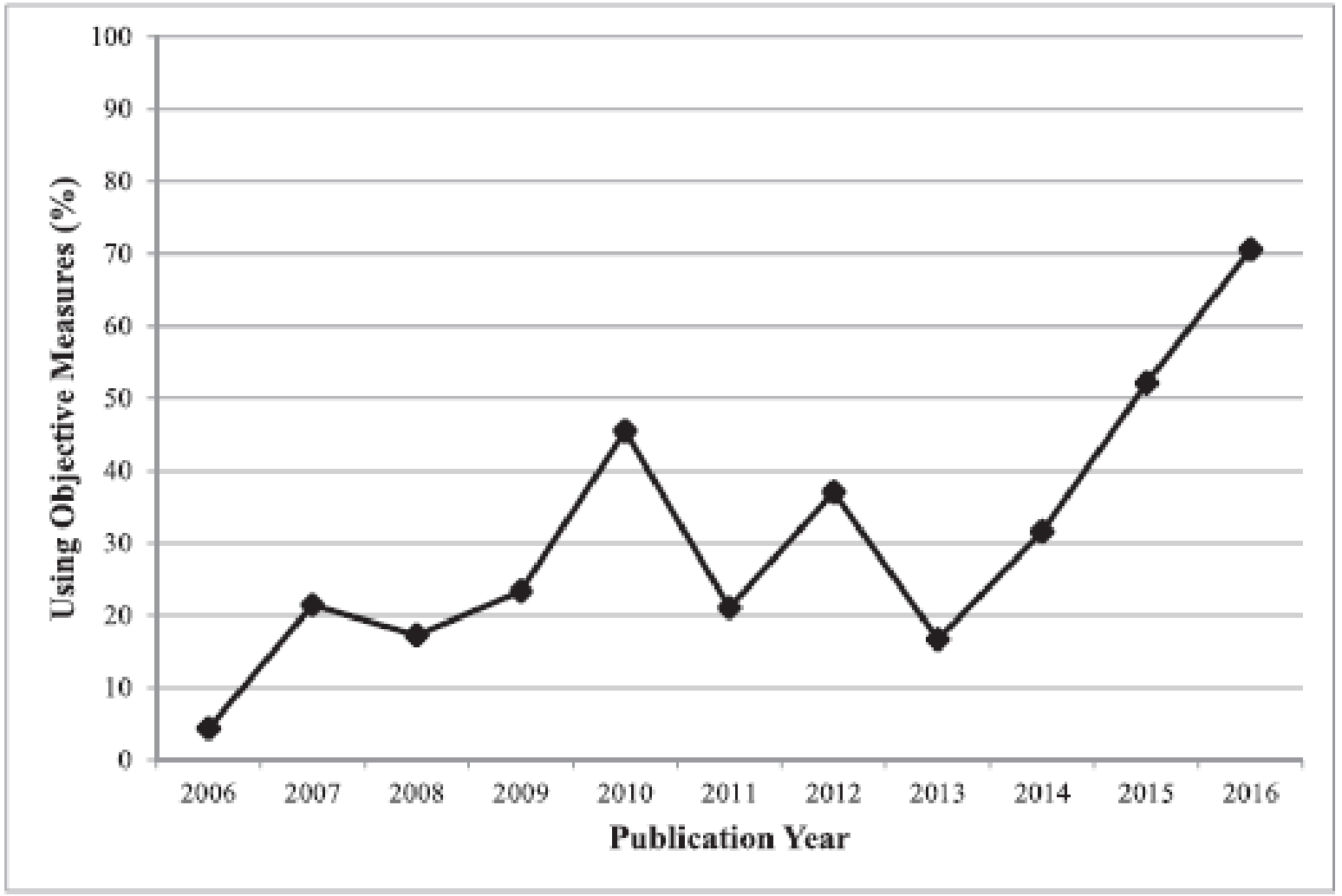
Why do we need to measure PA?

- In research it is important to detect/measure the amount that create the effect
- To report the result in meaningful and scientific way

How to measure PA

- Subjective methods
- Objective methods

V.J. Silfee et al, 2018



(Didace et al, 2017)

Table 1. Advantages and limitations of different methods for physical activity and energy expenditure measurement

Methods	Advantages	Limitations
DLW	· Highly accurate method, considered a gold standard for the measurement of TEE. · Allows freedom of activity to participants.	· High cost of the method (including the high price of DLW and expensive equipment for analysis). · Expertise required for the personnel. · The method does not provide any specific details on physical activity.
Direct calorimetry	· It is the most accurate method for quantifying the metabolic rate.	· High cost of the method. · Subject confinement required for 24 hr or more.
Indirect calorimetry	· Accurate and non-invasive method. · Provides information on the metabolic fuels being combusted. · Allows the assessment of energy expenditure in the field environment.	· Relatively high cost. · Trained personnel needed for the method's correct use.
Accelerometry	· Objective measurement of physical activity. · Can be used both in laboratory and field settings. · Non-invasive method and less burdensome to subjects. · Relatively inexpensive.	· Inaccuracy of predictive equations to translate activity counts into energy expenditure, especially when used across a range of various activities.
Heart rate monitor	· Objective tool for the measurement of physical activity and energy expenditure. · Relatively low cost. · Noninvasive and versatile method. · Can be used both in controlled settings and in free living conditions.	· Inaccurate in measuring sedentary and light activities. · Electrical or magnetic interference from common electrical devices.
Pedometry	· Inexpensive and non-invasive method. · Used to assess the most common activity (walking). · Can motivate people to maintain physical activity.	· Limited to measuring only walking activity. · Inaccurate for assessing the distance covered and energy expended.
Self-report methods	· Low cost, allowing their use in studies with large sample size. · Low burden to subjects. · Provide information on physical activity patterns.	· Low accuracy and reliability, especially linked with their dependency on the participant's memory.

DLW, doubly labeled water; TEE, total energy expenditure.

Benefits of CAT

- Multidimensional data in different domains
- Continues data flow
- Easy to track
- Objective, transferable, analyzable data
- Acceptable validity

Limitations of CAT

- Accuracy
- Equations use (algorithm)
- Large amount of data
- Technical barriers
- Compliance

Themes

Research Projects

- The Artificial Pancreas
- FitMum
- EEG-based Alzheimer Diagnosis
- RADMIS
- GazeIT
- Detection of mortality after cancer surgery
- MONARCA II
- Motivating Physical Activity
- SCAUT
- Sound & Health
- REACH
- REAFEL
- Biometric Healthcare Research Platform
- The Phy-Psy Trial
- TEAM
- PACE
- Research Hub for Digital Enhanced Living

PhD Projects

FitMum: Fitness for good health of mother and child

There is a gap in evidence and practice towards tackling the significant public health issue of being physically inactive during pregnancy, and the vision of the FitMum project is to increase physical activity among Danish pregnant women. FitMum is

Funding

PARTNERS

- University of Copenhagen
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- Technical University of Denmark
- Aarhus University
- Deakin Universityi
- University of Graz

FitMum Study

- Method: three arm, one site randomized controlled trial RCT
- Population: 220 Inactive Danish pregnant women (before week 15)

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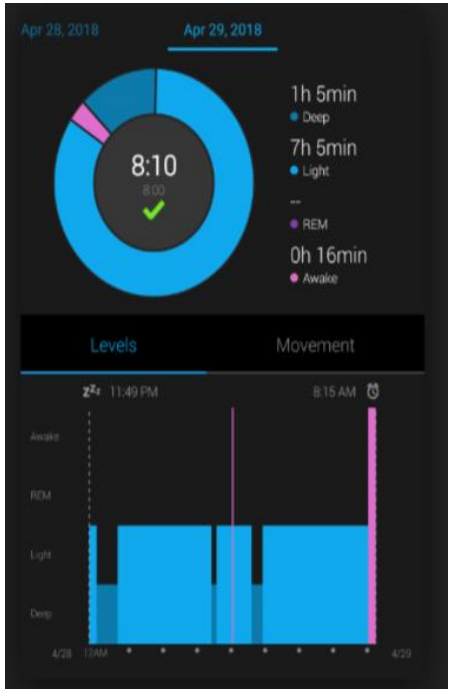
Why commercial tracker?

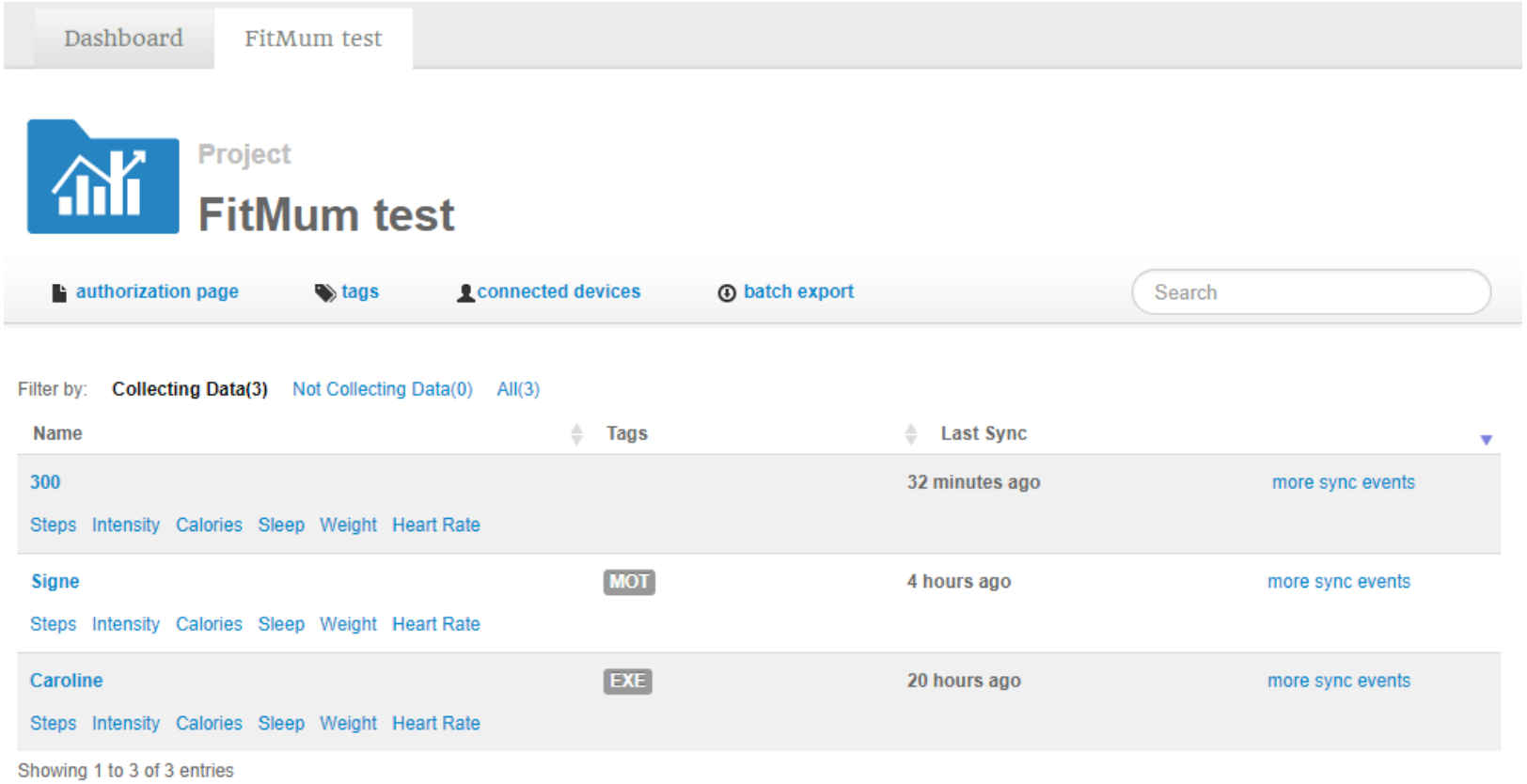
- To capture all dimensional, domains and to detect the behavior of both PA and inactivity 24/7
- To store and transfer high resolution data to platforms instantly
- Commercial tracker overcome subjective methods and need to included in pregnant population (Eva Guérin et al, 2018)

Measurements: PA level determine by activity tracker (Garmin Vívosport).

Garmin interface



Fitabase interface



Garmin Data

Daily activity information

VigorousIntensityDurationInSeconds	ModerateIntensityDurationInSeconds	ActiveTimeInSeconds	DurationInSeconds	DistanceInMeters	Steps	BmrKilocalories	ActiveKilocalories	ActivityDate	Id
420	840	4437	86400	3695	4614	2214	525	9/18/2018 0:00	300
0	0	2824	40500	3471	4335	1037	216	9/19/2018 0:00	300
0	0	3887	86400	2318	3182	1560	120	9/2/2018 0:00	Caroline
3420	1740	2883	86400	2264	3180	1560	576	9/3/2018 0:00	Caroline
0	0	3411	86400	2794	3924	1560	144	9/4/2018 0:00	Caroline
0	0	9464	86400	7797	10951	1560	616	9/5/2018 0:00	Caroline
0	0	7257	86400	6978	9801	1560	421	9/6/2018 0:00	Caroline
180	420	10656	86400	10091	13090	1560	661	9/7/2018 0:00	Caroline
0	0	14446	86400	11788	16209	1560	770	9/8/2018 0:00	Caroline
0	0	3044	86400	2416	3345	1560	171	9/9/2018 0:00	Caroline
0	0	4522	84360	3094	4345	1523	161	9/10/2018 0:00	Caroline
0	0	4759	86400	3708	5208	1560	357	9/11/2018 0:00	Caroline
2460	1380	4687	86400	2839	3987	1560	707	9/12/2018 0:00	Caroline
0	0	11198	86400	5685	7984	1560	597	9/13/2018 0:00	Caroline
0	0	7144	86400	5712	8023	1560	418	9/14/2018 0:00	Caroline
0	0	10735	86400	7502	10472	1560	457	9/15/2018 0:00	Caroline
2520	360	14366	86400	11870	13413	1560	856	9/16/2018 0:00	Caroline
360	540	5647	86400	3257	4566	1560	708	9/17/2018 0:00	Caroline
0	0	2129	53700	2268	3186	969	116	9/18/2018 0:00	Caroline
0	0	17815	86400	10286	13235	1750	818	9/1/2018 0:00	Signe
0	0	18025	86400	8987	11518	1750	881	9/2/2018 0:00	Signe
0	0	7715	86400	3791	4924	1750	331	9/3/2018 0:00	Signe
720	180	7560	86400	4109	5296	1750	407	9/4/2018 0:00	Signe
0	0	8748	86400	5865	7619	1750	545	9/5/2018 0:00	Signe
0	0	5475	86400	2848	3699	1750	223	9/6/2018 0:00	Signe
0	0	4486	86400	2956	3832	1750	258	9/7/2018 0:00	Signe
0	0	2450	45660	1376	1788	924	98	9/8/2018 0:00	Signe
0	0	0	86400	0	0	1750	0	9/9/2018 0:00	Signe
0	0	7537	86400	4432	5697	1750	415	9/10/2018 0:00	Signe
0	0	7121	86400	4541	5604	1750	523	9/11/2018 0:00	Signe
0	0	5143	86400	2543	3303	1750	264	9/12/2018 0:00	Signe
0	0	10522	86400	5689	7362	1750	504	9/13/2018 0:00	Signe
180	420	11007	86400	5880	7638	1750	622	9/14/2018 0:00	Signe
0	0	12343	86400	5869	7617	1750	490	9/15/2018 0:00	Signe
0	0	7095	86400	3652	4744	1750	191	9/16/2018 0:00	Signe
0	0	4035	86400	2119	2752	1750	140	9/17/2018 0:00	Signe
0	0	8820	86400	5433	7057	1750	374	9/18/2018 0:00	Signe
0	0	0	24420	0	0	494	0	9/19/2018 0:00	Signe

Heart Rate: High resolution intraday heart rate values in 15 second intervals.

HeartRate	ActivityTime	Id
77	9:24 9/18/2018	300
77	9:24 9/18/2018	300
77	9:24 9/18/2018	300
77	9:25 9/18/2018	300
77	9:25 9/18/2018	300
77	9:25 9/18/2018	300
77	9:25 9/18/2018	300

Sleep Details:

includes the time spent in different sleep levels (awake, light, deep).

Duration	eepStage	ActivityDateTime	SummaryId
1200	light	9/18/2018 21:35	x2824a0a-5ba15364-6dec
540	rem	9/18/2018 21:55	x2824a0a-5ba15364-6dec
540	light	9/18/2018 22:04	x2824a0a-5ba15364-6dec
1860	deep	9/18/2018 22:13	x2824a0a-5ba15364-6dec
720	light	9/18/2018 22:44	x2824a0a-5ba15364-6dec
540	rem	9/18/2018 22:56	x2824a0a-5ba15364-6dec
600	light	9/18/2018 23:05	x2824a0a-5ba15364-6dec
60	awake	9/18/2018 23:15	x2824a0a-5ba15364-6dec
1440	light	9/18/2018 23:16	x2824a0a-5ba15364-6dec
60	awake	9/18/2018 23:40	x2824a0a-5ba15364-6dec
1560	light	9/18/2018 23:41	x2824a0a-5ba15364-6dec
2700	rem	9/19/2018 0:07	x2824a0a-5ba15364-6dec
3780	light	9/19/2018 0:52	x2824a0a-5ba15364-6dec
480	rem	9/19/2018 1:55	x2824a0a-5ba15364-6dec
720	unmeasurable	9/19/2018 2:03	x2824a0a-5ba15364-6dec
1020	rem	9/19/2018 2:15	x2824a0a-5ba15364-6dec
60	awake	9/19/2018 2:32	x2824a0a-5ba15364-6dec
420	rem	9/19/2018 2:33	x2824a0a-5ba15364-6dec
2700	light	9/19/2018 2:40	x2824a0a-5ba15364-6dec
3000	rem	9/19/2018 3:25	x2824a0a-5ba15364-6dec
2040	light	9/19/2018 4:15	x2824a0a-5ba15364-6dec
660	rem	9/19/2018 4:49	x2824a0a-5ba15364-6dec
1020	light	9/19/2018 5:00	x2824a0a-5ba15364-6dec
60	awake	9/19/2018 5:17	x2824a0a-5ba15364-6dec
600	light	9/19/2018 5:18	x2824a0a-5ba15364-6dec

Epoch: represents the sum totals for data for each 15-minute interval.

METavg	METmins	DurationIn	ActiveKiloc	DistanceIn	Steps	ActivityDateTime	Id
1	6	360	0	0	0	9/18/2018 9:24	300
1.173516	17.60274	900	7	60.06	75	9/18/2018 9:30	300
1	15	900	0	0	0	9/18/2018 9:45	300
1	15	900	0	0	0	9/18/2018 10:00	300
1.130137	16.95205	900	3	47.25	59	9/18/2018 10:15	300
1.303653	19.55479	900	7	43.24	54	9/18/2018 10:30	300
1	15	900	0	0	0	9/18/2018 10:45	300
1.130137	16.95205	900	3	40.04	50	9/18/2018 11:00	300
1	15	900	0	0	0	9/18/2018 11:15	300
1	15	900	0	10.41	13	9/18/2018 11:30	300
1.216895	18.25343	900	5	45.65	57	9/18/2018 11:45	300
1.260274	18.90411	900	6	100.9	126	9/18/2018 12:00	300
1	15	900	0	0	0	9/18/2018 12:15	300
1	15	900	0	0	0	9/18/2018 12:30	300
1.043379	15.65069	900	1	16.01	20	9/18/2018 12:45	300
1	15	900	0	0	0	9/18/2018 13:00	300
1.173516	17.60274	900	4	144.15	180	9/18/2018 13:15	300
2.431507	36.4726	900	33	676.67	845	9/18/2018 13:30	300

Move IQ:

Summary data regarding automatically detected activities.

ActivitySub	ActivityTyp	DurationIn	StartTime	Id
	cycling	1080	9/18/2018 13:45	300
	cycling	1980	9/18/2018 15:38	300
	walking	1800	9/19/2018 8:08	300
	walking	600	9/19/2018 8:57	300

Input and feedback

What is the best practice to:

- handle large amounts of data, excel vs. SAS OR R?
- backup data, how often?

Is there any data program for CAT?